Borsa İstanbul Finance & Economics Conference (BIFEC) 2013

“Policy Issues and Challenges in the Global Financial System and Economies”

September 30 – October 1, 2013

www.bifec.com


BIFEC Book of Abstracts & Proceedings

Volume I

Issue I & Issue II

March 2014, İstanbul

The views expressed in this book are those of the author(s) and do not necessarily represent the official views of Borsa İstanbul or its members. The authors of the individual papers are responsible for technical, content, and linguistic correctness.

The refereeing process is managed by the Research and Business Development Department of Borsa İstanbul.

This e-book is published by Borsa İstanbul

Copyright © 2014
Borsa İstanbul Finance & Economics Conference (BIFEC) 2013

“Policy Issues and Challenges in the Global Financial System and Economies”

www.bifec.com

BIFEC Book of Abstracts & Proceedings

Volume 1 Issue 1

(Abstracts)

September 30 – October 1, 2013

İstanbul
## Contents (Volume I Issue I) - Abstracts

### Session 1a: Residential and Commercial Real Estate Market

- Auction versus Negotiated Sale: Evidence from Real Estate Sales ......................................................... 1
- Self-Assessed House Prices ......................................................................................................................... 1
- Counterparty Risk and Capital Structure ..................................................................................................... 2

### Session 1b: Investment Allocation and Strategies

- Diversification with Idiosyncratic Volatility in Real Time ........................................................................ 3
- The Determinants of Bilateral Cross-Border Bond and Equity Flows: A Sectoral Analysis ..................... 3
- Dynamic Relationship between Precious Metals ......................................................................................... 4
- Optimal Redemption Policies for Illiquid Investments ................................................................................ 4

### Session 1c: Behavioral Aspects of Investment

- Overconfidence, Familiarity Bias and Representativeness Heuristic of Equity Investors ....................... 5
- Sport Event Sentiment and Turkish Market Return ..................................................................................... 5
- Event Study Methodology for Borsa Istanbul ............................................................................................. 6
- Risk Choices of Portfolio Managers in an Emerging Market Economy ................................................... 6

### Session 2a: Empirical Asset Pricing Anomalies

- Playing Favorites: How Firms Prevent the Revelation of Bad News ......................................................... 8
- In Search of Fundamentals ........................................................................................................................... 8
- A Project-Level Analysis of Value Creation in Firms .................................................................................. 9
- Policy Uncertainty and Corporate Investment ............................................................................................ 9

### Session 2b: Financial Management of Institutions and Corporations

- Can Institutional Investors Cherry-pick Hot IPOs? .................................................................................. 10
- Managerial Accommodation, Proxy Access, and the Cost of Shareholder Empowerment ................... 10
- Measuring Takeover Premiums in Cross-Border M&As: Insights from Turkey ........................................ 11
- Short-term Wealth Effects of Mergers and Acquisitions: Evidence from Emerging Markets ............... 11

### Session 2c: Financial Literacy and Payment Systems

- Financial Illiteracy: Overconfidence and Consequences ........................................................................... 12
- Financial Literacy and Credit Card Arrears .................................................................................................. 12
- Formal and Informal Regulations for Credit Card Payment Services (*Full text in Issue II*) ................. 13
- Credit Card Satisfaction and Financial Literacy: Evidence from an Emerging Market Economy ....... 14

### Session 3a: Two Continents: Conventional and Islamic Finance

- Can an Interest-Free Credit Facility Be More Efficient Than a Usurious Payday Loan? ....................... 15
- Default and Prepayment Modeling in Participating Mortgages ................................................................. 15
- Developing Sukuk Market for Sustainable Development .......................................................................... 16
Session 4b: Empirical Methods in Financial Market Dynamics

The effect of investors' confidence on monetary policy-economic growth relationship: a Multivariate GARCH approach (Full text in Issue II) .......................................................... 27
Benchmarking the Performance of Some Computational Intelligence Methods for the Prediction of Entering Insolvency in Case of Romanian Businesses during the Financial Crisis .................................................. 27
Mitigating Turkey's Trilemma Tradeoffs ........................................................................ 28
The Linkage between Foreign Bank Penetration and Host Country Risks: The Case of Turkey ... 28

Session 4c: Issues on Trading and Volatility

Intraday Stealth Trading and Volatility the Evidence from the Warsaw Stock Exchange .......... 30
Agency and Transparency in Financial Markets (Full text in Issue II) ............................. 30

Session 5a: Financial Stability and Growth

Fiscal Responsibility and US Government Reaction to Debt Accumulation: A Time Varying Approach .............................................................................................................. 31
Financial Stability and Monetary Policy - The Case of Brazil ........................................... 32
Finance and Growth: For Whom? ................................................................................... 32
Inflation Dynamics and Business Cycles (Full text in Issue II) ........................................ 33

Session 5b: Quantitative Approaches in Finance

Efficiency and Competitiveness in Turkish Banking ....................................................... 34
Comovement and Polarization of Interest Rate & Stock Market in Turkey (Full text in Issue II) .......................................................... 34

BIFEC Book of Abstracts & Proceedings (Volume I Issue I)
The Intervention of Central Banks to Jumps in Exchange Rate Markets: The Case of Central Bank of the Republic of Turkey

**Session 5c: Financial Markets and Institutions**

What Explains the BIST Spread? Evidence from Conventional and Unconventional Policy Episodes in Turkey

Financial Intermediaries, Credit Shocks and Business Cycles

The Effects of Demographic Changes on the Long Term Housing Demand in Turkey

**Plenary Talk: How Much Mathematics Do We Need in Finance?**

**Session 6a: Interactions of the MENA Stock Markets in a Global Economy: Bi-Directional Influences**

The Effect of Global Shocks and Volatility on Herd Behavior in Borsa Istanbul

Volatility and Transparency of Financial Markets in the MENA Region

Drivers of Foreign and Domestic Demand for Sovereign Bonds in Developed and Emerging Economies: Fundamentals vs. Market Sentiment

**Session 6b: Asset Pricing Anomalies in Financial Markets**

The Equity Premium in a DSGE Model with Limited Asset Market Participation

Ambiguity, News and Asymmetric Correlations

Only When the Tide Goes Out: Downside Returns and Hedge Fund Performance

Global Financial Factors Driving Daily Changes in Sovereign Credit Default Swaps

**Session 6c: Thinking Over the Hedging Strategies**

Hedging Strategy for Electricity Market Price Volatility: The Case of Turkish Electricity Market

Interaction between Single Stock Futures and the Underlying Securities: A Cross Country Analysis

A Dynamic Kalman Filter Approach to Detect the Futures and Spot Markets Relation

Price Behaviour around Share Buyback in the Indian Equity Market

**Session 7a: A Closer Look to the Financial Crisis**

Anticipating the Financial Crisis: Evidence from Insider Trading in Banks

Credit Ratings and the Pricing of Sovereign Debt during the Euro Crisis

The impact of sovereign credit downgrades and CDS on holdings of government debt in developed and emerging economies

The Impact of Financial Innovation on Firm Stability

**Session 7b: Effects of Monetary Policy on Financial Markets**

Effects of Additional Monetary Tightening on Exchange Rates

Monetary Policy Misperception and the Risk-taking Channel

**Index of Authors**
Contents (Volume I Issue II) - Proceedings

Formal and Informal Regulations for Credit Card Payment Services ........................................... 1
   Güzin Günsün AKIN & Ahmet Faruk AYSAN & Gültekin GÖLLÜ & Levent YILDIRAN

Assembling International Equity Datasets – Review of Studies on the Cross-Section of Common Stocks ............................................................... 34
   Antonina WASZCZUK

Trading Puzzle, Puzzling Trade ........................................................................................................ 66
   Orhan ERDEM & Evren ARIK & Serkan YÜKSEL

The effect of investors’ confidence on monetary policy- economic growth relationship: a Multivariate GARCH approach ................................................................. 82
   Chiara GUERELLO

Agency and Transparency in Financial Markets ............................................................................. 110
   Sadettin Haluk ÇİTÇİ

Inflation Dynamics and Business Cycles ........................................................................................ 121
   Süleyman Hilmi KAL & Nuran ARSLANER & Ferhat ARSLANER

Comovement and Polarization of Interest Rate and Stock Market in Turkey ....................... 130
   Ahmet DURAN & Burhaneddin İZGİ

The Effect of Global Shocks and Volatility on Herd Behavior in Borsa Istanbul ................ 142
   Mehmet BALCILAR & Rıza DEMIRER

Volatility and Transparency of Financial Markets in the MENA Region ................................. 173
   Hamid MOHTADI & Stefan RUEDIGER

Hedging Strategy for Electricity Market Price Volatility: The Case of Turkish Electricity Market ........................................................................................................ 196
   Sezer Bozkus KAHYAOĞLU & M. Vedat PAZARLIOĞLU

The Impact of Financial Innovation on Firm Stability ................................................................. 211
   Fabian Kuehnhausen

Index of Authors ............................................................................................................................. 240

BIFEC Book of Abstracts & Proceedings (Volume I Issue II)
Session 1a: Residential and Commercial Real Estate Market

Chair: Yildray YILDIRIM, Syracuse University

Auction versus Negotiated Sale: Evidence from Real Estate Sales

Yuen Leng CHOW; National University of Singapore

Isa HAFALIR; Carnegie Mellon University

Abdullah YAVAS; University of Wisconsin-Madison

We offer a theoretical and empirical comparison of auctions and negotiated sales. We first build a simple model to show that auctions generate a higher relative price than negotiated sales when demand for the asset is strong, when the asset is more homogeneous, and when the asset attracts buyers with higher valuations. Using data from property sales in Singapore, we find support for our theoretical predictions. In addition, we find that auctions do not necessarily generate a higher price premium for foreclosed properties than for non-foreclosed properties.

Self-Assessed House Prices

Morris A. DAVIS; University of Wisconsin-Madison

We document that during the 2000-2006 house price boom and subsequent 2006-2010 bust, self-assessed house prices in 20 different metro areas do not rise nearly as rapidly during the boom or decline as severely in the bust as the Case-Shiller-Weiss house price indexes. We argue this evidence is consistent with homeowners extracting a signal on the unobserved but true value of their home from publicly available data. In the first half of the paper, we specify a process for true and unobserved house prices and show that the optimal signal extraction for this process is the Kalman Filter. We use data from the 2006-2010 bust to estimate the steady-state Kalman gain for this process, and then show via dynamic simulation analysis that this process fits the entire 2000-2010 experience remarkably well for all of the metro areas in our sample. In the second half of the paper, we specify and solve a dynamic infinite-horizon model where homeowners face a signal extraction problem about the value of their home. In the model, homeowners decide each period
whether or not to stay in their house, sell their house, or default. The model predicts that homeowners optimally “smooth” their self-appraised house values relative to the noisy public signal of house prices. In addition, uncertainty about the true value of their home leads homeowners to default less frequently than predicted by standard models in which homeowners perfectly know the value of their home each period.

**Counterparty Risk and Capital Structure**

*Brent W. AMBROSE, Pennsylvania State University*

*Thomas EMMERLING; Syracuse University*

*Henry H. HUANG; National Central University*

*Yildray YILDIRIM; Syracuse University*

The 2007-2009 financial crisis and recession highlighted the role of counterparty risk in financial contracts, many once thought immune to such problems. However, counterparty risk can be significant in a wide variety of contracting situations and can impact capital structure decisions. Using commercial real estate leases as an example, this paper presents a new model that endogenizes the capital structure of both parties to a contract. We follow Grenadier (1996) and Leland and Toft (1996) to examine the interaction between firm capital structures and equilibrium contract pricing. Moreover, in a commercial lease setting, our model demonstrates that consideration of credit risk is instrumental to confirm the complementarity between lease and debt as suggested by Lewis and Schallheim (1992).
Session 1b: Investment Allocation and Strategies

Chair: Koray ŞİMŞEK; Sabancı University

Diversification with Idiosyncratic Volatility in Real Time

Theodore MOORMAN, Baylor University

Ang et al. (2006) find an inverse relation between idiosyncratic volatility and stock returns, which is called into question by Bali and Cakici (2009), Fu (2009), Huang et al. (2009), and others. We find that an investor with uncertainty about this relation could have made real-time abnormal returns by investing in well-diversified, idiosyncratic volatility based portfolios during the 1974-2011 period. Abnormal returns are robust to variations in pricing models, transaction costs, short-sale constraints, risk aversion, utility functions, models to estimate idiosyncratic volatility, and the length of time to estimate and update parameters determining investment.

The Determinants of Bilateral Cross-Border Bond and Equity Flows: A Sectoral Analysis

Faruk BALLI; Massey University

Hatice Ozer BALLI; Massey University

Syed Abul BASHER; Qatar Central Bank

We explore a new disaggregated data-set on bilateral gross cross-border flows between 33 high-income countries over the 2001-2009 period. The disaggregation is available over classes of assets (bond, equity) for different sectors of the economy, namely financial institution, insurance, non-financial institutions, households and government. Employing a typical financial gravity model and controlling for endogeneity bias, we find that compared to aggregate data, sectoral investors have a much larger appetite for diversification. There is evidence of return-chasing motive in equity (although not bond), with households and financial companies tend to react more to positive source-host equity return differential. The influence of bilateral trade in goods on foreign asset portfolio is also much larger at the sectoral level, where the impact is higher for equity than bond holdings. Distance plays a crucial role in holding bonds by insurance companies and equities by households. Positive source-host GDP per-capita differential causes government sector to invest
more at home. Among the Eurozone member nations, bond home bias is more pronounced than equity home bias, validating past work.

**Dynamic Relationship between Precious Metals**

*Ahmet ŞENSOY; Borsa İstanbul*

We use a relatively new approach to endogenously detect the volatility shifts in the returns of four major precious metals (gold, silver, platinum and palladium) from 1999 to 2013. We reveal that the turbulent year of 2008 has no significant effect on volatility levels of gold and silver however causes an upward shift in the volatility levels of palladium and platinum. Using the consistent dynamic conditional correlations, we show that precious metals get strongly correlated with each other in the last decade which reduces the diversification benefits across them and indicates a convergence to a single asset class. We endogenously detect the shifts in these dynamic correlation levels and reveal uni-directional volatility shift contagions among precious metals. The results show that gold has a uni-directional volatility shift contagion effect on all other precious metals and silver has a similar effect on platinum and palladium. However, the latter two do not matter in terms of volatility shift contagion. Thus, investors that hedge with precious metals should, in particular, monitor the volatility levels of gold and silver.

**Optimal Redemption Policies for Illiquid Investments**

*Cenk C. KARAHAN; Boğaziçi University*

We consider a risk-averse investor whose investable assets are held in a perfectly liquid asset (a portfolio of cash and liquid assets or a mutual fund) and another investment that has liquidity restrictions. The illiquidity could be due to restrictions on the investments (such as hedge funds) or due to nature of the asset held (such as real estate). The investor’s objective is to maximize the utility he derives from his terminal wealth at a future end date of his investment horizon. Furthermore the investor wants to hold his liquid wealth above a certain subsistence level, below which he incurs hefty borrowing costs or shortfall penalty. We consider the optimal conditions under which the investor must liquidate his illiquid assets. The redemption notification problem for hedge fund investors has certain affinity with the optimal control methods used in widely-studied inventory management problems. We find that the optimal policy has a monotone structure similar in nature to inventory management problems.
Session 1c: Behavioral Aspects of Investment

Chair: Merih UĞTUM; City University of New York

Overconfidence, Familiarity Bias and Representativeness Heuristic of Equity Investors

Bulent TEKCE; Boğaziçi University

Neslihan YILMAZ; Boğaziçi University

Recep BİLDİK; Borsa İstanbul

We study the behavioral biases of individual equity investors in Turkey and find that overconfidence is more common among male, younger investors, with lower portfolio values and investors in less developed regions. Overconfident investors have lower returns. Similar to overconfidence, familiarity bias is more common among male, younger investors, with lower portfolio values and investors in less developed regions. For modest levels, familiarity bias has a negative effect on the return, whereas the opposite is valid for investors exhibiting high level of familiarity bias. Representativeness heuristic leads to lower return.

Sport Event Sentiment and Turkish Market Return

Ender DEMIR; İstanbul Medeniyet University

Chi Keung Marco LAU; Gaziantep Zirve University

Kwok Ho CHAN; United International College

This paper examines the impact of international soccer matches on the Turkish stock market using firm level and sorted portfolio data, i.e. microeconomic evidence. Since the share of local investors increased significantly in the mid-2000, a natural experiment can be conducted such that the sports event sentiment should be stronger in the early 2000’s. Applying the Edmands et al. (2007) estimation method, we get the same conclusion - a significant negative loss effect and stronger impact in pre- 2006 period. However, once using panel data analysis and modeling spatial and temporal effects explicitly, we not only reject the null hypothesis of the natural experiment, but also find that the international soccer games virtually have no power explaining stock return variation. The same conclusions are made when replacing win/loss dummies with unexpected win
(loss) variable and sorting portfolio returns by market capitalization, past returns and volatility. Although we found mild evidence that sports events can affect the variance of sorted portfolio returns, there is very limited micro-evidence to support the 'overreaction' hypothesis of individual investors using Turkish stock market data.

**Event Study Methodology for Borsa Istanbul**

Adil ORAN; Middle East Technical University

Ülkem BAŞDAŞ; Middle East Technical University and University of Michigan

The primary research question of this paper is to determine the appropriate event study methodology for studies carried out on the Borsa İstanbul. In order to find the most appropriate methodology we compare the performance of different models (mean adjusted returns, market adjusted returns, and simple market model) in the Turkish stock market with portfolio time-series standard deviation test of BW with arithmetic returns. Furthermore, the sensitivity of results to the length of the event window and event date clustering are considered. This paper takes the experimental design of Brown and Warner (1980; 1985) and extends it to the Turkish market. This paper provides guidelines for future researchers that would like to carry out event studies in the Borsa İstanbul or other emerging market stock exchanges. The findings for the Turkish stock market over 1988-2012 when compared to the findings of Brown and Warner for the US show that there seems to be slightly higher specification error and slightly lower power of the tests in Borsa İstanbul. However, the main methodology which has been used in the US seems to work fairly well in this market as well. The simplest mean adjusted returns model works pretty well, but can run into problems with event date clustering. The market adjusted returns model and simple market model perform quite well across a wide range of conditions. Lastly, keeping the event window as short as possible is important.

**Risk Choices of Portfolio Managers in an Emerging Market Economy**

Belma ÖZTÜRKKAŁ; Kadir Has University

K. Ali AKKEMİK; Kadir Has University

Asset markets in emerging markets exhibit high volatility and low liquidity. Under such circumstances, portfolio management becomes difficult. Among emerging markets, Turkey in particular has high turnover, even when compared to developed markets, and this makes it an
appealing case to study the risk choices of portfolio managers. This paper analyzes the determinants of risk choices and speculative preferences of portfolio managers for their own investments. We use a unique data set from a survey of portfolio managers in fall of 2012. The sample consists of 72 employees of portfolio management companies. In the empirical section, we run simple OLS and probit models.
Session 2a: Empirical Asset Pricing Anomalies

Chair: Fernando ZAPATERO; University of Southern California

Playing Favorites: How Firms Prevent the Revelation of Bad News

Lauren COHEN; Harvard Business School and NBER

Dong LOU; London School of Economics and CEPR

Christopher MALLOY; Harvard Business School and NBER

We explore a subtle but important mechanism through which firms manipulate their information environments. We show that firms control information flow to the market through their specific organization and choreographing of earnings conference calls. Firms that “cast” their conference calls by disproportionately calling on bullish analysts tend to underperform in the future. Firms that call on more favorable analysts experience more negative future earnings surprises and more future earnings restatements. A long-short portfolio that exploits this differential firm behavior earns abnormal returns of up to 101 basis points per month. Further, firms that cast their calls have higher accruals leading up to call, barely exceed/meet earnings forecasts on the call that they cast, and in the quarter directly following their casting tend to issue equity and have significantly more insider selling.

In Search of Fundamentals

Zhi DA; University of Notre Dame
Joseph ENGELBERGZ; University of North Carolina
Pengjie GAOX; University of Notre Dame

We use internet search volume for firms’ products to predict revenue surprises, earnings surprises and earnings announcement returns. We find that increases (decreases) in the search volume index (SVI) of a firm’s most popular product strongly predicts positive (negative) revenue surprises. This predictive power is weaker for standardized unexpected earnings (SUE). SVI has strong predictability for returns around earnings announcements, especially among firms with few products, growth firms and firms that manage their reported earnings. Taken together, the evidence suggests that search volume for a firm’s products is a value-relevant leading indicator about a firm’s future cash flow that the market does not fully incorporate into prices before the earnings announcement.
A Project-Level Analysis of Value Creation in Firms

Jonathan B. COHNY; University of Texas at Austin
Umit G. GURUN; University of Texas at Dallas
Rabih MOUSSAWI; Wharton Research Data Services

This paper analyzes value-creation in firms at the project level. Our analysis of new client and product announcements indicates that the stock market conditions its response to new project announcements on the nature of CEO incentives within the rm. Announcement returns are positively related to CEO pay-performance sensitivity and have an inverse u-shaped relationship with CEO age, consistent with both career concerns and older managers facing compressed time horizons. We do not find that corporate governance variables predict project announcement returns. We also show that firms are likely to time their project announcements so as to avoid announcing projects at times when investors are likely to be distracted by other firm news.

Policy Uncertainty and Corporate Investment

Huseyin GULEN; Purdue University
Mihai ION; Purdue University

Using the policy uncertainty index of Baker, Bloom, and Davis (2012), we investigate how corporate capital investment at the firm and industry level is affected by the uncertainty related to future policy and regulatory outcomes. Policy-related uncertainty is negatively related to firm and industry level investment, and the economic magnitude of the effect is substantial. Our estimates indicate that approximately two thirds of the 32% drop in corporate investments observed during the 2007-2009 crisis period can be attributed to policy-related uncertainty. More importantly, we document that the relation between policy uncertainty and capital investment is not uniform in the cross-section of U.S. firms. It is significantly stronger for firms with a higher degree of investment irreversibility, for firms which are more financially constrained, and for firms operating in less competitive industries. Policy uncertainty is also associated with higher cash holdings and lower net debt issuance. Overall, these results lend empirical support to the notion that policy-related uncertainty can depress economic growth through a decrease in corporate investment. This decrease is related to precautionary delays induced by investment irreversibility and to increases in the cost of external borrowing.
Session 2b: Financial Management of Institutions and Corporations

Chair: Güler ARAS; Yıldız Technical University

Can Institutional Investors Cherry-pick Hot IPOs?

Ufuk GÜÇBİLMEZ; University of Edinburgh Business School

Using a unique set of bookbuilding data, we provide comprehensive tests of Rock's (1986) theory of IPO underpricing. In particular, we examine whether uninformed and informed investors coexist in the IPO market. We find that alongside uninformed institutional investors who regularly participate in the IPO market, there exist informed ones who can avoid cold issues and cherry-pick the hot ones to appropriate higher average initial returns. Other findings help tie together uncertainty- versus sentiment-based explanations of positive initial returns.

Managerial Accommodation, Proxy Access, and the Cost of Shareholder Empowerment

Oğuzhan ÖZBAŞ; University of Southern California

John G. MATSUSAKA; University of Southern California

This paper develops a theory of corporate decision making to study the benefits and costs of shareholder empowerment. We show how permitting shareholders to propose directors or policies can cause value-maximizing managers to take value-reducing actions to accommodate activist investors with non-value-maximizing goals. The model identifies an important distinction between the right to approve and the right to propose. The right to approve is weak though always beneficial; the right to propose is impactful but can help as well as hurt shareholders. We identify implications for current policy discussions concerning director elections, proxy access, bylaw amendments, and shareholder voting.
Measuring Takeover Premiums in Cross-Border M&As: Insights from Turkey

Şerif Aziz ŞİMŞİR; Sabancı University

We investigate whether the merger announcement dates provided in a popular Mergers and Acquisitions (M&A) database, SDC, serve as accurate event dates for estimating the wealth effects of mergers on target firms located in Turkey. We find that 74% of SDC’s merger announcement dates are preceded by merger-related events such as merger rumors, target firms’ search for potential acquirers, and early stage merger negotiation announcements. Target cumulative abnormal return (CAR) estimates around these early dates are almost twice as large as the CAR estimates around SDC’s merger announcement dates. We argue that our findings have implications for the recently flourishing cross-border M&A literature.

Short-term Wealth Effects of Mergers and Acquisitions: Evidence from Emerging Markets

Ali M. KUTAN; Southern Illinois University at Edwardsville

Evren ARIK; Borsa İstanbul

This paper investigates the short-term response of stock returns for target firms in mergers and acquisitions in nineteen emerging markets. Employing standard event study methodology on a sample of 2,719 M&As throughout 1996 to 2012, it is documented that announcements of mergers and acquisitions generate 3.95% average abnormal return for the stocks of target firms within the three-day symmetric event window. Furthermore, cross-sectional regressions in order to find factors related to the variation in the abnormal returns indicate that cash-paid M&As have higher abnormal returns, as previous research suggests. Whether the bid is friendly or hostile and percentage share of the target company sought are also found to be significant on the abnormal returns.
Session 2c: Financial Literacy and Payment Systems

Chair: Orhan ERDEM; Borsa İstanbul

Financial Illiteracy: Overconfidence and Consequences

Rasim MUTLU; Borsa İstanbul

Orhan ERDEM; Borsa İstanbul

Ali COŞKUN; Boğaziçi University

In this study using survey of 1230 participants we analyze certain characteristics of overconfident individuals. Our results indicate that men are more overconfident than women, higher education and income levels are positively correlated with overconfidence and that overconfident individuals tend to be more optimistic about future. Furthermore our analysis shows that there is not a systematic relationship between saving habits of individuals and overconfidence.

Financial Literacy and Credit Card Arrears

Güzin Gülsün AKIN; Boğaziçi University

Tülin ARAZ; Boğaziçi University

Ahmet Faruk AYSAN; Central Bank of the Republic of Turkey

Levent YILDIRAN; Boğaziçi University

The study analyzes the effect of financial literacy on credit card arrears. Specifically, it questions whether the inefficient use of credit cards or unexpected external shocks causes a cardholder to experience financial difficulties and to face a credit card default. Our main explanatory variable, financial literacy, is defined in three dimensions: information, which measures the financial knowledge of the cardholder; sophistication, which measures how much the cardholder is involved in financial markets; and activeness, which measures to what extent the cardholder uses her financial knowledge in finance related decisions.

The analysis is conducted in two parts. In the first part, with an ordered probit model, we identify the determinants of financial difficulties experienced by cardholders. We proxy financial difficulties
with the number of months a cardholder does not pay at least the minimum amount due in her credit card bill. In the second part, with a binary logit model, we identify the determinants of credit card defaults. As explanatory variables we use measures of financial literacy, attitude toward consumption, external shocks, and some socioeconomic and demographic variables.

We find external shocks to be important determinants of financial difficulties. People who tend to spend more than they earn are also very likely to experience financial difficulties. Financial literacy, income and wealth are not significant in the first model. In the second part, we find that the people who are hit by external shocks are likely to overcome difficulties and avoid defaults, if they are financially literate, if their household income is high, and if their household size is large. The study shows that if financial literacy and consciousness of cardholders can be increased with financial education, credit card problems will decline.

**Formal and Informal Regulations for Credit Card Payment Services**

*(Full text in Issue II)*

**Abstract**

The Turkish credit card market has recently undergone two important formal regulations: the interchange fee regulation in 2005 and the interest rate regulation in 2006. Banks started to charge annual fees to cardholders after the interest rate regulation, before which credit card ownership was costless. This practice sparked a widespread public outcry and legislative activity to control annual fees. Consumer unions vigorously called for regulations. They argued that in response to the fall in their interest revenues, banks started to exercise excessive market power in the payment services market. By employing the Panzar and Rosse (1982, 1987) method and a unique data set for all non-participation banks between 2002 and 2008, we investigate the effects of the formal and informal regulations on competition in the payment services market. We find that despite the increase in prices, the credit card payment services market actually became more competitive after the interest rate regulation. We attribute the rise in banks’ prices to a rise in their costs. Because of the prevailing informal regulations banks could pass along only part of the increase in their costs to the prices of their payment services. The resulting fall in their price-cost margins reduced banks’...
market power in the payment services market. Thus, our results do not justify further price regulations.

Credit Card Satisfaction and Financial Literacy: Evidence from an Emerging Market Economy

Güzin Gülsün AKIN; Boğaziçi University

Ahmet Faruk AYSAN; Central Bank of the Republic of Turkey

Serap ÖZÇELİK; Boğaziçi University

Levent YILDIRAN; Boğaziçi University

Default problems and complaints about credit cards do not seem to diminish with declining credit card rates. Using a nationwide credit card user survey, we try to identify the determinants of customer satisfaction in the Turkish credit card market. Controlling for customer and card characteristics, we find that financial literacy is a major determinant of satisfaction. When people know more about financial matters and use their knowledge in their financial activities, they make more efficient decisions and have fewer financial problems, which in turn lead to higher satisfaction. We also find that people who tend to use their credit cards for unnecessary shopping and who have a history of credit card delinquency are less satisfied.
Session 3a: Two Continents: Conventional and Islamic Finance

Chair: Murat MAZIBAŞ; Borsa İstanbul

Can an Interest-Free Credit Facility Be More Efficient Than a Usurious Payday Loan?

M. Shahid EBRAHIM; Bangor University

Inefficiencies in mainstream credit markets have pushed selected households to frequent high cost payday loans for their liquidity needs. Ironically, despite the prohibitive cost there is still persistent demand for the product. This paper rides on the public policy objective of expanding affordable credit to rationed households. Here, we expound a simple model that integrates inexpensive interest-free liquidity facility within an endogenous leverage circuit. This builds on the technology of ROSCA/ ASCRA/ mutual/ financial cooperative and cultural beliefs indoctrinated in Islam. Our results indicate the potential Pareto-efficiency of this interest-free circuit in contrast to the competing interest-bearing schemes of payday lenders and mainstream financiers.

Default and Prepayment Modeling in Participating Mortgages

Yusuf VARLI; Borsa İstanbul

Yildray YILDIRIM; Syracuse University

Since the last financial crisis in 2007, mortgage market has been renovating its used tools and instruments in order to avoid a new crisis. Risk sharing and partnership play important roles in the developing mortgage market. One of the innovative instruments in the market is called Participating Mortgages in which the lender gains a part of the excess payoffs at the time of either operation or completion or both. In this paper we establish a financing model in participating mortgage which is stochastically modeled using not only stochastic prices but also stochastic short term interest rates. According to the context of participating mortgages, while the borrower on any mortgage can get a mortgage rate which is less than the market interest rate, return of the lender would be higher than the conventional mortgage rate. Moreover, early termination options such as default and two prepayment clauses “defeasance and prepayment penalty” are simultaneously added into the model of participating mortgages. We illustrate a detailed sensitivity analysis for the
values of all options to get practical results. The values of early termination options are found to depend on the parameters in the model, as well as the term structure of short term rates.

**Developing Sukuk Market for Sustainable Development**

*Zamir IQBAL; World Bank*

Islamic bonds or Sukuk are one of the fastest growing segment of Islamic financial markets. Sukuk are asset-based or securitized bonds which are compliant with the principles of Islamic finance. Sukuk have been issued by sovereigns, supra-nationals, and corporates for financing of several sectors such as infrastructure projects, real estate development, and business development. However, the application of Sukuk for economic development through micro-financing or SME financing has not been explored. The presentation will look into the potential and prospects of developing Sukuk market for promoting sustainable development and shared prosperity. Given that the majority of OIC countries are facing the issues of poverty and unemployment, countries wishing to promote Islamic finance can develop products to utilize Islam's instruments of redistribution and Sukuk to innovate market-based solutions for the financing of micro- and SME sector.

**Are Islamic Bonds Different from Conventional Bonds?**

**International Evidence from Capital Market Tests**

*M. Kabir HASSAN; University of New Orleans*

*Nafis ALAM, Nottingham University, Malaysia*

*Mohammad Aminul HAQUE, Nottingham University, Malaysia*

Islamic bonds (Sukuk) emerged as an innovative capital market instrument over the last decade. This paper investigate the impact of conventional bonds and Sukuk announcement on shareholder wealth and their determinants using 79 Sukus and 87 conventional bonds over the period of 2004-2012 in six developed Islamic financial market. The overall time frame is divided into three parts, 2004-2006 (before crisis); 2007-2009 (during crisis) and 2010-2012 (after crisis). It is revealed that the market reaction is negative for the announcements of Sukuk before and during 2007 global financial crisis. On the other hand market reaction is positive for announcement of conventional bond before the crisis period and negative during and after crisis periods. The size of bond offering appears to have a negative impact on the cumulative abnormal return in case of Sukuk and positive in case of conventional bond.
Causal Link between Islamic and Conventional Banking: Evidence from Turkish Banking Sector

Mutahhar ERTÜRK; Borsa İstanbul

Serkan YÜKSEL; Borsa İstanbul

This study aims to shed light on the risk structure in the presence of Islamic banking, in particular in Turkey. Islamic banking and conventional banking are considered to be different kind of sources for funding. Returns in the conventional banking expected to be heavily influenced by the interest rate in the money market. However, Islamic banking returns are interest-free so that interest rate changes are not expected to affect the deposit returns in Islamic banks. Interest rates in the economy is a proxy to highlight the general risk level of the economy. By looking at the causal relationship between the deposit returns of both Islamic banks and conventional banks, it is possible to address the different types of banking in the general risk structure of the economy. This is the first study to address the mentioned difference in banking sector in Turkish economy. This paper tries to identify the direction of causality between Islamic and conventional banking term deposit rates by means of Granger Causality. Also, Granger Causality test results will guide to explore the Islamic and conventional banking deposit return linkages.
Session 3b: Market Structure Issues in Liquidity

Chair: Dong LOU; London School of Economics and CEPR

Wash Sales as a Stock Market Manipulation Tool

Bedri TAŞ; TOBB University

We investigate “wash sales” using a unique individual trade level data from the Istanbul Stock Exchange (ISE). We empirically analyze the following research questions: 1) Do investors conduct “wash sales”? 2) Can investors that conduct wash sales earn profits? 3) Is there an optimal level of wash sales which maximizes investor profits? Using the complete trading history of stocks listed on the ISE over the 2003-2006 period, we find that significant number of investors perform wash sales in the ISE. We also conclude that the percentage of wash sales should be 1% or lower to be able to earn profits.

Determinants of Capital Structure: Evidence from a Dynamic Emerging Market Economy

Bülent KÖKSAL; İpek University

Cüneyt ORMAN; Central Bank of the Republic of Turkey

Arif ODUNCU; Central Bank of the Republic of Turkey

This paper uses a new and comprehensive dataset to investigate the determinants of capital structure for Turkish non-financial firms during 1996-2009. Our main findings are: i) The importance of a given leverage factor varies for different leverage definitions. Specifically, size, tangibility, and potential debt tax shields are, respectively, the most important factors for total, long-term, and short-term debt ratios. ii) Inflation is a main determinant of leverage and is by far the most important macroeconomic factor. iii) At an aggregate level, manufacturing and nonmanufacturing firms have similar leverage. iv) Larger firms have higher long-term and lower short-term leverage. There are also marked and consistent differences in how the debt ratios of small and large firms are related with various firm-specific and macroeconomic factors. v) Mature firms have lower debt ratios, but their built-up reputations enable them to maintain a more stable capital structure. vi) Firms seem to match the maturity of their liabilities with their assets. vii) Banking system and the stock market seem to be complements rather than substitutes. Overall, our
results suggest that the trade-off theory is a better description of the capital structure of the average non-financial firm than the pecking order theory.

**Rent versus Own Decision in the Cross Section of Expected Stock Returns**

_Figen Güneş DOĞAN; Bilkent University_

_Levent AKDENİZ; Bilkent University_

_Aşlıhan SALİH ALTAY; Bilkent University_

In the economy, firms differ in their choice of owning or renting capital. This may be due to the production technologies required by the industry the firm is in or other firm specific constraints. Here renting and owning capital means, using leased versus purchased inputs in the production process. These inputs are mainly the factors of production such as labor and physical capital. We argue that firms with high levels of rented capital to be riskier than firms with more owned capital and provide a theoretical background and empirical evidence supporting this claim. The evidence suggests that shareholders demand higher risk premia to invest in firms with high levels of rented capital relative to firms with more owned capital and consequently the expected stock returns of these firms are higher. On average, firms with high rental rates have higher future stock returns than firms with low rental rates, a difference of 9.1% per annum for equal weighted portfolios and 5.1% per annum for value weighted portfolios. In summary, our work identifies a new source of risk for shareholders: the level of firm’s rented capital representing a claim on the division of firm’s cash flows between lessors and shareholders.

**Stock Market Reaction to Exchange Rate Regime Choices and Exchange Rates Stress: Evidence from Selected European Markets**

_Nasib NABULSI; Hanken School of Economics_

This paper investigates two related issues of exchange rate; the exchange rate regime choices and the exchange rate stress. We study the effect of both policies on the stock markets of selected countries in Europe by using a simple regression. We identified the de facto exchange rate regimes choices by using Levy-Yeyati and Sturzenegger (2005) method and the stress is calculated from the exchange market pressure for the period of 2002-2012. The results suggest that stock return have sensitivities across many sectors in the selected markets. However, this sensitiveness varies
significantly from one country to another and from one sector to another. The Turkish and the Hungarian equity markets are the most sensitive to the regime choice but show no reaction if the currency is under stress. On the other hand, The Romanian and the Icelandic equity market are most affected by the currency stress across sectors but show less sensitivity to the exchange rate regime choice.
Does Innovation Strategy Matter in Capital Structure Decisions? A Study in Indonesian Manufacturing Firms

Fitri SANTI; Gadjah Mada University

This study uses the panel data analysis to test the influence of innovation strategy on firm’s capital structure. This study has three objectives. Firstly, the empirical investigation will assess the extent to which Indonesian manufacturing companies listed in BEI investing their money to R&D activities as the way to be an innovator in their industry. Secondly, we will investigate the role of innovation strategy in explaining the capital structure decision. Finally, the study will also examine the relationship between the interaction of innovation strategy and firm’s profitability on capital structure decision. Previous study suggest that firms pursuing an innovation strategy require a certain level of equity that provide a financial buffer to ensure stability and availability of funds for research and development efforts, new product launches, and on-going development of knowledge based capabilities. In other words, firms need to maintain their financial slack before decide to take innovation strategy as their grand strategy. This paper considers that corporate strategy can explain the variation in capital structure choices made by manufacturing companies in Indonesia. In an industry, competitive strategies will determine the strategic value of decision to retain their certain financial slacks. Using Annual Financial Report data of 67 manufacturing firms from 1990 until 2005, this study confirms that financial slack should be an important determinant for the firm to lead innovation strategy. Firms pursuing an innovation strategy have low financial leverage. This study also finds that the more important innovation for company strategy, the stronger the negative relationship between profitability and leverage will be.
Does Too Much Finance Good or More Harm for Economic Growth?

Siong Hook LAW; University Putra Malaysia

This study provides new evidence on the relationship between finance and economic growth using an innovative dynamic panel threshold technique. The sample countries consist of 87 developed and developing countries. The empirical results indicate that there is a threshold effect in the finance-growth relationship. In particular, we find that the level of financial development is beneficial to growth only up to a certain threshold; beyond the threshold level further development of finance tends to adversely affect growth. These findings reveal that more finance is not necessary good for economic growth and highlight that an “optimal” level of financial development is more crucial in facilitating growth.

How Local is the Local Risk

Sayad BARONYAN; Özyeğin University

Emrah ŞENER; Özyeğin University

Over the last decade Emerging Market (EM) sovereign local debt markets has become a firmly established strategic asset class. Investors seeking greater diversification in their portfolios have increasingly turned to EM debt, investing more than Dollar 2.5 trillion into the asset class as June 2011. How do financial markets value the local debt of emerging markets? What portion of local bond yield is directly attributable to global factors? How much of the yield stems from country’s own fundamentals? To answer these questions, we study the nature of credit (default) and currency risk embedded in local currency denominated bonds in Brazil, Mexico and Turkey during 2005-2012. We show that a simple theoretical arbitrage relationship allows us to decompose the EM local bond return for each country into credit (default) risk and currency risk components without recourse to indirect statistical procedures. We characterize the factors that account for variation in credit and currency risk both through time as well as across countries. First, we find that almost 80% of local bond spread is due to currency risk premia. Second, we find that credit and currency risk premia are time-varying and state-dependent. Third, we find that while EM sovereign credit risk is strongly related to global factors, currency risk has its roots in country’s macroeconomic fundamentals and political risk profile.
Assembling International Equity Datasets – Review of Studies on the Cross-Section of Common Stocks (Full text in Issue II)

Antonina WASZCZUK1

Chair of Finance and Capital Market Theory, European University Viadrina Frankfurt (Oder), Große Scharrnstraße 59, 15023 Frankfurt (Oder), Germany

Abstract

This paper reviews the data sources used in the research on the cross-section of international stock returns. Covering the wide range of internationally focused papers I give an overview of the applied data, sample coverage, classification schemes and data cleaning methods. I address the quality concerns in case of the non-U.S. data and methodologically relevant specifics of international data analysis providing references to available solutions. In regards to data cleaning I give an overview of applied screens, pointing out their diversity across studies. On that way I offer a structured insight into challenges and specifics of rapidly increasing amount of papers discussing the cross-section of common stocks in both single-country and multiple country frameworks.

1 This study was financially supported by the Graduate College “Risk Analysis in Baltic States and Central and Eastern Europe” of the European University Viadrina in Frankfurt (Oder). The author also thanks Roman Brückner, Matthias Hanauer, Sven Husmann, Michael Soucek and Krzysztof Kusidlo for their useful comments and support. Email address: euv36052@europa-uni.de (Antonina WASZCZUK)
Session 4a: Behavioral Biases in Finance

Chair: Serkan ÖZCAN; Odeabank

Strategic Announcements by Star Analysts

Gil AHARONI; University of Melbourne

Joshua SHEMESH; University of Melbourne

Fernando ZAPATERO; University of Southern California

Success in the competition among star analysts plays a key role in analyst rankings. We find that when two or more star analysts cover the same stock, the most accurate star analyst is likely to improve her rank in the Institutional Investors magazine annual rankings. By improving their rank, analysts can perpetuate star status. We also find that the forecast error of star analysts is lower in stocks that other star analysts also cover, relative to stocks that no other star covers. This suggests that star analysts are aware of their ranking and divert their effort accordingly. Overall, we provide further evidence for strategic considerations in analyst forecasts.

Trading Puzzle, Puzzling Trade (Full text in Issue II)

Orhan ERDEM; Borsa İstanbul

Evren ARIK; Borsa İstanbul

Serkan YÜKSEL; Borsa İstanbul

Many studies explain the high volume of trade in stock markets with non-rational trades of individuals. They claim high volume of trading seems to exceed the trading and hedging needs of the investors. Here we analyze the weekly aggregated daily trades in Borsa İstanbul (formerly Istanbul Stock Exchange) of 20,000 individual investors over two year period from 2011 to 2012. Borsa İstanbul has one of highest share turnover ratio worldwide (141.8% as of 2012) which makes it an ideal candidate to explore the effects of large turnover ratios. We examine the return performance of individual investors with respect to various factors such as portfolio size, turnover ratio and also demographic factors: gender and age. The main finding and the contribution of the paper is that, the return of the individual portfolio is positively correlated with the portfolio size. Interestingly, almost 70% of all individual investors cannot beat the market. Investors who have
high turnover underperform compared to those who have lower turnover ratios. Male investors trade more and lose more vis-à-vis the female and older investors have higher returns for both genders.

**Over-correlated Markets and Consecutive Overreactions**

*Ahmet DURAN; İstanbul Technical University*

It is crucial to understand the interaction of global financial markets and the role of related behavioral biases. For this purpose, we examine the daily returns from S&P 500 listed stocks, a number of closed-end funds trading on US markets, BIST - 30 and BIST - 100 indexes between 2003 and 2013. We observe that the consecutive overreactions may result in local bubbles, bounces or long term bubbles depending on balanced overreactions - corrections or skewed overreactions. We suggest that local financial or economic problems should be kept local as much as possible without exaggerations.

**Can You Teach Someone to be Financially Capable? A Meta-Analysis of the Literature**

*Margaret MILLER; The World Bank*

This paper presents a systematic review of the literature on financial education interventions using meta-analysis to provide a quantitative evaluation – a unique contribution as previous reviews have been narrative in nature. The focus is on studies that evaluate financial literacy and capability interventions of various types which are designed to strengthen financial knowledge and behaviors of consumers. In line with this approach, the authors identify 126 papers and articles which present impact results of interventions designed to increase consumers’ financial knowledge (financial literacy) and / or skills and behaviors (financial capability). These papers are diverse across a number of dimensions including objective of the program intervention, intensity and duration of the intervention, delivery channels used and target population to name just a few. However, there are several outcome indicators where a subset of papers are comparable including those addressing savings behavior, defaults on loans and financial skills such as record keeping. The results from the meta-analysis indicate that financial literacy and capability interventions may have a positive impact in some areas (increasing savings, promoting financial skills such as record keeping) but not in others (credit default). The analysis also helps to clarify the importance of going beyond a simple view of consumer behavior in financial markets as rational agent / profit maximizing to one which takes into account limits to rationality due to parabolic discounting, procrastination, limits in
ability to process information, importance of social networks, etc. and thus the role for behavioral finance perspectives in financial capability outreach and financial market regulation.
Session 4b: Empirical Methods in Financial Market Dynamics

Chair: Ege YAZGAN; İstanbul Bilgi University

The effect of investors' confidence on monetary policy- economic growth relationship: a Multivariate GARCH approach (Full text in Issue II)

Chiara GUERELLO\textsuperscript{2} University of Genoa – Department of Economics\textsuperscript{3}

Abstract

The financial stability's effects on the monetary policy transmission mechanisms are investigated. Specifically, the heteroskedasticity of the errors is exploited, in a MGARCH, to obtain endogenously estimated measures of uncertainty. A two steps estimator of a Multivariate GARCH-in-mean model highlights the indirect effects of monetary growth on financial markets at different time horizons. The estimates, although preliminary in line with who views the "Great Moderation" as the main cause of the financial crises, lead to reversed results once avoided spurious regression problems, accounting for permanent changes in the monetary policy (structural breaks in the variances 'series).

Benchmarking the Performance of Some Computational Intelligence Methods for the Prediction of Entering Insolvency in Case of Romanian Businesses during the Financial Crisis

Vasile GEORGESCU; University of Craiova

In this paper, we benchmark the performance on bankruptcy prediction of two state-of-the-art classifiers based on Computational Intelligence, namely the Neural Networks and the Support Vector Machines, against three more conventional methods (Multivariate Discriminant Analysis,

---

\textsuperscript{2} I am very grateful to Prof. Marco Mazzoli for his thorough comments at different stages of this work. Helpful conversations with Prof. Gianni Amisano and Prof. Mike Clements are also gratefully acknowledge. All mistakes are mine.

\textsuperscript{3} Department of Economics (DIEC), University of Genoa, via Vivaldi 5, 16100 Genova, Italy.

Email: chiara.guerello86@vodafone.it
Naïve Bayes and Decision Trees), using a sample of 130 Romanian companies listed on Bucharest Stock Exchange (BSE). Our experimental setup consists of evaluating the in-sample and the out-of-sample predictive power of the competing methods, using the area under the ROC curve (AUC), a more reliable metric than accuracy, to avoid misleading results caused by a dataset with unbalanced classes. We put a particular emphasis on testing the generalization performance vs. the risk of overfitting the data.

Mitigating Turkey's Trilemma Tradeoffs

Yasin AKÇELİK; Central Bank of the Republic of Turkey

Orcan CORTUK; Central Bank of the Republic of Turkey

İbrahim M. TURHAN; Borsa İstanbul

We study the trilemma configuration of the Turkish economy for 2002 - 2011. This includes calculating the trilemma indices and regressing them on a constant following Aizenman, Chinn and Ito (2008). Yet, we extend this approach by applying Kalman filter to the classical linear regression to capture the time-varying importance of policy decisions. Next, we reveal the role of central bank foreign reserves and required reserves in mitigating the trilemma tradeoffs through their relation with the trilemma residuals in a VAR framework - we show that foreign reserves to GDP ratio and required reserve ratio have positive significant impact on the residuals, thus making the policy tradeoffs smaller.

The Linkage between Foreign Bank Penetration and Host Country Risks: The Case of Turkey

Derviş KIRIKKALELI, University of Stirling

In this paper, I purpose to examine the two-way linkage between FBP and country risk (namely, political risk, economic risk and financial risk indexes) in Turkey using quarterly data from 1992Q4 to 2009Q4. My findings indicate that one cointegrating vector is detected between FBP and political risk and between foreign bank penetration and economic risk in whereas I failed to find any long-run relationship between FBP and financial risk using the Johansen co-integration test. In the long run, I found that foreign bank entry affects significantly economic and political risk indexes. Moreover, I investigated the short-run causality based on VAR approach between FBP and financial risk but I failed to find any significant causality in the bivariate VAR model, even at the 10% level. The results of impulse response functions also reveal that; (i) surprisingly, there is
negative relationship between political risk and foreign bank entry; (ii) rising foreign bank penetration is associated with less economic risk and the reverse effect is close to zero throughout 12 quarters; (iii) finally, no relationship between foreign bank entry and financial risk is observed.
Session 4c: Issues on Trading and Volatility

Chair: Ali COŞKUN; Boğaziçi University

Intraday Stealth Trading and Volatility the Evidence from the Warsaw Stock Exchange

Barbara BEDOWSKA-SOJKA; Poznan University of Economics

The intraday volatility and volume U-shape pattern is well documented in the literature. It describes the common pattern of investor's behavior on the stock markets: investor's trade in the beginning and the end of the day more intensive than in the lunch time. However that pattern does not differentiate between trades' sizes and investors characteristics. The stealth trading hypothesis states that informed traders tend to hide their information. There is a need for such behavior at the time of low volatility and they may achieve this by breaking up their trades into smaller parts. At the time of high volatility informed traders are willing to place large orders at the beginning and the end of the trading day because high volatility provides a sufficient camouflage for their information. We examine volatility pattern for small, medium and large trades and consider how durations between trades and spreads differ between trade size categories. Our sample consists of the data from the Warsaw Stock Exchange, which is organized as an order driven market. We show that medium-size trades are associated with relative large cumulative stock price changes, however these results are not robust when liquidity measures and durations between the consecutive trades are taken into account.

Agency and Transparency in Financial Markets (Full text in Issue II)

Sadettin Haluk ÇİTÇİ4; Gebze Institute of Technology

Abstract

We analyze incentive effects of transparency on delegated portfolio management. When portfolio return is observable, disclosure of portfolio composition decreases expected return and lowers the investor's ability to identify the manager's actual type. More information about the portfolio return

4 Tel: 90-262-605-1431; fax: 90-262-654-3224. Address: Gebze Institute of Technology - Science of Strategy Department, P.K.141, 41400 Gebze - Kocaeli, Turkey. E-mail address: hcitci@gyte.edu.tr
before renewal of management agreement also decreases expected return, while, conditionally, it may provide more information about manager’s actual ability.

**Session 5a: Financial Stability and Growth**

Chair: Murat YÜLEK; İstanbul Commerce University

**Fiscal Responsibility and US Government Reaction to Debt Accumulation: A Time Varying Approach**

_Hiroshi MORITA; City University of New York_

_Merih UÇTUM; City University of New York_

Sustainability of governments’ fiscal stance is subject of active and ongoing debate in academic and policy circles since the 1980 debt crises. A broadly adopted approach (Bohn criterion) analyzes if the government reacts to excessive debt accumulation by generating a primary budget surplus (excluding debt services). Then the budget is deemed to be solvent and this is considered a sufficient condition for sustainability of fiscal policy.

In this study, we examine the government’s reaction function by remedying two problems in the existing literature. We allow the government reaction to vary over time and control for endogeneities by employing a multivariate framework. We use the US data because of the high quality of the data and also because most studies use a similar set of data, facilitating comparison of our results with the existing findings. Moreover, this question occupies the front pages of the popular press in the country and has been a recurrent campaign theme during the election periods.

Our findings are: the response of the government’s primary surplus to a 1% debt shock displays first a deterioration of the primary balance, followed by a sustained improvement, consistent with a fiscally responsible policy. The shape of the impulse response (IR), however, depends on the sample period. For example, until the recent financial crisis, the IRs shows that the negative response reverses after two quarters and becomes positive within 2 years. Yet, the IR in 2011 displays a large drop at impact and further deterioration but a more sustained improvement in the following quarters. The median estimates of the fiscal reaction are consistent with the IRs. Our study thus shows that (i) The US government has been following fiscally responsible policies even during slowdowns; (ii) a fixed-coefficient IR analysis or single-equation estimates are likely misleading because their results will not be robust to a change in sample.
Financial Stability and Monetary Policy - The Case of Brazil

Benjamin M. TABAK; Central Bank of Brazil

This paper proposes a new way to model contagion within interbank networks. We use a unique dataset for the Brazilian financial system and include all active financial intermediaries. We show that the contagion chain has a short propagation path. First round contagion is generated by banks, and medium-sized banks can generate contagion, which implies that size is not the sole determinant of importance within networks. Most vulnerable financial institutions are not banks. We also compare the contagion process structure during and after the crisis and find no relevant changes in the process, except that the interbank market has become smaller and less connected. Overall, the model and empirical results are relevant contributions to the discussion of modeling contagion and risk within financial systems.

Finance and Growth: For Whom?

Tatiana DIDIER; World Bank

This paper examines whether the overall expansion in capital markets around the world during the 2000s has been accompanied by firms issuing securities to obtain financing and grow. Using data on over 45,000 listed firms from 51 developed and developing countries, the paper shows that relatively few firms (around 20 per country, per year) use equity and bond markets to obtain financing. Not only relatively few firms raise capital, even fewer attract most of the financing. Moreover, firms that issue equity or bonds are different and behave differently from other publicly listed firms. The capital raising activity is concentrated in large, fast-growing, and less profitable firms, with the top 5 issuers capturing around 60-70 percent of the activity. After issuing, the assets, sales, and number of employees of issuers grow substantially more than those of non-issuers (assets grow at 10 and 4 percent per year for issuers and non-issuers, respectively). Only in market based, high income countries smaller firms tend to issue securities. These differences between users and nonusers exist before the capital raising, are associated with the probability of raising capital, and become more pronounced afterward. Therefore, the firm size distribution of issuing firms shifts more over time than that of non-issuing firms, implying little convergence. To the extent that financial markets act as the brain of the economy, investigating how widespread the use of capital markets by firms is and ascertaining the consequences on firm dynamics of a more globalized financial system would inform policy makers not only of where the potential gaps lie but also of how financial shocks get transmitted to firms and, through them, to the real sector. This
research would thus shed light on the type of measures needed to shield the domestic economy from volatility in financial markets.

**Inflation Dynamics and Business Cycles (Full text in Issue II)**

*Süleyman Hilmi KAL; Central Bank of the Republic of Turkey*

*Nuran ARSLANER; Central Bank of the Republic of Turkey*

*Ferhat ARSLANER; Borsa Istanbul*

The paper aims to investigate whether the effect of the backward-looking inflation expectations, nominal effective exchange rate, money supply, gross domestic product and import prices on inflation depends on business cycle. For this purpose, a two states Markov Switching Auto Regression model with time varying transition probabilities to a generic inflation model is implemented for the period 2003-2013. In this model the states are assigned whether output gap is positive or negative. The inflation forecasting in-sample and out-of-sample is also utilized by adopting mean squared error and Diebold Mariano test to measure explanatory and forecasting power of our model. Our main finding provides that the determinants of inflation have different dynamics during boom periods as compared to recessions.
Session 5b: Quantitative Approaches in Finance

Chair: Cenk C. KARAHAN; Boğaziçi University

Efficiency and Competitiveness in Turkish Banking

Canan YILDIRIM; Kadir Has University

Using a novel approach, we derive “shadow unrealized profit scores” as well as “shadow input-output prices” for each year and bank in the Turkish banking sector from 2002 to 2011. We demonstrate these scores operationalize the Hicksian concept of “monopolistic quiet life.” We provide some evidence the sector came closer to the “zero profit condition” as well as displaying a closer approximation to the “law of one price” over time. We show the variability of these “shadow prices” essentially coincides with that of corresponding actual prices. We utilize shadow price information to show banks’ competitive choices differ based on their ownership structure. We undertake second stage regressions and find foreign banks outperform their private Turkish counterparts. Large banks are much more efficient compared to medium and small ones. Asset quality turns out to have a consistently strong and positive impact on performance.

Comovement and Polarization of Interest Rate and Stock Market in Turkey (Full text in Issue II)

Ahmet DURAN; Istanbul Technical University

Burhaneddin İZGİ; Istanbul Technical University

It is important to analyze and distinguish the comovement and polarization behaviors for securities in financial markets. In this paper, we examine the comovement and polarization of interest rates and daily returns of BIST - 100 index between 2010 and 2013 in order to understand the corresponding behavioral dynamics. We examine Heston stochastic volatility model which may capture such behaviors and reflect fat-tails and high peaks in the price distributions under various market situations. We present extensive simulations using numerical solutions of the stochastic differential equations. Heston stochastic volatility model predicts that the average logarithmic stock return increases as interest rate rises. Actually, we observe that there are also sufficiently large time intervals where interest rates were decreased and stock prices increased gradually in US stock markets and Borsa Istanbul, unlike the Heston stochastic volatility model suggests.
The Intervention of Central Banks to Jumps in Exchange Rate Markets: The Case of Central Bank of the Republic of Turkey

Ramazan EKİNCİ; Dokuz Eylül University
Hakan KAHYAOĞLU; Dokuz Eylül University

Central Bank of the Republic of Turkey announces that the floating exchange rate system will be her strategy regarding the monetary policy. However Central Bank of the Republic of Turkey need to intervene the exchange rate markets during the increase in the volatility. In general, jumps lead to increase in the volatility level of exchange rate markets. The persistence of volatility in the exchange rate markets are analyzed by using the jump diffusion approaches in the related literature to come up with a conclusion on related markets. It is important to analyze the effects of Central Banks’ implementations on the persistency of jump diffusions. In this work, the persistency of volatility in the Turkish exchange rate markets is analyzed by using the above mentioned approaches. In addition, the effect of Central Bank Intervention will be estimated to understand whether this causes any asymmetric effects in Turkish exchange rate markets.
Session 5c: Financial Markets and Institutions

Chair: Talat ULUSSEVER; Borsa İstanbul

What Explains the BIST Spread? Evidence from Conventional and Unconventional Policy Episodes in Turkey

Hande KÜÇÜK; Central Bank of the Republic of Turkey

Pınar ÖZLÜ; Central Bank of the Republic of Turkey

Anıl TALASLI; Central Bank of the Republic of Turkey

Deren ÜNALMIS; Central Bank of the Republic of Turkey

Canan YÜKSEL; Central Bank of the Republic of Turkey

As of end-2010, the Central Bank of the Republic of Turkey (CBRT) has adopted a new monetary policy framework aimed at managing the macro financial risks caused by external imbalances, excessive credit growth and volatile capital flows. In this respect, the general framework of the inflation targeting regime was modified and additional policy instruments were developed to support the adoption of financial stability as a complementary objective. The new policy mix entailed the joint use of the interest rate corridor between overnight borrowing and lending rates, liquidity policy and required reserves in addition to the short-term policy rate. As of end-2011 reserve option mechanism has been added to this policy mix.

Active liquidity management in conjunction with a wide interest rate corridor allows the overnight market interest rate to deviate from the average cost of CBRT funding provided to banks. The spread between the two rates has become wider and more volatile since the second half of 2010 compared to the conventional policy episode. Such a spread might not be desirable under a conventional inflation targeting regime as it might be interpreted as a loss of control by the central bank over the short-term money market rate. However, this is not the case in an unconventional monetary policy framework with multiple instruments and objectives, whereby short-term market interest rates can be affected by instruments other than the policy rate.

In this paper, we analyze the determinants of the spread between the overnight money market rate (BIST overnight repo rate), and the average cost of funding provided by the CBRT (CBRT average funding rate) providing evidence from both the conventional and the unconventional monetary policy episodes in Turkey. We try to find out to what extent the nonstandard monetary policy measures implemented by the CBRT affects the BIST spread. This analysis is important to shed light
on the changing nature of the monetary transmission since the adoption of the new policy framework in 2010. We use an OLS framework to regress the BIST spread on a range of variables related to the liquidity policy of the CBRT and other policy instruments such as the liquidity needs of banks, interest rate expectations and uncertainty. We find that the liquidity policy of the CBRT is an important determinant of the money market spread in the unconventional monetary policy episode, while it did not play an important role in the earlier episode of conventional inflation targeting regime where policy rate was the single instrument of monetary policy. Hence, we argue that the rise in the short-term money market spread in the new episode is a natural consequence of pursuing a monetary policy with multiple instruments rather than an indication of a weakening in the transmission from the policy rate to the overnight interest rate.

Financial Intermediaries, Credit Shocks and Business Cycles

Yasin MİMİR; CBRT Istanbul School of Central Banking

I document key business cycle facts of aggregate financial flows in the U.S. banking sector: (i) Bank credit, deposits and loan spread are less volatile than output, while net worth and leverage ratio are more volatile, (ii) bank credit and net worth are procyclical, while deposits, leverage ratio and loan spread are countercyclical and (iii) financial variables lead the output fluctuations by one to three quarters. I then present an equilibrium real business cycle model with a financial sector, that is capable of matching these newly documented stylized facts. An agency problem between banks and their depositors induces endogenous capital constraints for banks in obtaining funds from households. Empirically-disciplined shocks to bank net worth alter the ability of banks to borrow and to extend credit to firms. I find that these financial shocks are important not only for explaining the dynamics of financial flows but also for the dynamics of standard macroeconomic aggregates. They play a major role in driving real fluctuations due to their impact on the tightness of bank capital constraint and the credit spread. The tightness measure of credit conditions in the model tracks the index of tightening credit standards constructed by the Federal Reserve Board quite well.
The Effects of Demographic Changes on the Long Term Housing Demand in Turkey

Yavuz ARSLAN- Central Bank of Turkey
Evren CERİTOĞLU- Central Bank of Turkey
Birol KANIK- Central Bank of Turkey

Abstract

In this study, we investigate the effects of age structure dynamics of population on the housing demand in Turkey. The critical question is how the housing demand moves in the environment of positive population growth with declining rate and aging population. We use TurkStat Household Budget Survey to determine the link between household housing demand and household age cohorts. We obtain housing demand for each age cohorts and long term housing demand for Turkey by utilizing TurkStat population forecasts. Estimation results indicate that age structure of population has a notable effect on the growth of housing demand besides population growth. The results show that housing demand will increase 1.48 percent annually on average from 2009 to 2050 where 1.08 percent of the increase will be contributed by population growth and the rest of 0.40 percent will be derived by the change in age structure of the population.

Plenary Talk: How Much Mathematics Do We Need in Finance?

Mete SONER

After the recent financial crisis, the use of sophisticated methods in financial engineering is often criticized. Even some went to the comical extend to try to portray it as the sole cause of the meltdown. It is clear that mathematical methods, starting with the theories of Harry Markowitz, Paul Samuelson, Robert Merton, Fischer Black and Myron Scholes is now playing the central role in finance. It would be ludicrous to abolish quantitative methods from finance or other social sciences. However, in view of our experiences it is would be beneficial to question how, how much and which. In this talk, I will provide my own perspective as a mathematician who has been involved in this development over the past two decades.
Session 6a: Interactions of the MENA Stock Markets in a Global Economy: Bi-Directional Influences

Chair: Fatma DOĞRUEL; Marmara University

The Effect of Global Shocks and Volatility on Herd Behavior in Borsa Istanbul (Full text in Issue II)

Mehmet BALCILAR
Department of Economics
Eastern Mediterranean University
Famagusta, T. R. North Cyprus, via Mersin 10, Turkey.

Rıza DEMIRER
Department of Economics & Finance
Southern Illinois University Edwardsville
Edwardsville, IL 62026-1102

Abstract

This paper contributes to the literature on the financial integration in international stock markets by examining the dynamic relationship between global factors and herd behavior in an emerging market. Utilizing a time-varying transition probability Markov Switching model (TVTP-MS), we examine the role of global risk factors on investor behavior in Borsa Istanbul, dominated largely by foreign investors who hold a substantial share of the stocks traded in this market. Our tests yield three distinct market regimes-low, high, and extreme volatility- and evidence consistent with herd behavior during both the high and extreme volatility regimes. U.S. market related factors are found to dominate regime transitions and thus significantly contribute to herd behavior in all market sectors with the exception of industrials, suggesting that industrials are relatively immune from global shocks. Policy and portfolio implications are discussed next.
Volatility and Transparency of Financial Markets in the MENA Region *(Full text in Issue II)*

Hamid MOHTADI; University of Wisconsin-Milwaukee

Stefan RUEDIGER; Arizona State University

Abstract

Furman-Stiglitz (1998) hypothesize that improved transparency in financial markets intensifies volatility, yet more conventional wisdom exemplified by the International Monetary Fund’s position states that lack of transparency intensifies volatility. Mohtadi-Ruediger (2012) provide a theoretical model which brings the two concepts together, identifying a U-shaped relationship between volatility and transparency. This paper estimates the impact of transparency on financial volatility in MENA countries using a sample of 12 MENA countries over 10 years. The particular focus of the paper is to determine if financial markets in MENA follow different volatility patterns due to the impact of natural resources returns on the general economy. Taking into account the large importance of natural resources we identify a U-shaped pattern showing that financial transparency initially worsens and eventually decreases volatility of financial markets. Thus, the results provide important implications for reform of financial markets in the MENA economies.

Drivers of Foreign and Domestic Demand for Sovereign Bonds in Developed and Emerging Economies: Fundamentals vs. Market Sentiment

Tomasz ORPISZEWSKI; AXA Investment Managers

Using a new large dataset compiled from national sources this paper attempts to explain the determinants of demand for government debt from domestic institutions, private foreign holders and foreign central banks. In Peripheral Eurozone, foreign institutional investors’ holdings are significantly associated with less sustainable debt, weaker government effectiveness and higher bond yields, while in the Core Eurozone they purchase debt only if public finances improve. Prior to the crisis rising risk aversion pushed private non-resident investors to purchase bonds issued by Safe Haven and Eurozone countries, whereas from 2008 rising risk aversion pushed investors to buy non-euro Safe Haven assets and sell bonds issued by both core and peripheral Eurozone. In turn, demand of foreign central banks is associated one hand with sound fiscal policies and higher growth rates,
but on the other with strong reactivity to interest rates and global market sentiment. Finally, the more government debt is held by domestic banks, the higher the probability for the government to resort to IMF funding due to unsustainable budget situation and high interest rates.
Session 6b: Asset Pricing Anomalies in Financial Markets

Chair: Emrah ŞENER; Özyeğin University

The Equity Premium in a DSGE Model with Limited Asset Market Participation

Lorenzo MENNA; University of Milan-Bicocca

Models based on the representative agent assumption cannot rationalize observed equity premia, i.e. the observed correlation between asset returns and consumption growth is "too weak". In response to this, exchange economy models have introduced agents heterogeneity, typically in the form of bond and equity holders. In this case the correlation between aggregate consumption and equity returns no longer matters for the equity premium. We reconsider the issue introducing Limited Asset Market Participation in an otherwise standard DSGE model. Our model fits financial data well, while largely improving over the corresponding representative agent model from the macroeconomic point of view. We obtain that the correlation between asset holders consumption and financial returns strongly increases in the share of agents excluded from financial markets participation, the predicted unconditional equity premium is therefore large. We also identify the relative importance of shocks and frictions in generating macro and financial results.

Ambiguity, News and Asymmetric Correlations

Said Mehmet OZSOY; Ozyegin University

Empirical studies find that the correlations of stock returns are greater during joint downside movements than during joint upside movements. This asymmetry is different in nature than correlations being counter-cyclical and unlike the counter-cyclical correlations it cannot be explained just by the heightened market volatility. In this paper, I first show that this asymmetry in conditional correlations does not originate from the correlation of the corresponding dividend growth rates. Then I propose a general equilibrium model to explain these empirical findings. Ambiguity aversion captures agents’ lack of confidence in the news quality. When observing ambiguous news, investors maximize their expected utility under the endogenous worst-case scenarios. Investors perceive bad news as more reliable, while good news tends to be attributed to noise. Therefore, bad news is treated as a stronger signal than good news. This mechanism drives
the conditional correlation asymmetry. Motivated by the model, I uncover a new empirical regularity: the higher the idiosyncratic volatility, the higher the correlation asymmetry.

Only When the Tide Goes Out: Downside Returns and Hedge Fund Performance

Ashley WANG; Board of Governors of the Federal Reserve

We investigate whether hedge fund managers that better weather market downturns are more skillful and hence deliver superior future performance. We construct two conditional performance measures, Downside Returns and Upside Returns, based on the average fund performance over periods of relative hedge fund market weakness (strength), respectively. Our main results indicate that, on average, funds with better Downside Returns continue to outperform their peers in the future, whereas funds with better Upside Returns do not outperform subsequently. After adjusting for risk, funds in the highest Downside Returns quintile outperform funds in the lowest quintile by 5% in the subsequent year. Funds with higher Downside Returns are shown to have better risk management and less systemic risk.

Global Financial Factors Driving Daily Changes in Sovereign Credit Default Swaps

Alper BAKDUR; Bilkent University

We investigate the global determinants of the change in sovereign Credit Default Swaps (CDS) spreads for 54 countries as an indicator of innovation in sovereign credit risk. We document that percentage daily change in world market (MSCI All Country World Index), percentage daily change in lagged Chicago Board of Exchange Volatility Index (VIX) and US Dollar Swap Interest Rate (second principal component obtained from principal component analysis of daily change of 1 to 10 year US Dollar Swap Rates) are statistically significant global factors. This is more prominent during the crisis for both developed and emerging countries. We explore the possible stock market pricing implications of the CDS spreads that are not attributable to the documented global factors. Global factors removed innovations in sovereign CDS spreads show statistically significant relationship with the sovereign main stock index. This finding supports the existence of local information in sovereign CDS.
Session 6c: Thinking Over the Hedging Strategies

Chair: Muammer ÇAKIR; Borsa İstanbul

Hedging Strategy for Electricity Market Price Volatility: The Case of Turkish Electricity Market (Full text in Issue II)

Sezer Bozkus KAHYAOĞLU, sezer.bozkus@gtturkey.com

M. Vedat PAZARLIOĞLU, vedat.pazarlioglu@deu.edu.tr

Abstract

Turkish Electricity Market was launched in 2006. This event could be treated as a new and revolutionary period in Turkish Energy Markets since the electricity spot prices are determined by the market conditions thereafter. There was an amendment and advancement in the electricity price determination system in 2009 in order to enhance the electricity pricing mechanisms. In this respect, the volatility of electricity prices becomes the major explanatory variable for the forecast of electricity price demand in Turkey.

It is important for the markets participants to analyze and compare historical price behavior across the energy markets, along with a forecast of price volatility which provide price signals which can be incorporated into their inter-jurisdiction energy trade planning. In addition, these market participants may consider price volatility signals in their future investment plans in order to minimize the potential financial risks to which they might be exposed. However there is neither electricity nor any other energy futures market which makes it difficult for the market participants to utilize as hedging instruments in Turkey. In this work, Petrol Future Contracts are analyzed to forecast whether these contracts could be used as hedging instruments against the volatility of Turkish electricity market prices. Volatility in the Turkish electricity market prices are quantified and the optimal hedging ratio is estimated by using relevant econometric methods and approaches. Based on our empirical findings, recommendations are made for the market participants to assist them for hedging strategies and minimizing the energy costs.
Interaction between Single Stock Futures and the Underlying Securities: A Cross Country Analysis

Elif MUTLU; Borsa İstanbul

Evren ARIK; Borsa İstanbul

We investigate the lead-lag relationship between price movements of single stock futures (SSFs) and spot stock markets in four organized markets, namely, Korea Exchange, National Stock Exchange of India, Warsaw Stock Exchange, and Moscow Exchange. Employing a vector error correction model and using daily data of 192 single stock futures-stock pairs, we find that, in the long-run, spot market leads futures market in 30% of the sample. Leading role of the SSF market in the long-run becomes evident in only 5% of the sample. Regarding the short run dynamics, leading roles of SSFs and stocks are more balanced; the SSF market leads the spot market in 29%, whereas the spot market leads the SSF market in 22% of the sample. We find that relative trading activity (SSF volume/spot volume) and maturity/age of the SSF have a significant positive effect on the leading role of the SSFs.

A Dynamic Kalman Filter Approach to Detect the Futures and Spot Markets Relation

Hasan ERTUĞRUL; Undersecretariat of Turkish Treasury

In this empirical paper, we use a dynamic Kalman filter approach to investigate time varying interaction between spot and futures equity markets. In addition to static Bounds Test, we use a dynamic Kalman filter approach that provides an iterative process for parameter estimation. The methodology is practically tested with a growing futures market in Turkey in the crisis period. Results of empirical evidence show that the prices of futures index in the markets can be predicted by spot prices indicating that the markets have not got information efficiency, yet. The methodology in the paper can be applied in other markets to detect time varying dynamic relationship between spot and futures markets.
Price Behaviour around Share Buyback in the Indian Equity Market

Chanchal Chatterjee; Assistant Professor; International Management Institute Kolkata

Paramita Mukherjee*; Associate Professor; International Management Institute Kolkata

2/4C, Judges Court Road, Alipore, Kolkata 700027, India. Phone No.: +91 33 6652 9667 (O), +91 33 2359 9290 (R), +91 94331 20454 (C). The authors are indebted to Ms. Rajashri Chatterjee for research assistance.

Extended Abstract

Share repurchase is becoming an important corporate practice in India of late. Share buyback is believed to inject some buoyancy into stock prices as the buyback price is generally higher than the prevailing market price. Several studies have examined the underlying motives behind share repurchase programmes and most common motives identified include returning surplus cash to shareholders, capital structure adjustment, anti-takeover mechanism, means for transferring wealth from participating to non-participating shareholders and the application of preferential tax rates (Liao, Ke and Yu, 2005). Studies like Dann (1981), Vermaelen (1984), Netter and Mitchell (1989), Comment and Jarrell (1991) support the undervaluation hypothesis and observe significant positive abnormal returns around buyback announcement period in US. However, the regulatory framework around share repurchase varies across nations and has significant impact on this corporate practice from different dimensions. Rau and Vermaelen (2002) find that the form and intensity of repurchase activity in the UK is influenced by the tax consequences for pension funds. Firms in UK announcing share buybacks earn smaller excess returns, both in the short-run and in the long-run than those earned by firms in the US.

Unfortunately, in India, there exists a paucity of systematic study regarding the motives, nature and impact of buyback on share prices of respective companies. While numerous studies have been conducted on share buybacks in US, UK, Canada etc., this area has remained almost a virgin area in the Indian context. This paper makes an attempt to examine the effect of share repurchase announcement by Indian companies through open market route during 2008 to 2012 on their share prices around the announcement date. The paper contributes to the literature by analysing the market reaction to share buyback announcement, by applying the market model not used so far in the Indian studies and by
undertaking a rigorous analysis of share repurchase. A total of 63 buyback announcements by the companies listed in BSE pertaining to the period of July 2008 to July 2012 are taken into consideration. The analysis extends from previous 30 to post 30 trading days with respect to the announcement date. By employing the standard event methodology based on ordinary least squares market model, the average abnormal return and the cumulative abnormal returns are estimated and further analysed. Since the price behaviour may not be same across all companies, price behaviour is investigated further, separately for different categories like the size of the company, size of the buyback and the type of the industry the firm is in.

Our analysis throws some light on the issue with interesting findings. In general, it has been observed that both average and cumulative abnormal returns before and after the buyback announcement are negative and their difference is not statistically significant. A summary of the findings are stated here. First, unlike the US market, the trend in average additional return does not support any motive like undervaluation or maximizing shareholders’ value. Second, the cumulative abnormal returns also do not reveal any increase in share price of the company after the repurchase announcement. Third, the sample shows that more of small and unknown companies go for share buybacks compared to known or large companies. Fourth, most importantly, the average abnormal returns are not statistically different from zero in most of the cases both in pre and post announcement period, implying that this corporate activity does not carry much information to the investors, possibly because of the ownership structure of Indian companies being majority owned or otherwise controlled by promoters. The lesson for the company is that it cannot revive the share prices through repurchase announcements in India. The implication for the regulator might be to check the real motives of such buybacks in India and accordingly formulate policies.
Session 7a: A Closer Look to the Financial Crisis

Chair: Ahmet DURAN; İstanbul Technical University

Anticipating the Financial Crisis: Evidence from Insider Trading in Banks

Ozlem AKIN; Universitat Pompeu Fabra
Jose M. MARINZ; Universidad Carlos III de Madrid
Jose-Luis PEYDROX; Universitat Pompeu Fabra and Barcelona GSE

Banking crises are recurrent phenomena and often induced by ex-ante excessive bank risk taking. Banks may take on excessive risk due to behavioural reasons (i.e. they neglect risks), but also due to rationally exploiting agency problems between banks and the state (i.e. banks understand risks). We test for US banks whether bank performance in the 2007-08 crisis are related to bank insiders net sell of shares in the period prior to the initial fall in house prices in mid 2006. We find robust evidence that on average ex-ante insiders’ net sell of shares implies worse bank performance during the crisis. Importantly, the negative relationship becomes more significant for top officers such as CEO and CFO, i.e. the ones with the highest set of information. One standard deviation movement in top five officers’ sell implies -5.34% drop in bank crisis period performance. Finally, we find that the impact of ex-ante insiders’ sell on worse performance during the crisis is stronger for larger banks and for banks with higher exposure to the real estate sector. These results, therefore, have important implications for banking theories, public policy and for understanding the causes of the recent financial crisis.

Credit Ratings and the Pricing of Sovereign Debt during the Euro Crisis

Joshua AIZENMAN; University of Southern California and NBER

Mahir BINICI; Central Bank of the Republic of Turkey

Michael M. HUTCHISON; University of California, Santa Cruz

This paper investigates the impact of credit rating changes on the sovereign spreads in the European Union and investigates the macro and financial factors that account for the time varying effects of a given credit rating change. We find that changes of ratings are informative,
The impact of sovereign credit downgrades and CDS on holdings of government debt in developed and emerging economies

Tomasz ORPISZEWSKI; AXA Investment Managers

Abstract

Using a new broad dataset on holdings of government bonds in 22 countries this article investigates investors’ reaction to changes in sovereign CDS prices and sovereign ratings. On global scale, international flows into government bond markets more than doubled in the crisis period and the intensity of those flows goes in line with global market risk aversion. A paradox emerges with regards to investors’ risk aversion, as downgrades in credit ratings in the Eurozone and Safe Haven countries fuel inflows of non-resident capital into bond markets. In case of Greece, Ireland and Spain initial rating downgrades were actually followed by a rise in demand from both domestic banks and non-resident investors and it was due to later serial downgrades coupled with the surge in CDS prices that were triggered the outflow of non-resident funds. Among domestic investors I find significant differences in reaction to risk for different bond maturities, investor types, and foreign vs. national ownership. Finally I find significant cross-country spillover effects enticed by both ratings and CDS ratings that explain massive outflows from Peripheral Eurozone debt in summer of 2011 and record inflows into Japanese, UK and US Treasuries.
The Impact of Financial Innovation on Firm Stability (*Full text in Issue II*)

Fabian Kuehnhausen

Abstract

In this paper, I evaluate the impact of competition on firm stability between financial agents who are able to invest in innovations to reap profits. Given a vast array of concerns and interconnections between financial innovations, financial distress of firms and financial crises provided by theoretical assessments, I analyze empirically the causal link between a financial agents’ innovativeness and stability.

Using a unique data set on financial innovations in the USA between 1990 and 2002, I can show that a larger degree of innovation negatively affects firm stability safe for the underlying firm characteristics. The results are robust against different modifications of innovation measures and against different fragility parameters indicating profitability, activity risk and risk of insolvency.
Session 7b: Effects of Monetary Policy on Financial Markets

Chair: Ali M. KUTAN; Southern Illinois University at Edwardsville

Effects of Additional Monetary Tightening on Exchange Rates

Ergun ERMİŞOĞLU; Central Bank of the Republic of Turkey

Yasin AKÇELİK; Central Bank of the Republic of Turkey

Arif ODUNCU; Central Bank of the Republic of Turkey

Temel TAŞKIN; Central Bank of the Republic of Turkey

Since the global financial crisis, central banks have used various policy tools to sustain financial stability besides price stability. Additional Monetary Tightening is one of these tools that the Central Bank of the Republic of Turkey used in 2011-2012. The effects of this tool on the exchange rate are the main theme of this paper. Our analysis indicates that additional monetary tightening has a significant role in reducing volatility in the exchange rate. It is also shown that during the days of additional tightening Turkish Lira appreciated against the emerging market currencies.

Monetary Policy Misperception and the Risk-taking Channel

Michael ZABEL; University of Munich

In highlighting the role of the interest rate as a signal for the central bank's reaction function, this paper offers a new perspective on the "risk-taking channel" of monetary policy. In a model setup where the central bank is both concerned about the economic outlook (thus the classic "Taylor rule" ingredients) and the stability of the financial sector but where the financial sector is only imperfectly informed about the economic forecasts of the central bank and the specific weights of its stabilization motives, I demonstrate that misperception of monetary policy can lead to dangerous risk-taking incentives. Further, it is shown that the concept of monetary policy misperception provides new insights into the build-up of financial sector risk preceding the financial crisis. I conclude that better monetary policy communication and more central bank transparency are decisive means to increase the stability of the financial sector.
Index of Authors

Abdullah YAVAS, 1
Adil ORAN, 6
Ahmet DURAN, 25, 34, 48
Ahmet Faruk AYSAN, 12, 13, 14
Ahmet ŞENSOY, 4
Ali COŞKUN, 12, 30
Ali M. KUTAN, 11, 51
Alper BAKDUR, 43
Anıl TALASLI, 36
Antonina WASZCZUK, 23
Arif ODUNCU, 18, 51
Ashley WANG, 43
Ashlan SALIH ALTAY, 19
Barbara BEDOWSKA-SOJKA, 30
Bedri TAŞ, 18
Belma OZTÜRKKAL, 6
Benjamin M. TABAK, 32
Birol KANIK, 38
Brent W. AMBROSE, 2
Bülent TEKCE, 5
Burhaneddin İZGİ, 34
Bülcen KÖKSAL, 18
Canan YILDIRIM, 34
Canan YÜKSEL, 36
Cenk C. KARAHAN, 4, 34
Chi Keung Marco LAU, 5
Chiara GUERELLO, 27
Christopher MALLOY, 8
Cüneyt ORMAN, 18
Deren ÜNALMIS, 36
Derviş KIRIKKALELİ, 28
Dong LOU, 8, 18
Ege YAZGAN, 27
Elif MUTLU, 45
Emrah ŞENER, 22, 42
Ender DEMİR, 5
Ergun ERMiŞOĞLU, 51
Evren AKRİL, 11, 24, 45
Evren CERİTOĞLU, 38
Faruk BALLİ, 3
Fatma DOĞRUEL, 39
Ferhat ARSLANER, 33
Fernando ZAPATERO, 8, 24
Figen Güneş DOĞAN, 19
Fitri SANTI, 21
Fuat ERDAL, 21
Gil AHARONI, 24
Güler ARAS, 10
Gültekin GÖLLÜ, 13
Güzin Günsün AKIN, 12, 13, 14
Hakan KAHYAOĞLU, 35
Hamid MOHTADI, 40
Hande KÜÇÜK, 36
Hasan ERTUĞRUL, 45
Hatice Ozer BALLİ, 3
Henry H. HUANG, 2
Hiroshi MORITA, 31
Huseyin GULEN, 9
Isa HAFALIR, 1
İbrahim M. TURHAN, 28
John G. MATSUZAKA, 30
Jonathan B. COHNY, 9
Jose M. MARINZ, 48
Jose-Luis PEYDROX, 48
Joseph ENGELBERGZ, 8
Joshua AIZENMAN, 48
Joshua SHEMESH, 24
K. ARI AKKEMİK, 6
Koray ŞİMŞEK, 3
Kwok Ho CHAN, 5
Lauren COHEN, 8
Levent AKDENİZ, 19
Levent YILDIRAN, 12, 13, 14
Lorenzo MENNA, 42
M. Kabir HASSAN, 16
M. Shahid EBRAHIM, 15
M. Vedat PAZARLIOĞLU, 44
Mahir BINICI, 48
Margaret MILLER, 25
Mehmet BALCIAR, 39
Merih UÇTÜM, 5, 31
Mete SONER, 38
Michael M. HUTCHISON, 48
Michael ZABEL, 51
Mihai IONY, 9
Mohammad Aminul HAQUE, 16
Morris A. DAVIS, 1
Muammer ÇAKIR, 44
Murat MAZIBAŞ, 15
Murat YÜLEK, 31
Mutahhar ERTÜRÜK, 17
Nafis ALAM, 16
Nasib NABULSI, 19
Neslihan YILMAZ, 5
Nuran ARSLANER, 33
Öğuzhan ÖZBAŞ, 10
Orcan CORTUK, 28
Orhan ERDEM, 12, 24
Özlem AKIN, 48
Pengjie GAOX, 8
Pınar ÖZLÜ, 36
Rabih MOUSSAWI, 9
Ramazan EKİNÇI, 35
Rasim MUTLU, 12
Recep BİLDİK, 5
Rıza DEMİRER, 39
Sadettin Halak ÇITÇİ, 30
Said Mehmet OZSOY, 42
Sayad BARONYAN, 22
Serap ÖZÇELİK, 14

Serkan ÖZCAN, 24
Serkan YÜKSEL, 17, 24
Sezer Bozküş KAHYAOGLU, 44
Siong Hook LAW, 22
Stefan RUEDIGER, 40
Süleyman Hilmi KAL, 33
Syed Abul Bashery, 3
Şerif Aziz ŞİMŞİR, 11
Talat ULUSSEVER, 36
Tatiana DIDIER, 32
Temel TAŞKIN, 51
Theodore MOORMAN, 3
Thomas EMMERLING, 2
Tomasz ORPISZEWSKI, 40, 49
Tülin ARAZ, 12
Ufuk GÜÇBİLMEZ, 10
Umit G. GURUN, 9
Ülkem BAŞDAŞ, 6
Vasile GEORGESCU, 27
Yasemin AKÇELİK, 28, 51
Yasemin MİMİR, 37
Yavuz ARSLAN, 38
Yıldırım YILDİRİM, 1, 2, 15
Yuen Leng CHOW, 1
Yusuf VARLI, 15
Zamir IQBAL, 16
Zhi DA, 8
Borsa İstanbul Finance & Economics Conference (BIFEC) 2013

“Policy Issues and Challenges in the Global Financial System and Economies”

September 30 – October 1, 2013

www.bifec.com


BIFEC Book of Abstracts & Proceedings

Volume I Issue II

(Proceedings)

March 2014, İstanbul

The views expressed in this book are those of the author(s) and do not necessarily represent the official views of Borsa İstanbul or its members. The authors of the individual papers are responsible for technical, content, and linguistic correctness. The refereeing process is managed by the Research and Business Development Department of Borsa İstanbul. This e-book is published by Borsa İstanbul

Copyright © 2014
Contents (Volume I Issue II) - Proceedings

Formal and Informal Regulations for Credit Card Payment Services ........................................ 1
  Güzin Gülşün AKIN & Ahmet Faruk AYSAN & Gültekin GÖLLÜ & Levent YILDIRAN

Assembling International Equity Datasets – Review of Studies on the Cross-Section of Common Stocks .......................................................... 34
  Antonina WASZCZUK

Trading Puzzle, Puzzling Trade .................................................................................................. 66
  Orhan ERDEM & Evren ARIK & Serkan YÜKSEL

The effect of investors’ confidence on monetary policy- economic growth relationship:
  a Multivariate GARCH approach .......................................................................................... 82
  Chiara GUERELLO

Agency and Transparency in Financial Markets ........................................................................ 110
  Sadettin Haluk ÇİTÇİ

Inflation Dynamics and Business Cycles ................................................................................. 121
  Süleyman Hilmi KAL & Nurun ARSLANER & Ferhat ARSLANER

Comovement and Polarization of Interest Rate and Stock Market in Turkey ....................... 130
  Ahmet DURAN & Burhaneddin İZGİ

The Effect of Global Shocks and Volatility on Herd Behavior in Borsa Istanbul ............... 142
  Mehmet BALCILAR & Rıza DEMIRER

Volatility and Transparency of Financial Markets in the MENA Region .............................. 173
  Hamid MOHTADI & Stefan RUEDIGER

Hedging Strategy for Electricity Market Price Volatility: The Case of Turkish
  Electricity Market ..................................................................................................................... 196
  Sezer Bozkuş KAHYAOĞLU & M. Vedat PAZARLIOĞLU

The Impact of Financial Innovation on Firm Stability ........................................................... 211
  Fabian Kuehnhausen

Index of Authors ....................................................................................................................... 240

BIFEC Book of Abstracts & Proceedings (Volume I Issue II)
Formal and Informal Regulations for Credit Card Payment Services

Güzin Gülsün AKIN; Boğaziçi University

Ahmet Faruk AYSAN; Central Bank of the Republic of Turkey

Gültekin GÖLLÜ; Boğaziçi University

Levent YILDIRAN; Boğaziçi University

Abstract
The Turkish credit card market has recently undergone two important formal regulations: the interchange fee regulation in 2005 and the interest rate regulation in 2006. Banks started to charge annual fees to cardholders after the interest rate regulation, before which credit card ownership was costless. This practice sparked a widespread public outcry and legislative activity to control annual fees. Consumer unions vigorously called for regulations. They argued that in response to the fall in their interest revenues, banks started to exercise excessive market power in the payment services market. By employing the Panzar and Rosse (1982, 1987) method and a unique data set for all non-participation banks between 2002 and 2008, we investigate the effects of the formal and informal regulations on competition in the payment services market. We find that despite the increase in prices, the credit card payment services market actually became more competitive after the interest rate regulation. We attribute the rise in banks’ prices to a rise in their costs. Because of the prevailing informal regulations banks could pass along only part of the increase in their costs to the prices of their payment services. The resulting fall in their price-cost margins reduced banks’ market power in the payment services market. Thus, our results do not justify further price regulations.

Keywords Competition, Self-regulation, Threat of Regulation, Panzar-Rosse, Annual Fees, Merchant Discounts

JEL classification G21, G28, O16

1. Introduction
The regulation of annual credit card fees has been an issue of intense controversy in Turkey since 2006. Credit card ownership came at no cost until then. However, after the interest rate (IR) regulation in 2006, banks started to collect annual fees from cardholders. Due to the prevailing
anti-credit-card public sentiment, this practice elicited a widespread outcry from consumers, who ardently called for regulations on annual fees as well. Various consumer courts ruled that banks could not collect annual fees from cardholders in this period. Some politicians stated that annual fees were unfair, and announced that a bill was being prepared to regulate them. It has been argued that in response to the fall in their interest revenues, banks repriced their services and started to exercise excessive market power in the payment services markets. The purpose of this paper is to investigate whether banks acted uncompetitively after the IR regulation and whether further regulations were warranted.

In credit card markets banks provide both credit and payment services. In return for their credit services, issuing banks earn interest revenues from revolving cardholders. From their payment services, on the other hand, banks earn noninterest revenues: they collect annual fees from cardholders, merchant discounts from merchants, and interchange fees (IFs) from acquirers. There are externalities between credit services and payment services markets, as these two services are embodied in one product. This is one of the very few studies that examine the consequences of such interrelations.

Because of the high prices of credit and payment services, and the high profitability of the credit card business (signaling banks’ market power), the Turkish credit card market has recently undergone two important formal regulations: the IF regulation for payment services in 2005 and the IR regulation for credit services in 2006. These regulations attest to the presence of abovementioned externalities. After the IR regulation, which was particularly designed to reduce banks’ market power in the credit services market, banks increased the unregulated prices of their payment services. We aim to determine whether these price increases were justified. More broadly, we aim to identify the nature of competition in the payment services market, and to investigate the impacts of the formal and informal regulations on banks’ prices, revenues, and market power in this market.

We employ the well-known Panzar and Rosse (1982, 1987) (PR hereafter) method and a data set collected from the Central Bank of the Republic of Turkey (CBRT), the Banking Regulation and Supervision Agency (BRSA), and the Banks Association of Turkey (BAT). The data set covers all non-participation banks in the Turkish credit card market for the period from the last quarter of 2002 to the last quarter of 2008. We find that banks enjoyed collusive oligopoly power in the payment services market before the regulations. We detect no change after the IF regulation. However, after the IR regulation, we observe somewhat paradoxically that although their prices and revenues increased in the payment services market, banks actually lost their market power.
Our analysis reveals that banks experienced a rise in their costs concurrently with the IR regulation. We attribute the rise in their prices for payment services to this rise in their costs. As the IR regulation restrained their prices in the credit services market, banks had to pass along the rise in their costs to the unregulated prices of payment services. However, because of the prevailing informal regulations, banks could not freely and excessively increase their prices. The resulting fall in their price-cost margins reduced banks' market power in the payment services market.

Informal regulation, self-regulation and the threat of government regulation all cause firms to voluntarily restrain their prices or improve on some nonprice aspects in order to forestall formal regulations. Informal regulation is mostly associated with environmental issues. Pargal and Wheeler (1996) posit that when formal regulations are weak or absent, communities informally pressure polluting plants in their vicinity to abate pollution. Pargal et al. (1997) suggest that local communities escalate the expected marginal penalty for pollution by, for example, exercising social pressure on employees, the threat (or use) of violence, boycotts of the firm’s products, adverse publicity, recourse to civil law, putting pressure through regulators (politicians and administrators), etc. With their general model of equilibrium pollution, they find that in richer and more educated communities informal regulations are more intense and emissions are lower. They explain that such communities have stronger preferences for environmental quality and are more capable of exerting political, social and economic pressure. Other studies use different proxies for informal regulation. Murty and Prasad (1999) use communities’ rate of participation in elections and find that the more active the local people are politically, the lower is the pollution in that area. Kathuria (2007) shows that informal regulation, as measured by the number of articles in the local and national press, along with public interest litigation decisions, is effective in reducing pollution.

Maxwell et al. (2000) provide many examples of self-regulation, where firms restrain their conduct with different motives. In their theoretical model of corporate environmentalism, firms self-regulate in order to preempt government regulation. They show that an increased threat of government regulation induces firms to voluntarily reduce pollution. They also complement their analysis with empirical evidence. In his dynamic model of self-regulation, Stefanadis (2003) illustrates that the mere threat, rather than the actual implementation, of government regulation may suffice to discipline participants in the financial industry. In a theoretical model, Glazer and McMillan (1992) formalize the regulatory threat hypothesis. When the probability of regulation is tied to prices, firms will constrain their prices to stave off regulation. Olmstead and Rhode (1985) and Erfle and McMillan (1990) recount that for fear of government regulation or public hostility,
oil companies restrained their prices during the 1920 and 1979 oil crises. Block and Feinstein (1986) show how the threat of anti-trust enforcement spilled over from neighboring states and caused highway construction cartels in various states to reduce their bids between 1977 and 1982. Stango (2003) documents how the threat of the President to place a binding cap on credit card interest rates in 1991 led to immediate price cut announcements from major credit card issuers. To sum up, we broadly term all such public pressures, regulatory threat, media coverage, and litigation decisions, which can ultimately make formal regulations more likely, informal regulations.

Very few studies address the interrelations between credit and payment services of credit cards. Bolt et al. (2011) present a theoretical model to determine the optimal annual fees and merchant discounts in credit card markets, where both payment and credit services are provided. They conclude that when determining the optimal prices for payment services, the externalities between payment and credit services should be taken into account.

Akin et al. (2012) provide evidence from the Turkish credit card market for the interactions between credit and payment services in a three-stage least squares (3SLS) framework, where banks’ interest and noninterest revenues are assumed to be determined simultaneously. They find that while the IF regulation did not effect much change, the IR regulation led to a fall in interest revenues and a rise in noninterest revenues. This finding suggests that to compensate for the fall in their interest revenues, banks increased the unregulated prices of their payment services.

The PR method has been extensively used for the banking sector in numerous countries.1 Shaffer and Thomas (2007) present the first study that applies it to credit card markets.2 They find that the American credit card market typifies neither perfect competition nor collusive oligopoly, but is actually monopolistically competitive. Following Shaffer and Thomas (2007), and establishing the externalities between credit and payment services markets, Akin et al. (2013) examine banks’ total revenues and market power in the Turkish credit card market before and after the regulations. While banks enjoyed considerable market power before the regulations, they find that both banks’ total revenues and competition in the market increased after the regulations.

In this study, we investigate the effects of the abovementioned regulations on banks’ noninterest revenues from payment services. Our results support and complement the previous studies. We discern no change after the IF regulation. However, after the IR regulation, although their prices

---

1 For recent applications of the PR method in banking, see, e.g., Claessens and Laeven (2004), Al-Muhammedi et al. (2006), Yildirim and Philippatos (2007), Matthews et al. (2007), Coccone et al. (2004, 2009), Berger et al. (2009), Schaeck et al. (2009), and Goddard and Wilson (2009).

2 The reason why the PR method has not been extensively applied to credit card markets so far is that data on interest and noninterest revenues for credit card operations are not readily available.
and revenues increased, banks actually lost their market power in the payment services market. We conclude that informal regulations were influential in reducing banks’ market power in this period. Thus, for the post-regulations period examined in this study our results do not justify further price regulations.

The article is presented in the following order: The next section lays the background for credit card payment services. The third section gives an account of the formal and informal regulations in the Turkish credit card market. The fourth section explains the data and model used in the analysis. The fifth section presents the results. The final section highlights the policy implications and concludes.

2. Background for Credit Card Payment Services

The credit card business requires huge investments in technological infrastructure. Both credit and payment services are provided in credit card markets. With credit services banks slacken the liquidity constraints of cardholders, and in return they earn interest revenues from revolvers. Payment services involve very complicated business arrangements. To create value banks must provide the payment services simultaneously to both cardholders and merchants (i.e., “they must get both sides on board”); thus such payment systems are two-sided markets. Banks must issue credit cards to cardholders so that they make their payments via credit cards, and at the same time banks must acquire merchants so that they accept credit cards for payments. For these two sides to remain on board, their benefits from payment services should outweigh the fees they have to pay. Payment services provide both cardholders and merchants with convenience, improved security and record keeping facility. Also, merchants enjoy the boosted sales, and cardholders profit from the interest free grace period and obtain some benefits like travel miles, bonus points, rewards, discounts, travel insurance, the possibility of paying in installments, etc. In return for payment services they provide, banks earn noninterest revenues: They collect annual fees from cardholders, merchant discounts from merchants, and IFs from acquirers.

In today’s four-party credit card payment systems, where issuing and acquiring banks can be different, the payment mechanism works as explained in Figure 1. When a credit card purchase takes place, as the cardholder makes her payment at the end of the interest-free grace period, the issuing bank makes the payment on the cardholder’s behalf to the acquiring bank net of IF, which is accounted for by the issuing bank’s funding cost during the grace period, and by the fraud and default risks attributed to the cardholder. The acquiring bank then transfers the payment to the

---

3 See Rochet and Tirole (2003) and Evans and Schmalensee (2005b) for more on two-sided markets.

*BIFEC Book of Abstracts & Proceedings (Volume I Issue II)*
merchant with a discount (merchant discount), which includes the IF and its own commission. The cardholder pays an annual fee for this payment service to the issuer. If the cardholder does not pay her outstanding balance in full on the due date and thus uses the credit service, she becomes a revolver and has to pay interest charges as well.

Figure 1: Credit Card Payment Services Market

The regulation of credit card payment services does not only entail annual fees. Retailer associations complain that merchant discounts are very high, that merchants pay much more than cardholders to sustain the two-sided payment system, and that collusively determined IFs are anti-competitive and thus lead to excessive merchant discounts.

Many lawsuits were filed against collusively determined IFs in, for example, the US, UK, EU and Australia (Weiner and Wright, 2005). However, in all these cases competition authorities, including the Turkish Competition Authority (TCA), acknowledged that collusively determined IFs were not necessarily anti-competitive. They were actually essential to enhance the competition with unitary payment systems, like Diners Club and American Express, where cardholders and merchants directly subscribe to the network. Moreover, the alternative of compelling member banks to make bilateral agreements was prohibitively costly. As a result, to

---

4 If the cardholder and merchant are the customers of the same bank, then the bank, which is both the issuer and acquirer, makes the payment directly to the merchant with a discount (merchant discount). Such transactions are called on-us transactions.

5 Merchant discount rates charged on Visa and Mastercard transactions in the US average 2.1 percent, of which about 0.4 percent is retained by acquirers (Evans and Schamalensee, 2005a).

6 The network provider, which is located between the issuer and acquirer, is omitted for the sake of simplicity.
reduce the inefficiency of collusive price fixing, competition authorities devised policies to achieve marginal cost pricing. They stipulated that IFs should be transparent, objective and based on relevant costs (Evans and Schmalensee 2005b).

In two-sided markets, it is quite common that the two sides are priced asymmetrically for the services they receive. For instance, tenants pay more than landlords in real estate agencies, and men contribute more than women in dating services. Credit card payment services are also asymmetrically priced. While merchants pay merchant discounts, cardholders may effectively pay negative fees due to the interest free grace period and transaction-based reward programs. Baxter (1983) and Rochet (2003) propose the following justifications for these skewed prices: Issuing cards is more costly than acquiring merchants; payment services yield more benefits to merchants; cardholders have more elastic demand; and the adoption of credit cards by cardholders have positive externalities on merchants. On the other hand, retailer associations contend that the imbalance between merchants’ and cardholders’ contributions is inefficient; hence, to optimally sustain the payment system, merchant discounts should be regulated and cardholders should pay higher annual fees.

Determining the optimal annual fees and merchant discounts is very difficult and beyond our scope. It depends, besides many other factors, on the market powers of issuers and acquirers, on the externalities among merchants, cardholders, revolvers and convenience users, and on the demand elasticities of cardholders and merchants. Our analysis mainly aims to answer the following question: Do annual fees and merchant discounts collected in the payment services market suggest that banks exercise market power, which is defined as the power to charge prices above average costs and thus to obtain positive economic profits?

3. The Turkish Credit Card Market

Turkish consumers met with credit cards (Diners Club) in 1968. However, the market flourished in the last decade, mostly due to unusually favorable local and global macroeconomic conditions. The number of credit cards increased more than threefold from 13.4 million in 2000 to 43 million in 2008, making Turkey the second largest credit card market in Europe after the UK in this respect. Likewise, total outstanding balances and total transaction volume increased more than fivefold in the 2002-2008 period. There were 25 card-issuing banks, but the market was quite

---

7 About 60-70 percent of banks’ non-interest revenues in the US come from the merchants’ side (Evans and Schmalensee, 2005a).
concentrated. The six largest issuers controlled 87% of total outstanding balances and 80% of all customers. 15–25% of the total profits of these banks were due to their credit card operations.

Two important formal regulations were enacted in the Turkish credit card market. On the payment services side, a lawsuit was filed against the Interbank Card Center (ICC) on grounds of illegally fixing IFs and thus leading to very high merchant discounts. After examining the case, the TCA decreed in July 2005 that the ICC could continue fixing IFs. However, in November 2005, it modified the formula the ICC used to determine IFs, relating them to banks’ funding costs and to the operational costs of the ICC. The IF fell from 2.75% in 2004 to 1.75% in November 2005 and gradually declined to 0.91% by the end of 2008.

On the credit services side, credit card interest rates were extremely high before 2006. They reached 130% annual effective rates while inflation and short-term interest rates were 10 and 19%, respectively. These untenable rates provoked a very strong anti-credit-card public sentiment. Soaring complaints, arrears, delinquencies, bankruptcies, and the plight of those who experienced foreclosures culminated in the Credit Cards Law that was enacted in March 2006. The Law authorized the Central Bank to regulate the credit card market. The Law and the regulations prepared by the Central Bank included many provisions that would affect banks’ interest revenues, such as those on the interest rates, minimum amount payable, interest fee calculation method, credit card limits, format of the contract, solicitations, etc. While the monthly credit card interest rates were about 7% by the end of 2005, the Central Bank imposed a cap of 5.75% in June 2006 and gradually lowered that cap to 4.39% by the end of 2008.

The following figures portray the evolution of the Turkish credit card market. In Figure 2, we observe that banks’ total revenues, mostly due to interest revenues, grow very rapidly in the 2002-2005 period. Around 75% of banks’ total revenues are from the interest component in this period. Afterwards, the regulations kick in: Interest revenues stagnate, noninterest revenues mount.

Figure 2: Revenues from credit cards

---

9 Four of them were participation banks. They are not included in our sample as they have different modes of operation.
10 CBRT. The six largest issuers are Yapı Kredi, Garanti, Akbank, İşbank, Finansbank and HSBC.
11 The ICC is the local network provider in the Turkish credit card market. It was established in 1990 as a partnership of 13 public and private banks to settle the local credit and debit card transactions and to develop rules and standards for the Turkish card payment system.
12 For more on the IF regulation see Karayol (2007).
The columns display the sum of credit card revenues for Akbank, TEB, Finansbank, Fortis, HSBC, ING, İşbank, Vakıfbank and Yapı Kredi. The other banks were left out to avoid missing observations across time. The revenues are in thousand TL and deflated.

Figure 3: Means of normalized interest and noninterest revenues (Average prices of credit and payment services)

The columns display the means of interest and noninterest revenues normalized (divided) by outstanding balances for Akbank, TEB, Finansbank, Fortis, HSBC, ING, İşbank, Vakıfbank and Yapı Kredi. The other banks were left out to avoid missing observations across time.

When normalized by outstanding credit card balances, interest and noninterest revenues can be interpreted as average prices charged by banks for their credit and payment services, respectively. These prices, shown in Figure 3, provide important insights into banks' strategic behavior. In the
rapid growth period, we observe that the prices of payment services vis-à-vis those of credit services remain low.13 Banks did not collect annual fees in this period. Acquiring new cardholders was probably the most important concern for banks. Given that credit card markets entail high switching costs14, charging no fees for payment services must have been vital for banks in the acquisition period.15 This period was indeed characterized by banks’ aggressive marketing strategies and soliciting campaigns. They distributed credit cards on streets or at universities heedless of prospects’ default risks.16 However, with the advent of the IR regulation in mid-2006, we observe that prices for payment services climb. Although credit card ownership normally came at no cost until 2006, all issuers began to collect annual fees from cardholders after the IR regulation.17 Anecdotal evidence shows that merchant discounts also rose in this period.18

The IR regulation, which aimed at reducing banks’ market power in the credit services market, did not suffice to mitigate the prevailing anti-credit-card sentiment. Consumers immediately and fiercely reacted against annual credit card fees, which ranged from 3 to 30 TL (about 2 to 20 USD). Numerous lawsuits were filed against banks in consumer (arbitration) courts, most of which ruled in favor of consumers.19 Banks responded with counter lawsuits. Finally, the Supreme Court of Appeal ruled that annual fees could not be collected unless they were visibly and explicitly specified and mutually agreed upon in the contract, placing the burden of proof on banks.20 Consumer unions, in the meanwhile, persistently called for regulations from legislators and the BRSA to ban annual fees. Some politicians stood by consumers and stated that annual fees were unfair. The Ministry of Industry and Commerce occasionally intervened between banks and

---

13 The decline in prices in the first few quarters can be attributed to the steep fall in the cost of funds after the 2000 and 2001 banking crises (Figure 4).
15 As cardholders did not pay annual fees in this period, convenience users, who used their credit cards only as a payment instrument, were cross subsidized by merchants, who paid merchant discounts, and by revolvers, who borrowed on their credit cards and thus paid interest charges.
16 Regulations in 2006 precluded banks from offering credit cards without the formal application of prospects.
17 As a rare practice, some banks charged annual fees for their highly prestigious credit cards before 2006. However, the common practice of charging fees for all cards began after the IR regulation.
18 For instance, one of the leading banks demanded the following merchant discounts from Arçelik retailers for not-on-us transactions: 1.90 % in July 2006, 2% in April 2007 and 2.2 % in October 2007. In a not-on-us transaction, where the acquirer and issuer are different banks, the merchant discount includes the IF that the acquirer pays to the issuer. As IFs declined in this period, the above rates suggest that merchant discounts rose after 2006.
19 Some of the earliest lawsuits were filed in October and November 2006. For those court decisions, see (http://www.tuketiciler.org/?com=files.read&ID=12&pID=87). For further evidence that public reaction against annual fees started with the IR regulation, one can consider the following: A major newspaper (Hürriyet) search of “Annual credit card fees” consistently yields about 4 matches every year in the 2002-2005 period, while it gives 11, 32, and 37 matches in 2006, 2007, and 2008, respectively.
consumer unions to resolve these issues, and ultimately announced in March 2008 that a bill was being prepared to regulate annual fees. The Minister personally declared in July 2008 that with the new Consumer Protection Law annual fees would be collected only once when the contract was first made. This was followed by a number of other declarations, some stating that annual fees would be collected tri-annually, and some saying they would be banned altogether. In sum, we observe that the informal regulations, which comprised public, media and legislative pressures along with court decisions, for annual credit card fees took effect with the IR regulation in mid-2006 and prevailed all throughout the post-regulations period.

4. Data and Model

Our previously unavailable unbalanced panel data set is collected from the CBRT, the BRSA, and the BAT. It comprises all 21 nonparticipation banks operating in the Turkish credit card market. However, Citibank and Eurobank Tekfen drop from the sample due to missing values for some variables. We also exclude Tekstil Bank as it has only a few observations with erratic noninterest revenue values. Further, we treat Dışbank after it was acquired by Fortis as a different bank from Dışbank in the pre-acquisition period, because there is an abrupt jump in the data with the acquisition. Thus, our estimations are based on the quarterly data of 19 banks and 360 observations between the last quarters of 2002 and 2008. All the nominal values are deflated using CPI conversion.

The PR method is a New Empirical Industrial Organization (NEIO) approach used to investigate the type and degree of competition in a market. It has been widely used in numerous countries and markets because of its many advantages over traditional and other NEIO approaches. It is independent of the definition of geographic and product markets, data requirements are modest (only revenues and factor prices), and it does not entail the estimation of the cost function. Typically, the factor price elasticities in the following reduced form revenue equation are estimated:

\[
\ln (R_{it}) = \alpha_0 + \sum f \alpha_f \ln (P_f, it) + \sum k \beta_k X_k, it + \epsilon_{it},
\]  

(1)

21 The first five observations of Yapı Kredi are deleted, as they are far different from the other observations for the same bank and suggest entry error or a change of recording method. This is also the case for one observation for Millenium Bank.

22 The sample begins with 2002 to eliminate the effects of the 2000 and 2001 banking crises in Turkey.

23 For an extensive review of the empirical literature on competition in banking and on the PR method, see Berger et al. (2004), and Degryse and Ongena (2008) and the references therein.
where \( R_{it} \) is the revenue of firm \( i \) at time \( t \). The \( P_f \) denotes the price of the factor input \( f \), and \( X_k \) denotes the control variable \( k \). \( \epsilon_{it} \) is the error term. In accordance with the intermediation approach in which banks are assumed to employ borrowed funds, labor, and physical capital to generate income-earning assets, most studies on banking consider three factor prices: the cost of funds, the price of physical capital, and the wage rate.

The PR \( H \)-statistic, \( H = \sum f \alpha_f \), is the sum of the factor price elasticities of revenue. The comparative static analysis of the firm under alternative behavioral hypotheses indicates that \( H=1 \) for firms in long-run competitive equilibrium, whereas \( H \leq 0 \) for monopolists or colluding oligopolists. Estimates that satisfy \( 0<H<1 \) are consistent with monopolistic competition.

The intuition behind the monopoly case comes from the fact that marginal revenue is equal to marginal cost in equilibrium, as the profit-maximization condition. Thus, an increase in factor input prices and marginal cost will lead to a fall in equilibrium output, which will in turn lower total revenues. In other words, an increase in factor prices will increase the marginal cost and the optimal monopoly price. As a monopolist always operates in the elastic region of demand, an increase in the price will in turn reduce the monopolist’s revenue.

To see the reasoning for the competitive case, suppose that all factor prices rise by 1%. As the average cost (AC) function is homogeneous of degree one in factor prices, any such increase shifts the AC curve upward by 1%, leaving its minimum point unchanged. Further, in long-run competitive equilibrium, firms pass along all increases in their costs to prices, and they always operate at an output level where their AC is minimized. Thus, in response to a 1% rise in factor prices, revenues of competitive firms will also rise by 1%.

To implement the PR test in the Turkish credit card market, the following benchmark model is used. Panel fixed effect estimators are employed to control for unobserved heterogeneity.

\[
NIR_{i,t} = c_i + \alpha_1 CF_{i,t} + \alpha_2 W_{i,t} + \alpha_3 PK_{i,t} + \beta_1 Age_{i,t} + \beta_2 LC_{i,t} + \beta_3 Trt + \beta_4 TrSt + \\
\gamma_1 IF_{reg} + \gamma_2 (IF_{reg} * CF)_{i,t} + \gamma_3 (IF_{reg} * W)_{i,t} + \gamma_4 (IF_{reg} * PK)_{i,t} + \\
\delta_1 IR_{reg} + \delta_2 (IR_{reg} * CF)_{i,t} + \delta_3 (IR_{reg} * W)_{i,t} + \delta_4 (IR_{reg} * PK)_{i,t} + \xi_{i,t} (2)
\]

The definition of the variables is as follows: \( NIR_{i,t} \) (Noninterest revenue) is the quarterly noninterest revenue (the sum of annual fees, interchange fees and merchant discounts) from payment services for bank \( i \) at time \( t \). \( CF_{i,t} \) (Cost of funds) is the average quarterly cost of funds, which is measured by the ratio of the sum of interest expenses on deposits, funds borrowed, and
money market borrowings to the sum of the values of deposits, funds borrowed, and money market borrowings. PKi,t (Price of physical capital) is defined as quarterly depreciation expenses divided by the value of property and equipment. Wi, t (Wage) is the average quarterly wage rate that is obtained by dividing quarterly personnel expenses by the number of employees. Agei,t is a standard control variable in the literature. It is commonly used as a proxy for the longevity and reputation of a bank, and is expected to positively affect revenues. LCi, t (Liquidity cost) is another control variable that was first used by Shaffer and Thomas (2007). It is a measure of liquidity management cost that is defined as the ratio of the value of interbank money market borrowings to outstanding credit card balances. In credit card markets, banks commit to provide liquidity up to the credit limit of cardholders. Thus, they must either hold excess liquid assets or be prepared to borrow in interbank markets. Shaffer and Thomas (2007) show that failing to account for liquidity management costs overstates economic profits and market power in the US credit card market. All above variables are expressed in natural logarithms, and hence the input price elasticities are directly given by the coefficients.

In our sample period, during which unusually favorable macroeconomic conditions prevailed, consumption expenditures, demand for credit, etc., were all on the rise around the world. The variables Trt (Trend) and TrSt (Trend squared) are used in order to control for any quadratic effect of such macroeconomic conditions on Noninterest revenue.

To investigate the effect of the IF regulation on banks' revenues and competition, we add a regulatory change dummy, IF reg (IF regulation dummy) and three interaction terms (IF reg *CF, IF reg *W, and IF reg *PK) to the model. The IF regulation dummy equals one after the IF regulation and zero prior to it. We fix the last quarter of 2005 as the implementation time of the IF regulation. The coefficient of the IF regulation dummy indicates whether banks' revenues are affected by the IF regulation after controlling for any time patterns. The interaction terms indicate whether the IF regulation affects the factor price elasticities of revenue. The PR H-

\[ \text{money market borrowings} = \text{deposits} + \text{funds borrowed} + \text{money market borrowings}. \]

\[ \text{PKi}_t = \frac{\text{quarterly depreciation expenses}}{\text{property and equipment}}. \]

\[ \text{Wi}_t = \frac{\text{quarterly personnel expenses}}{\text{number of employees}}. \]

\[ \text{Agei}_t \]

\[ \text{LCi}_t = \frac{\text{interbank money market borrowings}}{\text{outstanding credit card balances}}. \]

\[ \text{in credit card markets, banks commit to provide liquidity up to the credit limit of cardholders.} \]

\[ \text{Shaffer and Thomas (2007) show that failing to account for liquidity management costs overstates economic profits and market power in the US credit card market.} \]

\[ \text{All above variables are expressed in natural logarithms, and hence the input price elasticities are directly given by the coefficients.} \]

\[ \text{In our sample period, during which unusually favorable macroeconomic conditions prevailed, consumption expenditures, demand for credit, etc., were all on the rise around the world.} \]

\[ \text{The variables Tr}_t (\text{Trend}) \text{ and Tr}_t^2 (\text{Trend squared}) \text{ are used in order to control for any quadratic effect of such macroeconomic conditions on Noninterest revenue.} \]

\[ \text{To investigate the effect of the IF regulation on banks’ revenues and competition, we add a regulatory change dummy, IF}_t (\text{IF regulation dummy}) \text{ and three interaction terms (IF}_t \ast \text{CF, IF}_t \ast \text{W, and IF}_t \ast \text{PK}) \text{ to the model. The IF regulation dummy equals one after the IF regulation and zero prior to it. We fix the last quarter of 2005 as the implementation time of the IF regulation. The coefficient of the IF regulation dummy indicates whether banks’ revenues are affected by the IF regulation after controlling for any time patterns.} \]

\[ \text{The interaction terms indicate whether the IF regulation affects the factor price elasticities of revenue.} \]

\[ \text{The PR H-} \]

\[ \text{\[ Because obtaining factor input prices for payment services is not possible, we take those for general banking as proxies. The same holds for the control variables as well.} \]

\[ \text{\[ Another possible measure for liquidity management cost is the ratio of liquid assets to outstanding credit card balances. This measure is highly correlated with ours and gives similar results.} \]

\[ \text{\[ Many studies that apply the PR method also include total assets in their estimations to control for any scale effect. We choose not to follow them because of the criticism by Bikker et al. (2007). They show that when total revenues divided by total assets is used as the dependent variable, the revenue equation is transformed into a price equation in which case the PR tests are misspecified. The same thing happens if total assets or other scale variables are used as control variables.} \]
statistic before the regulations is calculated as \( H = \alpha_1 + \alpha_2 + \alpha_3 \), and between the IF and IR regulations, it is \( H_{IF} = \alpha_1 + \alpha_2 + \alpha_3 + \gamma_2 + \gamma_3 + \gamma_4 \).

Similarly, to examine the effect of the IR regulation, we add another regulatory change dummy, IR reg (IR regulation dummy), and three interaction terms (IR reg*CF, IR reg*W, IR reg*PK). The IR regulation dummy equals one starting with the third quarter of 2006 and zero prior to it. However, it is not possible to disentangle the effect of the IR regulation from that of the informal regulations, which took effect with the IR regulation and prevailed all along. Thus, the IR regulation dummy actually denotes the combined effects of the IR regulation and the informal regulations for annual fees. As before, \( \delta_1 \) indicates whether banks’ revenues are affected by this change, and \( H_{IR} = \alpha_1 + \alpha_2 + \alpha_3 + \gamma_2 + \gamma_3 + \gamma_4 + \delta_2 + \delta_3 + \delta_4 \) gives the corresponding PR H-statistic in this period. \( \xi_{i,t} \) is the random error term. Table 1 provides the summary statistics of the data.

Table 1 Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of observations</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noninterest revenue* **</td>
<td>360</td>
<td>30,005</td>
<td>40,770</td>
<td>0.6233</td>
<td>222,305</td>
</tr>
<tr>
<td>Cost of funds</td>
<td>360</td>
<td>0.0260</td>
<td>0.0105</td>
<td>0.0041</td>
<td>0.1085</td>
</tr>
<tr>
<td>Price of physical capital</td>
<td>360</td>
<td>0.0392</td>
<td>0.0265</td>
<td>0.0005</td>
<td>0.1617</td>
</tr>
<tr>
<td>Wage* **</td>
<td>360</td>
<td>8.8818</td>
<td>1.6841</td>
<td>3.2225</td>
<td>16.9770</td>
</tr>
<tr>
<td>Age</td>
<td>360</td>
<td>47.0653</td>
<td>30.3809</td>
<td>5.5000</td>
<td>120.0000</td>
</tr>
<tr>
<td>Liquidity cost</td>
<td>360</td>
<td>8.9230</td>
<td>27.0162</td>
<td>0.0001</td>
<td>214.8219</td>
</tr>
<tr>
<td>Advertisement expense* **</td>
<td>360</td>
<td>82,318</td>
<td>96,869</td>
<td>0.0899</td>
<td>458,813</td>
</tr>
<tr>
<td>Credit quality</td>
<td>335</td>
<td>0.0780</td>
<td>0.0672</td>
<td>0.0059</td>
<td>0.4195</td>
</tr>
</tbody>
</table>
5. Results

The results of the regression based on equation (2) are given in the first column of Table 2. The PR H-statistic, which is the sensitivity of noninterest revenues to changes in the factor prices, is estimated for three different time periods: before the regulations, between the IF and IR regulations, and after the IR regulation. For the first two periods, the H-statistics are $H = 0.22$ and $H_{IF} = -0.44$, as seen in the bottom of Table 2. For these periods, the null hypothesis that $H=1$ is rejected, but $H\leq0$ cannot be rejected. This finding signifies that banks had monopoly (collusive oligopoly) power in the payment services market before the regulations and that the IF regulation could not change the existing market structure.

As noninterest revenues were all from the merchants’ side till 2006 (IFs are passed through to merchant discounts by acquirers), we conclude that banks had market power over merchants, and thus merchant discounts were inefficiently high in these periods. The ineffectiveness of the IF regulation can be interpreted in three ways. The ICC might not have exercised market power and have already charged fair IFs prior to the regulations. Since the ICC was established as a partnership of banks mainly to promote credit card usage, it indeed did not have a clear profit maximization objective. Alternatively, despite the meticulous calculation of the relevant costs, the formula dictated by the TCA to determine IFs might not be binding in these periods. Or, the effect of this regulation was not immediately visible.

However, in the last period, the H-statistic is estimated as $H_{IR}=0.75$. For this period, the null hypothesis that $H\leq0$ is rejected, but $H=1$ fails to be rejected. This finding signifies that banks lost their market power after the IR regulation and the payment services market approached a perfectly competitive structure. After the IR regulation, which was designed to reduce banks’

---

27 Anecdotal evidence shows that acquirers in Turkey had enough market power to price discriminate among merchants, depending on the market power and/or bargaining power of merchants. For example, we know that the merchant discounts collected from fuel stations whose profit margins were very low, and from supermarket chains whose bargaining powers were very high, were much lower than the merchant discounts collected from small retailers.

28 See Karayol (2007).
market power in the credit services market, competition increased in the payment services market as well.

The coefficient of the Trend variable shows that banks’ noninterest revenues were on the rise in our sample period, as expected. However, no significant quadratic effect is observed. Moreover, from the insignificant coefficient of the IF regulation dummy and the positively significant coefficient of the IR regulation dummy we conclude that although the former did not effect any change, the latter led to a rise in banks’ noninterest revenues, even after controlling for Trend and other factors.

Table 2 Fixed effects regression results

Dependent variable: Noninterest revenue

All variables except for Trend, Trend squared, and dummy variables are in natural logarithmic form. The t statistics are shown in parentheses. The (*), (**), and (***) correspond to significance at the 10%, 5%, and 1% levels respectively.

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>With Advertisement expense</th>
<th>With Advertisement expense and Credit quality</th>
<th>With GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost of funds</strong></td>
<td>0.2676</td>
<td>0.2416</td>
<td>0.2640</td>
<td>0.043</td>
</tr>
<tr>
<td></td>
<td>(2.24)**</td>
<td>(2.04)**</td>
<td>(1.95)*</td>
<td>(0.38)</td>
</tr>
<tr>
<td><strong>Price of physical capital</strong></td>
<td>-0.1523</td>
<td>-0.1709</td>
<td>-0.1595</td>
<td>-0.059</td>
</tr>
<tr>
<td></td>
<td>(-2.68)**</td>
<td>(-3.02)**</td>
<td>(-2.76)**</td>
<td>(-1.02)</td>
</tr>
<tr>
<td><strong>Wage</strong></td>
<td>0.1095</td>
<td>0.0456</td>
<td>0.2085</td>
<td>0.291</td>
</tr>
<tr>
<td></td>
<td>(0.44)</td>
<td>(0.18)</td>
<td>(0.76)</td>
<td>(1.08)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>-2.5596</td>
<td>-2.6128</td>
<td>-2.7281</td>
<td>-1.101</td>
</tr>
<tr>
<td></td>
<td>Coefficient</td>
<td>t-value</td>
<td>Coefficient</td>
<td>t-value</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td>---------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Liquidity cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.0501</td>
<td></td>
<td>-0.0463</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.47)**</td>
<td></td>
<td>(-2.30)**</td>
<td></td>
</tr>
<tr>
<td><strong>Trend</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0927</td>
<td></td>
<td>0.0768</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4.82)**</td>
<td></td>
<td>(3.85)**</td>
<td></td>
</tr>
<tr>
<td><strong>Trend squared</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.0009</td>
<td></td>
<td>-0.0005</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.58)</td>
<td></td>
<td>(-0.89)</td>
<td></td>
</tr>
<tr>
<td><strong>Advertisement expense</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Credit quality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IF regulation dummy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.0657</td>
<td></td>
<td>-1.1665</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.89)</td>
<td></td>
<td>(-0.99)</td>
<td></td>
</tr>
<tr>
<td><strong>IR regulation dummy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1444</td>
<td></td>
<td>2.5788</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.20)**</td>
<td></td>
<td>(1.82)*</td>
<td></td>
</tr>
<tr>
<td><strong>IF regulation × Cost of funds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.4871</td>
<td></td>
<td>-0.4911</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.02)**</td>
<td></td>
<td>(-2.06)**</td>
<td></td>
</tr>
<tr>
<td><strong>IF regulation × Price of physical capital</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.0970</td>
<td></td>
<td>0.0948</td>
<td></td>
</tr>
<tr>
<td>Term</td>
<td>Coefficient 1</td>
<td>Coefficient 2</td>
<td>Coefficient 3</td>
<td>Coefficient 4</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>IF regulation × Wage</td>
<td>-0.2788</td>
<td>-0.2254</td>
<td>-0.4004</td>
<td>-0.160</td>
</tr>
<tr>
<td>IR regulation × Cost of funds</td>
<td>0.6000</td>
<td>0.4904</td>
<td>0.6848</td>
<td>0.563</td>
</tr>
<tr>
<td>IR regulation × Price of physical capital</td>
<td>0.3344</td>
<td>0.3548</td>
<td>0.3226</td>
<td>0.264</td>
</tr>
<tr>
<td>IR regulation × Wage</td>
<td>0.2570</td>
<td>0.3590</td>
<td>0.4343</td>
<td>-0.061</td>
</tr>
<tr>
<td>Constant</td>
<td>17.1626</td>
<td>17.0608</td>
<td>17.2775</td>
<td>-5.495</td>
</tr>
</tbody>
</table>

Number of observations: 360
Number of banks: 19
R-squared (within): 0.49
F-statistic: 20.94***

H estimate before regulations: 0.22
p-value of F statistic to test H₀: H≤0 vs H₁: H>0: 0.21
H estimate after IF regulation: -0.44

BIFEC Book of Abstracts & Proceedings (Volume I Issue II)
<table>
<thead>
<tr>
<th>p-value of F statistic to test $H_0$: $H \leq 0$ vs $H_1$: $H &gt; 0$</th>
<th>0.78</th>
<th>0.88</th>
<th>0.79</th>
<th>0.58</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-value of F statistic to test $H_0$: $H = 1$ vs $H_1$: $H &lt; 1$</td>
<td>0.00</td>
<td>0.004</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>H estimate after both regulations</td>
<td>0.75</td>
<td>0.70</td>
<td>1.00</td>
<td>0.64</td>
</tr>
<tr>
<td>p-value of F statistic to test $H_0$: $H \leq 0$ vs $H_1$: $H &gt; 0$</td>
<td>0.01</td>
<td>0.01</td>
<td>0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>p-value of F statistic to test $H_0$: $H = 1$ vs $H_1$: $H &lt; 1$</td>
<td>0.22</td>
<td>0.17</td>
<td>0.50</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Taken together, we conclude somewhat paradoxically that banks’ prices and revenues rose, but their market power fell in the payment services market after the IR regulation. Recall that $H$ is the elasticity of noninterest revenues with respect to factor prices. Since our analysis yields that noninterest revenues increased and $H$ approached one after the IR regulation, we infer that factor input prices (and consequently banks’ costs) also rose in this period. Figures 4 (a, b and c) confirm our inferences.

Figure 4: Factor Prices

*Industry average factor prices weighted by banks’ noninterest revenues. Cost of funds (a), Wage (b), Price of physical capital (c). Vertical lines represent the dates of IF and IR regulations.*
We observe from Figures 4 (a, b and c) that all factor prices were on the rise around the IR regulation. Figure 4-a shows that after the 2000-2001 banking crises Cost of funds fell steeply till 2005, remained stable for a few quarters, and then rose again until 2007. Although Wage displays an erratic pattern in Figure 4-b, we discern a general rise, particularly around the IR regulation. Price of Physical capital, except for the initial rise, remained stable till 2006, but then jumped to a higher level. The rise in all factor prices around the IR regulation can be attributed to the financial turbulence experienced in April-June 2006.29

Since the IR regulation had already restrained their prices in the credit services market, we conclude that banks had to pass along the rise in their costs to the unregulated prices of their payment services (i.e., annual fees and merchant discounts). How much could be passed along to prices in such a case depends on the elasticity of demand for payment services and the prevailing

informal regulations. Akin et al. (2012) find that the demand for payment services is not elastic in Turkey. Our current results (the rise in prices and revenues in the payment services market after the IR regulation) corroborate this finding, suggesting that the pass along ratio could be high. However, the rise in competition and hence the fall in price-cost margins in the payment services market after the IR regulation indicate that the pass along ratio was low and that the rise in the prices for payment services actually came short of the rise in the costs. Thereby, we infer that the prevailing public hostility, unfavorable court decisions, media pressures, and the threat of government regulation induced banks to refrain from excessively increasing their prices in order to forestall further formal regulations.

To summarize, we conclude that banks had considerable market power before the regulations. IFs and merchant discounts collected in this period earned banks positive economic profits. No change is detected between the regulations. However, we certainly find that banks’ market power vanished in the post-regulations period, where noninterest revenues from annual fees, IFs, and merchant discounts just covered banks’ costs. We conclude that informal regulations were effective in this period.

As for the control variables, the effect of Age on noninterest revenues turns out to be negative and significant unlike the previous results in the literature. Although Age is a standard measure of reputation in the literature, it does not effectively proxy reputation in Turkey. Many big groups with reputation, experience and expertise in banking such as HSBC, Citygroup, ING, and BNP Paribas recently entered the Turkish banking sector and acquired considerable market shares despite their low ages. Age is actually a proxy for openness to new banking practices and willingness to invest in new technologies in our case. The banks with high market shares in the Turkish credit card market are the relatively young ones. Contrary to old banks, they adopted modern banking practices, emphasized retail banking and consumer credits, and heavily invested in information technology. Hence, the negative influence of Age on noninterest revenues is actually not surprising. The effect of Liquidity cost is negative and significant as predicted by Shaffer and Thomas (2007).30

To check the robustness of our results, Advertisement expense and Credit quality are added consecutively to the explanatory variables in different specifications (columns 2 and 3 in Table 2). Advertisement expense is the quarterly advertisement expenses of banks and greater expenditures are expected to increase revenues by increasing the customer base and/or the number of

---

30 To control for seasonality we ran the regressions with quarter dummies (first quarter, second quarter, third quarter and fourth quarter dummies) as well, but our results did not change.
transactions. The coefficient of this variable is positive and significant as expected. Credit quality is represented by the ratio of non-performing credit card balances to outstanding credit card balances. Noninterest revenues increase with cardholders’ transaction volume. As risky cardholders are generally granted lower credit card limits, banks with more risky cardholders are expected to attain smaller transaction volumes. The negative and significant coefficient for Credit quality confirms our expectations. Lastly, in column 4 we control for business cycle effects on bank revenues with GDP instead of Trend and Trend squared. As expected, we find that banks' noninterest revenues are positively related with GDP. All the other results are robust to the addition of these variables.

A critical feature of the PR approach is that the results for the perfect and monopolistic competition models depend on the assumption that firms are observed in long-run equilibrium. In a commonly used empirical test for long-run equilibrium, which was originally proposed by Shaffer (1982), the above regressions are run after replacing the dependent variable Noninterest revenues with the rate of return on assets (ROA) or equity (ROE). The rationale is that ROA or ROE should be stable in the long-run and be independent of input prices. Thus, the sum of elasticities of return with respect to input prices should equal zero in long-run equilibrium. We carried out these tests for all specifications and periods, and failed to reject the null hypothesis that the H-statistic is equal to zero in 21 out of 24 tests. The results are reported in Tables 3 and 4 in the appendix. Thus, we conclude that the PR test is correctly identified.

6. Conclusion

The Turkish credit card market has undergone two important formal regulations: the IF regulation in 2005 and the IR regulation in 2006. Banks started to collect annual fees from cardholders after the IR regulation, before which credit card ownership was practically costless. Fierce public and legislative pressures ensued, arguing that banks exercised excessive market power. Using the PR method and a data set for all nonparticipation banks in the 2002-2008 period, we investigate the impacts of the formal and informal regulations on the payment services market. We find that after the IR regulation banks’ prices and revenues rose, but their market power fell in the payment services market. We attribute the rise in banks’ prices to the rise in their costs that coincided with the IR regulation. As the IR regulation restrained their prices in the credit services market, we conclude that banks had to pass along the increase in their costs to the unregulated prices of their payment services. However, because of the prevailing informal regulations, banks could not freely increase their prices and recover the rises in their cost. As a result, banks’ price-cost margins in the payment services market declined after the IR regulation.
Thus, for the post-regulations period examined in this study our results do not justify further price regulations in the payment services market.

For cardholders to retain their credit cards, the value of the services they receive should outweigh the annual fees they have to pay. The value of credit card services varies among cardholders. For example, the value of convenience and safety of carrying a credit card can be much higher for some cardholders as they make much larger transactions with them. Similarly, while some cardholders use their cards only to make payments, others may be also frequently and heavily benefiting from the transaction-based reward programs and installment opportunities. Banning annual fees altogether, thereby, may not be welfare improving. The cost of providing credit card payment services (investment costs, personnel expenses, operational expenses, etc.) is borne by merchants and cardholders. Determining the optimal distribution between them is very difficult, as explained before. Optimality most probably does not require these prices to be symmetric, but it may not require that annual fees should be zero for all cardholders either. If annual fees are banned across the board, merchants will have to bear all the cost, which will in turn be passed along to their selling prices. Under the no surcharge rule, where merchants cannot charge higher prices for payments made by credit cards, a general rise in prices amounts to a transfer from non-cardholders or light users to heavy users of credit cards. Instead, banks can issue two different types of credit cards: one with no or low annual fees for those who use their credit cards only for basic payment services, and the other with higher annual fees for those who frequently use their credit cards and benefit from the transaction-based reward programs and installment opportunities. More optimally, banks can offer a range of services and annual fees, and let consumers self-select the best combination for them.

Our results yield some more general policy implications as well. No matter how reasonable the appeals for it appear, a regulation should always be based on sound economic analysis, clearly establishing the need for intervention and identifying the underlying market failures. Moreover, when regulations are designed for one aspect of a credit card market, which entails complicated business arrangements and extensive externalities, possible implications for all other aspects should be carefully considered. Lastly, our results suggest that informal regulation can be as effective as formal regulation, although the former is likely to be less costly and simpler than the latter.

Acknowledgements: The authors acknowledge the financial support of the Bogazici University Research Fund (Project # 08C103 and Project #09C105P).
References


Appendix

Table 3: Long-run equilibrium tests using Return on assets

*Fixed effects regressions*

*Dependent variable: Return on assets*

*All variables except for Trend, Trend squared, and dummy variables are in natural logarithmic form. The t statistics are shown in parentheses. The (*), (**) and (***) correspond to significance at the 10%, 5%, and 1% levels, respectively.*

<table>
<thead>
<tr>
<th></th>
<th>Benchmark</th>
<th>With Advertisement expenses</th>
<th>With Advertisement expenses and Credit quality</th>
<th>With GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of funds</td>
<td>-0.001</td>
<td>-0.000</td>
<td>0.000</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.15)</td>
<td>(0.08)</td>
<td>(0.28)</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Price of physical capital</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(-0.19)</td>
<td>(-0.06)</td>
<td>(-0.29)</td>
<td>(-0.17)</td>
</tr>
<tr>
<td>Wage</td>
<td>-0.017</td>
<td>-0.016</td>
<td>-0.011</td>
<td>-0.015</td>
</tr>
<tr>
<td></td>
<td>(-2.72)***</td>
<td>(-2.61)***</td>
<td>(-1.66)*</td>
<td>(-2.36)**</td>
</tr>
<tr>
<td>Age</td>
<td>0.011</td>
<td>0.012</td>
<td>0.003</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(0.96)</td>
<td>(1.00)</td>
<td>(0.23)</td>
<td>(0.58)</td>
</tr>
<tr>
<td>Liquidity cost</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.001</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(-0.41)</td>
<td>(-0.48)</td>
<td>(-1.44)</td>
<td>(-0.26)</td>
</tr>
<tr>
<td>Trend</td>
<td>0.000</td>
<td>0.001</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.87)</td>
<td>(1.15)</td>
<td>(0.48)</td>
<td></td>
</tr>
<tr>
<td>Trend squared</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.36)</td>
<td>(-1.58)</td>
<td>(-0.98)</td>
<td></td>
</tr>
<tr>
<td>Advertisement expenses</td>
<td>-0.001</td>
<td>-0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.06)</td>
<td>(-0.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit quality</td>
<td>-0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.59)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td></td>
<td></td>
<td></td>
<td>0.008</td>
</tr>
<tr>
<td>Term</td>
<td>Coefficient 1</td>
<td>Coefficient 2</td>
<td>Coefficient 3</td>
<td>Coefficient 4</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>IF regulation dummy</td>
<td>-0.054</td>
<td>-0.054</td>
<td>-0.032</td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td>(-1.85)*</td>
<td>(-1.09)</td>
<td>(-0.31)</td>
<td></td>
</tr>
<tr>
<td>IR regulation dummy</td>
<td>-0.006</td>
<td>-0.001</td>
<td>-0.013</td>
<td>-0.052</td>
</tr>
<tr>
<td></td>
<td>(-0.03)</td>
<td>(-0.37)</td>
<td>(-1.82)*</td>
<td></td>
</tr>
<tr>
<td>IF regulation × Cost of funds</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(-0.07)</td>
<td>(-0.07)</td>
<td>(-0.01)</td>
<td></td>
</tr>
<tr>
<td>IF regulation × Price of physical capital</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(-0.30)</td>
<td>(-0.25)</td>
<td>(-0.26)</td>
<td></td>
</tr>
<tr>
<td>IF regulation × Wage</td>
<td>0.023</td>
<td>0.022</td>
<td>0.013</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>(2.23)**</td>
<td>(1.22)</td>
<td>(2.25)**</td>
<td></td>
</tr>
<tr>
<td>IR regulation × Cost of funds</td>
<td>-0.002</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(-0.09)</td>
<td>(-0.07)</td>
<td>(-0.39)</td>
<td></td>
</tr>
<tr>
<td>IR regulation × Price of physical capital</td>
<td>0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(-0.02)</td>
<td>(-0.09)</td>
<td>(0.12)</td>
<td></td>
</tr>
<tr>
<td>IR regulation × Wage</td>
<td>0.001</td>
<td>0.000</td>
<td>0.006</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.57)</td>
<td>(0.05)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.007</td>
<td>-0.006</td>
<td>0.015</td>
<td>-0.134</td>
</tr>
</tbody>
</table>

*(1.34)*
<table>
<thead>
<tr>
<th></th>
<th>(-0.17)</th>
<th>(-0.14)</th>
<th>(0.35)</th>
<th>(-1.30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observations</td>
<td>360</td>
<td>360</td>
<td>335</td>
<td>360</td>
</tr>
<tr>
<td>Number of banks</td>
<td>19</td>
<td>19</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>R² (within)</td>
<td>0.06</td>
<td>0.07</td>
<td>0.05</td>
<td>0.06</td>
</tr>
<tr>
<td>F-statistic</td>
<td>1.51</td>
<td>1.48</td>
<td>0.93</td>
<td>1.58</td>
</tr>
<tr>
<td>H estimate before regulations</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.02</td>
</tr>
<tr>
<td>p-value of F statistic to test H: H=0 vs H: H≠0</td>
<td>0.01</td>
<td>0.01</td>
<td>0.17</td>
<td>0.02</td>
</tr>
<tr>
<td>H estimate after IF regulation</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>p-value of F statistic to test H: H=0 vs H: H≠0</td>
<td>0.76</td>
<td>0.73</td>
<td>0.95</td>
<td>0.64</td>
</tr>
<tr>
<td>H estimate after both regulations</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>p-value of F statistic to test H: H=0 vs H: H≠0</td>
<td>0.62</td>
<td>0.58</td>
<td>0.44</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Table 4: Long-run equilibrium tests using Return on equity

Fixed effects regressions

Dependent variable: Return on equity

All variables except for Trend, Trend squared, and dummy variables are in natural logarithmic form. The t statistics are shown in parentheses. The (*), (**) and (***) correspond to significance at the 10%, 5%, and 1% levels, respectively.
<table>
<thead>
<tr>
<th></th>
<th>Advertisement expenses</th>
<th>Advertisement expenses and Credit quality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost of funds</strong></td>
<td>0.031</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(1.79)*</td>
<td>(1.91)*</td>
</tr>
<tr>
<td><strong>Price of physical capital</strong></td>
<td>-0.000</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(-0.02)</td>
<td>(0.17)</td>
</tr>
<tr>
<td><strong>Wage</strong></td>
<td>-0.095</td>
<td>-0.090</td>
</tr>
<tr>
<td></td>
<td>(-2.63)**</td>
<td>(-2.48)**</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>-0.022</td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td>(-0.31)</td>
<td>(-0.25)</td>
</tr>
<tr>
<td><strong>Liquidity cost</strong></td>
<td>-0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(-0.90)</td>
<td>(-1.00)</td>
</tr>
<tr>
<td><strong>Trend</strong></td>
<td>0.009</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(3.20)**</td>
<td>(3.53)**</td>
</tr>
<tr>
<td><strong>Trend squared</strong></td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(-3.25)**</td>
<td>(-3.54)**</td>
</tr>
<tr>
<td><strong>Advertisement expenses</strong></td>
<td>-0.009</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(-1.56)</td>
<td>(-1.08)</td>
</tr>
<tr>
<td>Factor</td>
<td>0.003</td>
<td>0.136</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Credit quality</strong></td>
<td>(-0.42)</td>
<td></td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td></td>
<td>0.136</td>
</tr>
<tr>
<td><strong>IF regulation dummy</strong></td>
<td>(-1.41)</td>
<td>(-1.37)</td>
</tr>
<tr>
<td><strong>IR regulation dummy</strong></td>
<td>(-0.89)</td>
<td>(-0.66)</td>
</tr>
<tr>
<td><strong>IF regulation × Cost of funds</strong></td>
<td>(-1.39)</td>
<td>(-1.38)</td>
</tr>
<tr>
<td><strong>IF regulation × Price of physical capital</strong></td>
<td>0.005</td>
<td>0.005</td>
</tr>
<tr>
<td><strong>IF regulation × Wage</strong></td>
<td>0.020</td>
<td>0.015</td>
</tr>
<tr>
<td><strong>IR regulation × Cost of funds</strong></td>
<td>0.011</td>
<td>0.020</td>
</tr>
<tr>
<td><strong>IR regulation × Price of physical capital</strong></td>
<td>-0.010</td>
<td>-0.011</td>
</tr>
</tbody>
</table>

**BIFEC Book of Abstracts & Proceedings (Volume I Issue II)**
<table>
<thead>
<tr>
<th></th>
<th>Estimate 1</th>
<th>Estimate 2</th>
<th>Estimate 3</th>
<th>Estimate 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>IR regulation × Wage</td>
<td>0.101</td>
<td>0.093</td>
<td>0.122</td>
<td>0.078</td>
</tr>
<tr>
<td></td>
<td>(1.63)</td>
<td>(1.49)</td>
<td>(1.92)*</td>
<td>(1.26)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.384</td>
<td>0.393</td>
<td>0.401</td>
<td>-1.962</td>
</tr>
<tr>
<td></td>
<td>(1.55)</td>
<td>(1.58)</td>
<td>(1.57)</td>
<td>(-3.20)***</td>
</tr>
<tr>
<td>Number of observations</td>
<td>359</td>
<td>359</td>
<td>334</td>
<td>359</td>
</tr>
<tr>
<td>Number of banks</td>
<td>19</td>
<td>19</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>R² (within)</td>
<td>0.08</td>
<td>0.09</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>F-statistic</td>
<td>1.96**</td>
<td>2.00**</td>
<td>1.65*</td>
<td>2.25</td>
</tr>
<tr>
<td>p-value of F statistic to test H₀: H≠0 vs H₁: H₀</td>
<td>0.11</td>
<td>0.17</td>
<td>0.37</td>
<td>0.31</td>
</tr>
<tr>
<td>H estimate before regulations</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>H estimate after IF regulation</td>
<td>-0.09</td>
<td>-0.08</td>
<td>-0.09</td>
<td>-0.05</td>
</tr>
<tr>
<td>p-value of F statistic to test H₀: H≠0 vs H₁: H₀</td>
<td>0.27</td>
<td>0.30</td>
<td>0.26</td>
<td>0.53</td>
</tr>
<tr>
<td>H estimate after both regulations</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>p-value of F statistic to test H₀: H≠0 vs H₁: H₀</td>
<td>0.74</td>
<td>0.68</td>
<td>0.55</td>
<td>0.77</td>
</tr>
</tbody>
</table>
Assembling International Equity Datasets – Review of Studies on the Cross-Section of Common Stocks

Antonina WASZCZUK

Chair of Finance and Capital Market Theory, European University Viadrina Frankfurt (Oder), Große

Scharrnstraße 59, 15023 Frankfurt (Oder), Germany

Abstract

This paper reviews the data sources used in the research on the cross-section of international stock returns. Covering the wide range of internationally focused papers I give an overview of the applied data, sample coverage, classification schemes and data cleaning methods. I address the quality concerns in case of the non-U.S. data and methodologically relevant specifics of international data analysis providing references to available solutions. In regards to data cleaning I give an overview of applied screens, pointing out their diversity across studies. On that way I offer a structured insight into challenges and specifics of rapidly increasing amount of papers discussing the cross-section of common stocks in both single-country and multiple country frameworks.

Keywords:

cross-section of stocks, data quality, data cleaning, empirical research, data errors

1. Motivation

Up to recently, dominant number of papers on the cross-section of common stocks has been conducted using the U.S. equity data, making it the academically best explored market in the world. The advantages of the U.S. data, apart from the role and importance of the U.S. financial sector, are the length of the time-series, number of listed stocks and data quality. However, the common base for majority of empirical papers causes the problem labelled as data snooping, i.e., the concern “that prior empirical research may influence the way current

---

31 This study was financially supported by the Graduate College "Risk Analysis in Baltic States and Central and Eastern Europe" of the European University Viadrina in Frankfurt (Oder). The author also thanks Roman Brückner, Matthias Hanauer, Sven Husmann, Michael Soucek and Krzysztof Kusidlo for their useful comments and support. Email address: euv36052@europa-uni.de (Antonina WASZCZUK)
investigations are conducted”, Lo and MacKinlay (1990). Consequently, the statistical testing might support incorrect statements if results are not considered in the context of past inferences, see also Kothari et al. (1995), MacKinlay (1995). Therefore, an important query in financial markets research has become the need for robustness tests to ensure that the available results are not an artifact of data-mining. Tests on the persistence of patterns found in the cross-section of the U.S. equity data present a possibility to discard the data-related criticism. Relevant approach requires either (a) use of an alternative methodology or (b) use of an alternative data population. The first proposition refers to empirical design given that studies on the cross-section are subject to many arbitrary choices in regards to criteria like data frequency, weighting and classification schemes, data filtering or length of the estimation period.32 Second proposition gears towards the variation of input data, e.g. consideration of international markets as the source of alternative datasets or manipulation of the time-frame of the study. Over the long time the important problem of the international equity research was the difficulty in assembling a comprehensive international dataset constituting the individual stock data. Recently, the availability of the international data has improved. Further, over the last twenty five years new markets arose, e.g., emerging Europe and Chinese stock exchanges in Shanghai and Shenzhen that were opened in early 1990s. Although the length of the data time-series is significantly shorter than for the U.S. market, they present an interesting alternative data population. Their attractiveness stems from their (partial) segmentation from developed capital markets and deviating qualitative market characteristics like market infra- and microstructure or market efficiency and influence of different political and economical regimes what might affect the risk-return profile of assets. Further international data are possibly free from database specific biases and cover the market specific characteristics offering the opportunity to test relevant hypothesis under different market conditions. Over the years, empirical research has accumulated large amount of papers delivering mixed results indicating the differences across international equity markets. A notable recent example is delivered by Chui et al. (2010) who show that momentum profits are significantly related to some of country-specific variables and absent in the countries with the low level of individualism.

This paper gives an extensive overview of international data sources and related quality issues and methods to mitigate them. It provides numerous references to empirical papers considering both single-country and multiple-country data. To keep the focus I concentrate

32 Consult Waszczuk (2013b) for more details on the diversity in test designs.
on three most prominent patterns related to size, value and momentum. The rest of the paper is structured as follows. Section 2 gives overview of data sources used in both locally and internationally focused papers. Section 3 discusses the coverage of market, while Section 4 lists the solutions applied in the studies when dealing with data from countries within different currency regimes. Industry classifications serving as a base for industry grouping are presented in Section 5 while biases observed in the data samples are outlined in Section 6. Section 7 is devoted to the data cleaning procedures commonly applied on the data in the studies on the cross-section of common stocks. Section 8 concludes the paper.

2. Data sources

2.1. U.S. data

The primer source of U.S. stock data on the security prices, returns, and volume is the Center for Research in Securities Prices (CRSP). CRSP database have been used or referred to in the one-third of the studies in empirical finance since available, see Economist (2010), and provides time-series going back to 1926 for the NYSE, 1962 for Amex and 1972 for Nasdaq.33 The launch of the CRSP database in 1960s and initial use of the data is reviewed by Weinstein (2010) and Fama (2011). The starting date for the time series set to 1926 results from the intention of the founders to capture at least one whole business cycle of the NYSE history. Goetzmann et al. (2001) discuss the data available for the pre-1926 period but this pre-CRSP sample is not commonly investigated, mainly due to its quality.

The source of the U.S. firms’ accounting data is the Compustat that provides data series back to 1962 on quarterly basis and back to 1950 on annual basis. Davis et al. (2000) supplement the Compustat book common equity data of industrial firms that do not have Compustat data with the data from Moody’s Industrial Manuals to extend the coverage of the first years of the sample period. This data set going back to 1920s represents the most extensive accounting data sample for the U.S. market and underlies the standardised risk factors in the K. French data library.34

Most of the cross-sectional analysis on the U.S. data requires use of both CRSP and Compustat. Initially, matching both sources caused series of problems related to inconsistent and changing Cusip numbers, Chan et al. (1995). Recently, the merged sample is available as the CRSP/Compustat Merged Database (CCM) and perceived as a high quality base for the research

33 Within this thesis I refer to American Stock Exchange as Amex. However, in 2008 NYSE Euronext acquired Amex and re-branded it to NYSE Amex Equities.
34 http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

For stocks listed on NYSE and Amex, the quote data used in some studies as an alternative to the transaction prices are provided by the Institute for the Study of Securities Markets (ISSM) for 1983 to 1992 and by the New York Stock Exchange Trades and Automated Quotations databases (TAQ) for the later years. Closing-quote data for Nasdaq stocks come from the CRSP.

2.2. International data

Recently, for non–U.S. data, the Thomson Reuters DataStream (TDS) is the regularly used source offering the most comprehensive set in terms of covered markets (over 175 countries) and number of securities per market (57,000 companies). Bekaert et al. (2007) state that the total number of firms per market available through TDS accounts for, on average, about 90% of domestically listed firms reported by the World Bank's World Development Indicators. The TDS itself claims to cover 95% of global market value with up to 20 years of historical data. De Moor and Sercu (2013) argue that for many countries TDS contains information about all listed stocks. TDS contains data from two databases: returns and market capitalization data come from the DataStream while data like fiscal year endings, book value and market value on the fiscal year ending come from the Worldscope. TDS is the data source underlying the papers by Griffin (2002), Brown et al. (2008), Nijman et al. (2004), Chui et al. (2010), Guo and Savickas (2010), Narteaa et al. (2011), Hou et al. (2011), De Moor and Sercu (2013) and Cakici et al. (2013), among others.

Raising popularity and coverage of the TDS made it also to an alternative source of the U.S. data enabling a cross-check with the CCM data. The increasing number of publications deals with the quality of the equity data stating that any use of pricing models and risk factors relies on the credibility of information available. Frequently cited paper by Ince and Porter (2006) shows that momentum effect is not present in the raw U.S. data from TDS. The authors present two levels of screens and filters necessary to clean the data from TDS to make both U.S. data sources comparable and the TDS data suitable for further analysis. Extend to which these screening procedures, discussed in details in the paper, are considered by scholars working with TDS data is unknown. Several studies follow the recommendations, e.g.,

DataStream and Worldscope were merged as the Worldscope was acquired by Thomson Financial in June 2000.
Naranjo and Porter (2010), De Moor and Sercu (2013) or Hou et al. (2011). The latter paper conducts the study using both CCM and TDS data for the U.S. market and shows the robust evidence. Guo and Savickas (2010) apply their own screens that seem to be similar to those by Ince and Porter (2006) without referencing them. Other studies comparing both CRSP/Compustat and TDS data environments are, e.g., Schmidt et al. (2011) and Ulbricht and Weiner (2005). Chui et al. (2010) carry out a cross-check between TDS and PACAP for Asian Markets and confirm the consistency between both. On the other hand, Brocko (2013) presents several sources of data mismatches in the TDS data for the German market and points out the problems relevant for the final outcome of studies. Rossi (2011) discusses the data errors in TDS relevant for the UK market. Similar studies do not exist for other single markets what makes a general assessment about the influence of TDS data quality on the empirical analysis impossible at this stage.

Besides TDS, several other data vendors are in use when building an internationally scoped dataset. Fama and French (1998) and Bauer et al. (2008) use the Morgan Stanley’s Capital International Perspectives (MSCI) when examining developed markets. Bauman et al. (1998) uses Compustat Global Vantage file. The PACAP from the Pacific-Basin Capital Markets Research Center at the University of Rhode Island represents an alternative data source for the Asian markets used by e.g., McInish et al. (2008) and Chui et al. (2010). Studies investigating pricing mechanisms on the emerging markets use the Standard & Poor’s International Finance Corporation’s (S&P/IFC) Emerging Markets Database (EMDB), e.g., van der Hart et al. (2003), van der Hart et al. (2005), Beko et al. (2007), Umutlu et al. (2010), Borys and Zemcik (2011). To investigate the frontier markets De Groot et al. (2012b) use Standard & Poor’s Frontier Board Market Index (S&P/FBMI) and collect the data on total returns from the Interactive Data Exshare. Alternative source of return data for both developed and emerging markets is the Factset Pricing used by, e.g., Heston et al. (1999), Nijman et al. (2004) (for price data), van der Hart et al. (2005), Umutlu et al. (2010).

As stated by Gregory et al. (2013), combining several data sources enables to infill any missing data in TDS and raise the quality of data sample. Indeed, international samples are often biased towards large stocks and are therefore not fully representative. To ensure the high quality of the datasets, many studies supplement the primary data source with the data from other databases. Daniel et al. (2001) merge PACAP database with Daiwa Securities and Nihon Keizai Shimbun files to precisely cover the Japanese sample. van der Hart et al. (2005) compare total and price returns from S&P/IFC with the Factset Pricing database to ensure the
quality of return observations. Bekaert et al. (2007) uses monthly returns from EMDB and daily from TDS. To investigate the possibly wide spectrum of stocks including the micro-caps, Fama and French (2012) take the international stock returns and accounting data from Bloomberg and supplement them by TDS.37 De Groot et al. (2012b) works with problematic sample of frontier markets that suffer significant data-quality problems and therefore cross-check the data from S&P FBMI with Interactive Data Exshare, Bloomberg, TDS and data from the local stock exchanges. Chui et al. (2003) uses NEEDS, PACAP and TDS databases for different subperiods of investigated time window to guarantee the highest data quality and coverage.

2.3. National data

Publications on the cross-section of stock returns have been dominated by analysis of multiple country sets, mainly because in pooled samples more stocks can be used what raise the quality of statistical analysis. On the other hand, however, inferences about particular country are hardly to draw from such data. Also, market integration might not be a reasonable assumption for all considered country constellations. For those reasons, studies on single countries provide a necessary supplement for understanding the cross-section of stocks around the world.

Further advantage of one country analysis is that the authors make often use of national data delivered by local stock exchanges or data providers. As noted by Schmidt et al. (2011), these data might be inaccessible to other researchers. Also the quality of the data is easier to assemble on a national level with the degree that is often unmatched by the public data providers. Such independent datasets give an opportunity for the out-of-sample tests with high coverage of the market and freedom of possible biases, see, e.g., Nagel (2001). At the same time, however, the comparability of results might cause some difficulties due to the possible discrepancies in variable definitions and coverage of the sample.

The examples of the alternative data sources for the individual non-U.S. markets are:

• Australia: Securities Industry Research Center of Asia Pacific (SIRCA), Drew et al. (2006) or Australian Graduate School of Management database (AGSM) for market variables and Aspect Financial database for accounting data, Dempsey (2010),

37 Even though Bloomberg covers the majority of equity markets worldwide, Fama and French (2012) is the first paper using it as a primary data source of financial information.
• Canada: financial statement data from the Financial Post database and from Research Insight Compustat and the market data from Toronto Stock Exchange-Western tape supplemented by Research Insight Compustat, LHer et al. (2004),

• China: Taiwan Economic Journal Corporation (TEJ) China database, Eun and Huang (2007) or China Stock Market and Accounting Research (CSMAR), Huang et al. (2012),

• Germany: Karlsruher Kapitalmarktdatenbank (KKMDB) in Karlsruhe for the stock prices and Saling/Hoppenstedt Aktienführer for accounting data, see Artmann et al. (2012). Alternative database is maintained at Humboldt University in Berlin by Richard Stehle, Schulz and Stehle (2002) and Brückner et al. (2012).

• Japan: Pacific-Basin Capital Markets database, Chan et al. (1998), Daniel et al. (2001) or Griffin (2002); Japan Securities Research Institute (JSRI) tape, the Nihon Keizai Shinbun Nikkei Financial Data (NIKKEI) tape, and Nomura Securities, Inc. complementary, Rao et al. (1992),

• Poland: Bulletins of the Warsaw Stock Exchange, Lischewski and Voronkova (2012) and Waszczuk (2013c),

• South Korea: database of Korea Capital Market Institute and Kis-Value, Kim et al. (2012),

• Switzerland: Factset, Ammann and Steiner (2008),

• Taiwan: Taiwan Economic Journal Corporation (TEJ) Taiwan database, Lee (2012),


Besides above examples, TDS is often used as a source of the single-country data, see Burghoff and Prothmann (2011) and Siganos (2010) for UK, Griffin (2002) for UK and Canada, Glaser and Weber (2003), Amel-Zadeh (2011), Bank et al. (2012) and Hanauer et al. (forthcoming) for Germany, Akdeniz et al. (2000) for Turkey or Diacogiannis and Kyriazis (2007) for Greece.³⁸

³⁸ Despite these references, the TDS is less popular in the studies on the German market, Brückner (2013) due to the existence of several alternative data sources perceived as of higher quality.
3. Market and country coverage

Most of the recent studies on the U.S. equity market work with the universe of NYSE, Nasdaq and Amex stocks. Some studies use only the NYSE data arguing either that the NYSE is representative for the U.S. equity market covering the majority of capitalisation or that bias can be introduced due to the heterogeneous market structure. Nasdaq and Amex are known to be dominated by smaller stocks and the exclusion of those two exchanges decreases the strength of the size effects in the sample. Therefore the results obtained basing on the NYSE environment do not allow to draw much conclusions regarding the size-related effects.

Literature has recognised the phenomenon labelled the “Nasdaq effect”. Reinganum (1990) shows that returns of NYSE securities are about 6% higher than returns of securities listed on Nasdaq during the period 1973-1988. Loughran (1993) attributes most of Nasdaq stocks' underperformance to the underperformance of IPOs which is proportionately more important on Nasdaq. Fama and French (1993b) find that the difference between NYSE and Nasdaq returns for size sorted portfolios is not significant after risk adjustment by the Fama-French factors. Loughran (1993) and Brennan et al. (1998) show the opposite. To account for possible influence and differences, some studies introduce Nasdaq dummy variable, e.g., Brennan et al. (1998). Other type of robustness test is to re-estimate the results for the Nasdaq-only subsample. Following this method, Gutierrez and Kelley (2008) show no weekly reversal in returns, Bulkley and Nawosah (2009) no momentum and Goyenko et al. (2009) no liquidity effect in the Nasdaq market. Liu (2006) carries out a comparative study for NYSE/Amex/Nasdaq versus NYSE/Amex universe and, alternatively, examines two subsamples, NYSE/Amex and Nasdaq stocks separately. Kothari et al. (1995) and Yao (2012) run their analysis only for NYSE and Amex although the latter paper mentions the robustness of the results after Nasdaq inclusion.

Studies on non-U.S. equity markets include mostly the largest stock exchange in the country measured, e.g., in terms of number of stocks, i.e., Tokyo Stock Exchange, London Stock Exchange, Toronto Stock Exchange, see Daniel et al. (2001), Griffin (2002), Naranjo and Porter (2010), Chui et al. (2010). Argument supporting such choice is that these exchanges cover majority of relevant market capitalisation. Hou et al. (2011) and Huang et al. (2012) consider more than one exchange for large financial centers like China or Japan.

Many exchanges are divided into several segments targeting firms with different capitalisation and characterised by different requirements regarding transparency and reporting or
foreign-investment constraints. For example, Japanese stock exchange covers three different segments: First Section where largest and most successful stocks are listed, Second Section designed for less well known companies that have lower trading activity and the newest Mothers Section, established in 1999 that provides market for growth and emerging stocks. Chinese A-share class is tradable only for domestic investors. German Frankfurter Stock Exchange covers since 2007 two markets, Open Market and the Regulierter Markt. The third segment, Neuer Markt, was closed in 2003. Similar markets still exist in other European countries, e.g., the AIM in London, the Nouveau March in Paris or Nuovo Mercato in Milan.

However, not always exact information about which segments are considered in the analytical exercise is available. At the same time, Brückner (2013) argues that for the German market incorporation of wider set of stocks from different market segments might be influential on final outcome of quantitative analysis due to the potential market segment effect.

Further, international studies mostly focus on a particular subset of countries. The choice of the sample set might follow one of the listed criteria.


- the composition of official indices, e.g., constituents of the the S&P Frontier Board Market Index (De Groot et al. (2012b)), the Morgan Stanley Developed Country Index (Bekaert et al. (2012)),


- pre-defined country sets: G740 (Guo and Savickas (2010), Eiling et al. (2012), Bali, Cakici, and Fabozzi (2013)) or European Monetary Union (Ammann et al. (2012)),

- geographical location: global regions (Fama and French (2012), Cakici et al. (2013)), European countries (Bauer et al. (2008)), Visegrad countries (Borys and Zemcik

---

39 Two first points are related given that the S&P and MSCI build the indices basing on their own classification of the development level of included countries. However, studies like Griffin et al. (2007) categorise countries basing on the 1998 World Bank income classification.

40 G7 countries are U.S., Canada, United Kingdom, Germany, Italy, Japan and France. In terms of the market capitalisation they are a dominant part of the world market.
(2011)), Asian or Southeast Asian stock markets (Brown et al. (2008) and Narteaa et al. (2011), respectively), Gulf Cooperation Council (Bley and Saad (2012)) or West African Economic and Monetary Union (Soumare et al. (2012)).

Analysis of multiple-country sets can be conducted on both pooled and country-by-country level. In case of aggregate approach the results might be driven by country effects, i.e., by the results for the one or several countries, see Rouwenhorst (1999) and Ammann et al. (2012). Brown et al. (2008) argue that inclusion of Taiwan into their basket of investigated countries affects the large picture because, unlike remaining countries in the sample, Taiwan exhibits value discount.

4. Currency unit

The country-level price data are normally collected in local currency. However, international comparison using local currencies, e.g., Liew and Vassalou (2000) or Bali et al. (2013), might be misleading, especially if inflation and risk-free rates differ significantly across countries. Therefore, the examination of the international data requires setting of the common currency as an unit of calculations to make the results comparable across countries or to be able to use the pooled country set. Most of the studies work with the dollar-denominated returns obtained directly from the data vendors like TDS that provides dollar-denominated returns or adjusted by the researchers. This procedure, however, ignores the exchange risk related issues. Ignoring the exchange rate risk automatically assumes either (i) the complete purchasing power parity (PPP) between markets or (ii) that the assets cannot be used to hedge exchange rate risk, see Fama and French (2012). If the exchange rate risk issue is relevant might depend on the portfolio grouping procedure. If, for the purpose of analysis, the stocks are allocated to portfolios on country-level and only afterwards aggregated across countries then the pooled dataset contains the same percentage of stocks in given currency in both tail aggregated portfolios and the currency movements are irrelevant, see Rouwenhorst (1999), De Groot et al. (2012b). Also Bauer et al. (2008) claims that on the pan-country level by the well diversified portfolios without tilts towards any particular country the currency risk should affect the portfolios in a similar way and therefore not bias the results significantly.

41Bali et al. (2003) claim that their results are robust for dollar-denominated returns.

42Bali and Cakici (2010) take the exchange rate uncertainty quantitatively into account by incorporating the trade-weighted exchange rate index into the model. The authors show that the results are robust to currency uncertainty control. See also Eiling et al. (2012) for the examination of the currency risk. Zhang (2006) investigates the International CAPM with exchange rate risk.
In contrast, Bali and Wu (2010) show different results obtained under different currency regimes.

In empirical studies on single-markets the returns are calculated in local currency and are dollar-denominated for pooled analysis and for robustness, e.g., Liu et al. (2011), Bekaert et al. (2007), Brown et al. (2008). Rouwenhorst (1999), Barry et al. (2002), Griffin (2002), Bali and Cakici (2010), Chui et al. (2010), Hou et al. (2011), De Groot et al. (2012b), De Moor and Sercu (2013) and Cakici et al. (2013) use the dollar denominated returns in their pooled studies. Rouwenhorst (1998), Heston et al. (1999) and Nijman et al. (2004) utilize German Mark (Deutsche Mark) denominated returns calculated with the exchange rate from Financial Times, Bauer et al. (2008) analyses the returns in EUR.

5. Biases in equity databases

Data samples obtained from the data providers discussed above are subject to several biases that might influence the outcome of the empirical analysis. Below, I discuss the most important examples.

Sample selection bias. Selection bias is a consequence of the selection rule other than random sampling that causes some observations to be excluded from the sample, e.g., due to the data availability. The sample is also selection-biased when it has some specific characteristic non-existent in alternative samples. It is the case in Daniel et al. (2001) who explore Japanese equity market characterised by high book-to-market premium relatively to other markets. Dempsey (2010) emphasises the concentration of listed companies in few sectors in case of the Australian market. As stated by Rouwenhorst (1999), SP/IFC EMDB uses special criteria to include stocks into their indices in order to reflect the local market’s best and therefore the database is biased towards larger, more frequently traded stocks. MSCI database includes only large stocks constituting 80% of the market capitalisation for twelve developed markets investigated by Fama and French (1998). The SP/IFC global index aims to represent 70-80% of the total market capitalization of the local stock exchange. SP/FBMI covers around 80% of the capitalisation. As so, the international samples are usually not fully representative and some effects, mainly the size effect, cannot be investigated, see Kothari et al. (1995) for the U.S. and Fama and French (1998) for the international data consultation. For that reason Nijman et al. (2004) observe no clear size and value effects in their sample that covers fewer firms than sample by Heston et al. (1999) extracted from the same database for which the size effect for European stocks is restricted to the smallest three deciles.
With time new and small firms have become less under-represented in the TDS. As a consequence, results from studies using this data source might differ across time intervals due to changes in the coverage of the database. For example Brückner (2013) discusses the coverage issues in the TDS prior to 1990 that are relevant for the German market.

Survivorship bias: Survival bias is an example of the sample selection bias driven by the disproportionate exclusion of stocks that were delisted over time. Kothari et al. (1995), among others, argue that the inclusion of stocks that were distressed and survived is more likely in Compustat than inclusion of data on stocks that died. Survivors are likely to have unexpectedly high returns in the years just before inclusion in the Compustat and the database tends to back-fill the accounting data for small firms which were subsequently extreme winners, see Fama and French (1996). Such sample is biased towards winners because it contains mostly stock with better performance. Therefore, Jagannathan and Wang (1996) claim that Compustat is unsuitable for econometric analysis of asset pricing models.

Wang (2000) demonstrate that survival alone can cause the size effect and book-to-market effect. However, followed up on the arguments and evidence, many studies obtained results consistent with survivorship bias. Davis (1996) notes however that the significance of estimates from Compustat alone may cause overstated coefficients. Fama and French (1992), Kothari et al. (1995) and Avramov and Chordia (2006) control for the Compustat survival bias by excluding the first two years of Compustat data for every firm. Horowitz et al. (2000) avoid the survival bias just because the authors do not include accounting data from Compustat when investigating the isolated size effect. For more details on the survivor bias in Compustat and for further references, see, e.g., Chan et al. (1995) and Fama and French (1996).

For majority of countries TDS does not include delisted securities prior to 1991, so the data prior to this date suffer from survivorship bias, Griffin (2002). PACAP does not include delisted stocks prior to 1988. However, Daniel et al. (2001) argue that the delisting rate is less than seven stocks a year and use of value-weighted portfolios can effectively mitigate the bias. Rouwenhorst (1999) and van der Hart et al. (2003) do not include stocks immediately after their data are available in the S&P/IFC EMDB database but only after they are included in the IFC Composite Index so the backfilling bias is controlled for. Bauer et al. (2008) claim that MSCI database is not affected by the survivorship bias.

---

43 The data are available, e.g., for the German market but their quality is insufficient and is not recommended to be used in academic studies, Brückner (2013).
Another source of the survivorship bias emerges from the fact that the TDS exchange information often reflects only the current value of the classification variables, Ince and Porter (2006). As a consequence, only the most successful stocks that remain in the major exchanges are taken into account. Brückner (2013) discusses this problem when TDS data from the Top Segment of the German market is analysed.

Delisting bias. Several studies show that the CRSP database omits delisting returns for a large number of companies for the month in which a company is delisted from an exchange. Shumway (1997) notes that the omitted delisting returns, that average around -30%, can have important consequences for research applications. Shumway and Warther (1999) investigate this issue for the stocks listed on the Nasdaq exchange. The authors collect the data on delisting returns from the over-the-counter (OTC) market and replace the missing observations for delisted stocks with the proposed -55% return. After such correction they do not document the size effect on the Nasdaq exchange. On the other hand, Eisdorfer (2008) shows that on average about 40% of the momentum profit is generated by the returns of stocks that are delisted from the market during the holding period.

The extend to which the delisting bias should be controlled for depends on the amount of the surprisingly delisted stocks. Given that for many exchanges the stocks are typically not delisted unexpectedly, this concern might be less important than for the U.S. market. De Moor and Sercu (2013) show delisting bias to be irrelevant for their international data sample. Also Nijman et al. (2004) argue that missing returns adjustment for bankruptcy firms has limited influence on their momentum study and that results are more conservative because losers returns, i.e., the shorted side, to which the bankrupt firms and their highly negative final returns would be classified, are even more negative than expected. However, the relevance of the delisting bias for the non-U.S. data samples is rarely raised in the empirical papers.

6. Sector and industry classification

Industries and sectors are used as the unit of analysis in the equity pricing because firms within an industry tend to be highly correlated due to the similar activities. They operate in the same regulatory environment, exhibit similar behavior in the corporate finance arena and similar exposure to macroeconomic shocks, and are sensitive to similar supply and demand fluctuations, Moskowitz and Grinblatt (1999). At the same time portfolios built on industries are well diversified and there is a small concentration of firms by size than in case of artificial
portfolio grouping. Because sector grouping is neutral and less susceptible to data-mining problems, they present an attractive sample for independent evidence, see Cochrane (2005), Lewellen et al. (2010).

Some industry classification schemes are delivered by data providers. The basis for further reclassification of industries for U.S. market financial research is the Standard Industrial Classification (SIC), e.g., 17 industries used in Fama and French (1988) or 19 in Chan and Chen (1991). Fama and French (1997), basing on the SIC scheme, drew up their own set of homogeneous stock groups. Starting from four digits SIC codes, they categorize companies into 48 industry sectors. Also Moskowitz and Grinblatt (1999) use SIC codes to construct 20 industries according to two-digit SIC code.

Guenther and Rosman (1994) and Kahle and Walkling (1996) stress the significant differences between SIC coding in CRSP and Compustat. The degree of mismatches is around 36% for two-digit and 80% for four-digit. The divergence in defining industry groups might have a significant influence on the research outcomes. Interested reader might wish to consult Weiner (2005), Chan et al. (2007) or Naranjo and Porter (2010), among others, for further discussion.

Nijman et al. (2004) argue that using Moskowitz and Grinblatt (1999) classification scheme does not work well for European data because several industries would contain few or no stocks at all. Therefore, the authors apply the MSCI industry classification that considers 23 sectors. TDS employs the Industry Classification Benchmark (ICB) model for equities and applies the same criteria to define industries across countries what supports the comparability. The industry belonging is based on the source of (majority of ) revenues of companies. In case of a single country analysis, the national classification can be followed as done by Huang et al. (2012) who use the industry codes by the China Securities Regulatory Commission. Rouwenhorst (1998) constructs sector-neutral portfolios based on assignments to seven broad industry groups obtained from the Financial Times.

---

44. Profits from stock picking strategies across industries (mainly momentum) may also be indicative of an important role for industries in understanding financial markets. They are also used to measure the industry effects.
46. One of the methods to alleviate this problem is presented in Chou et al. (2012).
47. There are four classification levels by ICB industries (10), megasectors (19), sectors (41) and subsectors (114). Hou et al. (2011) and Liu et al. (2011) use the same industry classification. ICB classification is referred to as the FTSE's Global Classification system, Level 4 groupings because the classification was developed by FTSE Group and Dow Jones Index but is the owner of ICB.
Relevant issue is the way the sector belonging is reported in the database. Changing composition allows tracking the migration of stocks across classes while fixed composition reports usually only the last sector to which the stock was classified. The CRSP SIC code database contains the time-series of codes allowing for the time variation in industrial classification. Compustat only reports the most recent SIC codes. It has been shown, however, that differences between methodologies have only minor influence on results of U.S. studies.

7. Data screening - Filters and controls

Knez and Ready (1997) show that the size effect emerges from the 1% of tail observations due to the so called “turtle eggs effect”. Smallest-stocks portfolio outperforms other portfolios thanks to few extremely successful micro-stocks and not because most of the stocks within the portfolio perform well. As pointed out by Fama and French (2008), the micro-caps make on average 3% of the market capitalisation in the NYSE-Amex-Nasdaq universe but present 60% of the total stock number. At the same time the micro-cap stocks often suffer from severe data problems but, as noted by De Moor and Sercu (2013), it is difficult and time-consuming to distinguish genuine returns from errors. Further, micro-caps often suffer from large number of zero-returns. These returns result from the unchanged price between two considered periods as the effect of either (i) the price bouncing back to its initial level or (ii) lack of trading. The long series of zero-returns causes the reduction of total volatility and biases the loadings on the systematic risk factors.

For the reasons stated above, empirical literature sets filters on the data to alleviate micro-structure concerns and to avoid the over-weighting of extreme observations in the cross-sectional tests. The common data cleaning solutions are outlined below.

Selection of asset population. Basing on the industry classification schemes, majority of empirical papers exclude the financial sector from the analysis. Financials are subject to different accounting standards and valuation methods than industry sectors and their low equity level and resulting values of the leverage variables might have different interpretation than those of non-financial firms. This filter was proposed by Fama and French (1992) who investigated the proposition by Bhandari (1988) that leverage is related to the cross-section of stocks. However, this filter is omitted by some studies not considering leverage, Fama and

---

48 Given that the zero returns are more often interpreted as a sign of no trading, the data can be compared with trading volume time-series and optionally set to missing, see Chui et al. (2010). Zero-returns are also a base for one of the illiquidity measures, so called zero-returns, discussed in Lesmond et al. (1999).
French (1993a), Kothari et al. (1995) and Daniel et al. (2001). Barber and Lyon (1997) show that
the relation between size, book-to-market, and security returns is similar for financial and
nonfinancial firms.

The dominant number of studies limits the analyses to common stocks. In reality, however,
some firms issue multiple classes of shares and their treatment varies across studies. Multiple
classes might be integrated into one and treated as a single (value-weighted) portfolio of the
outstanding equity securities, as in Chan et al. (1998), Rouwenhorst (1999) or Ammann and
Steiner (2008), among others. Chui et al. (2010) include only primary share class. Worldscope
includes data for only one, most representative type of shares for each firm based on the
trading intensity and availability for foreign investors, Hou et al. (2011).

Also duplicates and cross-listings, preferred stocks, warrants, real estate investment trusts
(REITs), closed-end funds, exchange-traded funds, and American depository receipts (ADRs)
are regularly filtered out, see Liew and Vassalou (2000), De Moor and Sercu (2013). Further
common practice is to consider solely the domestic stocks, Fama and French (1992), Chan et
al. (1998), Waszczuk (2013a,b). Nevertheless, Chui et al. (2010) consider both domestic and
foreign stocks. In the pooled country samples, the cross-listings are regularly included in the
home country sample, Naranjo and Porter (2010), Chui et al. (2010).

Trimming. Cutting out a specified part of the dataset is one of the most straight forward
methods to eliminate a part of the data sample. Set limits are mostly study specific. Ball et al.
(1995) eliminates 5% of the smallest stocks, Jegadeesh and Titman (2001) exclude all stocks
that would be assigned to the lowest NYSE decile while Naranjo and Porter (2010) excludes
observations below the NYSE 25th percentile in local currency. Liu et al. (2011) assign returns
as missing for any stock below the 1st or above the 99th percentile of the return distribution
while Rouwenhorst (1999) and Naranjo and Porter (2010) set bottom and top 2.5%
observations to missing values. Jegadeesh and Titman (2001) and McInish et al. (2008) when
investigating the momentum effect exclude the top 1% and bottom 1% of performers during a
given week. Brown et al. (2008) considers only stocks belonging to the intersection of top 50%
market liquidity and top 50% market capitalisation. Additionally, after grouping stocks by
price level, they exclude bottom 50% for Korea, Taiwan and Hong Kong and bottom 30% for
Singapore.

Even after such radical sample limitations the authors capture more than 85% of market capitalisation for their sample countries.
Some studies apply alternative criteria like minimum capitalisation requirements to trim the data. De Moor and Sercu (2013) set the minimum capitalisation at $100 Mio. on the international sample and additionally limit the analysis to stocks with monthly trading volume larger than $100 Tsd.. van der Hart et al. (2005) set the capitalisation limit at $100 Mio. for the last month of the study sample and deflates the amount by 10% annually back to the sample beginning. Burghof and Prothmann (2011) use the threshold of 20 Mio. £ for the UK data.

Winsorising. Alternative control method is to limit the values of data to a particular minimum or maximum. Fama and French (1992) winsorise the 0.5% extreme book-to-market ratio observations while Hou et al. (2011) winsorise all value indicators at this level. Horowitz et al. (2000), McInish et al. (2008), Lewellen (2011) or Novy-Marx (2012) winsorise the characteristics, except returns, at their 1st and 99th percentiles.

Extreme returns. Extreme returns are the outliers in the return distribution. De Moor and Sercu (2013) show with the help of Eq. 1 that errors in prices spuriously increase the mean return and might significantly affect the results.

\[
\frac{1}{t} \frac{P_t (1 + \varepsilon)}{P_{t-1}} + \frac{P_{t+1}}{P_t (1 + \varepsilon)}
\]  

If \( \varepsilon \) is the percentage error in the price reported for the time \( t \), then regardless the sign of \( \varepsilon \) the spurious percentage drop is smaller than the spurious rise. In reference to this topic, Barry et al. (2002) show that after controlling for extreme returns, elimination of the upper and lower one percent tails of the return distribution, size is not present in the emerging markets sample. However, no official definition of extreme return exists in the literature and studies set their own limits. van der Hart et al. (2005) cut monthly returns at 150% or 300%. De Groot et al. (2012b) consider returns of 100% and -60% as extreme while Chui et al. (2010) those of 100% and -95%. Rouwenhorst (1999), when grouping stocks on past performance, excludes at each ranking date the extreme 5% of the prior six month return distribution. Waszczuk (2013c) sorts out the returns with absolute values above 50%.

Penny Stocks. Penny stocks are, according to the U.S. Securities and Exchange Commission (SEC) definition, stocks priced below 5 dollar. Low-price stocks are often fallen angels which are highly speculative, see Chan and Chen (1991). Many large brokerage firms set constraints
on investors to short penny stocks or impose significantly higher margin requirements. Horowitz et al. (2000) shows that size effect is generated mainly through the January performance of stocks with price lower than two dollars. The exclusion of such stocks is justified especially when they represent the majority of shorted portfolios.

The SEC definition is applied by Jegadeesh and Titman (2001), Gutierrez and Kelley (2008) and Bhootra (2011). Easterday et al. (2009), Chordia et al. (2011), Hou et al. (2011) or De Moor and Sercu (2013) exclude stocks with price lower than one dollar. As shown by Bhootra (2011), the exclusion of penny stocks filters out around 25% of stocks with cumulative capitalisation representing less than 1% of the whole U.S. market capitalisation. Alternative categorisation is used by Chordia and Swaminathan (2000) and McInish et al. (2008) who define penny stocks as such with the closing price that is within less than 5% band of the whole sample during the week.

Conrad and Kaul (1993) show that the measurement bias induced by the bid-ask effect is 56.25% for $1 stock and decreases to 6.25% for $3 stock. Further, authors show that losers portfolio exhibit the average price of included stocks that is close to $1.

In the studies on local markets using returns in national currencies the adjusted definition of penny stocks is applied. Waszczuk (2013c) treats stocks priced below 0.50 PLN as penny stocks. Brückner (2013) considers stocks with the price below 1 EUR and capitalisation below 5 Mio. EUR as penny stocks to include the high capitalised German stocks with low trading prices into the sample. Hou et al. (2011) shows for their international sample that the 1 dollar level lies at roughly 10th percentile for U.S. market while at around 25th percentile for non-U.S. markets. For robustness, they apply the price per share limit at 0.20 dollar for non-U.S. data which presents the 10th percentile. Alternatively, they apply the country individual limits set by 0.001$ for Philippines, 0.23$ for UK, 14$ for Denmark and 64$ for Switzerland. The filters on market price are set normally every month, Chordia et al. (2011).

Manual screens. The automated screens discussed above not always guarantee the sufficiently clean data set. De Moor and Sercu (2013) lists the possible causes of unfiltered extreme-return errors that can be influential for regression results. These are, e.g., decimal-sign shifting (a huge price rise preceding or following a similarly huge drop); anomalously low first price of a series (probably theoretical or illiquid); high reported returns not corresponding to a similar
change in the market capitalisation or price or not mirroring a huge dividend payout; data reported before the actual introduction date or after the actual delisting date; obvious typos and wrongly handled equity offerings. The authors visually screen such cases and eliminate high returns until the first one-hundred highest remaining returns seemed acceptable. Rouwenhorst (1999) manually filters out “suspiciously” high returns exceeding 100,000% that most probably come from the miscalculated stock split ratios.

Summarizing the methods presented above the word of caution is to mention. Applying some of the filters simultaneously might lead to confusing statements. As noticed by Bhootra (2011) if small-cap stocks are excluded and afterwards the penny stocks filter is applied for the robustness, the results are likely to be the same since by exclusion of micro stocks majority of penny stocks is eliminated as well, see also Jegadeesh and Titman (2001). Similar interrelation exists between Nasdaq and size screens because filtering out penny stocks might be sufficient. Bhootra (2011) states that because 75% of penny stocks excluded from the sample are Nasdaq stocks, the results he provides are qualitatively the same regardless inclusion of Nasdaq environment.

Further, some screens are applied only to ensure reliable analysis of a given attribute and reset for general analysis, e.g. negative book value stocks that are considered in the market portfolio proxy.

Apart from the more standardised controls listed above, there are further country or market specific characteristics that might be of importance. Some of them like foreign ownership or market domination are discussed in, e.g., Vaihekoski (2004).

7.1. Data availability and completeness

Further sample screens serve to guarantee the completeness of the data set. First availability criteria is related to the presence of stocks in the source databases. Fama and French (1992, 1993a) require stock to be included in both CRSP and Compustat. Intuitively, every empirical study examines stocks available in the considered database.

The second criteria refers to the time-point related requirements. Horowitz et al. (2000) consider only stocks with the daily tapes on the last day of a calendar year during sample years. Daniel et al. (2001) uses only stocks that have available price data in both March and September of formation year. By intuition, the sorting attribute must be available in the
formation period to include stock into empirical exercise in particular month, Rouwenhorst (1999).

Third selection criteria implies that stocks are included in the final sample subject to the completeness of the time-series by setting the minimal amount of available observations over the sample period. In most of the studies, the observations do not have to be continues, see Chordia et al. (2011). Type of criteria is mostly study specific. Fama and French (1992) and Bhootra (2011) exclude all firms with less than 24 monthly return observations over five-years estimation period to ensure the sufficient number of observations available to compute estimators. Davis et al. (2000) require stocks to have minimum 36 monthly returns observation over last 60 months while Avramov and Chordia (2006) consider only stocks with return observation in the current month and over the past 36 months.

Momentum studies often require the return data to be available at least 12 months prior to the formation period to allow for the formation of the middle-term performance characteristic for each stock. Daniel et al. (2001) exclude stocks with less than 18 monthly observations between t-42 and t-2 prior to the initial portfolio formation date.

International studies set criteria on number of stocks per country to ensure the feasibility of portfolio formation. van der Hart et al. (2003) excludes all countries with less than four stocks and those for which the data are available for less than 30% of the stocks while Griffin et al. (2003) excludes countries with less than 50 stocks available in the dataset.

Additionally, when investigating multiple effects authors can decide to consider only stocks for which all characteristics are available or, as done in Fama and French (1998) or van der Hart et al. (2003), take all stocks for which the attribute can be obtained.

8. Conclusions and Remarks

The ongoing internationalisation of capital markets is visible also in the recent academic publications investigating the cross-section of stock returns. The raising interest in universal validity of relationships documented for the U.S. equity market as well as prof- its from the international diversification result in numerous studies focused on broader universe of markets. Analysis of international datasets shares many data-related problems with the analogous analysis of the U.S. market. But it also faces several challenges unique for the multi-country datasets. Further, studies investigating single country other than U.S. require specific data treatment often based on the deep knowledge of market characteristics.
This paper presents in a structured way the variety of data sources and underlying problems in regards to data quality in the international research on equity markets. It aims to raise attention to the caveats of available data and necessity of extension of standard quality controls in terms of both data screening and empirical design. Further, the large amount of references to relevant papers serves to provide useful insight into the current focus of the research on the cross-section in the international equity markets.

References


Bali, T., Wu, L., 2010. The role of exchange rates in intertemporal risk-return relations. Journal of...
International Money and Finance 29, 1670–1686.


Economist, T., 2010. Data birth. fifty years after the dawn of empirical financial economics, is anyone the wiser?


Trading Puzzle, Puzzling Trade

Orhan ERDEM; Borsa İstanbul

Evren ARIK; Borsa İstanbul

Serkan YÜKSEL; Borsa İstanbul

Many studies explain the high volume of trade in stock markets with non-rational trades of individuals. They claim high volume of trading seems to exceed the trading and hedging needs of the investors. Here we analyze the weekly aggregated daily trades in Borsa İstanbul (formerly Istanbul Stock Exchange) of 20,000 individual investors over two year period from 2011 to 2012. Borsa İstanbul has one of highest share turnover ratio worldwide (141.8% as of 2012) which makes it an ideal candidate to explore the effects of large turnover ratios. We examine the return performance of individual investors with respect to various factors such as portfolio size, turnover ratio and also demographic factors: gender and age. The main finding and the contribution of the paper is that, the return of the individual portfolio is positively correlated with the portfolio size. Interestingly, almost 70% of all individual investors cannot beat the market. Investors who have high turnover underperform compared to those who have lower turnover ratios. Male investors trade more and lose more vis-à-vis the female and older investors have higher returns for both genders.

Keywords: Turnover, Overconfidence, Portfolio Size, Stock Returns, Individual Investor

I. Introduction

“High trading volume in financial markets is the single most embarrassing fact to the standard finance paradigm.”

Terrance Odean (1999)

Stock market movements are consequences of human judgment, interactions and behavior. Many studies provide extensive evidence that individual traders are imperfectly rational and prone to psychological biases that lead to costly investment mistakes50. Specifically, the high

trading level of the stock market is inconsistent with the rational expectation models (Shiller (1981)). Even the models supporting the efficient market hypothesis acknowledge high volatility of the asset prices. High volume of trading is often singled out as the raison d’être for this volatility and many other market anomalies (Miller (1977)). Studies on the market anomalies highlighted the importance of once ignored component of stock market: human itself. Shefrin and Statman (1994) used a behavioral CAPM model to show that the noise traders create higher volume in the market. Glaser et al. (2007) concluded that the rational motives for trade are not sufficient to explain the high trading volume in the stock markets.

In this study, we aim to focus on the potential characteristics of individual investors that affect their respective return performance. We explore the return performance of individual investors with respect to several factors such as portfolio size, turnover ratio, gender and age. In a pioneering study, Barber and Odean (2000) explored the relationship between turnover and portfolio return of individual investors. They found that as investor’s turnover increase, their respective portfolio return decreases using a monthly aggregated dataset. Here we improve their work by using a weekly aggregated data where the returns of individual portfolios are calculated weekly. Profitability of the trades of individual investors can switch when the analysis is conducted on weekly data rather than monthly. Barber and Odean (2001) noted that individuals, who trade frequently, make substantial benefits from intra-month trading. We think that Borsa Istanbul (formerly Istanbul Stock Exchange) may provide useful insight on this issue since it has 4th highest share turnover ratio in the world51. Since individuals have psychological biases and these cognitive biases affect their return performance (Kaniel, Saar and Titman (2008)); effects of age, gender, turnover and portfolio characteristics on the return performance of individual traders have been studied.

There has been long debate about the performance of individual investors in the literature. Individual traders often regarded as noise traders who are best uninformed. Therefore, several studies focus on performance of individual investors compared to general market returns. Before starting the main findings and discussions, we present that investors in general underperform the market. This result is consistent with earlier papers like Blume and Friend (1995), Odean (1999), Barber and Odean (2000), Grinblat and Keloharju (2000), and Hirshleifer (2001). However, there are some studies concluded contradictory results like Ivkovich and Weisbenner (2005) who found

---

51 141.8% as of 2012 according to World Federation of Exchanges Statistics
that home bias led individual investors to outperform the general market. Our results support the former papers that regardless of turnover characteristics of individual investors, their return performance is inferior to the general market returns. Also, underperformance of the individual investors is not dependent on the demographic characteristics.

Our second finding is on the relationship between turnover and return performance of the individual investors. As a high turnover stock market, analysis of the turnover of individual investors in Borsa Istanbul can give important insights about the investment practices. Even though only 37% of market capitalization belongs to domestic investors, 83% of all trades are executed by these investors. They generally hold on to their purchases for a very short period of time compared to the other institutional investors (Kaniel, Saar, Titman (2008)). Chuang and Susmel (2011) compared institutional to individual inventors on their return performances and found that individual investor trades even more aggressively in bearish markets whereas institutional investors trade relatively conservatively. This result is in line with Gervais and Odean’s (2001) conclusion that uninformed individuals trade more aggressively and they tend to be overconfident. This paper also contributes to the literature with the weekly performance analysis of individual investors. Our results indicate that as the turnover ratio of individual investors’ portfolio increases, the return of the portfolio decreases. This result can be considered as a supporting evidence for overconfidence hypothesis. (For further study on relation to the overconfidence hypothesis see Barber and Odean (2000), Yeoh and Wood (2011), Statman, Thorley and Vorkink (2006)).

We posit that effect of the portfolio characteristics on the return performance can give important information on the general structure of the stock market. Therefore we analyzed the return performance based on the portfolio size and conclude third and the main result of this paper: the bigger size portfolios have higher returns in general.

Lastly, we explored whether age and gender characteristics of individuals have an effect on their return performance. Since there are numerous characteristics for individual investors, in sake of simplicity and to keep track of significant characteristics of the individual investors, we only document the effect of age and gender on the return performance. With vast literature developed for the effect of gender characteristics on the aggressive trading strategies, we study both age and gender characteristics of individual investors. Previously, Goetzmann and Kumar (2008) found that individual investors who are younger and poorer tend to hold more under-diversified portfolios, suggesting that they may exhibit stronger cognitive biases due to their demographic characteristics. Moreover, the relationship between portfolio size and age can give
important insights about the individual investor's investment decisions. In another related study, Korniotis and Kumar (2009) showed that cognitive abilities decline with age and they have found evidence to support the notion that investment performance declines with age. Another line of study investigates the gender differences on the return performance and trading behavior. Barber and Odean (2001) showed that men underperform women in stock trading with higher tendency to trade more and significantly inferior return performance. (Choi et al. (2002), Agnew et al. (2003) and Mitchell et al. (2006) are among the other studies supporting the same result). However, Felton et al. (2003) and Feng and Seasholes (2008) found no significant evidence for the effect of gender characteristics on the return performance. Following Odean's study, Hamacher (2001) found a contrary result concluding “gender matters less than personal style, age and education when it comes to rendering good planning advice.” Grinblat et al. (1997) found that home bias, culture and demographic characteristics may have combined effect on the return performance. Here, we find that on average women have better performances than men. Likewise, age has a positive effect on the portfolio performance of individual investors. We also find that the coefficient “Age*Gender” has a negative and significant sign suggesting that females earn less compared to men when they get older. This interesting evidence implies that behavioral characteristics of individual investors need more attention and interaction effects of these characteristics should be studied before any conclusive intuition is asserted.

To the best of our knowledge, this study is one of the few studies with individual data. Also, this is among the few studies that focus only on characteristics of individual investor in an emerging market stock exchange. Only study that uses individual data from Turkey beside ours is Fuertes et al. (2012), which tracked brokerage house tracking accounts of 59,951 individual investors between 2008-2010. They investigated the behavioral reasons for the under diversified portfolio in Borsa İstanbul. Here, we rather study on the relationship between turnover and returns whereas their study concentrates on the relationship between portfolio size and returns.

Moreover, this study will contribute to the understanding of behavioral-cultural differences across the various stock markets. Huang, Heian and Zhang (2011) noted that Asian markets differ in significant dimensions to the Western markets especially for the cultural pattern as individuals are more prone to cognitive biases. Also, individual investors dominate the market for the small size stocks. Their study concludes that the fundamental differences in culture can spur the overtrading in the stock market (See also Chen et al. (2007), Kim and Nofsinger (2003) and Yates

See Barber and Odean (2011) for excellent coverage of the other individual level data studies across the many countries in developed and emerging markets.
et al. (1997)). Barber et al. (2008, 2010) and Gao and Lin (2010) analyzed the individual investors in Taiwan, and Feng and Seasholes (2004, 2005, 2008) studied the individual investors in China; both studies have found supporting evidence for the cultural characteristics on the return performance. This study is unique with its regional data and the individual investors’ gender and age characteristics analysis can be inferred as the indicator for cultural patterns, which have significant effects on the portfolio returns. Hence, we do not only contribute to the overconfidence literature but also add an important analysis of an emerging country data to the behavioral finance literature.

The rest of the paper is organized as follows. We explain the data and methodology in Section 2. Section 3 gives the empirical results and Section 4 concludes.

II. Data and Methodology

Our dataset, provided by the central security depository (M KK), covers the transactions in Borsa İstanbul. Borsa İstanbul is one of the most important and liquid markets in the Eastern Europe and MENA region with being the world’s 4th largest bond market on electronic order book. Equity market has 405 listed companies with $273 billion traded value and $301 billion market capitalization as of December, 2012. Even though only 37% of market capitalization belongs to domestic investors, their traded value is quite high, making 83% of the whole trade. There are 1,090,059 domestic individual investors that capture 21% the market capitalization. For this study, individuals who traded at least once in the two-year period and held portfolios more than 1,000 TRL (approx. $560) as of the end of 2012 are selected which amounts to 250,827 investors (See also Barber and Odean (2001) and Statman et al. (2006) for data selection criteria). We randomly select 20,000 investors from these investors and used weekly aggregated daily trades for them. That is, the portfolio returns of the individuals are calculated weekly contrary to most the literature which uses monthly aggregated data. Higher frequency is preferred with aim of having clearer picture for the performance of individuals since the turnover of the Borsa İstanbul is higher than most other markets (4th highest turnover in the world).3

The descriptive statistics of the sample is reported in Table 1. 83.1% of the individual investors are male (Percentage dominance of men was similar in Lease at al. (1974) as 80%, Barber and Odean (2001) as 78.7%). The average age of our sample individuals is 43 and average age of women is higher than that of men. Panel B shows that women have higher average portfolio size than men. Descriptive statistics indicate that distributions of the portfolio sizes are clearly

3 According to WFE Statistics as of 2012.
positively skewed: the median portfolio size is $8,922, whereas the average of the portfolio size is $71,943. Although median of the portfolio sizes are close to each other for males and females, the averages of the portfolio sizes greatly differ for different genders.

Table 1
Descriptive Statistics by age, gender and portfolio sizes of individual investors in the Borsa İstanbul

<table>
<thead>
<tr>
<th></th>
<th>All individuals</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of individuals</td>
<td>20,000</td>
<td>3,390</td>
<td>16,610</td>
</tr>
<tr>
<td>PANEL A: Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>43.4</td>
<td>44.8</td>
<td>43.1</td>
</tr>
<tr>
<td>median</td>
<td>42.0</td>
<td>43.0</td>
<td>41.0</td>
</tr>
<tr>
<td>standard deviation</td>
<td>11.5</td>
<td>12.6</td>
<td>11.3</td>
</tr>
<tr>
<td>PANEL B: Portfolio size</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>$71,943</td>
<td>$90,810</td>
<td>$68,092</td>
</tr>
<tr>
<td>median</td>
<td>$8,922</td>
<td>$8,036</td>
<td>$9,083</td>
</tr>
<tr>
<td>standard deviation</td>
<td>$2,192,690</td>
<td>$3,003,394</td>
<td>$1,987,095</td>
</tr>
</tbody>
</table>

This table reports the descriptive statistics by investor’s age, gender and portfolio size on Borsa İstanbul. The values are as of the end of 2012. Portfolio size values are in USD dollars. Portfolio sizes are taken from MKK in Turkish Lira (TRY and converted to USD dollar by CBRT effective average exchange rate). The source of the raw data is MKK.

To begin the analysis, we first define the turnover as follows:

\[
Turnover_{jt} = \frac{1}{2} \left( \frac{TradeValue_{jt}}{PSize_{jt}} \right)
\]                      (1)

where TradedValue is calculated as 0.5 times the average of weekly total trades in terms of market value for the each investor j, and \( PSize_{jt} \) represents the average of end-of-week portfolio holdings in terms of market value for the each investor. Hence, \( PSize_{jt} \) is a constant number for the sample period. Weekly aggregated trade data includes number of shares and values whereas the position data includes only number of shares. Therefore, prices are calculated from trade data and these prices used to obtain end-of-week portfolio values. Then, we calculate weekly turnovers as the market value of stocks traded in each week divided by the \( PSize_{jt} \). The second step is to estimate weekly returns of the investors using the positions data and adjusted stock prices, which are obtained from Bloomberg. We first calculate weekly returns of each stock and then calculate weighted weekly raw returns of portfolios.

54 Our calculation methodology is similar to Barber and Odean (2000), Chuang and Susmel (2011)).
where $r_{it}$ is the weekly return for stock $i$ in week $t$, $p_{ijt}$ represents the weight that was calculated by dividing the end-of-week market value for stock $i$ to the end-of-week market value of portfolio held by investor $j$, and $s_{jt}$ is the number of stocks held by investor $j$. Weekly market adjusted returns are calculated as follows:

$$r_{jt} = r_{jt}^{raw} - r_{it}^m$$

where $r_{it}^m$ denotes corresponding weekly rate of return on IMKB 100 index, main broad value-weighted stock index of Borsa Istanbul’s equity market. Having calculated market adjusted weekly returns in (3) and turnover in (1) for each investor, we calculate the average return $\bar{r}_j$ and average turnover $\overline{\text{Turnover}}_j$ for each individual $j$ over $T=104$ weeks from January 2011 to December 2012 as

$$\bar{r}_j = \frac{1}{T} \sum_{t=1}^{T} r_{jt}$$

$$\overline{\text{Turnover}}_j = \sum_{i=1}^{T} \text{Turnover}_{jt}$$

Note that the “average return” is market adjusted by subtracting the market index from raw returns as in (3). Next, to analyze return differences between investors with respect to turnover ratios, investors are sorted into quintiles based on weekly turnover. Also, investors are sorted on the basis of portfolio size.

We further analyze the effects of turnover and portfolio size as well as gender and age on average return for each investor in the following cross sectional regression:

$$\bar{r}_j = \beta_0 + \beta_1 \overline{\text{Turnover}}_j + \beta_2 \text{Gender}_j + \beta_3 \text{Age}_j + \beta_4 \text{GenderXAge}_j + \beta_5 \overline{\text{PSizeh}}_j$$

The variable “Turnover” which is defined in equation (5) is adjusted in a way that values higher than 100% are taken to be 100%. This restriction affects only 0.2% of the investors in the sample. $\overline{\text{PSizeh}}_j$ is a dummy variable indicating that the investor has a portfolio higher than the median. The gender is also a dummy variable which equals to 1 if the investor is female. The variable “Age” is the value of investor’s age divided by 10 (following Barber and Odean (2001)).
III. Results

First, we present our results by giving the the return performance of individual investors. As Panel B of Table 2 indicates, the average return is negative ($\bar{r}_j = -0.28\%$) which shows that in this high-turnover market, the individuals cannot beat the market on average. Kramer (2012) and Coval, Hirshleifer and Shrumay (2005) showed that only informed individuals can beat the market. Our results give supportive evidence for the fact that individual investors with limited information or limited skill set such as IQ, underperform the market (Grinbalt, Keloharju and Linnainmaa (2011, 2012). Women significantly outperform men in terms of average returns (-0.16% compared to -0.31%), which is consistent with the findings of Barber and Odean (2001), Choi et al. (2002) and Mitchell et al. (2006).

As Panel A of Table 2 shows, turnover for the whole sample is 113%. This result is significantly higher than 8.8% reported by Barber and Odean (2000), 2.52% reported by Kaniel et al. (2008) and 4.7% reported by Foucault et al. (2011). Moreover, the results indicate that both the mean and the median turnover are significantly lower for women than men on the average. That is women trade less than men.

Table 2
Turnover and Return Performance of Individual Investors

<table>
<thead>
<tr>
<th></th>
<th>All individuals</th>
<th>Women</th>
<th>Men</th>
<th>Gender Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of individuals</td>
<td>20,000</td>
<td>3,390</td>
<td>16,610</td>
<td></td>
</tr>
<tr>
<td>Panel A: Average Turnover</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>113.0%</td>
<td>73.3%</td>
<td>121.2%</td>
<td>-47.9%*</td>
</tr>
<tr>
<td>median</td>
<td>38.4%</td>
<td>31.2%</td>
<td>39.9%</td>
<td>-8.7%***</td>
</tr>
<tr>
<td>Panel B: Average Return</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>-0.281%***</td>
<td>-0.162%***</td>
<td>-0.306%***</td>
<td>0.144%***</td>
</tr>
<tr>
<td>median</td>
<td>0.225%***</td>
<td>-0.100%***</td>
<td>-0.251%***</td>
<td>0.151%***</td>
</tr>
</tbody>
</table>

Average Turnover is calculated as in equation (5), average return is calculated as in equation (4).
*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Tests for differences in medians are based on Wilcoxon signed rank and Wilcoxon/Mann-Whitney test statistics.

We further analyze the relationship between returns and turnover in more detail. In order to highlight the effect of turnover on the return performance, we sort the individuals according to their turnover ratios and divide them into quintiles. As Figure 1 clearly indicates there is an inverse relationship between turnover and average return (The exact numerical results can be

---

55 Concerning that the mentioned studies use monthly data, our weekly calculated result would have been even higher if a monthly data had been used.
found in Appendix). That is, average return decreases as turnover increases. Consistent with Barber and Odean (2000, 2001), Kramer (2012) and Statman, Thorley and Vorkink (2006); higher trading activity results in inferior return performance for individual investors. Note that, highest turnover quintile has almost four times higher turnover than the average individual investor and sixty times higher than the lowest quintile. This high turnover has mainly been attributed to overconfidence by many studies (Odean (2000, 2001), Statman, Thorley and Vorkink (2006)). However some other studies claim that high turnover is due to information asymmetry (Kramer (2012)), private information (Kaniel, Saar, Titman (2012)) or rather individual’s assessment of the firm characteristics (Hoffman, Shefrin, Pennings (2012)). Though these studies in the literature focus more on the reasons for overtrading, our study rather concentrates on the overtrading puzzle rather than the behavioral foundations of overtrading.

Figure 1
Relationship between Turnover and Return

There is also a positive relationship between average return and portfolio size. Figure 2 shows that, as portfolio size increases, the average return of the investor increases (see Panel B of Table 3 in Appendix for numerical details). High returns for bigger portfolios may be attributed to lower liquidity constraints for wealthy investors, e.g., they may not be forced to sell their stocks in hard times. They may also benefit more from professional investment services of the industry. As Kramer (2012) and Chang et al. (2009) noted that the individual investors who are superior informed or have better financial advice earn higher returns compared to uninformed high turnover traders. However, Barber and Odean (2000) have found that, small portfolios perform better though the return performance difference is not significantly different than zero.
Final analysis is performed via a cross section regression of the returns on the before mentioned variables: turnover, portfolio, gender together with age. This regression is done in order to control other variables' effect on returns. Results of equation (4) are given in Table 4, which indicates that all the independent variables considered in this study are significant at 1% significance level. The main finding of our analysis is confirmed here: Portfolio size has a positive and significant coefficient (it has also the highest t-statistics among all variables), implying that wealthier investors have better earnings. This may be due to two main reasons as it is discussed above: First wealthier investors may be benefiting more from professional services. As Kramer (2012) pointed that “advised portfolios perform much better than self-directed portfolios, thus reducing avoidable risk.” Second wealthier investor may have lower liquidity constraints to sell their stocks especially in hard times. The other variables have expected signs and the significance levels consistent with the literature: Turnover has a negative effect on returns consistent with our previous findings and literature (Barber and Odean (2000, 2001), Statman et al. (2006)). The gender dummy indicates that women have higher returns than men which confirms our previous findings and the results given by Choi et al. (2002), Angew et al. (2003) and Mitchell et al. (2006) and Barber and Odean (2001). Regression results also indicate that the age has a positive impact on investors’ performance. This can be explained by Koestner et al. (2012)'s finding that individuals do learn from their mistakes. But the coefficient of genderxage is negative which suggest that women' earnings increase less than males as they get older.
Table 4
Cross Sectional Regression of Return

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Market adjusted return (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.666 (-38.46)***</td>
</tr>
<tr>
<td>Turnover</td>
<td>-0.009 (-13)***</td>
</tr>
<tr>
<td>Gender dummy</td>
<td>0.279 (6.91)***</td>
</tr>
<tr>
<td>Age/10</td>
<td>0.070 (17.86)***</td>
</tr>
<tr>
<td>Gender X Age</td>
<td>-0.033 (-3.81)***</td>
</tr>
<tr>
<td>Portfolio size high</td>
<td>0.148 (18.30)***</td>
</tr>
<tr>
<td>R²</td>
<td>6.1%</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>6.0%</td>
</tr>
<tr>
<td>F-value</td>
<td>257.12</td>
</tr>
</tbody>
</table>

This table presents the results of the cross-sectional regression analysis performed in equation (6). Reported are the estimated coefficients with their t-statistics in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Standard errors are corrected for heteroscedasticity.

IV. Conclusion

Concerning the high volume of trade in stock markets, one can ask whether these trades generate high returns or not. As Glaser et al. (2004) suggested, the rational motives for trade are not sufficient to explain the high trading volume in financial markets. Here, we investigated the individual investors in Borsa İstanbul from a behavioral perspective. With the important specialty of the Borsa İstanbul which is having one of highest turnover ratio in the world (141.8% as of 2012), we used weekly aggregated daily trades of 20.000 individual investors from January 2011 to December 2012. Regarding the limited number of individual data sets utilized in the literature, we expand the data covered in this line of research to a new market, which has one of the highest turnovers throughout the world. This study first documents the turnover, return performances of individual investors and analyzes the relationship between the two. This analysis is repeated for the return and portfolio size. A regression analysis is carried out to find the effects of several variables such as turnover, portfolio size, age and gender on the portfolio returns of the individuals. Our analysis provides five important results:

- The main result of the study is that there is a positive relationship between portfolio size and returns. That is the bigger the portfolio size, the higher the returns.

The other results are:

- First, the individual investors underperform the market.
• Second, there is a reverse relationship between turnover and returns.
• Third, men are trading more than women, and hence they underperform the women.
• Fourth, age has a positive effect on the portfolio returns.

These results are consistent with the behavioral finance literature which suggests that individuals (mainly due to their overconfidence) that trade aggressively have lower returns compared to the average investor. We contribute to the literature by putting evidence on the reverse relationship between portfolio size and returns. One of the important aspects of our study is that, different from the general tendency in the literature, the analysis is performed with weekly aggregated portfolios. Moreover, we present important evidence for high trading activity from an emerging market which can have some different behavioral patterns compared to the most of the studies in the literature. Any further studies that elaborate more on the behavioral aspects of these individuals from emerging markets can give important inferences to the understanding of the behavioral patterns behind the individual investors’ actions and also cultural characteristics that affect those actions.

APPENDIX

Table 3
Returns for Investor Quintiles Based on Mean Turnover and Portfolio Size

<table>
<thead>
<tr>
<th>Quintile</th>
<th>All investors</th>
<th>1 (low)</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 (high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean turnover</td>
<td>113.0%</td>
<td>7.3%</td>
<td>20.8%</td>
<td>38.8%</td>
<td>71.5%</td>
<td>427.8%</td>
</tr>
<tr>
<td>Raw return</td>
<td>-0.043%</td>
<td>0.092%</td>
<td>0.025%</td>
<td>-0.04%</td>
<td>-0.07%</td>
<td>-0.202%</td>
</tr>
<tr>
<td>Market adj. return</td>
<td>-0.281%</td>
<td>-0.103%</td>
<td>-0.205%</td>
<td>-0.27%</td>
<td>-0.33%</td>
<td>-0.494%</td>
</tr>
</tbody>
</table>

Panel A: by turnover

<table>
<thead>
<tr>
<th>Panel A: by portfolio size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean portfolio size</td>
</tr>
<tr>
<td>Mean turnover</td>
</tr>
<tr>
<td>Raw return</td>
</tr>
<tr>
<td>Market adj. return</td>
</tr>
</tbody>
</table>

Records of 20,000 investors are sorted into quintiles based on weekly turnover. Quintile 1 contains investors with the lowest turnover; quintile 5 contains investors with the highest. Raw return is the average weekly return for the average investor. Market adjusted return is calculated as subtracting benchmark market index from raw return. The values are as of the end of 2012. Mean Portfolio size values are in USD dollars. Portfolio sizes are taken from MKK in Turkish Lira (TRY and converted to USD dollar by CBRT effective average exchange rate for 2011 to 2012). The source of the data is MKK.
REFERENCES


The effect of investors' confidence on monetary policy-economic growth relationship: a Multivariate GARCH approach

Chiara GUERELLO56 University of Genoa – Department of Economics57

Abstract

The financial stability's effects on the monetary policy transmission mechanisms are investigated. Specifically, the heteroskedasticity of the errors is exploited, in a MGARCH, to obtain endogenously estimated measures of uncertainty. A two steps estimator of a Multivariate GARCH-in-mean model highlights the indirect effects of monetary growth on financial markets at different time horizons. The estimates, although preliminary in line with who views the "Great Moderation" as the main cause of the financial crises, lead to reversed results once avoided spurious regression problems, accounting for permanent changes in the monetary policy (structural breaks in the variances 'series).

Keywords: Financial Stability; PEG; Monetary Policy; Uncertainty; Multivariate GARCH-in-mean.

JEL Classification: G12; E44; E52.

Introduction

The impact of uncertainty on money growth has received great attention in recent years and it is a crucial issue for Central Banks, particularly for those who focus on monetary policy analysis. A strong debate has arisen on whether the behaviour of the main Central Banks (FED58, ECB59, etc.) in the last decades might be listed among the causes of the recent financial turmoil.

Stylized facts show that since the '90s, a quite passive interest rate rule and an official target of output stabilization around its long run trend, have generated very low macroeconomics variability. As many empirical findings argued that a passive policy and a low money's variance lead to high instability of the financial markets, the loosing monetary policy of the last two

---

56 I am very grateful to Prof. Marco Mazzoli for his thorough comments at different stages of this work. Helpful conversations with Prof. Gianni Amisano and Prof. Mike Clements are also gratefully acknowledge. All mistakes are mine.
57 Department of Economics (DIEC), University of Genoa, via Vivaldi 5, 16100 Genova, Italy.
Email: chiara.guerello86@vodafone.it
58 US Federal Reserve
59 European Central Bank

BIFEC Book of Abstracts & Proceedings (Volume I Issue II)
decades, called Great Moderation, might have caused the recent financial crisis. However, in opposition to the main empirical findings, the theoretical contribution still argued in favour of monetary stock stabilization.

Since several factors affect the transmission mechanisms of the monetary shocks to the financial markets, the problem is more complex and articulated than what appears. This paper focus on the interrelations among the uncertainty shocks and tries to shed light on the question with an accurate empirical analysis.

The role played by the Great Moderation in the crisis is investigated through the analysis of both unconditional and conditional second moments of GDP, money stock and investor's confidence. If it is possible to exclude the Great Moderation from the recent turmoil's causes, this can be seen as a confidence crisis without any origins in the Central Banks' behaviour. However, whether with a different monetary policy the crisis could have been smoothed is still an open question.

Several channels through which the monetary policy affects the financial markets have been designed, but the relation between monetary policy, real economy, and financial markets has not been clearly disentangled yet. Even if there are many partial equilibrium models including the three uncertainty measures among the exogenous shocks, the empirical evaluation of the three-side relationship has not catch much the attention, and the main influential papers have focus on the bi-variate ones.

(Serletis & Rahman, 2009) shed light on the controversial impact of monetary policy on the economy during the last decades: they found that money growth volatility has significant negative effect on the growth rate of the real GDP.

Despite the early theoretical literature emphasized the interest rate channel thought which money growth volatility affects the level of economic activity, influential papers as (Mascaro & Meltzer, 1983) and (Evans, 1984) argued that, as monetary volatility increases interest rate, it adds to bonds’ riskiness. Increasing in the risk of holding bonds affects the demand for money and the interest rates, and hence reduces investment and output.

---

60 Among the other (Choi & Oh, 2003) analysed the effect of second order shocks in money and output growth in case of both low and high financial market volatility. (Bekaert, et al., 2009) considered also the joint second moments analysing the relations among financial markets, consumption growth, and dividend yields. A more detailed description of the theoretical literature is provided in section(2)
Recently (Bekaert, et al., 2010) and (Jovanovic, 2011) found that the monetary policy directly affects the risk aversion of the investors, and the latter is linked through a non-linear relation to uncertainty.

Finally, recent papers reveal a growing interest in the effects of financial stability on macroeconomic activity. (Puhan, 2011) provides evidences that shifts in the economy and monetary policy variables help to explain the time varying patterns in assets valuations during the last decades.

The difficulties in measuring uncertainty are at the basis of the small literature over the topic. Endogenous measures of uncertainty have not been largely used, but previous studies have often employed either "ad hoc" estimates or sample's measures of volatility.

This paper, through a multivariate GARCH-in-mean, highlights the relationship that occurs among investors' confidence, real money growth, and economic activity. In this way, it contributes to the debate from two directions: on the one hand, using a multivariate models, the correlations between monetary policy, real economy, financial market, and their measure of uncertainty are simultaneously estimated using multivariate models. On the other hand, the use of a volatility model allows endogenously investigating the problem in term of uncertainties, with no need to search for an appropriate proxy.

Focusing on the US economy allows for long and rich series (a period from 1959 to 2011 with different FED chairmen). The main drawback from such a series' length is the presence of possible structural breaks due to institutional changes. The changes in either the conduct of monetary policy or in the assets market regulation could strongly affect the estimates of the covariance between money stock growth and investors' confidence.

The analysis relays on a two steps estimator of the multivariate GARCH in mean model as described above. This technique allows for investigating from a complete perspective the relation between the variables in level and their measure of uncertainty. Indeed, the variables in levels enter each variance's equations and the model could be estimated for different lags 'length, accounting for delayed effects.

The paper is organized as follows: section 2 describes the main findings in the literature and sketches the model from a theoretical perspective. Section 3 describes the main econometric issues, and section 4 reports the main results. Section 5 concludes.
Theoretical background

Despite little has been said about the empirical counter-factual of the theories, the theoretical literature points out that, in most cases, an increase in any variable's volatility leads to an increase in money demand. Furthermore output uncertainty decreases assets prices and hence risk aversion, and financial markets' uncertainty is negatively correlated with consumption.

Over the last decades uncertainty has taken on a more central role in describing the real economy dynamics. Furthermore, recently the works by (Bloom, 2009) and (Bloom, et al., 2012) theoretically established the relevance of the uncertainty shocks in driving the business cycle. Three main channels has been found that theoretically link uncertainty in either assets market or in money growth to real economy.

First, as in (Boyle, 1990) and (Boyle & Peterson, 1995), an increase in output uncertainty affects money demand positively through both moving the interest rate and decreasing the rate of return of the assets.

As underlined by (Choi & Oh, 2003), once both money and financial services are considered in the household’s utility function, the uncertainty due to volatility in either money growth or output, affects both money and financial services' demand, through the so called ‘wealth effect’. However the final sign of the effects of a second order shocks in money growth or output are ambiguous. A problem arises as the wealth effect can be decomposed in two opposite forces:

1. Substitution effect. As the uncertainty related to money growth (output) increases, the households, who dislikes risk, substitute consumption with money (money with consumption), because less risky.

2. Precautionary effect. In a situation of high money (output) volatility people prefer to save more (less) and consume less (more), hence there is an increase (decrease) in the demand for money and financial services.

The coefficients' sign of the volatility measures in the money demand and hence the prevailing sign depend on both the households' degree of risk aversion and the policy parameters, in particular on the strength of Central Bank’s response to output volatility.

In addition, financial uncertainty, if dominating, may reverse the sign of the substitution effect, because the households substitute between more risky assets and money, rather than money with
consumption. Therefore, an increase in uncertainty, on the financial market, on money growth or on output, always leads to an increase in money demand.

Finally (Bekaert, et al., 2009) analysed the role of financial markets through the correlation between assets price, consumption growth and dividends yields. As consumption and inflation volatility are the main determinants of output volatility, it is possible to generalize the results about consumption to GDP. Assets valuation is affected by both consumption growth and its volatility. Due to the negative correlation between consumption and its volatility and the positive one between consumption and dividend yields, an increase in output volatility has two opposite effects on assets price: it increases equity price due to a term structure effects, but it sums up to a negative cash flow effect. In addition, an adding up in dividends' volatility increases assets market’s volatility, due to an increase of liquidity costs and more favourable growth options. Finally, risk aversion and financial market uncertainty are negatively correlated with consumption.

**Methodological approach**

**Data and variables description**

In this study three monthly data series for United States are employed \footnote{Graphical description of the series is reported in table (1), covering a period of more than fifty years, from January 1959 to December 2011. Such an interval includes several periods of either high or low inflation, as well as different Fed chairmen with alternative approaches to monetary policy. During mid-1970s, and late 1980s/early 1990s shocks of relatively large magnitude impacted both inflation and consumption, as well as the whole economic activity. This time interval covers also the recent financial crisis.}

As a measure of monetary policy stance, the growth rate of a liquid monetary stock is preferred over real interest rate measures. It accounts for movements of monetary base caused by either movements in the demand for money or due to the monetary policy decisions. The real M2 stock is used, which is calculated as the natural log of nominal M2 less the natural log of the CPI. Data for the monetary stock are collected from the Federal Reserve Economic Database FRED, maintained by the Federal Reserve Bank of St. Louis.

Reporting the economic situation, it is necessary to rely on a single variable to capture the whole macroeconomic volatility. The most common variable used is the Gross Domestic Product, but monthly series are not available. Overcoming the problem, the GDP series quarterly published by
the US bureau of economic analysis (BEA) is interpolated, as proposed by (Chow & Lin, 1971), with the Main Economic Indicator (MEI), monthly published by OECD. As M2, the variable is divided by the CPI and taken in log.

A measure of assets risk premium is the best choice to describe the stock market shocks. This measure summarizes the unpredictable movements of the stock market index due to changes in the investor's confidence over the market. According with the `Long run risk model' of (Bansal & Yaron, 2004), the marginal rate of substitution of the representative agent, and hence the equity risk premium, positively co-vary with the price dividend ratio and the ex post equity return, hence the assets valuation. The most common measures of risk premium are the financial metrics that determine the relative trade-off between the price of a stock, the earnings generated per share, and the company expected growth. Following the idea of (Puhan, 2011), the Price-Earnings (PE) ratio is a good proxy. PE ratio is a financial statistic used by the investors to evaluate when a company is over (under)-evaluated, because a decreasing PE ratio implies a decreasing investors' confidence in the growth of the companies. However the Price-Earning on Growth ratio (PEG) might be regarded as a better indicator. This index reflects more the growth potentials since it includes several earnings generating factors, such as brand, human capital, expectations, and barriers to entry. In order to compute this index, data of the Price-Earnings ratio and the Earnings Growth ratio were collected from the Robert Shiller web site (Shiller, 2000).
An empirical issue: measuring the uncertainty

Recently the main theoretical literature (e.g. (Bloom, et al., 2012) and (Christiano, et al., 2010)) has perturbed the theoretical model with second order shocks to explain business cycle. In this way, they define uncertainty as the variance of the stochastic, or unpredictable, component of a variable.

A large part of the empirical literature used exogenous proxies as measures of uncertainty, typically forecasted dispersion from the Philadelphia FED’s Survey of Professional Forecasters (see (Giordani & Soderlind, 2003)) or measures of implied volatility (see (Bloom, 2009)).

The premises of this paper relay on (Serletis & Shahmoradi, 2006) critique: the relationship that occurs among monetary, macroeconomic and financial uncertainty can be more rigorously addressed by using a GARCH-in-mean model. This specification exploits the features of the data, namely the presence of ARCH effect in the series, to produce endogenous time varying measures of uncertainty.
In GARCH model, if the conditional variances are correctly parameterized, it is possible to endogenously get consistent measures of the true levels of uncertainty. If other sample-based measures of uncertainty, like moving averages, are used, they are in general inconsistent.

Table 2: Correlation among different measures of uncertainty

<table>
<thead>
<tr>
<th>Endogenous measures</th>
<th>Forecast dispersion*</th>
<th>Implicit volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>h.GDP</td>
<td>0.449819</td>
<td>VIX***</td>
</tr>
<tr>
<td>h.PEG</td>
<td>0.355696</td>
<td>0.543757</td>
</tr>
</tbody>
</table>

* forecast dispersion measure are taken from the FED Survey of Professional Forecasters (SPF).

** real GDP and stock 10 = the log difference of the 75th and 25th percentile ratio of respectively the 1-year-ahead forecast probability of real GDP and the 10-years-ahead forecast probability of the S&P500.

*** VIX = the price of a volatility option, CBOE Volatility index (VIX).

Table (2) compares the estimated measures of uncertainty for real GDP growth and stock market with some alternative measures of uncertainty. Specifically, as forecast dispersion measures from the SPF: the log difference of the 75th and 25th percentile ratio of either the 1-year-ahead forecast probability of real GDP or the 10-years-ahead forecast probability of the S&P500. In addition, the price of a volatility option, CBOE Volatility index (VIX). The most highly correlated proxies are the implied volatilities (VIX), as found by (Orlik & Veldkamp, 2012), but do not achieve more than a 60% correlation with our uncertainty measures.

Since there is not any uncertainty about the forecasting model and the parameters, uncertainty and volatility are the same concept and the different proxies of volatility do not differ. As uncertainty about the model and parameters is accounted, the measures of uncertainty could differ because any of them is able to capture the whole uncertainty. Specifically, although the survey based measures are able to partially capture the uncertainty about the model and parameters, using the range of disagreement among individual forecasts does not give information about each individual’s uncertainty regarding their own forecast.

Analysis of the individual series

Before proceeding with the model description and estimation, it is necessary to examine the stationarity of the series. Different variants of the Augmented Dickey-Fuller lead to ambiguous results for which the test can neither reject nor accept the null hypothesis. In this case, either the presence of heteroskedasticity of the errors or the specification of the residuals with a general
ARMA (p, q) model, may lead to a misspecification of the AR (1) model underlying the test. Therefore the estimator, over which the test is run, is inconsistent.

As suggested by (Phillips, 1987) and (Phillips & Perron, 1988) the estimator can be adjusted so that it would be asymptotically similar to the real one, but consistent. The Philipps-Perron tests point to M2 and PEG the series being integrated of order zero and thus stationary. GDP series is not stationary, but as highlighted by (Amado & Terasvirta, 2011), in presence of structural breaks the series can be locally stationary. If we account for structural breaks in the variance equation, the unconditional variance would be constant in different sub-samples and thus the series stationary.

Looking at Figure (i) and the previous findings in literature, due to heteroschedastic residuals the estimates from a simple Vector Autoregressive (VAR) model would be inconsistent. Therefore further diagnostic tests are required. Tests for ARCH effect over the single series point out the residuals to be auto-correlated. Considering the conditional variance in the model is feasible and suggested. Hence it is a good proxy for uncertainty.

Motivation and choice of the main econometric specification

Given previous evidences in the literature and already from the descriptive part of this work, it is clear that there are high co-dependencies between all the uncertainty measures. Using a Multivariate GARCH-in-mean model allows for accounting for the time varying nature of variances and covariances, and investigating the relationship among the fluctuations associated with the volatilities of the variables.

Despite the univariate specifications and properties of the ARCH models are widely known, the multivariate case requires some further specifications for two main reasons:

1. The model has to be flexible enough to be able to represent the dynamics of the conditional variances and covariances. However, since the number of parameters exponentially increases with the dimension of the model, the specification should be detailed enough to allow for both relatively easy estimation of the model and interpretation of the parameters.
2. Further specifications over the variance-covariance matrix are required to impose positive definiteness.

Although VECH, diagonal VECH, and BEKK being the most common covariance matrix formulations, using a third class of specification model is preferred. Once discharged the idea of a
diagonal variance-covariance matrix, accounting for the correlations matrix requires estimating a huge number of parameters. The assumption that the correlations are null is far away from reality and from what has been found in the last years. Therefore a full correlations matrix is necessary and interesting for the research.

Due to computation easiness is preferred to design the conditional single variance and covariance equations, rather than straightforward modelling the variance-covariance matrix, as generalizations of the Constant Conditional Correlation (CCC) model do.

In this case the variance-covariance matrix is defined as:

\[ H_t = D_t P_t D_t \]

Where \( D_t = \text{diag}(\sqrt{h_{1t}}, \sqrt{h_{2t}}) \) for \( i \neq j \) and \( P_t \) is the matrix of the correlations.

During the analysis two different models of the Conditional Correlation family are considered: Constant Conditional Correlation model proposed by (Bollerslev, 1990) and the Dynamic Conditional Correlation model (DCC) proposed by (Tse & Tsui, 2002). In both models a GARCH representation is used to estimate the diagonal variance matrix \( D_t \). They differ on the specification of the correlation matrix \( P_t \), the DCC model allows for some dynamics, rather than define \( P_t \) as constant symmetric positive definite matrix.

In order the MGARCH in mean estimator to be consistent, a problem of serial correlation of the errors should not arise. Therefore a VAR (1) specification for the main equation is chosen considering the exponential growth of the number of parameters as the numbers of lags increases. Consequently the model used can be formulated as the following statistical specification:

\[ Y_t = CX_t + BY_{t-1} + \Delta H_{t-1} + \varepsilon_t \]

\[ \varepsilon_t = H_t^{-1} z_t \]

\[ z_t \sim N(0, D_t P_t D_t) \]

\[ D_t^2 = d(A_{0,t}) + d(A_{1,t}) \otimes (z_{t-1} z_{t-1}') + d(A_{2,t}) \otimes D_t^2_{t-1} \]

\[ P_t = (1 - \lambda_1 - \lambda_2) S + \lambda_1 \Psi_{t-1} + \lambda_2 P_{t-1} \]
\[
\Psi_{t-1} = \frac{\frac{\varepsilon_{i,t-1} \varepsilon_{j,t-1}}{\sqrt{h_{it}} \sqrt{h_{jt}}}}{\frac{\varepsilon_{i,t-1}^2}{h_{it}} \frac{\varepsilon_{j,t-1}^2}{h_{jt}}}
\]

Or for CCC

\[
P = (\rho_{ij})
\]

\[
\rho_{i,j} = \frac{\frac{\varepsilon_{i,t-1} e_{j,t-1} - 1}{\sqrt{h_{it}} \sqrt{h_{jt}}}}{\frac{\varepsilon_{i,t-1} e_{j,t-1} + 1}{\sqrt{h_{it}} \sqrt{h_{jt}}}}
\]

With \(P_t\) the estimated covariance matrix, and \(S\) the unconditional correlation matrix.

Parameterization of correlations matrix has the same requirements as the variance-covariance matrix, it has to be assured that both the matrices are symmetric and the diagonal of the conditional correlation must be unity. Therefore, the dynamic parameters in the correlation's equations are the same, only the unconditional correlation (constant) varies, and are constrained between zero and one.

For assessing the robustness, some likelihood ratio tests are performed to check if, in order, the lags, ARCH and GARCH parameters, and the dynamic parameters of the correlations equation are jointly significantly. Looking at table (6), it is clear that a VAR (1) with a MGARCH DCC specification of the errors is the best choice possible among those considered.

Two steps estimator

In order to disentangle the relationship among the riskiness measures and the variables in level, it is appropriate to use a two steps estimator of the multivariate GARCH in mean. As proposed by (Grier & Perry, 1998), a VAR model is performed in which the monetary, macroeconomic and financial uncertainty are measured by the respective estimated conditional variances. The conditional variances and covariances are estimated in the first step by a GARCH (1, 1)-DCC-VAR (1).

Despite using estimated variables in a VAR model causes the t-test to be biased, it is possible to detect the relationships by a Granger causality test, which is still robust. Furthermore, the two steps approach has many advantages. Specifically:
• Each conditional variance equation incorporates the lagged values of real money growth, GDP growth and PEG.

• This approach allows to capture the lagged causal effects of the conditional variances on the conditional means, at different levels of lag’s length. Therefore, it is able to capture the effects of variables, typically the uncertainty measures, which have a delayed impact on the others.

• This approach allows to examine causality on a bidirectional basis between various pairings of variables (Cronin, et al., 2011) and hence test for different hypothesis (Fountas & Karanasos, 2007).

• As pointed out by (Fountas, et al., 2006), it minimizes the numbers of parameters to be estimated.

The system of equations estimated in the second step is specified as follows:

\[ Y_{1,t} = \sum_{p=1}^{P} B_{1,p} Y_{1,t-p} + B_2 X_t + u_t \]

The vector of dependent variables \( Y_{1,t} \) is composed by six variables, the conditional mean and variance of investors' confidence, GDP and monetary stock, in order: realM2, realGDP, PEG, hrealM2, hrealGDP and hPEG. On the right hand side, in addition to the lagged value of the dependent variables, there are a matrix of exogenous regressors composed by a constant term, a trend, and the one period lagged estimated conditional covariances from the same GARCH(1,1)-DCC-VAR(1) model used to estimate the variances. As the equations are estimated with different lag structures (1, 2, 4, 8, or 12 lags), the number of the endogenous variables' vectors, on the left hand side of the equations, depends on the lags' lengths. Lags' lengths are consistent with the analysis of the single series, previous literature (Cronin, et al., 2011), (Fountas, et al., 2006) and (Fountas & Karanasos, 2007)), and Friedman's indication that there are long lags with varying effects in the impact of money on the other economic variables.

Accounting for structural break in the series

The period from 1959 to 2011 covers several significant periods of both high and low inflation, as well as of different Fed chairmen with alternative approaches to monetary policy. Mainly, the FED has used the federal funds rate as the primary operating instrument since early 1990s, before the monetary policy was pro-cyclical. In this period, called "Great Moderation", economic volatilities sharply declined their levels and time-variations. It happens because the macroeconomic
volatility is strongly correlated with the change in the monetary policy towards a clearly inflation oriented rule. In addition in the late 1970s and early 1980s the inflation rates reached historically high levels.

A variety of recent studies advocates structural breaks in several macroeconomic time series and (Puhan, 2011) proves the existence of potential breaks in the correlation between the volatilities of inflation and consumption growth, the auto-correlations of the volatilities themselves and the level of inflation.

Since there are evidences of structural breaks in all the three time series considered, it is necessary to check the robustness of the results in different sub-sample periods. Specifically we accounted for the main shifts in the FED’s conduct:

May 1971: The end of Breton Woods’s agreements, after which the main target of the FED shifted from the stability of the exchange rate to the stability of output gap.

July 1980: Depository Institutions Deregulation and Monetary Control Act signs Volcker’s policy for reducing inflation that becomes the first purpose of the FED and starts a periods of financial markets deregulation.


**Table 3: Estimated Conditional Variances and Covariances**

![Table 3: Estimated Conditional Variances and Covariances](image)

A variety of recent studies advocates structural breaks in several macroeconomic time series and (Puhan, 2011) proves the existence of potential breaks in the correlation between the volatilities of inflation and consumption growth, the auto-correlations of the volatilities themselves and the level of inflation.
September 2008: Default of Lehman Brothers Investment Bank. It signed the starting point of the recent financial turmoil with high financial markets variability and extraordinary monetary policy conduct.

One solution is to allow for time dummy-variables to enter the conditional variance equations. In order to assure the positiveness of the conditional variance equation’s parameters, these dummies enter in a multiplicative way. In addition, they are design such that they take value one in the period before the shock, and zero after. It is possible to interpret the dummy’s coefficient as the causal effect of the end of some established policy, as for instance the fixed exchange rate regime.

Table 4: Effects of changing in the monetary policy and financial market regulation

<table>
<thead>
<tr>
<th></th>
<th>Multivariate GARCH CCC with structural breaks</th>
<th>PEG</th>
<th>realM2</th>
<th>realGDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>var</td>
<td>mean</td>
<td>var</td>
</tr>
<tr>
<td>BW</td>
<td>0.133*</td>
<td>2.376***</td>
<td>0.126</td>
<td>-0.0480</td>
</tr>
<tr>
<td></td>
<td>(0.0730)</td>
<td>(0.544)</td>
<td>(0.186)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>SMP</td>
<td>-0.0693***</td>
<td>-0.291</td>
<td>0.425***</td>
<td>-0.0543</td>
</tr>
<tr>
<td></td>
<td>(0.0241)</td>
<td>(0.586)</td>
<td>(0.129)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>GM</td>
<td>-0.0850**</td>
<td>-0.437</td>
<td>0.0609</td>
<td>0.00244</td>
</tr>
<tr>
<td></td>
<td>(0.0394)</td>
<td>(0.441)</td>
<td>(0.146)</td>
<td>(0.0722)</td>
</tr>
<tr>
<td>FC</td>
<td>0.0691</td>
<td>-1.137</td>
<td>-0.0238</td>
<td>0.0762</td>
</tr>
<tr>
<td></td>
<td>(0.0555)</td>
<td>(0.789)</td>
<td>(0.155)</td>
<td>(0.212)</td>
</tr>
<tr>
<td>N</td>
<td>634</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < 0.1, ** p < 0.05, *** p < 0.01

FC = Current Financial Crisis Dummy(Sept’08) SMP = Shift in Monetary Policy Dummy(Aug’80)

In agreement with what shown in Table(3), the results in Table(4) underline the relevance of events as the end of Breton Wood and the Volcker’ shift in monetary policy of early ’80. Moving to a flexible exchange rate system, strongly decreased the unconditional variances of both GDP growth and investors’ confidence. The Volcker shift in the FED policy significantly reduced the variance of the GDP.

Rather than focusing on the causal effect of these policy, it is interesting to highlight their significance and, as consequence, the risk of spurious regression problem, once it is not controlled for them in the models.
In addition, all models belonging to the GARCH family are very sensitive to outlier values. Looking at Table (6), during the crisis period both the investors' confidence and its variance shows peaks not in line with the other periods values. As a consequence, the sample is reduce to the pre-crisis period (before Sept. 2008).

Empirical results and further investigations

First step: variances' estimation

A Multivariate GARCH is used to investigate the interrelations among the macroeconomic and monetary uncertainty, as well as, highlight how the financial stability affects both those measures. Estimating the conditional variances and covariances, the very statistical properties of the series, that show a conditional heteroskedasticity problem, are exploited to obtain the desired measures of uncertainty.

From a preliminary analysis of the results, Table (7) shows that both macroeconomic and monetary uncertainty are positively correlated. This contrasts with the main models that account for uncertainty, but it is in line with previous empirical results. They support Friedman’s theory that in period of high economic uncertainty individuals tend to raise real money holding, generating an increase in the demand of money. As it is feasible to assume that monetary uncertainty has its origins in money growth, an increase in the economic growth uncertainty leads to an adding up in the monetary uncertainty.

The results in Table (7) confirm the recent idea that prolonged monetary stability leads to a larger financial instability, through a negative correlation with the investors' confidence variability. However, the Great Moderation cannot be clearly included among the causes of the recent financial crisis, because the correlations between real GDP and investors’ confidence is positive. This contrast partially with the findings of (Puhan, 2011), that indicate inflation and consumption uncertainty (the main determinant of macroeconomics uncertainty) to be negatively correlated with assets valuation and its volatility.

As reported in Table (8), the ARCH and GARCH terms in general are significant for all the variables in the model. In addition they sum up to one, or minus one, suggesting that second order shocks are strongly persistent.

\[^{61}\text{see (Friedman, 1983) and (Friedman, 1984)}\]
As reported in the Table (9) and due to the problems of spurious regression and outliers values, once controlled for the necessary time dummies and reduced the sub-sample to the pre-crisis period, the results remain robust only for the relationships among either monetary volatility, or PEG volatility, and economic growth stability. Instead the correlation of PEG with respect to monetary growth becomes not significantly different from zero.

Although unexpected, the latter result supports several recent theories about the effects of a permanent changes in the monetary policy over the macroeconomic growth and financial stability.

As highlighted in (Papademos, 2003), economic cycles are caused by various factors. Monetary policy influences economic cycles by direct effects on aggregate demand and supply in both product and financial markets, as well as, by affecting expectations and institutions.

Once it has taken out the effect that permanent changes in monetary policy have on the expectations and hence on the investors’ confidence stability, the correlations among volatilities reflect the short run relationships among the volatilities. The negative correlation between investors’ confidence and real money is downward biased by the long run relationships between the permanent shocks in monetary policy and the investors’ confidence volatility. Whatever is the effect on money stock’s volatility of a permanent change in the monetary policy, it adds to the investors’ confidence’s variability. The modified expectations are negative shocks for the economy, as well as, positive second order shocks over the assets market, affecting both investor confidence and its stability.

Accounting for the main institutional shocks and for the effects of monetary policy changes on institutions and expectations, low volatility for the real money growth does not generate volatile assets markets.

Second step: multivariate GARCH in mean estimation

A Multivariate GARCH-in-mean model is estimated by a two steps estimator, as proposed by (Grier & Perry, 1998). In this case the conditional variances estimated in the first step by a Multivariate GARCH, enter the model as dependent variables.

The analysis relays on the Granger causality tests. A variable Granger-causes another if the first time series is useful to forecast the other. The test is an F-test over the jointly explanatory power of the lagged values of one variable in the equation of another variable. Despite the correlation
test, as the t-test, are the mostly used, the Granger causality test is preferred because provides indications on the direction of the causality and is consistent to the use of estimated variables.

Six variables (realM2, realGDP, PEG, hrealM2, hrealGDP and hPEG), along with a constant term, a trend, and the one period lagged estimated conditional covariances from the same GARCH (1, 1)-DCC-VAR (1) used to estimate the variances, are included in the equations on which the exclusion tests are undertaken. The equations are estimated with different lag structures (1, 2, 4, 8, or 12 lags). The lags' length is chosen looking at BIC and AIC index, as well as, according to previous literature.

The Chi-squared statistics of Table (10) point out that real GDP immediately increases after a jump in investors' confidence. However, the increase in real GDP after a positive shocks in money growth arises with a delay of one years, underlining the late response of real economy to monetary policy impulses. Furthermore, the policy response (an increase in M2) to a negative shock in the real economy has at least 4 lags of delay. The same delay is notable for the policy response (decrease of M2) to a jump in investors' confidence.

Both monetary and output volatilities Granger-cause money growth and output. The positive sign for money growth (with 12 lags of delay) and the negative one for output are in line with the findings of (Serletis & Rahman, 2009) and support the theory of (Choi & Oh, 2003) that high money or output volatility affects money demand, consumption and output through the wealth channel, but the final effects are ambiguous. The prevailing effect after a second order shock in money growth is the substitution one. However after a second order shock in output the precautionary effect prevails because it leads to an increase in assets volatility. Indeed, in an environment with high assets volatility, the substitution between risky assets and money overrules the one between money and consumption.

The results contrast what found by (Mascaro & Meltzer, 1983) and (Puhan, 2011) because both monetary and output uncertainty do not Granger-cause investors’ confidence and assets price. Instead high values for PEG are able to explain both output and assets price uncertainty. In addition, high output growth and money growth, despite generating high monetary uncertainty, are respectively able to lower both output and financial variability or only output uncertainty. The latter finding overturn the results of (Bekaert, et al., 2010) and (Jovanovic, 2011) that monetary policy affects assets price and its volatility by the direct effect on risk aversion.

62 see (Rigobon & Sack, 2003) for further consideration on the implicit role of assets price in monetary policy decisions.
The positive correlation between money growth and GDP is supported and justified by the positive effect of an increase in output volatility on real money uncertainty. Despite the preliminary analysis pointed out the correlation between PEG and GDP to be positive, the variability of GDP positively Granger causes the variability of PEG, but the latter negatively Granger-causes the output uncertainty. Following (Bekaert, et al., 2009), the positive correlations between dividend volatility and assets market volatility justifies the positive sign of the coefficients of the lagged output volatility in the PEG volatility equation. Instead the negative correlations between financial markets uncertainty and consumption, and the positive one of the latter with its volatility can explain the negative sign of lagged PEG uncertainty in GDP uncertainty equation.

These results, jointly with the first step analysis of the correlations matrix, strongly contradict the theory that the FED’s behaviour during the Great Moderation period has been among the main causes of the recent financial turmoil. After the initial high financial volatility due to the change in the monetary policy conduct, low macroeconomic uncertainty leads to low assets markets volatility, which is not affected by the low monetary growth volatility. Therefore the optimal response to a second order shock on the asset markets is to stabilize as much as possible output and monetary growth volatility, as it has been carried out by FED in the last years.

Conclusions

This paper investigates how assets valuation affects the relationship among monetary policy and macroeconomic growth. The focus has been on highlighting the role of uncertainty. The heteroskedasticity of the employed time series suggests to estimate the uncertainty measures endogenously, by a multivariate GARCH-in-mean.

It was found an empirical framework encompassing two opposite strands of literature. Despite, with a largely used specification, the results underline the trade-off between monetary and financial market stability, further investigations highlight that the previous findings rely on spurious regressions and could be misleading. Indeed the former results show how monetary and macroeconomic growth stability, high correlated among themselves, could eventually lead to high financial instability, as happened during the "Great Moderation": indeed lowering output volatility reduces both monetary and financial volatility, but the lower monetary volatility could increase the financial volatility more than the initial drop.
Accounting for structural breaks in the series, the estimates support the strand of literature in favor a more financial stability oriented monetary policy. Indeed, correcting for the main structural breaks in the monetary growth and investors' confidence conditional variance time series, the results contrast what has been said by the main literature over the topic. Joint stability on money and macro-economy, leads to stability in the financial market because the money volatility does not affect the assets price uncertainty. Therefore, the idea that the Great Moderation is the main cause of the recent financial turmoil has not been longer supported.

Through a two steps estimator of a GARCH-in-mean over the relations between the conditional mean and the conditional variance has been disentangle in a deeper way. They main findings can be summarize:

Even if the FED has not explicitly declared to target assets price in the operational interest rule, the PEG is able to explain most of monetary decisions.

Opposite to what believed, monetary policy is not able to affect directly both investors' confidence and its volatility.

Stabilizing output does not lead to high financial variability, but reduces it. Therefore the stabilization of output is not among the causes of the recent financial crisis.

High investors' confidence is able to explain high GDP uncertainty. Therefore controlling for the assets price to be close to its fundamentals is beneficial for the economy.

In conclusion, what come out from the investigation is that, even if monetary policy cannot directly control assets market and its stability, they have to be accounted among the target of the monetary policy due to their strong correlation with GDP and its volatility. For sure, it is necessary to follow the example of the Sveriges Riksbank, which control for the house price and credit amount to be in line with the fundamentals.
References


Tables and Figures

### Table 6: Test for mispecification of the functional form

<table>
<thead>
<tr>
<th></th>
<th>CCC (1) simple</th>
<th>VCC (2) simple</th>
<th>(3) no-arch</th>
<th>(4) VAR(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>corr(PEG,realM2)</td>
<td>0.241***</td>
<td>1.625</td>
<td>0.487***</td>
<td>-0.0867**</td>
</tr>
<tr>
<td></td>
<td>(0.0380)</td>
<td>(2.007)</td>
<td>(0.101)</td>
<td>(0.0440)</td>
</tr>
<tr>
<td>corr(PEG,realGDP)</td>
<td>-0.495***</td>
<td>-3.477</td>
<td>-0.843***</td>
<td>0.120***</td>
</tr>
<tr>
<td></td>
<td>(0.0335)</td>
<td>(4.281)</td>
<td>(0.141)</td>
<td>(0.0444)</td>
</tr>
<tr>
<td>corr(realM2,realGDP)</td>
<td>-0.487***</td>
<td>-5.361</td>
<td>-0.797***</td>
<td>0.310***</td>
</tr>
<tr>
<td></td>
<td>(0.0311)</td>
<td>(7.135)</td>
<td>(0.152)</td>
<td>(0.0413)</td>
</tr>
<tr>
<td>Constant variance</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ARCH effect</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>GARCH effect</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Corr.Dynamics</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>VAR(1)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>LR test statistic</td>
<td>42.44</td>
<td>1476.1</td>
<td>7323.7</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>6.07e-10</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Standard errors in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

### Table 9: Multivariate GARCH-VAR(1) with structural breaks

<table>
<thead>
<tr>
<th></th>
<th>Simple (1)</th>
<th>Structural Breaks (2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BW-SMP</td>
<td>BW-SMP-FC</td>
<td>FC</td>
<td>subsample</td>
</tr>
<tr>
<td>VAR(1)</td>
<td></td>
<td>BW-SMP</td>
<td>BW-SMP-FC</td>
<td>FC</td>
<td>subsample</td>
</tr>
</tbody>
</table>
| Conditional Mean Equations
<p>| y_{i,t} = \beta_0 + \beta_1 y_{1,t-1} + \beta_2 y_{2,t-1} + \beta_3 y_{3,t-1} + \beta_4 y_{4,t} + \sum_{p=1}^{3} \delta_{p,i} d_{p,i} + e_{i,t} |
| PEG L.realGDP      | 0.0193     | 0.0122                 | 0.0267 | 0.0223 | 0.0224 |
|                    | (0.0300)   | (0.0308)               | (0.0317) | (0.0314) | (0.0313) |
| L.realM2           | -0.00376   | -0.00565               | -0.00507 | -0.00550 | -0.00586 |
|                    | (0.00735)  | (0.00732)              | (0.00725) | (0.00723) | (0.00733) |
| L.PEG              | 0.991***   | 0.993***               | 0.993*** | 0.993*** | 0.993*** |
|                    | (0.00310)  | (0.00329)              | (0.00328) | (0.00328) | (0.00330) |
| Const.             | -0.00214   | 0.00897                | -0.122   | -0.0761 | -0.0154 |</p>
<table>
<thead>
<tr>
<th></th>
<th>Simple (1)</th>
<th>Structural Breaks (2)</th>
<th>Structural Breaks (3)</th>
<th>Structural Breaks (4)</th>
<th>Structural Breaks (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VAR(1)</td>
<td>BW-SMP</td>
<td>BW-SMP-FC</td>
<td>FC</td>
<td>subsample</td>
</tr>
<tr>
<td>FC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>realM2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.realGDP</td>
<td>-1.482***</td>
<td>-1.478***</td>
<td>-1.500***</td>
<td>-1.475***</td>
<td>-1.171***</td>
</tr>
<tr>
<td></td>
<td>(0.121)</td>
<td>(0.125)</td>
<td>(0.127)</td>
<td>(0.125)</td>
<td>(0.133)</td>
</tr>
<tr>
<td>L.realM2</td>
<td>-0.0874***</td>
<td>-0.0872***</td>
<td>-0.0863***</td>
<td>-0.0850***</td>
<td>-0.0754**</td>
</tr>
<tr>
<td></td>
<td>(0.0302)</td>
<td>(0.0306)</td>
<td>(0.0305)</td>
<td>(0.0307)</td>
<td>(0.0324)</td>
</tr>
<tr>
<td>L.PEG</td>
<td>0.0114</td>
<td>0.00834</td>
<td>0.00785</td>
<td>0.00826</td>
<td>0.00857</td>
</tr>
<tr>
<td></td>
<td>(0.0105)</td>
<td>(0.0112)</td>
<td>(0.0111)</td>
<td>(0.0112)</td>
<td>(0.0108)</td>
</tr>
<tr>
<td>Const.</td>
<td>7.320***</td>
<td>7.347***</td>
<td>7.573***</td>
<td>7.336***</td>
<td>7.280***</td>
</tr>
<tr>
<td></td>
<td>(0.381)</td>
<td>(0.385)</td>
<td>(0.460)</td>
<td>(0.395)</td>
<td>(0.409)</td>
</tr>
<tr>
<td>realGDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.realGDP</td>
<td>0.995***</td>
<td>0.988***</td>
<td>0.986***</td>
<td>0.989***</td>
<td>0.987***</td>
</tr>
<tr>
<td></td>
<td>(0.00496)</td>
<td>(0.00733)</td>
<td>(0.00675)</td>
<td>(0.00814)</td>
<td>(0.00643)</td>
</tr>
<tr>
<td>L.realM2</td>
<td>-0.000422***</td>
<td>-0.000470***</td>
<td>-0.000426***</td>
<td>-0.000466***</td>
<td>-0.000645***</td>
</tr>
<tr>
<td></td>
<td>(0.000154)</td>
<td>(0.000176)</td>
<td>(0.000159)</td>
<td>(0.000182)</td>
<td>(0.000167)</td>
</tr>
<tr>
<td>L.PEG</td>
<td>0.0000934</td>
<td>0.0000860</td>
<td>0.0000575</td>
<td>0.0000901</td>
<td>0.0000878</td>
</tr>
<tr>
<td></td>
<td>(0.0000726)</td>
<td>(0.0000825)</td>
<td>(0.0000830)</td>
<td>(0.0000819)</td>
<td>(0.0000849)</td>
</tr>
<tr>
<td>Trend</td>
<td>0.00000506</td>
<td>0.0000199</td>
<td>0.0000258*</td>
<td>0.0000181</td>
<td>0.0000223*</td>
</tr>
<tr>
<td></td>
<td>(0.00000983)</td>
<td>(0.0000141)</td>
<td>(0.0000139)</td>
<td>(0.0000139)</td>
<td>(0.0000135)</td>
</tr>
<tr>
<td>Const.</td>
<td>0.0134</td>
<td>0.0282*</td>
<td>0.0317***</td>
<td>0.0265</td>
<td>0.0317***</td>
</tr>
<tr>
<td></td>
<td>(0.00981)</td>
<td>(0.0150)</td>
<td>(0.0129)</td>
<td>(0.0166)</td>
<td>(0.0126)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conditional variance equations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$$\sigma^2_{i,t} = \alpha_0 + \alpha_1 \epsilon_{i,t-1} \epsilon_{i,t-1} + \alpha_2 \sigma^2_{i,t-1} + \alpha_3 \sum_{p=1}^{3} \gamma_{p,t} d_{p,t}$$

<table>
<thead>
<tr>
<th></th>
<th>Simple (1)</th>
<th>Structural Breaks (2)</th>
<th>Structural Breaks (3)</th>
<th>Structural Breaks (4)</th>
<th>Structural Breaks (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEG</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.arch</td>
<td>0.163***</td>
<td>0.163***</td>
<td>0.170***</td>
<td>0.173***</td>
<td>0.150***</td>
</tr>
<tr>
<td></td>
<td>(0.0304)</td>
<td>(0.0336)</td>
<td>(0.0337)</td>
<td>(0.0343)</td>
<td>(0.0333)</td>
</tr>
<tr>
<td>L.garch</td>
<td>0.835***</td>
<td>0.807***</td>
<td>0.799***</td>
<td>0.789***</td>
<td>0.811***</td>
</tr>
<tr>
<td></td>
<td>(0.0262)</td>
<td>(0.0341)</td>
<td>(0.0334)</td>
<td>(0.0353)</td>
<td>(0.0357)</td>
</tr>
<tr>
<td>Const.</td>
<td>0.00114**</td>
<td>-4.435***</td>
<td>-4.385***</td>
<td>-2.808***</td>
<td>-6.252***</td>
</tr>
<tr>
<td></td>
<td>(0.000186)</td>
<td>(0.410)</td>
<td>(0.397)</td>
<td>(0.870)</td>
<td>(0.356)</td>
</tr>
<tr>
<td>BW</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SMP</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>FC</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>realM2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.arch</td>
<td>-0.0218**</td>
<td>-0.0226**</td>
<td>-0.0228**</td>
<td>-0.0226**</td>
<td>-0.0173**</td>
</tr>
<tr>
<td></td>
<td>(0.00936)</td>
<td>(0.00993)</td>
<td>(0.0102)</td>
<td>(0.00991)</td>
<td>(0.00773)</td>
</tr>
<tr>
<td>L.garch</td>
<td>-0.977***</td>
<td>-0.977***</td>
<td>-0.977***</td>
<td>-0.977***</td>
<td>-0.983***</td>
</tr>
<tr>
<td></td>
<td>Simple (1)</td>
<td>(2) BW-SMP</td>
<td>(3) BW-SMP-FC</td>
<td>(4) FC</td>
<td>(5) subsample</td>
</tr>
<tr>
<td>----------------</td>
<td>------------</td>
<td>-------------</td>
<td>---------------</td>
<td>-------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td>VAR(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0107)</td>
<td>(0.0107)</td>
<td>(0.0109)</td>
<td>(0.0107)</td>
<td>(0.00836)</td>
</tr>
<tr>
<td>Const.</td>
<td>2.335***</td>
<td>0.845***</td>
<td>0.848***</td>
<td>0.846***</td>
<td>0.958***</td>
</tr>
<tr>
<td></td>
<td>(0.150)</td>
<td>(0.0900)</td>
<td>(0.0899)</td>
<td>(0.0901)</td>
<td>(0.0924)</td>
</tr>
<tr>
<td>BW</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SMP</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>FC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>realGDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L.arch</td>
<td>0.103***</td>
<td>0.237</td>
<td>0.186**</td>
<td>0.229</td>
<td>0.269***</td>
</tr>
<tr>
<td></td>
<td>(0.0279)</td>
<td>(0.149)</td>
<td>(0.0815)</td>
<td>(0.168)</td>
<td>(0.0708)</td>
</tr>
<tr>
<td>L.garch</td>
<td>0.885***</td>
<td>0.505</td>
<td>0.643***</td>
<td>0.528</td>
<td>0.223</td>
</tr>
<tr>
<td></td>
<td>(0.0268)</td>
<td>(0.454)</td>
<td>(0.192)</td>
<td>(0.504)</td>
<td>(0.192)</td>
</tr>
<tr>
<td>Const.</td>
<td>0.0000000279**</td>
<td>-9.815***</td>
<td>-10.26***</td>
<td>-9.876***</td>
<td>-11.91***</td>
</tr>
<tr>
<td></td>
<td>(0.000000130)</td>
<td>(1.197)</td>
<td>(0.790)</td>
<td>(1.408)</td>
<td>(0.379)</td>
</tr>
<tr>
<td>BW</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SMP</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>FC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Conditional Covariance equations

\[ \rho_{i,j,t} = (1 - \lambda_1 - \lambda_2) \rho_{i,j} + \lambda_1 \varphi_{t-1} + \lambda_2 \rho_{i,j,t-1} \]

<table>
<thead>
<tr>
<th></th>
<th>(6) PEG,M2</th>
<th>(7) PEG,GDP</th>
<th>(8) M2,GDP</th>
<th>(9) lambda1</th>
<th>(10) lambda2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.0867***</td>
<td>-0.0877*</td>
<td>-0.0887*</td>
<td>-0.0880*</td>
<td>-0.0773</td>
</tr>
<tr>
<td></td>
<td>(0.0441)</td>
<td>(0.0464)</td>
<td>(0.0467)</td>
<td>(0.0470)</td>
<td>(0.0619)</td>
</tr>
<tr>
<td></td>
<td>0.119***</td>
<td>0.125***</td>
<td>0.122**</td>
<td>0.128***</td>
<td>0.195***</td>
</tr>
<tr>
<td></td>
<td>(0.0445)</td>
<td>(0.0483)</td>
<td>(0.0484)</td>
<td>(0.0494)</td>
<td>(0.0740)</td>
</tr>
<tr>
<td></td>
<td>0.311***</td>
<td>0.320***</td>
<td>0.323***</td>
<td>0.319***</td>
<td>0.287***</td>
</tr>
<tr>
<td></td>
<td>(0.0413)</td>
<td>(0.0445)</td>
<td>(0.0441)</td>
<td>(0.0452)</td>
<td>(0.0645)</td>
</tr>
<tr>
<td>lambda1</td>
<td>0.00751</td>
<td>0.00973</td>
<td>0.0108</td>
<td>0.0106</td>
<td>0.0175*</td>
</tr>
<tr>
<td></td>
<td>(0.0107)</td>
<td>(0.00996)</td>
<td>(0.0103)</td>
<td>(0.0100)</td>
<td>(0.00986)</td>
</tr>
<tr>
<td>lambda2</td>
<td>0.893***</td>
<td>0.912***</td>
<td>0.908***</td>
<td>0.913***</td>
<td>0.943***</td>
</tr>
<tr>
<td></td>
<td>(0.0951)</td>
<td>(0.0685)</td>
<td>(0.0672)</td>
<td>(0.0644)</td>
<td>(0.0377)</td>
</tr>
<tr>
<td>( N )</td>
<td>634</td>
<td>634</td>
<td>634</td>
<td>634</td>
<td>596</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* \( p < 0.10 \), ** \( p < 0.05 \), *** \( p < 0.01 \)

FC—CUrrent Financial Crises Dummy (Sept'08) SPM—Shift in Monetary Policy Dummy (Aug'80)

Table 7: Conditional covariance estimated from a MGARCH

<table>
<thead>
<tr>
<th></th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho_{i,j,t}$</td>
<td>$\rho_{i,j,t}$ = $(1 - \lambda_1 - \lambda_2)\rho_{i,j} + \lambda_1 \varphi_{t-1} + \lambda_2 \rho_{i,j,t-1}$</td>
</tr>
<tr>
<td>PEG-M2</td>
<td>-0.0867**</td>
</tr>
<tr>
<td></td>
<td>(0.0441)</td>
</tr>
<tr>
<td>$\lambda_1$</td>
<td>0.00751</td>
</tr>
<tr>
<td></td>
<td>(0.0107)</td>
</tr>
<tr>
<td>$\lambda_2$</td>
<td>0.893***</td>
</tr>
<tr>
<td></td>
<td>(0.0951)</td>
</tr>
<tr>
<td>Observations</td>
<td>634</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: ARCH and GARCH effects estimated from a MGARCH

<table>
<thead>
<tr>
<th></th>
<th>Variance GARCH equations</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2_{i,t}$</td>
<td>$\sigma^2_{i,t} = \alpha_0,i + \alpha_1,\epsilon_i,t-1\epsilon_{i,t-1} + \alpha_2,\sigma^2_{i,t-1}$</td>
</tr>
<tr>
<td>PEG</td>
<td>0.00114**</td>
</tr>
<tr>
<td></td>
<td>(0.000486)</td>
</tr>
<tr>
<td>M2</td>
<td></td>
</tr>
<tr>
<td>L.arch</td>
<td>0.163***</td>
</tr>
<tr>
<td></td>
<td>(0.0304)</td>
</tr>
<tr>
<td>L.garch</td>
<td>0.835***</td>
</tr>
<tr>
<td></td>
<td>(0.0262)</td>
</tr>
<tr>
<td>Observations</td>
<td>634</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
### Table 10: Granger-casualty test

<table>
<thead>
<tr>
<th>Excl.</th>
<th>Lags</th>
<th>realM2</th>
<th>realGDP</th>
<th>PEG</th>
<th>hrealM2</th>
<th>hrealGDP</th>
<th>hPEG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>57.456**(-)</td>
<td>.79635(+)</td>
<td>302.25**(+)</td>
<td>1.6697(-)</td>
<td>.37893(+)</td>
<td></td>
</tr>
<tr>
<td>realM2</td>
<td>1</td>
<td>64.735***(+)</td>
<td>7.4489**(+)</td>
<td>301.3**(+)</td>
<td>7.6356**(+)</td>
<td>1.6669(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>54.365***(-)</td>
<td>6.4383(+)</td>
<td>209.88***(-)</td>
<td>3.3405(-)</td>
<td>5.3027(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>40.960**(-)</td>
<td>13.331(+)</td>
<td>371.14***(+)</td>
<td>26.204***(+)</td>
<td>5.2015(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>83.514***(+)</td>
<td>16.618(-)</td>
<td>3703.4***(-)</td>
<td>24.602***(-)</td>
<td>12.527(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>.74244(-)</td>
<td>.93147(-)</td>
<td>1.4328(+)</td>
<td>49.2(-)</td>
<td>2.5533(-)</td>
<td></td>
</tr>
<tr>
<td>realGDP</td>
<td>1</td>
<td>2.4854(-)</td>
<td>.46196(-)</td>
<td>.64368(+)</td>
<td>51.546***(-)</td>
<td>3.7013(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>28.520***(-)</td>
<td>.2596(-)</td>
<td>17.019***(+)</td>
<td>55.322***(-)</td>
<td>11.503(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>15.719**(-)</td>
<td>3.6549(-)</td>
<td>24.033***(+)</td>
<td>117.45***(-)</td>
<td>23.803(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>426.92***(-)</td>
<td>17.71(-)</td>
<td>71.57***(+)</td>
<td>181.1***(-)</td>
<td>27.399***(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>.2351(+)</td>
<td>14.46***(+)</td>
<td>.00004(-)</td>
<td>9.3775***(+)</td>
<td>1.7207(+)</td>
<td></td>
</tr>
<tr>
<td>PEG</td>
<td>1</td>
<td>2.3656(+)</td>
<td>13.126***(+)</td>
<td>.05525(-)</td>
<td>6.28**(+)</td>
<td>57.394***(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>14.55* (+)</td>
<td>22.14*** (+)</td>
<td>10.034(-)</td>
<td>28.561***(+)</td>
<td>95.222***(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>190.72*** (+)</td>
<td>26.008***(+)</td>
<td>21.95**(-)</td>
<td>39.992***(+)</td>
<td>112.57***(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>93.352*** (+)</td>
<td>17.182***(-)</td>
<td>.00511(-)</td>
<td>2.4379(+)</td>
<td>.19811(+)</td>
<td></td>
</tr>
<tr>
<td>hrealM2</td>
<td>1</td>
<td>296.17***(+)</td>
<td>24.007***(-)</td>
<td>.6742(+)</td>
<td>7.4456***(+)</td>
<td>.85861(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>305.9***(-)</td>
<td>25.917***(-)</td>
<td>.0403(+)</td>
<td>3.3621(-)</td>
<td>1.6351(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>202.31***(+)</td>
<td>24.908***(-)</td>
<td>9.3084(+)</td>
<td>7.1891(-)</td>
<td>1.3268(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>161.86***(-)</td>
<td>26.963***(-)</td>
<td>11.951(-)</td>
<td>19.173(-)</td>
<td>3.4463(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>8.6891***(-)</td>
<td>26.207***(-)</td>
<td>.00568(-)</td>
<td>.05939(+)</td>
<td>.1412(-)</td>
<td></td>
</tr>
<tr>
<td>hrealGDP</td>
<td>1</td>
<td>28.994***(-)</td>
<td>29.77***(-)</td>
<td>.369665(-)</td>
<td>.93369(-)</td>
<td>.13928(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>44.012***(-)</td>
<td>142.98***(-)</td>
<td>6.7674(+)</td>
<td>20.603***(+)</td>
<td>14.768***(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>45.626***(-)</td>
<td>126.74***(-)</td>
<td>12.09(+)</td>
<td>46.618***(+)</td>
<td>24.879***(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>36.218***(+)</td>
<td>111.9***(-)</td>
<td>23.363***(-)</td>
<td>53.802***(-)</td>
<td>20.140***(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>.5402(-)</td>
<td>2.922**(-)</td>
<td>2.9816(+)</td>
<td>.62594(+)</td>
<td>5.104**(-)</td>
<td></td>
</tr>
<tr>
<td>hPEG</td>
<td>1</td>
<td>2.3559(-)</td>
<td>3.9745(-)</td>
<td>4.9119*(+)</td>
<td>2.0469(+)</td>
<td>1.1081(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>5.2537(-)</td>
<td>7.0029(-)</td>
<td>7.3382(+)</td>
<td>2.7377(+)</td>
<td>11.154**(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>14.977(+)</td>
<td>14.977(+)</td>
<td>16.915(-)</td>
<td>9.8445(+)</td>
<td>33.224***(-)</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
- Numerical entries are chi²-statistics. The 2nd column gives the # of lags in the causality tests.
- A + (-) indicates that the sum of the causing variable is positive (negative).
- * p < 0.1, ** p < 0.5, *** p < 0.01
Agency and Transparency in Financial Markets

Sadettin Haluk ÇITÇİf; Gebze Institute of Technology

Abstract

We analyze incentive effects of transparency on delegated portfolio management. When portfolio return is observable, disclosure of portfolio composition decreases expected return and lowers the investor’s ability to identify the manager’s actual type. More information about the portfolio return before renewal of management agreement also decreases expected return, while, conditionally, it may provide more information about manager’s actual ability.

Keywords: transparency; career concern; delegated portfolio management

JEL Codes: D82; G32; J33; L21; M12

Introduction

Investors widely invest their money in financial markets through delegating management of it to financial institutions. For example, in the US, institutional investors held more than half of the total corporate equities at the end of 2009. Similarly, in the UK, institutional investors own more than 70% of the stock market in 2010. Thus, investment of more than half of the equities in financial markets is controlled by money managers and can be subject to agency problems.

One of the themes that may create an agency problem in financial markets is the transparency of financial institutions. Although transparency of financial institutions is widely discussed by both policymakers and academics, less attention is given to potential influences of transparency on the agency relation between the investors and the fund managers.

In this paper, we focus on this interaction in financial markets. We analyze incentive effects of transparency over a career-concerned manager’s portfolio choice and portfolio return. We argue that more observation on composition of a career-concerned manager’s portfolio choice or on the portfolio return may lead him to choose riskier and "nosier" portfolios in order to prevent information revelation from these observations about his managerial ability. Specifically, we show

---

63 Tel: 90-262-605-1431; fax: 90-262-654-3224. Address: Gebze Institute of Technology - Science of Strategy Department, P.K:141, 41400 Gebze - Kocaeli, Turkey. E-mail address: hcitci@gyte.edu.tr
that when the portfolio return is observed, increasing transparency over composition of manager's portfolio choice certainly lowers the investor's welfare. It decreases expected return and lowers the investor's ability to screen the manager's actual ability. Similarly, more information about the portfolio return definitely lowers expected return, while it conditionally may or may not improve the investor's ability to identify the manager's actual type.

There are a handful of papers mentioning potential adverse incentive effects of transparency (see e.g. Cremer, 1995: 275-95; Maskin and Tirole, 2004: 1034-1054; Prat, 2005: 862-877; Fox and Weelden, 2011: 142-150). Among others, the closest papers to ours belong to Prat (2005: 862-877) and Fox and Weelden (2011: 142-150). Prat (2005: 862-877) argues that under some conditions, learning actions of a career-concerned expert may lead him to ignore valuable signals, whereas learning the consequence of the expert's actions has never such an effect. Fox and Weelden (2011: 142-150) further show that the latter result is sensitive to cost structure: when priors about the state of world is sufficiently strong, observing the consequence of a career-concerned expert's actions may also lead him to disregard useful private signal, so decreases principal's welfare. Differently from these papers, we point out another channel in which more transparency over portfolio choice (the action) and the portfolio return (the consequence) leads adverse incentive effects: in our setting, increasing transparency leads the manager to choose portfolios that reduce informativeness of signals about his type, rather than the ones maximizing investor welfare. Moreover, to our knowledge, this is the first paper that studies incentive effects of each type of the transparency regime on both alignment of principal and agent interests and information revelation about manager's actual ability.

Our paper is also related to Hermalin (1993: 127-135). He analyzes effects of managers' career concerns on their risk taking behavior. He points out that career concerns of managers may lead them to construct high risky portfolios and contractual schemes do not always correct the problem. Our paper shares the idea with Hermalin (1993: 127-135) that risky investments may provide less information about an agent's type than that of safer investments. However, our paper differs both in its setup and more importantly the questions it address. We analyze instead the optimal transparency regime under career concerns.

**Model**

To make our point, a simple model as the following will be sufficient. We consider an economy with two dates, $t \in \{1, 2\}$. A risk-neutral investor (principal) chooses a manager (agent) from a competitive managerial labor market to delegate fund management in each period. Managers
differ in their managerial ability. Both the investor and the manager initially do not know the actual ability of the manager. However, it is common knowledge that unknown managerial ability $\theta$ is normally distributed with mean $\bar{\theta}$ and variance $\text{var}(\theta)$. Thus, all parties’ prior assessment about managerial ability is $\bar{\theta}$.

In each period, the employed manager chooses a risky portfolio (or asset) from a continuum of portfolios and his expertise lies in generating "alpha" for the investment. In other words, managers with higher abilities generate higher risk-adjusted expected return. The return function is given by,

$$\pi_t = \theta_t + s_t$$

where $\theta_t$ denotes managerial ability in generating higher risk-adjusted expected return and $s_t$ denotes stochastic component of a portfolio, which is normally distributed with mean $\mu_{s,t}$ and variance $\text{var}(s_t)$. Each portfolio in the feasible set is identified by its stochastic component $s_t$ and differs in its expected value and the degree of risk. Similar to Palomino and Prat (2003), we define the set of feasible portfolios, $P$ as the following:

$$P = \{ \mu_{s,t}, \text{var}(s_t) \mid \text{var}(s_t) \in R^+, -\infty < \mu_{s,t} \leq f(\text{var}(s_t)) \}$$

where the function $f(.)$ is twice differentiable, strictly concave, and has a maximum at $\mu^*_s = f(\text{var}(s^*))$. The function $f(\text{var}(s_t))$ constitutes the boundary of the set and can be considered as efficient frontier.

In the feasible set $P$, portfolios with higher variances than $\text{var}(s^*)$ are second-order stochastically dominated and have lower expected values than $\mu^*_s$. Hence, neither a risk-averse nor a risk-neutral individual in principle should choose such kind of portfolios. However, as we show in the analysis section, increasing transparency indeed induces career-concerned managers to choose this kind of portfolios.

Managers are risk neutral and their per-period utility, $u_t$, is increasing function of managerial compensation, $w_t$. As our aim is to point out incentive effects of different transparency regimes under career concerns, contractual schemes do not affect our results in any important way. So, we

---


65 One caveat is that our results do not critically depend on the specified properties of the feasible portfolio set. This structure enables us to highlight the scope of the moral hazard problem. However, in another setting where the investor and the manager have finite risk tolerance and portfolios have the same expected return, differing only in their variance, qualitative results of the paper remain same.
assume for the analytical convenience that the manager is compensated with fixed management fee and there is no lending or borrowing.

The sequence of events is as follows. At the beginning of the first period, the investor chooses a fund manager at random. The employed manager invests in a portfolio. Then, the first-period return is realized, the manager is paid and at the end of the first period, the investor either rehires the manager for the second period, or picks a new one from the managerial labor market. In the second period, the rehired or the newly employed manager chooses a portfolio. The second-period return is realized, the manager is paid and the firm is dissolved.

We identify equilibrium outcomes in delegated portfolio management under following two information structures: (i) the investor observes both the manager's choice of portfolio and the return on it. We refer this case as Full Transparency. This information structure also constitutes the benchmark for our analysis. (ii) only the portfolio choice or the portfolio return is transparent, but not both. We label this case as Partial Transparency. We also distinguish two types of Partial Transparency. First, the investor observes the return, but does not observe the choice of portfolio. Second, the investor observes the portfolio choice, whereas he does not observe the return before renewal of the contract (i.e. before the second period). The second information structure represents, for example, a principal-agent relationship between an investor and a pension fund, which invested in long-term assets, and the investor cannot commit not to renegotiate the contract before the realization of return.

Analysis

We proceed backwards, starting with the analysis of the second period. As the firm dissolves at the end of this period, the manager, either the rehired or the new one, has no career concern. Then, the assumption of fixed management fee ensures that the manager is indifferent between choosing any portfolio, including the optimal one.66

This result is independent of whether the principal observes only the portfolio choice, the portfolio return, or both. This is because as the perception on the manager's ability in the second period has no effect on his current compensation and the manager has no career concern in this period, the information provided by realized return, portfolio choice has no direct/indirect effect on manager's utility.

66 For clarity, we assume that when the manager is indifferent between any portfolio choices, he chooses the optimal one with the highest expected value, $\mu^*_i$. 
Since the managerial incentives and so, the portfolio choice in this period is same for all managers, what matters for maximizing the second-period return is the managerial talent. This leads the managerial turnover decision to be solely based on the comparison of expected managerial abilities. Any manager chosen in the labor market will have an expected ability $\bar{\theta}$. Hence, the principal hires a new manager for the second period if and only if the expected ability of the already employed manager is less than $\bar{\theta}$.

We now turn to analysis of the first-period equilibrium. In this period, the manager takes into account that his portfolio choice can affect the investor's assessment of his ability. Now, transparency over portfolio choice and portfolio return interdependently plays a critical role in the emergence of moral hazard problem. To shed light on this interdependency, we analyze transparency under two cases.

Full Transparency

As a benchmark, we start with the analysis of Full Transparency and then compare the equilibrium outcome with the ones obtained in the Partial Transparency. For the analysis of Full Transparency, assume for now that the investor observes not only the portfolio return, but also the portfolio choice, before making managerial turnover decision. However, we still assume that both the investor and the manager initially do not know the actual ability of the manager. Upon observing the first-period portfolio choice and return, the investor's expectation about managerial ability $\hat{\theta}$ will be function of both the prior estimate of managerial ability and the observed outcome. Specifically, the posterior belief is represented by the following equation:

$$\hat{\theta} = \frac{1}{\text{var}(\theta)} \bar{\theta} + \frac{1}{\text{var}(s_1)} (\pi_1 - \mu_{s,1})$$

$$= \frac{\text{var}(s_1) \bar{\theta} + \text{var}(\theta)(\pi_1 - \mu_{s,1})}{\text{var}(\theta) + \text{var}(s_1)}$$

(1)

Simple calculations show that the expected value of the posterior belief, $E[\hat{\theta}]$, is equal to the prior assessment about managerial ability, $\bar{\theta}$. Moreover, the variance of the posterior belief, $\hat{\theta}$, is equal to
\[ \text{var}(\hat{\theta}) = \frac{(\text{var}(\theta))^2 (\text{var}(\theta) + \text{var}(s_1))}{(\text{var}(\theta) + \text{var}(s_1))^2} \]

Equation (2) shows that the variance of the posterior belief, \( \text{var}(\hat{\theta}) \), is inversely related to portfolio variance, \( \text{var}(s_1) \). As the portfolio is riskier and has greater variance, the variance of the posterior belief will be smaller. The reason behind this result is the following: the posterior belief is weighted average of the prior belief and the observed outcome. The prior belief is deterministic, whereas the observed outcome, \( \pi_1 \), is stochastic. Therefore, as the known variance of the portfolio increases, the weight put on the stochastic observation decreases, so does the variance of the posterior belief.

The career-concerned manager who tries to reduce his lay-off risk uses this effect strategically. The firm’s optimal firing rule gives manager an incentive to minimize his likelihood of being below average. Although the choice of portfolio does not affect the mean of the expected managerial ability, it does the variance of the expectation. Thus, in order to minimize the likelihood of his assessed ability to be below average, the manager tries to minimize the variance of the posterior belief about his ability. This leads manager to strategically choose the riskiest portfolio available and to make the signal of observed outcome uninformative as much as possible. However, this portfolio has lower expected return than that of optimal one characterized with \( \mu^*_c \) and it is also second-order stochastically dominated. Hence, when both the portfolio choice and the return are transparent, the equilibrium outcome is suboptimal from the perspective of the investor. Following result summarizes these findings.

Proposition 1 When both the composition of portfolio choice and the portfolio return are transparent, a career-concerned manager chooses the riskiest portfolio available. The chosen portfolio has lower expected return than \( \mu^*_c \) and it is second-order stochastically dominated.

Partial Transparency

Now, to assess the impact of reducing transparency on the investor’s welfare, we proceed by characterizing equilibrium outcomes under Partial Transparency. We consider two possibilities under this information structure. First, we analyze the case in which the investor still observes the

\[ \text{This result is also provided by Hermalin (1993: 127-135).} \]
portfolio return as he does under Full Transparency, but now he does not observe the portfolio choice of the manager.\textsuperscript{68}

Under non-transparent portfolio choice, since the investor cannot observe the portfolio choice, the weights put on the prior belief and on the observed outcome are constant and they do not depend on manager's unobserved choice of portfolio. Rather, the weights are determined by the investor's belief on which portfolio the manager would choose. Let $\tilde{s}_1$ denote the portfolio that the investor inferred to be chosen by manager and $\mu_{\tilde{s},1}$, $\text{var}(\tilde{s}_1)$ denote corresponding mean and variance. Now, the equation for the posterior belief can be written as

$$\hat{\theta} = \frac{\text{var}(\tilde{s}_1)\bar{\theta} + \text{var}(\theta)(\pi_1 - \mu_{\tilde{s},1})}{\text{var}(\theta) + \text{var}(\tilde{s}_1)}$$

Moreover, mean and variance of the posterior belief are given by,

$$E[\hat{\theta}] = \bar{\theta} + \frac{\text{var}(\theta)(\mu_{\tilde{s},1} - \mu_{\tilde{s},1})}{\text{var}(\theta) + \text{var}(\tilde{s}_1)}$$

$$\text{var}(\hat{\theta}) = \frac{\text{var}(\theta)^2(\text{var}(\theta) + \text{var}(s_1))}{(\text{var}(\theta) + \text{var}(\tilde{s}_1))^2}$$

There are two important implications of these new mean and variance equations. First, (4) indicates that the expected value of managerial ability now depends on the difference between the actual mean of the chosen portfolio, $\mu_{\tilde{s},1}$, and the mean of the portfolio that the investor believed to be chosen, $\mu_{\tilde{s},1}$. Therefore, the expected managerial ability can be greater or less than $\bar{\theta}$, depending on the inferred and actual mean of the portfolio choice. Second, since the weights are fixed, an increase in the variance of unobserved portfolio choice does not decrease the variance of the posterior belief. Rather, conversely to the case in Full Transparency, the variance of the posterior belief increases with an increase in the variance of unobserved portfolio choice, $\text{var}(s_1)$.

To determine Bayesian equilibrium, we consider three polar alternatives: the portfolios with the highest and the smallest variances and the optimal portfolio with the highest expected return, $\mu^*_s$. Consider first that the principal's belief is that the manager would choose the portfolio with the highest variance. If it is the case, the manager can deviate with an off the equilibrium portfolio choice: he can increase expectation on his ability by choosing any other portfolio with higher

\textsuperscript{68} One can consider that the presented portfolios combine many assets, at least more than two assets, so the investor cannot deduce the manager’s choice of portfolio by observing portfolio return.
expected return (i.e., the optimal portfolio) instead of choosing the one with the highest variance. This implies that the investor's belief is inconsistent with the manager's strategy. Thus, this case does not constitute Bayesian equilibrium. Next, consider that the investor's belief is that the manager would choose the portfolio with the smallest variance. Again, the manager can increase the posterior belief by choosing, for example, the optimal portfolio. Thus, this belief of investor is also inconsistent with the manager's strategy. Actually, equations (4) and (5) indicate that any belief that the manager would choose a portfolio other than the optimal portfolio with maximum expected return is inconsistent with the manager's strategy because the manager has incentive to deviate by choosing the portfolio with maximum expected return. However, if the investor's inference is that manager's portfolio choice would be the optimal portfolio, this constitutes a consistent belief. Since the optimal portfolio yields the highest expected return, $\mu^e$, the manager can do no better by deviating with another portfolio choice with smaller expected return. Hence, in Bayesian equilibrium, the manager's unique strategy is to choose the optimal portfolio. The following lemma summarizes this discussion.

**Lemma 1** Suppose that the portfolio return is transparent, whereas the manager's portfolio choice is not. In equilibrium, the career-concerned manager chooses the optimal portfolio, maximizing investor welfare.

Lemma 1 indicates that reducing transparency with concealed portfolio choice improves the current expected return. Still, one can consider that although non-disclosure of portfolio choice may solve moral hazard problem, benefits of disclosing composition of the portfolio may outweigh through information revelation about manager's ability. It may be expected that since the principal has more observation on manager under Full Transparency, it may be easier to screen the manager's actual ability. However, comparing variances of posterior beliefs under these two cases indicates that the equilibrium outcome under concealed portfolio choice is also better for information revelation about the manager's actual ability. Since the equilibrium portfolio choice under concealed portfolio choice has smaller variance than the one under Full Transparency, the observed portfolio return under concealed portfolio choice provides more information about the manager's type. Therefore, comparing equilibrium outcomes under Full Transparency and concealed portfolio choice shows that non-disclosure of portfolio choice is not only better for maximizing current expected return, but also for identifying the manager's actual type.

**Proposition 2** When the portfolio return is observable, disclosing manager's portfolio choice both decreases expected portfolio return and lowers the investor's ability to evaluate the manager's
actual type. Compared to the equilibrium outcome under Full Transparency, the investor is strictly better off under concealed portfolio choice.

The other form of Partial Transparency is that the principal observes manager’s portfolio choice, the action, while he does not observe the return before renewal of the contract (i.e., before the second period). This information structure models environments where investors cannot commit not to renegotiate the contract before the realization of return (i.e., a principal-agent relationship between an investor and a pension fund), or where it is difficult for investors to completely evaluate the return. Since this case involves pre-return performance evaluation, the posterior belief on managerial ability is equal to the prior belief on it. The manager cannot effect the posterior belief by his portfolio choice. Therefore, the manager is indifferent between any portfolio choices.

Lemma 2 Suppose that the manager's portfolio choice is observable, whereas the return is not. In equilibrium, the career-concerned manager is indifferent between any portfolio choices.

Lemma 2 implies that keeping the return concealed mitigates the agency problem. However, the concealed return prevents any information revelation about manager’s ability. Thus, the equilibrium under Full Transparency is superior to the equilibrium under the concealed return for information revelation about manager’s ability, if there is no available portfolio with infinite variance. However, if there is at least one portfolio with infinite variance, Full Transparency regime is no better than the concealed return case even for identifying the manager's actual ability. This is because if a portfolio with infinite variance is available under Full Transparency, this portfolio choice makes the observed return totally uninformative. Overall comparison of these two information scenarios leads following result:

Proposition 3 Disclosing portfolio return decreases expected return unconditionally, while it increases the investor's ability to screen the manager's actual type if portfolio variances are finite. Otherwise, the investor is certainly better off under the case of concealed return.

**Discussion and Conclusion**

After the Financial Crisis of 2008, many regulatory frameworks have been amended to increase transparency in financial markets. In 2009, the European Union proposed Alternative Investment Fund Manager Directive which aimed, among others, to increase transparency over fund management. Similarly, in the US, the Hedge Fund Transparency Act of 2009 introduced a bill imposing tighter disclosure requirements for hedge funds.
We have analyzed two kinds of transparency regime that may help to figure out some incentive implications of these policy frameworks: Full Transparency and Partial Transparency. Overall comparison of these information structures through their effects on aligning investor - manager preferences and on information revelation about manager's actual ability indicates that the investor welfare is highest when the composition of managers' portfolio choice is non-disclosed. This transparency regime both ensures the manager to take the action yielding the first-best outcome and it provides the most information about the manager's type. Considering the effect of transparency on alignment of principal and agent interests, the case of concealed portfolio return is also definitely superior to Full Transparency, while superiority between these two information structures through their effects of information revelation about manager's ability depends on availability of portfolios with infinite variance.

A testable prediction of our model is that disclosure of portfolio composition decreases expected return. In fact, findings of various empirical studies provide supporting evidence for this prediction. For example, empirical analysis of Agarwal et al. (2013: 739-783) indicates that hedge funds with more confidential holdings have higher risk adjusted performance compared to their counterparts. Shi (2012) provides a more direct evidence on adverse effects of transparency. She examines effects of SEC's portfolio disclosure obligation that comes into effect when a fund's assets exceed $100 million. She shows that this discontinuous change in disclosure obligation results to a sudden drop in funds' performances, whereas there is no such drop for funds that are not subject to this obligation. Further, she shows that fund performance decreases both in disclosure periods and as fraction of assets disclosed increases. All of these findings are consistent with our prediction that increasing transparency may decrease expected return.

To conclude, implications of transparency can be more complex than it seemed at first glance. When designing policies for information revelation, one needs to take into account its possible adverse incentive effects. In this regard, one direction for further research may be to analyze optimal contracts and the transparency regime in a unified framework.
References


Inflation Dynamics and Business Cycles

Süleyman Hilmi KAL; Central Bank of the Republic of Turkey

Nuran ARSLANER; Central Bank of the Republic of Turkey

Ferhat ARSLANER; Borsa Istanbul

The paper aims to investigate whether the effect of the backward-looking inflation expectations, nominal effective exchange rate, money supply, gross domestic product and import prices on inflation depends on business cycle. For this purpose, a two states Markov Switching Auto Regression model with time varying transition probabilities to a generic inflation model is implemented for the period 2003-2013. In this model the states are assigned whether output gap is positive or negative. The inflation forecasting in-sample and out-of-sample is also utilized by adopting mean squared error and Diebold Mariano test to measure explanatory and forecasting power of our model. Our main finding provides that the determinants of inflation have different dynamics during boom periods as compared to recessions.

Keywords: Inflation; Output Gap; Exchange Rate Pass-Through; Markov Switching Autoregressions; Business Cycles

JEL: C32, E30, E31, E37, E58

1. Motivation

After 2007-2008 financial crises and ensuing the Great Recession, despite the fact that money supply increased substantially by the central banks especially in the United States, in the European Union, and in the other countries, the inflationary pressures still nonexistent; instead there are concerns of deflation emerged in these regions. This anomaly leads us to make the following argument that there may be some other variables influence the relationship between inflation and the factors that determine the inflation such as money supply, exchange rate pass trough and output. In economic literature, these variables are usually named as state variables. In this paper, we will attempt to evaluate whether the output gap as one of the possible factors determining the different dynamics, which take important role in explaining inflation during various phases of the economy, i.e. the business cycles.
Our motivation comes from the Keynesian view that when the economy is below its potential \(Y_{FE}\) in Figure 1, a shift in aggregate demand or in money supply may not have an important impact on price changes. So, basically, this is the theoretical framework and the motivation behind our work.

2. Short Literature Review

Unfortunately, there is not much literature about the effects of business cycle on inflationary factors even though there is considerable literature on exchange rate pass-through. Joey Chew et al (2011) find for Singaporean economy that there is asymmetric exchange rate pass-through. They documented that the exchange rate pass-through occurs more during recessionary periods than it occurs during expansionary periods.

Nidhaleddine (2012) detected that there is nonlinear exchange rate pass-through for 12 EU Countries. Higher exchange rate pass-through is detected when inflation exceeds a certain threshold.

Oinonen et al (2013)’s study provided evidence that economic dynamics of inflation US has changed and output gap became more important in US since 1990.

In the following graphs (Figure 2, 3 and 4), bar graphs are output gap, red line is the rate of inflation and blue line is broad definition of money supply which is M2, import price index and manufacturing industrial production index. One can see from the figures that, there is no strong
linear relationship between inflation and money supply. Similarly, there is not any linear pattern between inflation and import prices and between inflation and industrial production index. We analyze the relationships among those variables using Markov switching regression method.

Figure 2. Output Gap, Inflation and Money Supply (%), Jan. 1998 - March 2014

Figure 3. Output Gap, Inflation and Import Price (%), Jan. 1998 - March 2014
3. Methodology

Markov switching regression model was first used pretty early in 1953 by Quant and Goldfeld and became popular by Hamilton’s work in 1990s.

Markov switching regime models are basically space models. The relationship between two variables depends on observed state variable. The unobserved state variable follows a Markov chain.

Markov regime switching model assume that the observed changes in a variable between two-consecutive periods are a random draw from two distributions. The unobserved state variable evolves according to Markov chain. Probabilities of switching from one state to another - transition probability- is not exogenous but endogenous. Basically we use two normal distributions each of which has a different mean and standard deviation in this article.

State variables \((S_t)\) determine the distribution for the period. In a two-state case, when \(S_t = 1\) the observed changes are a random draw from: \(y_t/s_t = 1 \sim N(\mu_1, \sigma^2_1)\)

When \(S_t=2\) from: \(y_t/s_t = 2 \sim N(\mu_2, \sigma^2_2)\)
Mean and the variance of the $y_t$ depend on the state. Density of $y_t$ is conditional on $S_t$ and is as follows:

$$f(y_t|S_t = i) = \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{(y_t - \mu_i)^2}{2\sigma_{is}^2}\right)$$

4. Model

We use a generic inflation model (Goldberg and Knetter, 1997) by running monthly data for the period 2003 and 2014 which is as follows:

$$\inf_t = \alpha_1 \inf_{t-1} + \alpha_2 \Delta ms_t + \alpha_3 \Delta prod_t + \alpha_4 \Delta neer_t + \alpha_5 \Delta imp_t + \epsilon_t$$

where

$\inf_t$: The rate of inflation in consumer prices,

$\inf_{t-1}$: Backward looking inflation expectation

$\Delta ms$: Change in money supply,

$\Delta prod$: Change in industrial production index,

$\Delta neer$: Change in nominal effective exchange rate,

$\Delta imp$: Change in import price index,

$\epsilon_t$: Error Term.

If output gap is used as state variables,

State 1: When output gap is positive.

State 2: When output gap is negative

---

60 2003 is especially picked for the beginning of the analysis period because it is the start of inflation targeting regime in Turkey.
5. Results

Markov regime switching regression has two sets of coefficients; one for each state. In other words coefficients for the recessionary periods (negative output gap) are different than the coefficients for the expansionary periods (positive output gap).

According to the results, when the output gap is negative which is State 1, a change in money supply interestingly reduces the rate of inflation as opposed to the expectations. Moreover, an increase in manufacturing industrial production increases the inflation. They are statistically highly significant. However, regarding to nominal effective exchange rate and import price index, they are not statistically significant. This is just we found the opposite of Singaporean economy. During the recessionary times, we do not see exchange rate pass through for the Turkish economy when the output gap is negative whereas the powerful pass-through exists when the output gap is positive that is to say, during the boom times, expansionary periods. Money supply and industrial production are still statistically insignificant, yet if you look at the pass-through coefficient, nominal effective exchange rate and import prices are highly significant. Their total pass-through effect is 0.07.

Table 1. Coefficients Estimated by Two-State Markov Switching Process

<table>
<thead>
<tr>
<th>States</th>
<th>Variables</th>
<th>Coefficients</th>
<th>t-ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>INF_{t-1}</td>
<td>( \alpha_{11} )</td>
<td>1.0535</td>
</tr>
<tr>
<td>Output</td>
<td>( \Delta M_2 )</td>
<td>( \alpha_{12} )</td>
<td>-0.0307</td>
</tr>
<tr>
<td>Gap</td>
<td>( \Delta \text{PROD} )</td>
<td>( \alpha_{13} )</td>
<td>0.1019</td>
</tr>
<tr>
<td>(State 1)</td>
<td>( \Delta \text{NEER} )</td>
<td>( \alpha_{14} )</td>
<td>-0.0114</td>
</tr>
<tr>
<td></td>
<td>( \Delta \text{IMP} )</td>
<td>( \alpha_{15} )</td>
<td>-0.0196</td>
</tr>
<tr>
<td>Positive</td>
<td>INF_{t-1}</td>
<td>( \alpha_{21} )</td>
<td>0.8948</td>
</tr>
<tr>
<td>Output</td>
<td>( \Delta M_2 )</td>
<td>( \alpha_{22} )</td>
<td>0.0212</td>
</tr>
<tr>
<td>Gap</td>
<td>( \Delta \text{PROD} )</td>
<td>( \alpha_{23} )</td>
<td>-0.0296</td>
</tr>
<tr>
<td>(State 2)</td>
<td>( \Delta \text{NEER} )</td>
<td>( \alpha_{24} )</td>
<td>0.0268</td>
</tr>
<tr>
<td></td>
<td>( \Delta \text{IMP} )</td>
<td>( \alpha_{25} )</td>
<td>0.0456</td>
</tr>
</tbody>
</table>

*, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
Additionally, Wald test is implemented in order to see whether the coefficients in both states are statistically different from each other or not. Wald test results are encouraging. According to these results, all the coefficients are significant. Therefore, in each state for all the variables are statistically significantly different from each other.

**Table 2. Wald Test Results**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Test Results</th>
</tr>
</thead>
</table>
| INF
| 8.0107 |
| ΔM2 | 7.9264 |
| ΔPROD | 15.1797 |
| ΔNEER | 4.194 |
| ΔIMP | 10.0332 |

*Note: All numbers indicate that a variable is significant at 5% significance level according to the $\chi^2$-distribution.*

We also did in-sample estimation in order to understand the success of our model. In-sample estimation mimics the realized inflation. We also used random walk and ordinary least square estimation of the same model whether the model is success. In terms of mean square errors, Markov processed model produces significantly lower errors than that of OLS and also the random walk.

**Figure 5. Coefficients Estimated by Two-State Markov Switching Process**

Graph 4 shows the transition probabilities of the output gap which we will be derived with the HP filter, nominal exchange rate and money supply of State 1. In addition to in-sample estimation,
out-of-sample estimation is also done. It is seen that the model successfully predicts mimics of ups and downs the rate of inflation. We used 16 periods as out-of-sample observations (Figure 5&6). The $R^2$ of the model is 80 per cent. We take out the previous inflation from the model is still around above 30 per cent. Therefore, the model from that point of view seems to be promising.

**Figure 6.** Realized Inflation and Out-of-Sample Estimation

![Graph of Realized Inflation and Out-of-Sample Estimation](image)

6. Conclusions

Our main conclusion is that inflation dynamics depends on the business cycles. So, the determinants of inflation have different dynamics during boom periods as compared to recessions.

Agenda for future research is that states may be determined whether the expected inflation is realized or not and reel effective exchange rate is overvalued or undervalued. Cross country analysis can also be done by using the same model and methodology.
Reference


Oinonen, S., M. Paloviita and L. Vilmi 2013. “How have inflation dynamics changed over time? Evidence from the euro area and USA”, Bank of Finland Research Discussion Papers 6

Comovement and Polarization of Interest Rate and Stock Market in Turkey

Ahmet DURAN; Istanbul Technical University

Burhaneddin İZGİ; Istanbul Technical University

It is important to analyze and distinguish the comovement and polarization behaviors for securities in financial markets. In this paper, we examine the comovement and polarization of interest rates and daily returns of BIST - 100 index between 2010 and 2013 in order to understand the corresponding behavioral dynamics. We examine Heston stochastic volatility model which may capture such behaviors and reflect fat-tails and high peaks in the price distributions under various market situations. We present extensive simulations using numerical solutions of the stochastic differential equations. Heston stochastic volatility model predicts that the average logarithmic stock return increases as interest rate rises. Actually, we observe that there are also sufficiently large time intervals where interest rates were decreased and stock prices increased gradually in US stock markets and Borsa Istanbul, unlike the Heston stochastic volatility model suggests.

Keywords : Numerical solutions of stochastic differential equations, Heston model, comovement, polarization, BIST-100.

1. INTRODUCTION

There are many time dependent variables in financial markets and it is essential to analyze and distinguish their comovement and polarization. In this study we are interested in the comovement and polarization of interest rates and daily returns of BIST - 100 index between 2010 and 2013.

It is hard to find one single model to capture all kinds of behaviors in stock markets. Therefore, it is valuable to examine strengths and weaknesses of related mathematical models or approaches. In this paper, we focus on Heston stochastic volatility model (see [6]) which may capture limited kinds of behaviors and may reflect fat-tails and high peaks in the price distributions under various market situations. We conduct various simulations using numerical solutions of the stochastic differential equations (SDE) with different parameters via Milstein method (see [8] and [10]). Heston stochastic volatility model suggests that the average logarithmic stock return increases as
interest rate increases. On the other hand, it is important to find polarization domains where comovement of financial variables may turn out to be distant from each other (see [3] and references therein). Therefore, we check that whether there are also sufficiently large time intervals where the Heston stochastic volatility model may not work in terms of interest rates and daily returns in real data.

The remainder of the paper is organized as follows. In Section 2, we present high peak and fat tail formation of stock price distributions from Heston model under different market situations. In Section 3, we discuss the comovement and polarization of interest rates and daily returns of BIST-100 index between 2010 and 2013. Section 4 concludes the paper. The Appendix includes Milstein method, Heston model and statistical tables for the distribution of stock price via simulations under various market situations such as flight to more stable or more unstable situation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t = 0;$</td>
<td>the initial time</td>
</tr>
<tr>
<td>$q = 0;$</td>
<td>the dividend yield</td>
</tr>
<tr>
<td>$\rho = 0.7;$</td>
<td>the correlation coefficient</td>
</tr>
<tr>
<td>$\nu = 0.4;$</td>
<td>the initial variance</td>
</tr>
<tr>
<td>$T = 1;$</td>
<td>the terminal time-in years</td>
</tr>
<tr>
<td>$\sigma = 0.01;$</td>
<td>the uniform mesh size</td>
</tr>
<tr>
<td>$S_0 = 10;$</td>
<td>the initial stock price</td>
</tr>
<tr>
<td>$k = 4;$</td>
<td>the rate of mean reversion</td>
</tr>
<tr>
<td>$\theta = 0.3;$</td>
<td>the long run variance</td>
</tr>
<tr>
<td>$\epsilon = 0.1;$</td>
<td>the volatility parameters of variance process</td>
</tr>
<tr>
<td>$N = 1000;$</td>
<td>number of paths</td>
</tr>
<tr>
<td>$n = 100;$</td>
<td>the number of discretization points between 0 and T</td>
</tr>
</tbody>
</table>

Table 1. Simulation parameters

![Figure 1. One thousand realizations of simulation](image)

2. HIGH PEAK and FAT-TAIL ANALYSIS for some MODEL PARAMETERS

We believe that Heston model can reflect limited kinds of fat-tails and high peaks in the price distributions under various market situations. We obtain figure 1 by performing simulations with...
the model parameters which are given in table I. We observe that stock prices have fat-tails and high peaks when the interest rate is 5% and speed of mean reversion are $K = 2$ and 4 while the correlation coefficients ($\rho$) are 0.8 and -0.8 respectively.

Figure 2. Distribution of stock price when $r = 5\%$ and $K = 2$

Figure 2 describes the distribution for the logarithm of the stock price when $r = 5\%$ and $K = 2$.

We obtain that $\log(S_{\text{min}}) = 0.4919$, $\log(S_{\text{max}}) = 4.043$ and range = 3.551 in figure 2, while $\log(S_{\text{min}}) = 0.5227$, $\log(S_{\text{max}}) = 4.181$ and range = 3.659 for larger mean reversion in figure 3.

We observe that the average logarithmic price for positive correlation coefficient is larger than that of negative correlation coefficient between Brownian motions of asset price process and the variance process, when we compare figure 4 and figure 5. While $\log(S_{\text{min}}) = 0.3043$, $\log(S_{\text{max}}) = 3.802$ and range = 3.498 in figure 4, we obtain $\log(S_{\text{min}}) = 0.6418$, $\log(S_{\text{max}}) = 4.029$ and range = 3.388 in figure 5.
We analyze stock return behaviors with respect to some of the model parameters especially for various interest rates ($r$) and speed of mean reversion $K$ when the stock variance ($\theta$) increases.
or decreases. We perform simulations for the following parameters \( r = 2.5 \%, 5 \%, 10 \%, 15 \% \), \( K = 0.1, 1, 2, 3, 4, 5, 6 \) while stock variance changes \( \theta \) from 0.3 to 0.4 and vice versa at our analysis. We obtain 3-D graphics of average logarithmic stock return, interest rate and speed of mean reversion as are in figure 6 and figure 7. In figure 6, the average logarithmic stock return increases as interest rate and speed of mean reversion increase. Please see table II in appendix for further quantitative information. In figure 7 and table III, the average logarithmic stock return increases as interest rate increases for all values of \( K \). On the other hand, the average logarithmic stock return increases as the speed of mean reversion increases for larger values of \( K \) ( \( K \geq 2 \)), while it drops for \( 0.1 \leq K < 2 \). The results in figure 7 is in the line of the findings in [1].

**Figure 6.** The average logarithmic stock return when the variance of the stock increases

**Figure 7.** The average logarithmic stock return when the variance of the stock decreases
3. COMOVEMENT and POLARIZATION of INTEREST RATES and DAILY RETURNS

While daily interest rates in Turkey had large oscillations at high levels between 1996 and 2002, they decreased slowly relatively lower levels with smaller oscillations between 2002 and 2013 according to Central Bank of the Republic of Turkey, as seen in Figure 8. By using the methodology having time-dependent return correlation matrices to measure the time dependent polarization (see [5]), we observe that the polarization of BIST 100 and interest rates increases from 2010 to 2011, later it levels off at a relatively high level between 2011 and 2012, and then the polarization decreases slowly in 2013. Figure 9 shows the comovement and polarization of BIST 100 versus interest rates from May 31, 2010 to June 17, 2013.

Figure 8. Daily Interest Rates, 1996 - 2013

Figure 9. Bist100 vs Interest Rates
4. CONCLUSIONS

Heston stochastic volatility model may capture comovement of stock price return and interest rates. We observe that the average logarithmic stock return rises gradually as interest rate and speed of mean reversion increase, while stability of stock market decreases, according to the Heston model. Actually, interest rates were decreased around 2008 and stock prices increased gradually in US stock markets, unlike the Heston model suggests. Borsa Istanbul experienced similar situations between 2002 and 2013, and this is a kind of polarization of stock price return and interest rates for some sufficiently large time intervals. Krugman, 2008 nobel laureate in economics, appreciates lower interest rates in order to encourage investments (see Krugman [9]). The polarization may be explained by Krugman's this argument.

Moreover, the Heston model predicts that the average logarithmic stock return increases as interest rate goes up for all values of K, when the stability of stock market gets better. On the other hand, the average logarithmic stock return increases as the speed of mean reversion increases for larger values of K, while it drops for $0.1 \leq K < 2$ and this is consistent with the arguments of Avellaneda and Jee [1]. We have been developing a mathematical model having appropriate stochastic differential equations to capture certain kinds of comovement and polarization behaviors, in our another paper.
REFERENCES


APPENDIX

Definition: Let $\tilde{y}_N$ be the numerical approximation to $y(t_N)$ after N steps with constant stepsize $h = (t_N - t_0)/N$; then $\tilde{y}_N$ is said to converge strongly to y with order p if $\exists C > 0$ (independent of $h$) and $\delta > 0$ such that

$$E\left(\|\tilde{y}_N - y(t_N)\|\right) \leq Ch^p, h \in (0, \delta)$$

I.1. MILSTEIN METHOD

Let's consider the following SDEs:

$$dy = f(t, y)dt + g(t, y)dW, y(0) = y_0, \quad (1)$$

Milstein method has the following form for the equation (1):

$$\Delta y_i = f(t_i, y_i)\Delta t_i + g(t_i, y_i)\Delta W_i + \frac{1}{2} g(t_i, y_i) \frac{\partial g}{\partial y}(t_i, y_i)(\Delta W_i^2 - \Delta t_i)$$

$$\Delta t_i = t_{i+1} - t_i$$

$$\Delta W_i = W_{i+1} - W_i$$

Milstein Method has strong order 1 for solving SDEs. Also Brownian motion $\Delta W_i$ can be modeled as $\Delta W_i = z_i\sqrt{\Delta t_i}$ where $z_i$ is chosen from $N(0,1)$ standard normally random variable. (see [10]).

I.2. HESTON MODEL

In Heston's stochastic volatility model the asset price process $S_t$ and the variance process $\nu_t := \sigma_t^2$ solve the following two-dimensional stochastic differential equation (see [6]):

$$dS_t = (r - q)S_t dt + \sqrt{\nu_t} S_t dW_1(t)$$

$$d\nu_t = \kappa(\theta - \nu_t) dt + \xi \sqrt{\nu_t} dW_2(t)$$
At the Black-Scholes-Merton (BSM) model (see [2]) the volatility $\sigma$ was assumed to be constant. The main difference between BSM and Heston model is volatility behavior. It is stochastic and it satisfies mean reverting property with a mean reverting drift at the Heston model. The $W_1$ and $W_2$ represent Brownian motions of asset price process and the variance process are correlated, with correlation coefficient $\rho \in [-1,1]$. Here $\xi > 0$ is the volatility parameter of the variance process, $r \geq 0$ is the risk-free interest rate, $q \geq 0$ is the dividend yield, $\kappa \geq 0$ is the rate of mean reversion, and $\theta \geq 0$ is the long run variance level (see [6]). Stochastic volatility model of Heston (1993) is frequently used. Heston’s model is derived from the CIR model of Cox, Ingersoll and Ross (1985) for interest rates (see [4]). We choose the parameters as they satisfy the Feller condition $2\kappa \theta \geq \xi^2$ at our simulations so that non-negativity of volatility can be guaranteed (see [7]).
Table 2 When $v_0 = 0.3; \theta = 0.4$

<table>
<thead>
<tr>
<th>K = 1</th>
<th>r = 2.5 %</th>
<th>r = 5 %</th>
<th>r = 10 %</th>
<th>r = 15 %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>min</td>
<td>0.237</td>
<td>0.255</td>
<td>0.206</td>
<td>0.239</td>
</tr>
<tr>
<td>max</td>
<td>0.215</td>
<td>0.230</td>
<td>0.201</td>
<td>0.219</td>
</tr>
<tr>
<td>mean</td>
<td>0.09961</td>
<td>0.09649</td>
<td>0.09607</td>
<td>0.09735</td>
</tr>
<tr>
<td>mode</td>
<td>0.255</td>
<td>0.239</td>
<td>0.239</td>
<td>0.239</td>
</tr>
<tr>
<td>std</td>
<td>0.1139</td>
<td>0.09649</td>
<td>0.09607</td>
<td>0.09735</td>
</tr>
<tr>
<td>range</td>
<td>0.661</td>
<td>0.324</td>
<td>0.320</td>
<td>0.320</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K = 2</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>0.238</td>
<td>0.238</td>
<td>0.209</td>
<td>0.209</td>
</tr>
<tr>
<td>max</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
</tr>
<tr>
<td>mean</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
</tr>
<tr>
<td>mode</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
</tr>
<tr>
<td>std</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
</tr>
<tr>
<td>range</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K = 3</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>0.238</td>
<td>0.238</td>
<td>0.209</td>
<td>0.209</td>
</tr>
<tr>
<td>max</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
</tr>
<tr>
<td>mean</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
</tr>
<tr>
<td>mode</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
</tr>
<tr>
<td>std</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
</tr>
<tr>
<td>range</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K = 4</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>0.238</td>
<td>0.238</td>
<td>0.209</td>
<td>0.209</td>
</tr>
<tr>
<td>max</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
</tr>
<tr>
<td>mean</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
</tr>
<tr>
<td>mode</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
</tr>
<tr>
<td>std</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
</tr>
<tr>
<td>range</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K = 5</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>0.238</td>
<td>0.238</td>
<td>0.209</td>
<td>0.209</td>
</tr>
<tr>
<td>max</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
</tr>
<tr>
<td>mean</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
</tr>
<tr>
<td>mode</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
</tr>
<tr>
<td>std</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
</tr>
<tr>
<td>range</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>K = 6</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>0.238</td>
<td>0.238</td>
<td>0.209</td>
<td>0.209</td>
</tr>
<tr>
<td>max</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
<td>0.215</td>
</tr>
<tr>
<td>mean</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
<td>0.09814</td>
</tr>
<tr>
<td>mode</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
<td>0.238</td>
</tr>
<tr>
<td>std</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
<td>0.0758</td>
</tr>
<tr>
<td>range</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
<td>0.316</td>
</tr>
</tbody>
</table>
Table 3. When $v_0 = 0.4; \theta = 0.3$
The Effect of Global Shocks and Volatility on Herd Behavior in Borsa Istanbul

Mehmet BALCILAR
Department of Economics
Eastern Mediterranean University
Famagusta, T. R. North Cyprus, via Mersin 10, Turkey.

Rıza DEMİRER
Department of Economics & Finance
Southern Illinois University Edwardsville
Edwardsville, IL 62026-1102

Abstract

This paper contributes to the literature on the financial integration in international stock markets by examining the dynamic relationship between global factors and herd behavior in an emerging market. Utilizing a time-varying transition probability Markov Switching model (TVTP-MS), we examine the role of global risk factors on investor behavior in Borsa Istanbul, dominated largely by foreign investors who hold a substantial share of the stocks traded in this market. Our tests yield three distinct market regimes-low, high, and extreme volatility- and evidence consistent with herd behavior during both the high and extreme volatility regimes. U.S. market related factors are found to dominate regime transitions and thus significantly contribute to herd behavior in all market sectors with the exception of industrials, suggesting that industrials are relatively immune from global shocks. Policy and portfolio implications are discussed next.

Keywords: Herd behavior; Emerging markets; Markov-switching; Time-varying probabilities.

1. Introduction

Financial integration in international stock markets, particularly from the perspective of emerging markets, has been examined in numerous recent studies. One strand of the literature including Chiang et al. (2007), Markwat et al. (2009), Dooley and Hutchison (2009) and Syllignakis and Kouretas (2011) examine market linkages from a contagion perspective with a focus on major financial crises experienced over the past several decades. On the other hand, studies including
Driessen and Laeven (2007), Cheng et al. (2010) and You and Daigler (2010) approach from an international diversification perspective and examine the potential diversification effects of integration (or segmentation) in financial markets. Although earlier studies including Henry (2000) and Bekaert et al. (2002) document an increase in foreign equity flows into local markets and in the size of local equity markets following financial liberalizations, the concept of “hot money” and potentially destabilizing effects of foreign investors in emerging markets have often been the topic of heated discussions among policy makers. This study contributes to the debate by examining the role of global factors and volatility on herd behavior in an emerging market, Borsa Istanbul, where total market capitalization is largely dominated by foreign investors who also account for a substantial volume of trading in this market.

Turkey, like several other emerging nations including South Africa, Brazil, Chile and India with high levels of current-account deficit relative to its GDP, depends heavily on capital inflows and, indirectly, foreign investors’ risk appetite and confidence towards its economy. However, one structural weakness of the Turkish economy is that the deficit has largely been financed by short-term capital inflows often characterized as “hot money” which makes its stock market particularly sensitive to foreign investors’ sentiment driven by local as well as global fundamentals. A number of studies in the literature including Choe et al. (1999) and Kim and Wei (2002) document evidence of herding by foreign investors in emerging markets, in particular during the Asian crisis of 1997. Therefore, it can be suggested that herd behavior in the Turkish stock market which is dominated largely by foreign investors, if present, will be highly sensitive to global risk factors that may drive the flow of “hot money” in and out of this market through correlated trades of foreign investors as well as local investors watching for signals from their trades. The relationship between global fundamentals and investor behavior in a developing market largely dominated by foreign investors is particularly of concern to policy makers as a number of studies including Bikhchandani et al. (1992), Nofsinger and Sias (1999) and Blasco et al. (2012) suggest that herd behavior might contribute to excess volatility as well as pricing inefficiencies in financial markets. Therefore, the findings can provide insight to market regulators in order to establish mechanisms to manage the potentially destabilizing effects of global shocks in emerging markets.

This study has two main contributions. First, we contribute to the literature on herd behavior by extending herding tests to an emerging stock market, Borsa Istanbul, which has experienced significant growth in market size and depth over the past decade thanks to a booming economy with impressive GDP growth rates during much of the 2000s (Figure 1). The fact that the market is largely dominated by foreign investors who held 65.4% of the publicly-held stocks in their
portfolios in 2012 (Table 1) and the arguments of “hot money” often used by politicians to
demonize the speculative activities of foreign investors make it especially interesting to examine
investor behavior in this market from a herd behavior context. Second, we use a dynamic
approach to test the presence of herd behavior by utilizing a time-varying transition probability
Markov Switching model (TVTP-MS) where regime transitions are modeled as a function of
domestic market volatility and global risk factors. The TVTP-MS model allows us to explore the
dynamic effects of global factors on transitions to (from) the market regimes during which herd
behavior is observed and provides a new perspective not offered in the herding literature.
Therefore, this study contributes both to the literature on herd behavior and on financial
integration in international markets.

Our tests yield three distinct market regimes-low, high, and extreme volatility- and evidence
consistent with herd behavior during both the high and extreme volatility regimes. The results
suggest that regime transition probabilities are time varying rather than constant across periods.
Global factors as well as domestic market volatility are found to be significant determinants of the
time varying transition probabilities in all market sectors with the exception of industrial stocks
suggesting that industrials are relatively immune from global shocks. U.S. market related factors
including the S&P 500 index return and the CBOT volatility index (VIX) are found to dominate
regime transitions suggesting that market stress in the U.S. is not only picked up by investors in
this emerging market, but also significantly contributes to herd behavior among investors.

The remainder of the paper is organized as follows. Section 2 briefly summarizes the literature on
the Turkish stock market as well as tests of herd behavior with a focus on emerging markets.
Section 3 provides the description of the data and the testing methodology. Section 4 presents
empirical results and Section 5 concludes the paper and discusses implications of the findings.

2. Previous studies

Neaime (2012) notes that Turkey has never implemented any restrictions on the trades of foreign
investors since 1989 and that the Turkish market provides an opportunity to document the true
behavior of foreign investors free of any restrictions and post-liberalization effects. As reported in
Table 1, foreign investors has consistently dominated the share of publicly-held stocks in this
market, partially due to the fact that the stocks listed on this exchange can be traded without
restrictions by foreign investors under the same rules applicable to domestic investors. A number

70 It is worth noting that although more than 60% of total market capitalization is held by foreign investors,
domestic investors, mostly individual investors, account for around 80% of trading volume.
of papers in the literature have examined the role of foreign investors in the Turkish stock market. In an early paper, Kiymaz (2001) documents that rumors on earning expectations’ as well as purchases by foreign investors generate greater impact on stock prices than other rumors in the market. Alper and Yilmaz (2004) provide evidence of volatility contagion from the financial centers in advanced markets especially in the aftermath of the Asian Crisis to the Istanbul Stock Exchange (renamed as Borsa Istanbul). Similarly, Ciner and Karagozoglu (2008) find that foreign trading activity is associated with informed trading in this market. On the other hand, Diyarbakirlioglu (2011) reports that foreign investors are likely to be trend-followers implied by a significant contemporaneous relation between the net purchases of local stocks by foreign investors and the returns on this market. In more recent studies, Ulku et al. (2012) analyze the interaction between foreigners’ trading and emerging stock returns and find that net foreign flows forecast future market returns and that price impacts are permanent, suggesting that foreigners’ trading incorporates information. Similarly, Umutlu et al. (2013) document a link between foreign equity flows and the average total market volatility and conclude that foreign investors’ trades contain firm-specific and market-wide information. More recently, Hatipoglu et al. (2013) find that bubbles originating from the U.S. market lead to bubbles in the Turkish market and note a significant relation between volatility in the Turkish asset markets and financial crises abroad. Indeed, an examination of the CBOE S&P500 volatility index (VIXUS) and the 21-day volatility index for Borsa Istanbul (VIXBIST) in Figure 1 reveals a strong association between the two time series with a correlation value of 47% between these indices.

On the other hand, the literature on herd behavior in financial markets is expanding rapidly with numerous studies published within the past few years. The literature offers several methodologies to test the presence of herd behavior some of which are based on trading data and some based on return data.71 Starting with earlier studies including Christie and Huang (1995) on U.S. equities, Chang et al. (2000) on international stocks, Gleason et al. (2003) on commodity futures traded on European exchanges, and Gleason at al. (2004) on exchange traded funds, the more recent literature has focused mostly on herd behavior in emerging markets. The recent literature includes Demirer and Kutan (2006), Tan et al. (2008), Lee et al. (2013) and Yao et al. (2013) on Chinese stock markets, Demirer et al. (2010) on Taiwanese stocks, Chiang and Zheng (2010) on global stock markets, Economou et al. (2011) on southern European stock markets, Balcilar et al. (2013) on Gulf Arab stock markets, Philippas et al. (2013) on real estate investment trusts, and Demirer et al. (2013) on American Depository Receipts. The evidence in the literature generally

71 Demirer et al. (2010) provide a brief evaluation and comparison of the different methodologies.
supports the presence of herd behavior in emerging markets suffering from market inefficiencies due to a number of institutional and market issues including liquidity, lack of regulation, institutional investor participation and underdeveloped investment culture, among others. However, none of these studies have explored the dynamic role of global factors on herd behavior in their tests and the emerging Turkish stock market which is largely dominated by foreign investors provides fertile ground for such an examination.

3. Data and testing methodology

The benchmark model employed in this study is well established in the literature and has been applied to a number of emerging markets including the Chinese stock market (Tan et al., 2008), Taiwanese stock market (Demirer et al., 2010), global stock markets (Chiang and Zheng, 2010), and Gulf Arab stock markets (Balcilar et al., 2013). Originally proposed by Chang et al. (2000), this methodology utilizes cross-sectional dispersion of individual stocks returns measured by the cross-sectional average dispersion (CSAD) statistic defined as

\[ CSAD_t = \frac{1}{n} \sum_{i=1}^{n} \left| R_{i,t} - R_{m,t} \right| \]  

where \( R_{i,t} \) and \( R_{m,t} \) is the return on stock i and the market portfolio for period t, respectively and n is the number of stocks in the portfolio. In this study, following the suggestion by Bikhchandani and Sharma (2001) that herd formation would be more likely to occur at the level of investments in a group of stocks such as stocks in an industry where investors face similar decision problems and can observe the trades of others in the group, we group individual stocks into four sector portfolios including Financials, Industrials, Services, and Technology. The sector based portfolio classification is further supported by the observation that foreign investors in the Turkish stock market focus largely on financials with financial stocks accounting for 71% of the total traded value by foreign investors in 2011 (Borsa Istanbul annual factbook, 2011). Furthermore, as Choi and Sias (2009) suggest, the typical assignment of financial analysts takes place at the industry level and investors may receive signals about a given firm based on information available about other firms in the same industry which may further contribute to herding tendencies at the industry level.

The benchmark model proposed by Chang et al. (2000) follows the conditional CAPM specification of stock returns and establishes the test based on the linear relation between asset returns and the market return as predicted by the CAPM. According to this specification in which
asset returns are expected to react to market shocks based on their sensitivities to the market factor, i.e. asset betas, one would expect cross-sectional dispersion of returns to have a positive and linear relation with the market return. However, in a market characterized by herd behavior, the correlated trades of investors would lead asset returns to display greater directional similarity, thus lower than expected cross-sectional dispersions. Considering the suggestion that investors would be more likely to exhibit herding tendencies during periods of market stress characterized by large price movements (e.g. Christie and Huang, 1995), the benchmark model examines the behavior of return dispersion during periods of large price movements and estimates

\[ CSAD_t = \alpha_0 + \alpha_1 |R_{m,t}| + \alpha_2 R^2_{m,t} + \epsilon_t \]

(2)

where a significant and negative \( \alpha_2 \) estimate is used as support for the presence of herd behavior.

The data used in the analysis consist of daily closing prices for all listed stocks on Borsa Istanbul obtained from Datastream, for the period Jan. 4, 2000–March 8, 2012 containing 3,052 observations. Domestic variables employed in the analysis include the BIST 100 index and the 21-day volatility index for Borsa Istanbul and the global variables include the S&P 500 index, the Turkish Lira-U.S. Dollar exchange rate and the CBOE S&P 500 Volatility Index. As will be explained in Section 3.1, the global factors are utilized in the estimation of regime transition probabilities in the Markov Switching models.

Table 1 provides the summary statistics of return dispersions and the global factors utilized in the study. Figure 1 provides a graphical comparison of nominal index returns as well as volatility indexes for the U.S. and Turkish stock markets. As expected, the market index, represented by the Borsa Istanbul SE National 100 index, experienced greater average return and volatility compared to the S&P 500 index during the sample period. Average return dispersion (CSAD) values for Turkish stocks range between a low of 1.84% for Technology and high of 2.21% for Services. The high level of cross-sectional return dispersion in the Services sector suggests that stock returns in this sector experienced greater cross-sectional variability further suggesting greater diversification opportunities in this sector relative to other sectors in this market. On the other hand, the low return dispersion observed in the Technology sector suggests that stock returns in this sector exhibit greater directional similarity relative to other sectors which may be due to the relatively small number of listed firms in this sector.
3.1 The TVTP-MS model with global factors

As Balcilar et al. (2013) note, the benchmark model in Equation 2 is static in the sense that the model parameters are assumed to be constant over time and thus fails to capture possible structural changes, leading to misspecification in the model. However, by definition, herd behavior is a dynamic phenomenon that is expected to occur during periods of market stress (e.g. Christie and Huang, 1995). Therefore, the static model in Equation 2 fails to accurately capture the market states during which herd behavior may be present or otherwise. An alternative specification based on the Markov Switching (MS) model is proposed in a recent study by Balcilar et al. (2013) who show that the nonlinear MS herding models are strongly favored over the static model using both the AIC and LR tests.

Applications of the MS specification to model stock returns have been documented in a number of studies including Tyssedal and Tjostheim (1988), Hamilton (1988), Schwert (1989), Pagan and Schwert (1990), Sola and Timmermann (1994), Schaller and van Norden (1997), Kim, et al. (1998), Kim and Nelson (1998), and Mayfield (1999). However, Balcilar et al. (2013) offers the first such application to herding tests in the literature. Clearly, if herd behavior is expected to be more prevalent during periods of market stress, then a model which differentiates the different market states should be able to correctly test its presence (or lack thereof). Therefore, we build on the MS model of Balcilar et al. (2013) and estimate the following regime switching model of return dispersions

$$\text{CSAD}_t = \phi_0 + \phi_1 |\text{RM}_t| + \phi_2 \text{RM}_t^2 + \epsilon_t$$

(3)

where $\epsilon_t \sim iid(0, \sigma^2_{\epsilon_t})$ and $S_t$ is a discrete regime variable taking values in {0,1,2} and following a three-state Markov process. Note that our tests for the optimal number of regimes support three regimes against the linear (1-regime) and the 2-regime alternatives. For brevity, the tests for alternative regime specifications are not included, but are available upon request. Several studies including Guidolin and Timmermann (2006), Maheu et al. (2009) and Cakmakli et al., (2011) also suggest that that the 3-regime model better describes the stock return dynamics. The volatility term in Equation (3) is modeled to be heteroscedastic with

$$\sigma_t^2 = \sigma_0^2 S_{0t} + \sigma_1^2 S_{1t} + \sigma_2^2 S_{2t}$$

(4)
where $S_k = 1$ if $S = k$ and zero otherwise ($k = 0, 1, 2$). This specification differentiates market regimes in terms of the level of volatility in each regime, i.e. $^2_t = ^2_k$, for regimes $k = 0, 1, 2$ and allows the variance of cross sectional dispersions to switch across different regimes.

As explained earlier, one of the contributions of this study is to assess the role of global shocks on herding regimes in the Turkish market. For this purpose, unlike the constant transition probability specification employed in Balcilar et al. (2013), we allow regime transition probabilities to be time varying. The TVTP-MS model, therefore, allows the length of time when herd behavior is present to fluctuate depending on the duration of the particular market volatility regime or the persistence of investor sentiment resulting from global or local shocks. Furthermore, we establish a direct link between global shocks and herding regimes by modeling regime transition probabilities in the Markov chain in Equation 3 as

$$p_{ij,t} = P(S_t = i | S_{t-1} = j, Z_{t-1})$$

(5)

where $Z_t$ is a vector of exogenous global variables.72 More specifically, let $^{ij}_t$ be the vector of parameters of exogenous variables associated with the transition probability of switching from state $j$ at time $t-1$ to state $i$ at time $t$. The time-varying transition probabilities are then defined as

$$p_{ij,t} = (Z_{ij,t})^{ij}, \quad i = 0, 1 \text{ and } j = 0, 1, 2$$

(6)

where $^{(\cdot)}$ is the normal cumulative distribution function (CDF). This way, we allow the transition probabilities across market regimes to be constant or time-varying. The TVTP specification in Equation (6) is also preferable as it restricts the transition probabilities to values within the interval $[0, 1]$, and also allows smooth adjustments.73 Finally, the transition probabilities satisfy $^2_t p_{ij,t} = 1$ for $t=1, 2, ..., T$ simultaneously.

Clearly, in the emerging Borsa Istanbul which is largely dominated by foreign investors, herd behavior, if present, will be highly sensitive to global shocks. For this purpose, we employ in the

72 The variables in $Z_t$ impact the transition probabilities with one lag since the transition probabilities governing the regime switches that occur from $t-1$ to $t$ must be determined at time $t-1$.
73 Smoothed probabilities are calculated following Kim (1994).
TVTP specification the S&P 500 index return (RUS) as well as the CBOE S&P 500 volatility index (VIXUS) which is also termed as the fear index as a widely accepted measure of market sentiment. Additionally, one would also expect a close relation between movements in the foreign exchange rate and herding regimes, if present, as investors in this market often view foreign currencies, particularly the U.S. dollar, as a safe haven during times of market stress. Besides, if the “hot money” argument is indeed correct, then foreign investors’ correlated actions of moving in and out of the Turkish Lira denominated assets would also lead to a close association between exchange rate movements and possible herd behavior. Therefore, we also include in the TVTP model the Turkish Lira/USD exchange rate (FX). Finally, we include in the model the 21-day volatility index for Borsa Istanbul (VIXBIST) in order to control for the effect of the market’s own volatility on herding regimes. Thus, the vector \( Z = [z_i] \) \( i=0,1,...,4 \) in Equation 6 is then defined as \( Z = (1, \text{VIXBIST}, \text{RUS}, \text{FX}, \text{VIXUS}) \) with the variables measured in returns. For instance, according to the specification in Equation 6, the parameter, \( \theta_{12,3} \), captures the impact of the TL/USD exchange rate movements \( z_3t \) on the transition probability from market regime 2 to regime 1, i.e. \( p_{12} \).

4. Empirical results

This section presents the findings for the static model of Equation (2) and the TVTP-MS model described in Equations (3) through (6). Note that the static models are rejected by both the standard and Davies (1987) LR tests against the MS alternatives. Furthermore, the constant transition probability MS model is rejected against the time-varying transition probability specification. For brevity, model selection tests are not reported in the paper, but are available upon request.

4.1. The results of the static model

Table 3 presents our estimates for the static benchmark model in Equation (2). Consistent with the conditional CAPM specification, all \( \alpha_i \) estimates are found to be positive and significant. However, the herding coefficients, \( \alpha_2 \), are found to be highly significant and negative for all sectors, suggesting the presence of herd behavior in all market sectors as well as Borsa Istanbul in general. This is clearly bad news for investors in this market as herd behavior is associated with excessive volatility and asset price bubbles and subsequent crashes (e.g. Bikhchandani et al., 1992, Nofsinger and Sias, 1999 and Blasco et al., 2012). Having established strong evidence of herd
behavior in the Turkish market, we next shift our focus to the particular market regimes during which herd behavior is more likely to occur and the role of global shocks on herding regimes.

4.2. The results of the TVTP-MS model

Table 4 presents our findings for the TVTP-MS model specified in Equations (3) through (6).

Examining the regime specific volatility estimates ($\sigma_k^2$, $k=0, 1, 2$) in Table 4, market regimes are clearly identified in the form a low, high and extreme volatility regime in terms of the level of return volatility. In the case of Financials, for example, the extreme volatility regime is almost three times as volatile as the low volatility regime with a 0.75% volatility estimate for regime 2 compared to 0.25% for regime 0, i.e. the low volatility regime. Examining the herding coefficients in Table 4, we observe that herd behavior in the Turkish stock market is indeed associated with high volatility market states. In all market sectors except for Technology, herding is observed during both the high and extreme volatility regimes whereas investors in Technology stocks exhibit herding tendencies during the extreme volatility regime only. The findings in general yield no evidence of herd formation during the low volatility regime, underscoring the importance of market mechanisms that can be implemented in order to mitigate the potential destabilizing effects of market shocks that drive market volatility and thus herd behavior.

4.2.1. Persistence of market regimes

The estimated regime durations in Table 4 clearly suggest that the low volatility regime is the most persistent with the longest average regime durations across market regimes. The average duration for the low volatility regime ranges between a low of 7.7 days for Technology and a high of 32 days for Services. On the other hand, we observe the longest average duration for the extreme volatility regime in Financials and Industrials with 9.2 and 10 days, respectively. This suggests that the extreme volatility regime is the most persistent in Financials and Industrials. Furthermore, the extreme volatility regime is found to be as persistent as the high volatility regime for these two sectors, underscoring the importance of hedging instruments to deal with volatility persistence in these two sectors. The average duration for the extreme volatility regime ranges between a low of 3.3 days for Technology and a high of 10 days for Financials. Furthermore, we observe the shortest regime durations for all market regimes in the case of the Technology sector, implying more frequent regime switches in this sector. Frequent regime switching in this sector is also coupled with frequent volatility switching leading Technology to be the most volatile sector in this market relative to the other market sectors (see Table 2). This finding may
be due to the nature of Technology firms dealing with greater uncertainties resulting from their business activities or due to the small number of Technology firms traded in Borsa Istanbul which makes Technology stocks as a group more sensitive to information flows.

Figures 2 through 6 provide the market return and smoothed probability plots which allow a visual examination of the dynamic nature of regime transitions and herd behavior in each market sector. Figure (a) plots the market return. The shaded regions in Figure (a) correspond to regimes where herding is observed. Figures (b)-(d) plot the smoothed regime probabilities for the 3-regime nonlinear TVTP-MS model in Equations (3) through (5). The shaded regions in Figures (b)-(d) correspond to the maximum smoothed probability among the three smoothed probabilities and can be used to identify regime transitions. We observe that the market experienced persistent herding during early 2000s, the aftermath of the dot-com burst in the U.S., as well as during the 2008 global financial crisis period. However, comparing across sectors, we observe that herding is more widespread for Financials which experienced herding during much of the 2000’s. The smoothed probability plots generally suggest a low-high-extreme (LHE) volatility transition order in which the high volatility regime follows the low volatility regime and the extreme volatility regime follows the high volatility regime. This is in fact consistent with the evidence for advanced markets and provides market regulators with a warning signal before the extreme volatility regime. However, the smoothed probability plots also suggest bi-directional transitions across the high and extreme volatility regimes, suggesting a role for market regulators during crisis periods and potential for the use of market mechanisms in order to avoid possible transitions to the extreme volatility regime. Figures (b)-(d) also indicate that all market sectors move quite simultaneously into and from a particular regime, implying significant synchronization of sector returns. The only noteworthy difference is observed with respect to the Technology sector where switching seems more frequent, however it still coincides with the same periods during which the other market sectors switch.

4.2.2. Global factors and time-varying transition probabilities

As explained earlier, the parameters $ij$, $i = 0,1$ and $j = 0,1,2$ in Equation (6) capture the dynamic effects of domestic market volatility and global factors on transition probabilities across regimes. Significant parameter estimates imply that these factors play a role in leading the Turkish stock market from one regime to another, possibly driving herding regimes. As discussed earlier, we include in our analysis the S&P 500 index (RUS), CBOE S&P 500 volatility index (VIXUS), Turkish Lira/USD exchange rate (FX) and the 21-day volatility index for Borsa Istanbul
(VIXBIST) as potential drivers of regime transitions. Thus, the $l$th element of the vector $\hat{\eta}_l$, that is $\hat{\eta}_{ij}$ for $i = 0, 1$ and $j = 0, 1, 2$, is defined as $\{l = 0 \text{ (constant)}, 1 \text{ (market volatility index return)}, 2 \text{ (S&P 500 returns)}, 3 \text{ (FX rate changes)}, 4 \text{ (U.S. VIX return)}\}$ with six parameter estimates for each variable since there are only six free transition probabilities.

We find that the global factors are indeed significant in driving regime transitions in this emerging market indicated by significant $\theta$ estimates. The only exception to this is Industrials where global factors are found to be mostly insignificant in driving regime transitions and thus herd behavior. We observe that the domestic market volatility is generally the main driver of regime transitions for Industrial stocks. This finding suggests that Industrial stocks are relatively immune from global effects and can be used to explore potential portfolio strategies using these stocks. Interestingly, although global factors are found to significantly govern regime transitions in other market sectors, we observe that their effect is heterogeneous across sectors suggesting that global effects do not affect regime transitions in a uniform way. However, there are several exceptions to this observation where global factors have uniform effects on regime transitions. For example, $\theta_{00}, 2$ is found to be mostly negative across sectors suggesting that bullish U.S. market conditions make it less likely to stay in the low volatility regime when the current regime is low volatility. A similar pattern is observed for $\theta_{11}, 2$ suggesting that bullish U.S. market conditions make it more likely to stay in the high volatility regime when the market is in high volatility. Another uniform pattern is observed in the case of $\theta_{11}, 4$ suggesting that high levels of the CBOT volatility index (VIX) is associated with a higher probability of staying in the high volatility regime.

Figures 7 through 11 plot the time varying transition probability (TVTP) estimates for all market sectors. Overall, all market sectors have analogous transition probability patterns. Significant differences are only observed in magnitudes, as it was the case for $\hat{\eta}$ estimates discussed earlier. The estimated probabilities for being in regime $j$ when the previous regime was also $j$, $p_{jj,t}$, are all around 0.80 to 0.85 and quite smooth except $p_{22,t}$ for Services and Technology, and $p_{11,t}$ for the Technology sector, which are relatively less smoother. Significant time variation in the transition probability estimates is observed in the case of the cross regime transition probabilities, $p_{ij,t}$ ($i \neq j$). Considering that the transition probabilities are estimated as a function of the global factors, these findings suggest that the impact of global factors show significant time variation in the case of cross-regime switching probabilities. The probabilities of switching from the low volatility
regime to the crash regime, \( p_{20,t} \), and from the crash regime to the low volatility regime \( p_{02,t} \), are all estimated to be very low, mostly below 0.01 except the high volatility periods where significant spikes are observed. This implies that switching from low volatility to crash and crash to low volatility is quite rare. On the other hand, the estimates for the probability of switching from the high volatility to the crash regime and vice versa, \( p_{21,t} \) and \( p_{12,t} \) are around 0.14 to 0.60, implying that the high volatility regime is an intermediate regime between the low volatility and the crash regimes.

Consequently, the evidence clearly suggests that market stress in the U.S. is indeed picked up in this emerging market. Interestingly, no consistent exchange rate effect is observed on regime transitions. One explanation for this finding is that the U.S. market related variables most likely control for the effect of the exchange rate movements in the model. This may also suggest that risk management tools that are tied to U.S. market variables including the S&P 500 index, VIX may be utilized to mitigate the negative effects of exchange rate volatility in this market, underscoring the importance of risk management tools available to investors in this market.

5. Conclusions

This paper contributes both to the literature on the financial integration in international stock markets and the literature on investor herds by extending tests of investor herds to an emerging stock market, Borsa Istanbul. Utilizing a time-varying transition probability Markov Switching model (TVTP-MS), we examine the role of global risk factors on investor behavior in Borsa Istanbul, dominated largely by foreign investors who hold a substantial share of the stocks traded in this market. Unlike other studies in the herding literature, the TVTP-MS model allows us to examine the dynamic effect of global factors on regime transitions and thus herd behavior in this emerging market.

Our tests yield three distinct market regimes-low, high, and extreme volatility- and evidence consistent with herd behavior during both the high and extreme volatility regimes. The results suggest that regime transition probabilities are time varying rather than constant across periods. Global factors as well as domestic market volatility are found to be significant determinants of the time varying transition probabilities in all market sectors with the exception of industrial stocks, suggesting that industrials in this emerging market are relatively immune from global shocks. Our findings on the role of global factors generally suggest that the U.S. market related factors including the S&P 500 index return and the CBOT volatility index (VIX) dominate regime transitions. This suggests that market stress in the U.S. is not only picked up by investors in this
emerging market, but also significantly contributes to herd behavior among investors. Bi-directional regime transitions across the high and extreme volatility regimes and the dominant role of global factors on regime transitions underscore the importance of safety nets and circuit breakers that can be implemented in order to mitigate the negative effects of global risk factors on market volatility and herd behavior in emerging markets.

Acknowledgement

The authors are grateful to the members of the Research Department at Borsa Istanbul and the participants at the Borsa Istanbul Economics and Finance (BIFEC) 2013 conference for helpful comments.
References


Davies, R.B. (1987). Hypothesis testing when a nuisance parameter is present only under the alternative. Biometrika 74, 33-43.


Table 1. Stock market and economic characteristics.

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP growth (annual %)</th>
<th>Total listed firms</th>
<th>Market cap. (USD, billion)</th>
<th>Stocks traded (USD, billion)</th>
<th>Share of foreign investors (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>6.77</td>
<td>315</td>
<td>69.659</td>
<td>179.21</td>
<td>40.91</td>
</tr>
<tr>
<td>2001</td>
<td>-5.70</td>
<td>310</td>
<td>47.150</td>
<td>77.94</td>
<td>49.22</td>
</tr>
<tr>
<td>2002</td>
<td>6.16</td>
<td>288</td>
<td>33.958</td>
<td>70.67</td>
<td>43.0</td>
</tr>
<tr>
<td>2003</td>
<td>5.27</td>
<td>244</td>
<td>68.379</td>
<td>99.61</td>
<td>51.5</td>
</tr>
<tr>
<td>2004</td>
<td>9.36</td>
<td>253</td>
<td>98.299</td>
<td>147.43</td>
<td>54.7</td>
</tr>
<tr>
<td>2005</td>
<td>8.40</td>
<td>257</td>
<td>161.537</td>
<td>201.26</td>
<td>66.3</td>
</tr>
<tr>
<td>2006</td>
<td>6.89</td>
<td>259</td>
<td>162.399</td>
<td>227.62</td>
<td>65.3</td>
</tr>
<tr>
<td>2007</td>
<td>4.67</td>
<td>259</td>
<td>286.572</td>
<td>302.40</td>
<td>72.3</td>
</tr>
<tr>
<td>2008</td>
<td>0.66</td>
<td>250</td>
<td>117.930</td>
<td>239.71</td>
<td>67.46</td>
</tr>
<tr>
<td>2009</td>
<td>-4.83</td>
<td>248</td>
<td>225.735</td>
<td>243.53</td>
<td>67.29</td>
</tr>
<tr>
<td>2010</td>
<td>9.16</td>
<td>264</td>
<td>306.662</td>
<td>421.59</td>
<td>66.83</td>
</tr>
<tr>
<td>2011</td>
<td>8.50</td>
<td>264</td>
<td>201.817</td>
<td>413.70</td>
<td>62.16</td>
</tr>
<tr>
<td>2012</td>
<td>2.20</td>
<td>227</td>
<td>308.77</td>
<td>348.51</td>
<td>65.46</td>
</tr>
</tbody>
</table>

Sources: The World Bank, Borsa Istanbul annual factbook and Capital Market Boards of Turkey monthly statistical bulletins. Share of foreign investors in the last column refers to the share of the market value of stocks held by foreign investors.
Table 2. Descriptive statistics.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return Dispersion (CSAD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borsa Istanbul</td>
<td>2.13%</td>
<td>0.72%</td>
<td>0.88%</td>
<td>8.96%</td>
<td>2.26</td>
<td>10.24</td>
</tr>
<tr>
<td>Financials</td>
<td>2.04%</td>
<td>0.84%</td>
<td>0.74%</td>
<td>9.45%</td>
<td>1.85</td>
<td>7.17</td>
</tr>
<tr>
<td>Industrials</td>
<td>2.08%</td>
<td>0.70%</td>
<td>0.88%</td>
<td>9.27%</td>
<td>2.22</td>
<td>9.99</td>
</tr>
<tr>
<td>Services</td>
<td>2.21%</td>
<td>0.81%</td>
<td>0.82%</td>
<td>10.04%</td>
<td>2.22</td>
<td>10.35</td>
</tr>
<tr>
<td>Technology</td>
<td>1.84%</td>
<td>0.97%</td>
<td>0.14%</td>
<td>9.82%</td>
<td>2.18</td>
<td>8.15</td>
</tr>
<tr>
<td>Market Index Return ($R_m$)</td>
<td>0.04%</td>
<td>2.41%</td>
<td>-19.98%</td>
<td>17.77%</td>
<td>-0.02</td>
<td>6.23</td>
</tr>
<tr>
<td>Volatility Index Return</td>
<td>-0.04%</td>
<td>6.29%</td>
<td>-40.32%</td>
<td>61.46%</td>
<td>0.59</td>
<td>11.46</td>
</tr>
</tbody>
</table>

**Global Variables**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>S&amp;P 500 Return</td>
<td>0.00%</td>
<td>1.36%</td>
<td>-9.47%</td>
<td>10.96%</td>
<td>-0.18</td>
<td>7.64</td>
</tr>
<tr>
<td>FX Return (TL/USD rate)</td>
<td>0.04%</td>
<td>1.22%</td>
<td>-12.56%</td>
<td>33.48%</td>
<td>7.03</td>
<td>200.45</td>
</tr>
<tr>
<td>VIX Return</td>
<td>-0.03%</td>
<td>6.20%</td>
<td>-35.06%</td>
<td>49.60%</td>
<td>0.67</td>
<td>4.69</td>
</tr>
</tbody>
</table>

Note: The table reports the descriptive statistics for daily cross-sectional return dispersions and daily percentage changes for the indexes utilized in the tests during the period Jan. 4, 2000–March 8, 2012 containing 3,052 observations. CSAD is the cross-sectional absolute deviation of returns for selected market sectors as a measure of return dispersion in each sector. Domestic variables include the ISE 100 index and the 21-day volatility index for Borsa Istanbul (V_XU100). Global variables include the S&P 500 index, the Turkish Lira-U.S. Dollar exchange rate (FX) and the CBOE S&P 500 Volatility Index (VIX). The global variables are used according to their stationarity or lack thereof.
Table 3. Estimates of the static benchmark model.

<table>
<thead>
<tr>
<th></th>
<th>Borsa Istanbul</th>
<th>Financials</th>
<th>Industrials</th>
<th>Services</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_0$</td>
<td>0.0157***</td>
<td>0.0144***</td>
<td>0.0154***</td>
<td>0.0165***</td>
<td>0.0139***</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.0003)</td>
</tr>
<tr>
<td>$\alpha_1$</td>
<td>0.3600***</td>
<td>0.3896***</td>
<td>0.3459***</td>
<td>0.3560***</td>
<td>0.2927***</td>
</tr>
<tr>
<td></td>
<td>(0.0166)</td>
<td>(0.0188)</td>
<td>(0.0174)</td>
<td>(0.0177)</td>
<td>(0.0263)</td>
</tr>
<tr>
<td>$\alpha_2$</td>
<td>-0.9497***</td>
<td>-1.0903***</td>
<td>-0.9072***</td>
<td>-0.9260***</td>
<td>-0.8849**</td>
</tr>
<tr>
<td></td>
<td>(0.2476)</td>
<td>(0.2652)</td>
<td>(0.2620)</td>
<td>(0.2431)</td>
<td>(0.3547)</td>
</tr>
<tr>
<td>$n$</td>
<td>3052</td>
<td>3052</td>
<td>3052</td>
<td>3052</td>
<td>3052</td>
</tr>
<tr>
<td>RSS</td>
<td>0.0858</td>
<td>0.134</td>
<td>0.0847</td>
<td>0.1293</td>
<td>0.2445</td>
</tr>
<tr>
<td>log L</td>
<td>11660.825</td>
<td>10980.1859</td>
<td>11680.5258</td>
<td>11034.4194</td>
<td>10062.9784</td>
</tr>
</tbody>
</table>

Note: The table reports the estimates for Equation 2. All estimations are done using the Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors. ***, ** and * represent significance at the 1%, 5%, and 10% levels, respectively. The numbers in parentheses are the HAC standard errors. RSS is the sum of the squared residuals and log L is the log likelihood. A significant and negative $\alpha_2$ estimate implies the presence of herd behavior.
Table 4. Estimates for the regime based herding models with global factors.

<table>
<thead>
<tr>
<th></th>
<th>Borsa Istanbul</th>
<th>Financials</th>
<th>Industrials</th>
<th>Services</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha_{0,0}$</td>
<td>0.0202***</td>
<td>0.0123***</td>
<td>0.0143***</td>
<td>0.0159***</td>
<td>0.0107***</td>
</tr>
<tr>
<td>$\alpha_{0,1}$</td>
<td>0.0154***</td>
<td>0.0171***</td>
<td>0.0181***</td>
<td>0.0200***</td>
<td>0.0168***</td>
</tr>
<tr>
<td>$\alpha_{0,2}$</td>
<td>0.0296***</td>
<td>0.0246***</td>
<td>0.0241***</td>
<td>0.0297***</td>
<td>0.0294***</td>
</tr>
<tr>
<td>$\alpha_{1,0}$</td>
<td>0.2158***</td>
<td>0.1654***</td>
<td>0.1559***</td>
<td>0.2164***</td>
<td>0.1581***</td>
</tr>
<tr>
<td>$\alpha_{1,1}$</td>
<td>0.2198***</td>
<td>0.2662***</td>
<td>0.2152***</td>
<td>0.2472***</td>
<td>0.1724***</td>
</tr>
<tr>
<td>$\alpha_{1,2}$</td>
<td>0.0864***</td>
<td>0.2825***</td>
<td>0.2858***</td>
<td>0.3046***</td>
<td>0.2088***</td>
</tr>
</tbody>
</table>

**Herding coefficients**

<table>
<thead>
<tr>
<th></th>
<th>$\alpha_{2,0}$</th>
<th>$\alpha_{2,1}$</th>
<th>$\alpha_{2,2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.6466***</td>
<td>-1.0564***</td>
<td>-1.2931***</td>
</tr>
<tr>
<td></td>
<td>0.3730***</td>
<td>-1.0240***</td>
<td>-0.5881***</td>
</tr>
<tr>
<td></td>
<td>1.3561***</td>
<td>-0.4260***</td>
<td>-0.9751***</td>
</tr>
<tr>
<td></td>
<td>0.9212***</td>
<td>-0.8734***</td>
<td>-1.0728***</td>
</tr>
<tr>
<td></td>
<td>0.3346***</td>
<td>0.5876***</td>
<td>-0.9639***</td>
</tr>
</tbody>
</table>

**Regime volatilities**

<table>
<thead>
<tr>
<th></th>
<th>$\sigma_0$</th>
<th>$\sigma_1$</th>
<th>$\sigma_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.0027***</td>
<td>0.0035***</td>
<td>0.0073***</td>
</tr>
<tr>
<td></td>
<td>0.0025***</td>
<td>0.0035***</td>
<td>0.0075***</td>
</tr>
<tr>
<td></td>
<td>0.0021***</td>
<td>0.0027***</td>
<td>0.0070***</td>
</tr>
<tr>
<td></td>
<td>0.0044***</td>
<td>0.0044***</td>
<td>0.0096***</td>
</tr>
<tr>
<td></td>
<td>0.0033***</td>
<td>0.0062***</td>
<td>0.0133***</td>
</tr>
</tbody>
</table>
### Time-varying transition probabilities

<table>
<thead>
<tr>
<th>( \theta_{00,0} )</th>
<th>(-21.2979^{***} (0.0000))</th>
<th>(1.8356^{***} (0.0000))</th>
<th>(1.8879^{***} (0.0811))</th>
<th>(11.9742^{***} (0.0000))</th>
<th>(0.9538^{***} (0.0000))</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta_{00,1} )</td>
<td>(11.0618^{***} (0.0000))</td>
<td>(-1.7205^{***} (0.0000))</td>
<td>(-1.7376^{***} (0.1022))</td>
<td>(-19.4216^{***} (0.0000))</td>
<td>(-1.0646^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{00,2} )</td>
<td>(-5.7229^{***} (0.0000))</td>
<td>(-9.8204^{***} (0.0000))</td>
<td>(-2.6427^{***} (0.5935))</td>
<td>(-2.6594^{***} (0.0000))</td>
<td>(-4.0917^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{00,3} )</td>
<td>(0.0613^{***} (0.0000))</td>
<td>(-3.3126^{***} (0.0000))</td>
<td>(-5.3462^{***} (1.3735))</td>
<td>(-0.1682^{***} (0.0000))</td>
<td>(0.1455^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{00,4} )</td>
<td>(0.0665^{***} (0.0000))</td>
<td>(2.2768^{***} (0.0000))</td>
<td>(2.0181 (2.3822))</td>
<td>(-0.3274^{***} (0.0000))</td>
<td>(1.1320^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{01,0} )</td>
<td>(-22.6043^{***} (0.0000))</td>
<td>(-0.4359^{***} (0.0000))</td>
<td>(4.7848 (3.6200))</td>
<td>(-2.6442^{***} (0.0000))</td>
<td>(-4.1544^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{01,1} )</td>
<td>(-0.0136^{***} (0.0000))</td>
<td>(34.4513^{***} (0.0000))</td>
<td>(-7.7415 (18.8654))</td>
<td>(0.2462^{***} (0.0000))</td>
<td>(14.7255^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{01,2} )</td>
<td>(0.1628^{***} (0.0000))</td>
<td>(-0.5138^{***} (0.0000))</td>
<td>(8.6075 (18.1021))</td>
<td>(0.1388^{***} (0.0000))</td>
<td>(9.4800^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{01,3} )</td>
<td>(-2.0996^{***} (0.0000))</td>
<td>(-0.1128^{***} (0.0000))</td>
<td>(-8.1809 (44.6737))</td>
<td>(7.1549^{***} (0.0000))</td>
<td>(0.4273^{***} (0.0000))</td>
</tr>
<tr>
<td>( \theta_{01,4} )</td>
<td>(-0.0927^{***} (0.0000))</td>
<td>(-31.2344^{***} (0.0000))</td>
<td>(-10.2310 (11.5178))</td>
<td>(0.0178^{***} (0.0000))</td>
<td>(-2.9131^{***} (0.0000))</td>
</tr>
</tbody>
</table>

---

*BIFEC Book of Abstracts & Proceedings (Volume I Issue II)*
| \( \theta_{1,0} \) | \(-1.7529^{***} (0.0000)\) | \(-8.5392^{***} (0.0000)\) | \(-1.0643^{***} (0.3478)\) | \(-2.4576^{***} (0.0000)\) | \(-32.2581^{***} (0.0000)\) |
| \( \theta_{1,1} \) | \(-2.2173^{***} (0.0000)\) | \(-1.7565^{***} (0.0000)\) | \(-1.8506^{***} (0.1091)\) | \(-1.8529^{***} (0.0000)\) | \(-1.2634^{***} (0.0000)\) |
| \( \theta_{1,2} \) | \(1.3989^{***} (0.0000)\) | \(1.2435^{***} (0.0000)\) | \(1.2689^{***} (0.1038)\) | \(1.0850^{***} (0.0000)\) | \(0.1659^{***} (0.0000)\) |
| \( \theta_{1,3} \) | \(4.3743^{***} (0.0000)\) | \(-0.5468^{***} (0.0000)\) | \(4.6633 (4.0256)\) | \(-0.111^{***} (0.0000)\) | \(-0.4522^{***} (0.0000)\) |
| \( \theta_{1,4} \) | \(0.0034^{***} (0.0000)\) | \(3.7155^{***} (0.0000)\) | \(-0.4477 (2.3804)\) | \(4.8318^{***} (0.0000)\) | \(2.9179^{***} (0.0000)\) |

| \( \theta_{2,0} \) | \(5.4627^{***} (0.0000)\) | \(1.1683^{***} (0.0000)\) | \(-1.6348 (1.8248)\) | \(6.4524^{***} (0.0000)\) | \(1.2068^{***} (0.0000)\) |
| \( \theta_{2,1} \) | \(-10.2874^{***} (0.0000)\) | \(0.0798^{***} (0.0000)\) | \(-6.8883 (95.5372)\) | \(0.1144^{***} (0.0000)\) | \(0.1808^{***} (0.0000)\) |
| \( \theta_{2,2} \) | \(0.0163^{***} (0.0000)\) | \(-2.9087^{***} (0.0000)\) | \(12.9032 (12.7950)\) | \(18.3063^{***} (0.0000)\) | \(-12.9097^{***} (0.0000)\) |
| \( \theta_{2,3} \) | \(18.7320^{***} (0.0000)\) | \(-8.6378^{***} (0.0000)\) | \(3.7098 (12.4941)\) | \(-0.1905^{***} (0.0000)\) | \(-25.8746^{***} (0.0000)\) |
| \( \theta_{2,4} \) | \(-8.4335^{***} (0.0000)\) | \(-0.0865^{***} (0.0000)\) | \(30.6194 (44.5684)\) | \(-0.1103^{***} (0.0000)\) | \(0.0205^{***} (0.0000)\) |

| \( \theta_{3,0} \) | \(-0.0132^{***} (0.0000)\) | \(23.7109^{***} (0.0000)\) | \(29.1704^{***} (11.1008)\) | \(-24.1978^{***} (0.0000)\) | \(-6.5967^{***} (0.0000)\) |
| \( \theta_{3,1} \) | \(8.5066^{***} (0.0000)\) | \(3.7096^{***} (0.0000)\) | \(0.1006 (7.3567)\) | \(-0.0846^{***} (0.0000)\) | \(2.1341^{***} (0.0000)\) |
| \( \theta_{3,2} \) | \(-0.8446^{***} (0.0000)\) | \(-0.1801^{***} (0.0000)\) | \(4.7257 (12.1186)\) | \(-0.1198^{***} (0.0000)\) | \(-0.5713^{***} (0.0000)\) |
| \( \theta_{3,3} \) | \(-0.0316^{***} (0.0000)\) | \(3.2820^{***} (0.0000)\) | \(0.3964 (3.1471)\) | \(8.0586^{***} (0.0000)\) | \(0.0823^{***} (0.0000)\) |
| \( \theta_{3,4} \) | \(0.8784^{***} (0.0000)\) | \(-4.6549^{***} (0.0000)\) | \(-0.3821 (3.2918)\) | \(1.4798^{***} (0.0000)\) | \(-4.7527^{***} (0.0000)\) |
### Table 4 (continued)

<table>
<thead>
<tr>
<th>Regime Durations</th>
<th>( \tau_0 )</th>
<th>( \tau_1 )</th>
<th>( \tau_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26.1232</td>
<td>11.0842</td>
<td>7.2500</td>
</tr>
<tr>
<td></td>
<td>21.004</td>
<td>10.1392</td>
<td>9.2031</td>
</tr>
<tr>
<td></td>
<td>26.5907</td>
<td>12.7284</td>
<td>10.0427</td>
</tr>
<tr>
<td></td>
<td>32.1411</td>
<td>20.4617</td>
<td>6.2547</td>
</tr>
<tr>
<td></td>
<td>7.7038</td>
<td>5.1452</td>
<td>3.2997</td>
</tr>
<tr>
<td>( n )</td>
<td>3051</td>
<td>3051</td>
<td>3051</td>
</tr>
<tr>
<td>( n_0 )</td>
<td>2910.0062</td>
<td>2890.1638</td>
<td>2932.9284</td>
</tr>
<tr>
<td>( n_1 )</td>
<td>3051</td>
<td>2756.7382</td>
<td>2792.9968</td>
</tr>
<tr>
<td>( n_2 )</td>
<td>2749.942</td>
<td>2709.9217</td>
<td>2715.1278</td>
</tr>
</tbody>
</table>

| LR               | 3235.032***  | (0.000)      | (0.000)      |
|                  | [0.000]      | [0.000]      | [0.000]      |
| LR               | 2820.846***  | (0.000)      | (0.000)      |
|                  | [0.000]      | [0.000]      | [0.000]      |
| LR               | 2816.706***  | (0.000)      | (0.000)      |
|                  | [0.000]      | [0.000]      | [0.000]      |
| LR               | 1953.551***  | (0.000)      | (0.000)      |
|                  | [0.000]      | [0.000]      | [0.000]      |
| LR               | 1812.635***  | (0.000)      | (0.000)      |
|                  | [0.000]      | [0.000]      | [0.000]      |

| AIC              | -25431.15    | -24733.22    | -25515.13    |
|                  | -23763.98    | -21890.16    |
| log L            | 13278.34     | 12390.61     | 13088.88     |
|                  | 12011.19     | 10969.3      |

Notes: This table presents the estimates of the three regime TVTP-MSH model given in Equations (3) through (6). Robust standard errors are reported in parentheses, which are obtained using the sandwich estimator of Huber (1967) and White (1982) based on the outer product of gradients and the second derivative matrix. \( n \) is the total number of observations, \( n_k \) is the number of observations in regime \( k \), \( \tau_k \) is the duration of regime \( k \), and LR test is the linearity test. The LR test is nonstandard since there are unidentified parameters under the null. The \( \chi^2 \) p-values with degrees of freedom equal to the number of restrictions plus the number of parameters unidentified are given in parentheses and the p-values of Davies (1987) test are given in square brackets. The asterisks ***, ** and * represent significance at the 1%, 5%, and 10% levels, respectively.
Figure 1. Nominal stock market returns and volatility index.

Note: Market index values are rebased at one as of January 2000 for comparison purposes. Returns are calculated using local currency based stock market index values. V_XU100 is the 21-day volatility index for Borsa Istanbul 100 index.
Figure 2. Return and Smoothed Probability of 3-Regime Nonlinear TVTP-MS Model for Borsa Istanbul

Figure 3. Return and Smoothed Probability of 3-Regime Nonlinear TVTP-MS Model for Financial Sector

Figure 4. Return and Smoothed Probability of 3-Regime Nonlinear TVTP-MS Model for Industrial Sector

Note: Figure (a) plots the market return. The shaded regions in Figure (a) correspond to regimes where herding is supported with negative coefficients on squared returns in Equation (3). Figures (b)-(d) plot the smoothed regime probabilities for the 3-regime nonlinear TVTP-MS model in Equations (3) through (5). The shaded regions in Figures (b)-(d) correspond to the maximum smoothed probability among the three smoothed probabilities. Regime 0 is the low volatility, Regime 1 is the high volatility and Regime 2 is the extreme volatility.
**Figure 5.** Return and Smoothed Probability of 3-Regime Nonlinear TVTP-MS Model for Services Sector

**Figure 6.** Return and Smoothed Probability of 3-Regime Nonlinear TVTP-MS Model for Technology Sector

**Note:** See Figure 1.
Note: Figures plot the estimates of time varying transition probabilities $p_{ij,t+1} = P(S_{t+1}=i|S_t=j)$, i.e. the transition probability from state $j$ to state $i$, defined in Equation (6).
Figure 10. TVTP Estimates for Services

Figure 11. TVTP Estimates for Technology

Note: See Figure 6.
Volatility and Transparency of Financial Markets in the MENA Region

Hamid MOHTADI; University of Wisconsin-Milwaukee
Stefan RUEDIGER; Arizona State University

Abstract

Furman-Stiglitz (1998) hypothesize that improved transparency in financial markets intensifies volatility, yet more conventional wisdom exemplified by the International Monetary Fund’s position states that lack of transparency intensifies volatility. Mohtadi-Ruediger (2012) provide a theoretical model which brings the two concepts together, identifying a U-shaped relationship between volatility and transparency. This paper estimates the impact of transparency on financial volatility in MENA countries using a sample of 12 MENA countries over 10 years. The particular focus of the paper is to determine if financial markets in MENA follow different volatility patterns due to the impact of natural resources returns on the general economy. Taking into account the large importance of natural resources we identify a U-shaped pattern showing that financial transparency initially worsens and eventually decreases volatility of financial markets. Thus, the results provide important implications for reform of financial markets in the MENA economies.

Keywords: information, transparency, financial volatility, natural resources, oil

I. Introduction

Information asymmetry in financial markets and lack of financial transparency permeate many developing countries, but are particularly sever in those developing markets where modern financial institutions are still in their infancy. That is the case in many of the countries of the Middle East and North Africa (MENA) region, though not limited to this region. However, what does set this region conceptually apart is the influence of oil, and the potential for a natural resource curse mechanism to lead to poor governance (see for example ERF working paper by Elbadawi and Gelb 2010), and in turn poor for governance to undermine institutional and financial transparency.
At a theoretical level, a consequence of lack of transparency is “herd” behavior and the associated information cascades. Wikipedia defines information cascades as circumstances “when people observe the actions of others and then make the same choice that the others have made, independently of their own private information signals.” This is precisely the implication of the classic Grossman-Stiglitz (1980) information free-ridership paradox. But what it implies is that cascades are likely to flourish in low transparency environments where uncertainty is high.

The underlying uncertainties that generate financial cascades reflect either an underlying lack of institutional transparency, or short-run uncertainties associated with underlying structural or financial crisis. An instance of the latter is fresh from the credit freeze of late 2008 while instances of the former are widely discussed in international policy circles. For example, the 1994-95 Mexican crisis and of the 1997-98 emerging market crisis have been blamed on “a lack of transparency” (IMF, 2001). In this report, lack of transparency is characterized as “inadequate economic data, hidden weaknesses in financial systems, and a lack of clarity about government policies and policy formulation contributed to a loss of confidence that ultimately threatened to undermine global stability.” (ibid).

One might ask; what is the mechanism that actually links uncertainties (driven by either a lack of transparency or an underlying structural crisis) to financial cascades and the resulting volatility and is this mechanism different in natural resource rich countries? The theoretical work has focused on herd behavior. In this view, herd behavior is a link that connects informational asymmetry on one end, to financial cascades and stock market volatility on the other end. Several papers have identified the mechanism of herd behavior, showing how individuals follow others observed behavior regardless of their own private information (definition of herd behavior) (see Bikhchandani et al. 1992 and Bikhchandani and Sharma, 2000) or where agents updated their priors upon observing the actions of others; hence, public information, in the form of equity prices, does not enter into investor/trader decision (Lee, 1993).

These explanations focus primarily on how herd behavior may be generated in a micro setting but in doing so they overlook the possibility that financial cascades may occur at a systems level and as a systemic phenomenon. But what happens if lack of institutional transparency of the type

74 The “flash crash” of the US stock market in May 6, 2010 has been attributed to program trading. Such trading could qualify as herd behavior if mass sell or buy occurs when one computer program follows another and another, so on. However, actually testing this claim is not an easy task.
discussed for example by Gelos and Wei (2002) or the IMF (2001), imply that prices may not accurately reflect true market fundamental in the first place? Is the kind of herd behavior that may arise in this case different? Furthermore, the role of transparency in reducing volatility has been questioned by some. Thus, Furman and Stiglitz (1998) have argued that more transparency, which they interpret as a higher frequency of information release, could imply a higher, rather than a lower, price volatility. Bushee and Noe (2000) provide a mechanism for this by finding a positive association between corporate transparency and the volatility of the firm’s stock price. They argue that firms with higher levels of disclosure tend to attract certain types of institutional investors which use aggressive, short-term trading strategies which in turn can raise the volatility of the firm’s stock price.

This paper tries to explain these conflicting outcomes. Mohtadi Ruediger (2012) provide an analytical model in which financial volatility arises from the herd behavior of agents which is capable of producing cascades and is acute when transparency is limited and thus prices do not convey full information.

The analytical model from Mohtadi and Ruediger (2012) examines how herd behavior, driven by uncertainty about the accuracy of prices to reflect true fundamentals, can lead to financial cascades and dramatically larger stock market volatility. A summary of that paper is outlined in the Appendix 1. The theoretical results show that an inverted-U pattern emerges depicting the effect of market transparency on volatility, i.e., for some limited range, increased transparency actually increases volatility, but beyond a certain point, for sufficiently large increases in market transparency, volatility declines. Thus, the first (upward) portion seems to be consistent with the Furman-Stiglitz (1998) thesis that more frequent news and information intensifies volatility, while the second (downward) portion of the inverted-U follows the more conventional wisdom exemplified by the quote from the International Monetary Fund cited earlier. The fact that different patterns emerge and are highly sensitive to whether traders readily update their preferences or not, is consistent with what we know from the chaos literature.

In this paper we aim to empirically test the existence of a inverted u-shape relationship between financial transparency (or lack of) and financial volatility. In the MENA countries, the influence of oil is likely to produce additional complication. Of the several natural resource curse channels that are outlined and analyzed by Elbadawi and Gelb (2010) through which oil has the potential
to influence the economies of this region, two channels are relevant to our analysis: One is the size of oil rents themselves that may potentially influence governance structures (e.g., corruption) and thus transparency of information, and the second is the oil price which has been shown to be associated with economic performance in select MENA countries (ibid).

We use panel data for 2000-2009 for 12 MENA countries to test the prediction of a nonlinear relationship between stock market volatility and transparency. Using financial market transparency data from the World Economic Forum (strength of audit, and transparency of government policy), our findings provide strong and robust support for the inverted U theory outline earlier. We do not find a general pattern for the impact of oil rents on stock market volatility.

There are two key overall policy lessons that stem from our research: The first lesson is that targeted reforms that address financial transparency directly, such as the strengthening of auditing practices, are more critical and effective in promoting financial stability than are general macro policies, though the latter can also be useful. The second lesson is that even such targeted reforms as the strengthening of auditing practices are effective only when they are extensive: Limited transparency reforms may in fact worsen financial instability as indicated by the inverted U pattern. One example of reforms that are extensive are banking reforms and the regulatory compliance of the banking systems with BASEL rules (BASEL II and III). These rules entail, among other elements, the strengthening of auditing practices but go much beyond. Such reforms should go a long way in producing greater financial stability.

In what follows we outline the empirical approach, discuss the results of our regression and provide concluding remarks and policy implications.

II. Empirical methodology

To determine if the relationship between volatility and transparency is nonlinear we use daily stock market data for a panel of 12 MENA countries for 2000 to 2009 from GFD, along with specific indicators of financial transparency from the World Economic Forum. We use two such measures that are closely associated with our concept of financial market transparency: the strength of audit, and the transparency of government standards. Additional controls such as stock market turnover (to control of degree of liquidity) and volume of trade as well as a number
of other controls are taken from Word Development Indicators. We choose year 2000 as the starting point to allow sufficient number of economies to be included in our sample.

The dependent variable is generated from daily stock index values for each country in the sample. All daily stock index observations are normalized using country level CPI data to calculate real stock market returns. Finally, we calculate the standard deviation per country for each year of the daily real stock returns.

We also use a variety of variables to control for the general economic environment in each country and the world economy. We include labor rates into the regression to account for the international dimension of financial volatility. The 3-month LIBOR rate reflects a risk premium and is thus a good indicator of financial uncertainty. This instrument has also a key advantage over regional country specific instruments (e.g. domestic interest rates) in that it is independent of domestic financial markets in a way that the volatility domestic interest rates are not. In addition, we use a measure of trade activity to determine the exposure of each country to the world market and thus control for other potential sources of economic uncertainty. We add GDP per capita as a control variable to account for the general state of the economy in each country. Furthermore, we use several measures of trading activity in the stock market, such as turnover, trading volume and stock market capitalization. Finally, we are interested in the effect of natural resources on stock markets. The “natural resource curse” suggests that countries which relatively more dependent on natural resources exhibit more economic uncertainty than other countries. To account for this possibility we include in the regression, fuel exports as a share of total manufacturing exports, the level of world oil prices, rents derived from oil and gas as a share of GDP and rents derived from oil and gas relative to the size of the population.

To estimate our regressions we use a fixed effects panel estimator and include time and country fixed effects. Using a fixed-effects model instead of a random effects model is also supported by results from the Hausman test. We incorporate a linear and a squared term of our transparency measure to be able to determine the existence of the inverted u-shape relationship between volatility and transparency as predicted by Mohtadi and Ruediger (2012).
III. Results

Descriptive statistics, list of countries and a description of the variables are presented in Appendix 2. Tables 1-3 report the results in pairs. In each pair the first column reports results for regressions including country fixed effects and the second column contains results for country and time fixed effects. The dependent variable in all cases is daily real return stock volatility. Table 1 reports results for the basic regression setup. In table 2 we show results for various “oil curse” measures and in table 3 we report results for a variety of alternative stock market measures.

Initial results (table 1) indicate strong support for the inverted U-effect as reflected by the signs for variable, “transparency of government policy. While the coefficients of the “strength of audit and accounting standards” variables have the correct signs, these coefficients are not statistically significant. Results in table 1 also show that fuel exports as a percentage of total manufacturing exports decrease volatility of financial markets. This is a surprising results as the general expectation is that the strong focus on oil in MENA countries cause a lack of diversification in the domestic economies and thus makes them more vulnerable to shocks. However, while more fuel exports lead to less volatility, an increase in trade leads to more volatility. Although the latter result is not statistically significant.

As for other regressors, one variable of interest is the dummy variable associated with the 2008 crisis. This variable takes on the value of 1 for 2008 and zero otherwise. Financial crisis seems to have increased financial volatility in the MENA countries. Finally, trade provides some stabilizing influence on financial volatility. However, neither of these results is statistically significant. Results for GDP per capita and the Libor are not statistically significant either and do not have consistent signs across regressions.

Let us now focus on the additional oil curse variables (table 2). For this purpose, we introduce three additional variables to the full sample: oil rents as a fraction of GDP, oil rents as a fraction of the population size and average world oil prices. Neither of the variables has a statistically significant impact on volatility. However, the sign on oil rents is positive and thus indicates that oil rents have an opposite effect on volatility as compared to fuel exports. Furthermore it needs to be noted that including these additional oil variables into the regression, eliminates the significance of the nonlinear effect.
Finally, we include two other measures of stock market activity in our regressions (Table 3), market capitalization and trading volume. The results in Table 3 confirm the findings of a nonlinear relationship between transparency and volatility presented in Table 1. We also find that larger stock markets in MENA countries exhibit less volatility than smaller stock markets (Table 3 Columns 9-12). It is possible that larger markets are generally more transparent and thus efficient than smaller markets and therefore experience less herd behavior and less volatility. The results for the impact of trading volume on volatility are insignificant and not consistent across regressions.

IV. Summary and conclusion

Since financial cascades flourish under extreme forms of uncertainty, they are likely to flourish in informationally and institutionally imperfect markets. Of the two empirical measures of transparency that we have presented the variable “transparency of gov’t policy” is found to provide solid support for the existence of a inverted u-shape pattern between transparency and volatility of financial markets.

There are two key overall policy lessons that stem from our research: The first lesson is that targeted reforms that address financial transparency directly, such as the strengthening of auditing practices, are more critical and effective in promoting financial stability than are general macro policies, though the latter can also be useful. The second lesson is that even such targeted reforms as the strengthening of auditing practices are effective only when they are extensive: Limited transparency reforms may in fact worsen financial instability as indicated by the inverted U pattern. It is in this range where the Furman and Stiglitz (1998) hypothesis that higher transparency can worsen financial volatility finds validity. One example of reforms that are extensive are banking reforms and the regulatory compliance of the banking systems with BASEL rules (BASEL II and III). These rules entail, among other elements, the strengthening of auditing practices but go much beyond. Such reforms should go a long way in producing greater financial stability.
References


Tobias, Adrian (2008) “Inference, Arbitrage, and Asset Price Volatility” Federal Reserve Bank of New York Staff Reports no. 187

Results

Table 1 – Volatility of daily stock index returns

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparency</td>
<td>112.03**</td>
<td>117.29**</td>
<td>23.412</td>
<td>24.994</td>
</tr>
<tr>
<td></td>
<td>(44.436)</td>
<td>(48.540)</td>
<td>(22.144)</td>
<td>(26.424)</td>
</tr>
<tr>
<td>transparency-squared$^2$</td>
<td>-11.950**</td>
<td>-12.560**</td>
<td>-1.9363</td>
<td>-2.1349</td>
</tr>
<tr>
<td></td>
<td>(4.7916)</td>
<td>(5.2578)</td>
<td>(1.9314)</td>
<td>(2.3114)</td>
</tr>
<tr>
<td>Loggdppc</td>
<td>-0.6151</td>
<td>-8.2389</td>
<td>7.3413</td>
<td>12.304</td>
</tr>
<tr>
<td></td>
<td>(3.7879)</td>
<td>(7.7444)</td>
<td>(5.9124)</td>
<td>(12.854)</td>
</tr>
<tr>
<td>Trade</td>
<td>0.04810</td>
<td>0.01414</td>
<td>0.001313</td>
<td>0.03518</td>
</tr>
<tr>
<td></td>
<td>(0.07426)</td>
<td>(0.06409)</td>
<td>(0.04542)</td>
<td>(0.07403)</td>
</tr>
<tr>
<td>Turnover</td>
<td>0.07934</td>
<td>0.09311</td>
<td>0.06571</td>
<td>0.05087</td>
</tr>
<tr>
<td></td>
<td>(0.04726)</td>
<td>(0.06343)</td>
<td>(0.07510)</td>
<td>(0.07087)</td>
</tr>
<tr>
<td>monthmn3</td>
<td>-0.1127</td>
<td>-0.3955</td>
<td>0.4463</td>
<td>0.6754</td>
</tr>
<tr>
<td>Country Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Time Fixed Effects</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>R²</td>
<td>0.645</td>
<td>0.659</td>
<td>0.349</td>
<td>0.356</td>
</tr>
<tr>
<td>N</td>
<td>47</td>
<td>47</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>

* p<0.10, ** p<0.05, *** p<0.01, standard errors in parenthesis, standard errors clustered at country level
## Table 2 – Volatility of daily stock index returns – alternative measures of oil revenue

<p>|       | (i)   | (ii) | (iii) | (iv) | (v)  | (vi) | (vii) | (viii) | (ix)  | (x)  | (xi) | (xii) | (xiii) | (xiv) | (xv)  | (xvi) |
|-------|-------|------|-------|------|------|------|-------|-------|------|------|------|-------|-------|------|-------|
|       | transpgovt | transpgovt | strgtaudit | strgtaudit | transpgovt | transpgovt | strgtaudit | strgtaudit | transpgovt | transpgovt | strgtaudit | transpgovt | transpgovt | strgtaudit |
| transparency   | 112.03** | 117.29** | 23.412 | 44.994 | 44.069 | 48.818 | 7.125 | 5.6083 | 67.800 | 78.284 | 8.8576 | 9.8615 | 68.469 | 77.915 | 12.892 |
| transparency-squared | -11.950** | -12.560** | -1.9363 | -2.1349 | -4.6818 | -5.2316 | -0.6797 | -0.4664 | -7.2626 | -8.4828 | -0.7316 | -0.9381 | -7.3080 | -8.4304 | -1.726 |
| fuelx   | -0.5382* | -0.5846 | -0.8854* | -0.8778 |
| oil_mean | 0.1586 | 0.1863 | -0.04659 | 0.03811 |
| logoilgasdp | 46.310 | 47.390 | 23.631 | 25.172 |
| logoilgaspop | -0.3202 | 1.3672 | -0.3561 | 1.9757 |</p>
<table>
<thead>
<tr>
<th>Country Fixed Effects</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Fixed Effects</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>R²</td>
<td>0.645</td>
<td>0.659</td>
<td>0.349</td>
<td>0.336</td>
<td>0.229</td>
<td>0.247</td>
<td>0.123</td>
<td>0.129</td>
<td>0.381</td>
<td>0.442</td>
<td>0.162</td>
<td>0.193</td>
<td>0.355</td>
<td>0.422</td>
</tr>
<tr>
<td>N</td>
<td>47</td>
<td>47</td>
<td>55</td>
<td>55</td>
<td>53</td>
<td>53</td>
<td>62</td>
<td>62</td>
<td>46</td>
<td>46</td>
<td>55</td>
<td>55</td>
<td>46</td>
<td>46</td>
</tr>
</tbody>
</table>

*p<0.10, **p<0.05, ***p<0.01, standard errors in parenthesis, standard errors clustered at country level
Table 3 – Volatility of daily stock index returns – alternative measures of stock market activity

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>transpgovtpol</td>
<td>transpgovtpol</td>
<td>strgtaudit</td>
<td>strgtaudit</td>
<td>transpgovtpol</td>
<td>transpgovtpol</td>
<td>strgtaudit</td>
<td>transpgovtpol</td>
<td>transpgovtpol</td>
<td>strgtaudit</td>
<td>strgtaudit</td>
<td></td>
</tr>
<tr>
<td>transparency</td>
<td>112.05**</td>
<td>117.29**</td>
<td>23.412</td>
<td>24.994</td>
<td>109.56*</td>
<td>111.91*</td>
<td>13.220</td>
<td>19.745</td>
<td>112.44**</td>
<td>115.76**</td>
<td>14.486</td>
<td>19.393</td>
</tr>
<tr>
<td></td>
<td>(4.7916)</td>
<td>(5.2578)</td>
<td>(1.9314)</td>
<td>(2.3041)</td>
<td>(5.2652)</td>
<td>(5.6609)</td>
<td>(0.9691)</td>
<td>(1.4846)</td>
<td>(5.4778)</td>
<td>(5.5994)</td>
<td>(0.8190)</td>
<td>(1.4524)</td>
</tr>
<tr>
<td>turnover</td>
<td>0.07934</td>
<td>0.09331</td>
<td>0.06731</td>
<td>0.09087</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.04726)</td>
<td>(0.06343)</td>
<td>(0.05790)</td>
<td>(0.07087)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stockvolume</td>
<td>0.004294</td>
<td>-0.009542</td>
<td>-0.007623</td>
<td>-0.02057</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.03669)</td>
<td>(0.03871)</td>
<td>(0.01377)</td>
<td>(0.01379)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>marketcap</td>
<td>-0.05021</td>
<td>-0.06248*</td>
<td>-0.02873**</td>
<td>-0.02914**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.03088)</td>
<td>(0.03323)</td>
<td>(0.01993)</td>
<td>(0.01241)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Time Fixed Effects</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>R²</td>
<td>0.645</td>
<td>0.659</td>
<td>0.349</td>
<td>0.356</td>
<td>0.608</td>
<td>0.645</td>
<td>0.523</td>
<td>0.350</td>
<td>0.631</td>
<td>0.652</td>
<td>0.338</td>
<td>0.359</td>
</tr>
<tr>
<td>N</td>
<td>47</td>
<td>47</td>
<td>55</td>
<td>55</td>
<td>47</td>
<td>47</td>
<td>55</td>
<td>55</td>
<td>47</td>
<td>47</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>

*p < 0.10, ** p < 0.05, *** p < 0.01, standard errors in parenthesis, standard errors clustered at country level
Appendix 1: Outline of Mohtadi-Ruediger (2012a and 2012b)

Mohtadi and Ruediger (2012a and 2012b) consider two distinct forms of information: the equity price, and the ask-to-bid volume ratio. The latter is a proxy for the equity price momentum as it reflects the underlying sell-to-buy ratio or strength of supply and demand for securities. Ask-to-bid volume ratio may also contain useful information when agents are heterogenous. In fact Wang (1994) argues that the heterogeneity among investors is precisely what gives rise to volume behavior, implying that volume conveys important information about fundamental values. Agents are thus distributed randomly by a continuum of these reservation prices and reservation ask-to-bid volume ratios such that the observed price or sell to buy ratio may exceed one agent's reservation value but be less than another agent's reservation value, thus creating a market of both sellers and buyers. A final decision by an agent of whether to sell or buy will be based on the weighted average of both price and quantity considerations, where the weight on the quantity factor (the bid to ask volume ratio) increases with the degree of price opacity. Even though agents' initial valuation may be random and subjective, it turns out that with full information, markets converge and are stable. But in the presence of price opacities cascades may emerge. We treat each channel separately, as if agents focused on one channel at a time. We then focus on the combined decision based on both price and quantity channels.

A key aspect of allowing for the quantity channel is that it produces a herd effect that dominates when market is uncertain and prices are opaque. Moreover this effect is unstable and represents the high level of volatility that is historically observed during financial crisis.

Several key equations of Mohtadi-Ruediger are as follows:

\[
\begin{align*}
\text{quantity channel:} & \quad \mathbb{Q} = \mathbb{Q} + \mathbb{Q} |\text{quantity channel} \\
\text{price channel:} & \quad \mathbb{P} = \mathbb{P} + \mathbb{P} |\text{price channel} \\
\end{align*}
\]

\[
\begin{align*}
\mathbb{Q} & = f(\eta_r) + g(P_r) \\
\mathbb{P} & = \Theta \mathbb{P} + \mathbb{P} |\text{price channel} \\
\end{align*}
\]

where \( f(\eta_r) \) and \( g(P_r) \) represent the distribution of agents as a function of their reservation price, \( P_r \) and reservation sell-to-buy ratio, \( \eta_r \) while \( P_r \) and \( \eta_r \) represent the observed value of these parameters at \( t \). One can think of \( 1-\Theta \) and \( \Theta \) as an indication of the weight that the market puts on prices, and other investors' behavior, respectively. Mohtadi and Ruediger show how \( \Theta \) is related to the opacity of the markets. Intuitively, since in non-transparent states of the market,
prices are not as informative, the herd effect or the reliance on other investor’s behavior (the quantity channel) becomes more prominent as a conveyor of information.

A key aspect of Mohtadi-Ruediger’s model is the role of the price adjustments. Prices are subject to (i) the usual Geometrical Brownian Motion as indicated by the Wiener process and (2) a price response function to ratio, analogous to economists’ excess demand function, using an innovation by Jarrow and Protter (2005):

\[ P_t(\eta_t) = P(0)G(\eta_t) \text{ with } G'(\eta_t) < 0 \]

To numerically simulate this model explicit form of the distributions are needed. Mohtadi and Ruediger (2012) use a Pareto distribution for and explain their choice based on Gabaix, et. al. (2006, 2008), Newman (2005) Johnson and Spagat (2005) and Mohtadi and Murshid (2009). Finally, the excess demand function has a constant elasticity form.

The Monte Carlo simulation revolves around randomizing two stochastic processes: the price adjustment process via the Wiener process and the macro-herd process. Using Matlab to carry out the simulation program for each choice of parameter value (see below) up to 10,000 simulations for 100 time periods are run corresponding roughly to 100 trading days. Details of simulation are available from Mohtadi and Ruediger. Simulation results point to an inverted U: A rise in transparency initially increases volatility before it brings it down. In the first leg of the figures, we have high values of (the quantity dimension is dominant). With greater transparency falls. However, the inherent volatility in prices means that the greater reliance on the price channel (as increases) does not necessarily lower volatility and in fact increases it. Eventually greater transparency conquers and price volatility falls (second leg). The explanation for the first leg of the curve is consistent with the Furman-Stiglitz effect (Furman and Stiglitz 1998) in which more transparency (which they interpret as a higher frequency of information release), increases price volatility. However, these findings seem to suggest that this is not because of what Bushee and Noe (2000) called the competition among fund managers (a form of herd behavior) but because of the inherent price fluctuations. While the macro quasi-herd behavior plays a key role in this process, its impact is not just direct, but also indirect acting via the price volatility that it entails.
Figure 1-Transparency and Volatility ($V$ indicates the speed of reservation value updates)

Panel A

Panel B

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>real_return_volatility</td>
<td>116</td>
<td>0.36</td>
<td>3.3</td>
<td>0</td>
<td>35.24</td>
</tr>
<tr>
<td>transpgovt-l</td>
<td>58</td>
<td>4.52</td>
<td>0.56</td>
<td>3.3</td>
<td>5.6</td>
</tr>
<tr>
<td>Strgtaudit</td>
<td>67</td>
<td>5.12</td>
<td>0.5</td>
<td>3.8</td>
<td>6.2</td>
</tr>
<tr>
<td>Loggdppc</td>
<td>112</td>
<td>9.08</td>
<td>1.2</td>
<td>6.95</td>
<td>11.37</td>
</tr>
<tr>
<td>Trade</td>
<td>Trade</td>
<td>108</td>
<td>92.7</td>
<td>31.52</td>
<td>39.02</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------------</td>
<td>-----</td>
<td>------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Turnover</td>
<td>Turnover ratio</td>
<td>117</td>
<td>41.48</td>
<td>46.49</td>
<td>0</td>
</tr>
<tr>
<td>monthmn3</td>
<td>LIBOR 3 month</td>
<td>113</td>
<td>3.2</td>
<td>1.83</td>
<td>0.69</td>
</tr>
<tr>
<td>Fuelx</td>
<td>Fuel Exports</td>
<td>101</td>
<td>44.22</td>
<td>49.71</td>
<td>0.01</td>
</tr>
<tr>
<td>oil_mean</td>
<td>Oil Price</td>
<td>120</td>
<td>49.61</td>
<td>23.36</td>
<td>24.46</td>
</tr>
<tr>
<td>logioilgas-p</td>
<td>Oil &amp; Gas Rents (% of GDP)</td>
<td>108</td>
<td>0.19</td>
<td>0.18</td>
<td>0</td>
</tr>
<tr>
<td>Logoilgaspop</td>
<td>Oil &amp; Gas Rents (% of Population)</td>
<td>99</td>
<td>2.67</td>
<td>1.63</td>
<td>-0.72</td>
</tr>
<tr>
<td>Stockvolume</td>
<td>Stocks traded, total value (%)</td>
<td>119</td>
<td>35.93</td>
<td>60.05</td>
<td>0</td>
</tr>
<tr>
<td>Marketcap</td>
<td>Market capitalization (%)</td>
<td>117</td>
<td>71.8</td>
<td>55.02</td>
<td>7.04</td>
</tr>
</tbody>
</table>

Panel C

![Price Volatility and Transparency](image_url)
Appendix 2.

Descriptive statistics

List of Countries

<table>
<thead>
<tr>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
</tr>
<tr>
<td>Egypt, Arab Rep.</td>
</tr>
<tr>
<td>Israel</td>
</tr>
<tr>
<td>Jordan</td>
</tr>
<tr>
<td>Kuwait</td>
</tr>
<tr>
<td>Lebanon</td>
</tr>
<tr>
<td>Morocco</td>
</tr>
<tr>
<td>Oman</td>
</tr>
<tr>
<td>Qatar</td>
</tr>
<tr>
<td>Saudi Arabia</td>
</tr>
<tr>
<td>Tunisia</td>
</tr>
<tr>
<td>United Arab Emirates</td>
</tr>
</tbody>
</table>

Description of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition and Construction</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Stock Market Return</td>
<td>Annual volatility of daily stock index returns</td>
<td>Global Financial Data</td>
</tr>
<tr>
<td>Volatility</td>
<td></td>
<td><a href="http://www.globalfinancialdata.com/">www.globalfinancialdata.com/</a></td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Source</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>accounting standards</td>
<td>performance in your country are (1=extremely weak, 7=extremely strong)</td>
<td></td>
</tr>
<tr>
<td>Transparency of government</td>
<td>Are firms in your country usually informed clearly by the government of</td>
<td>World Economic Forum, Global Competitiveness Report 2000-2009</td>
</tr>
<tr>
<td>policymaking</td>
<td>changes in policies and regulations affecting your industry? (1=never</td>
<td></td>
</tr>
<tr>
<td></td>
<td>informed, 7=always informed)</td>
<td></td>
</tr>
<tr>
<td>Fuel Exports</td>
<td>Fuel exports (% of merchandise exports)</td>
<td>WDI, 2012</td>
</tr>
<tr>
<td>Trade</td>
<td>Ratio of sum of Exports and imports to GDP</td>
<td>WDI, 2012</td>
</tr>
<tr>
<td>Turnover ratio</td>
<td>Total value of shares traded during the period divided by the average</td>
<td>WDI, 2012</td>
</tr>
<tr>
<td></td>
<td>market capitalization for the period</td>
<td></td>
</tr>
<tr>
<td>Stocks traded, total value (%)</td>
<td>Ratio of total value of stocks traded to GDP</td>
<td>WDI, 2012</td>
</tr>
<tr>
<td>(% of GDP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market capitalization (%)</td>
<td>Market capitalization (also known as market value) is the share price times</td>
<td>WDI, 2012</td>
</tr>
<tr>
<td>(% of GDP)</td>
<td>the number of shares outstanding. (% of GDP)</td>
<td></td>
</tr>
<tr>
<td>Log of GDP per capita</td>
<td>Ratio of total GDP to population in constant 2000 US$</td>
<td>WDI, 2012</td>
</tr>
<tr>
<td>LIBOR 3 month</td>
<td>Mean of Annual LIBOR data for 3-months</td>
<td>Wall Street Journal and <a href="http://www.mortgate-x.com">www.mortgate-x.com</a></td>
</tr>
<tr>
<td>Oil Price</td>
<td>Annual average Europe Brent Spot Price</td>
<td>U.S. Energy Information</td>
</tr>
<tr>
<td></td>
<td>FOB (Dollars per Barrel)</td>
<td>Administration, <a href="http://www.eia.gov">http://www.eia.gov</a></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td><strong>Oil &amp; Gas Rents (% of GDP)</strong></td>
<td>log of rents from oil + gas as share of GDP. Rents are defined as the price minus the average extraction costs. The data are described in Hamilton and Clemens (1999).</td>
<td>World Bank’s adjusted net savings dataset.</td>
</tr>
<tr>
<td><strong>Oil &amp; Gas Rents (% of Population)</strong></td>
<td>log of rents from oil + gas divided by size of population. Rents are defined as the price minus the average extraction costs. The data are described in Hamilton and Clemens (1999).</td>
<td>World Bank’s adjusted net savings dataset.</td>
</tr>
</tbody>
</table>
Hedging Strategy for Electricity Market Price Volatility: The Case of Turkish Electricity Market

Sezer Bozkus KAHYAOĞLU, sezer.bozkus@gtturkey.com

M. Vedat PAZARLIOĞLU, vedat.pazarlioglu@deu.edu.tr

Abstract

Turkish Electricity Market was launched in 2006. This event could be treated as a new and revolutionary period in Turkish Energy Markets since the electricity spot prices are determined by the market conditions thereafter. There was an amendment and advancement in the electricity price determination system in 2009 in order to enhance the electricity pricing mechanisms. In this respect, the volatility of electricity prices becomes the major explanatory variable for the forecast of electricity price demand in Turkey.

It is important for the markets participants to analyze and compare historical price behavior across the energy markets, along with a forecast of price volatility which provide price signals which can be incorporated into their inter-jurisdiction energy trade planning. In addition, these market participants may consider price volatility signals in their future investment plans in order to minimize the potential financial risks to which they might be exposed. However there is neither electricity nor any other energy futures market which makes it difficult for the market participants to utilize as hedging instruments in Turkey. In this work, Petrol Future Contracts are analyzed to forecast whether these contracts could be used as hedging instruments against the volatility of Turkish electricity market prices. Volatility in the Turkish electricity market prices are quantified and the optimal hedging ratio is estimated by using relevant econometric methods and approaches. Based on our empirical findings, recommendations are made for the market participants to assist them for hedging strategies and minimizing the energy costs.

Key Words: Hedge Ratio, M-GARCH, Electricity Price, Volatility

1. Introduction

Volatility is defined in the literature as the unpredictable variation of a process observed over time. Volatility is a key issue in economics and finance since volatility is fundamentally a measure to
study the risks in relation to holding assets when there is an uncertainty about the future value of the assets. Volatility forecasting and modeling is widely used for risk management and option valuation in financial markets (Jorion, 2001; Andersen et al., 2005) and also Jorion, (2001), Christoffersen, (2003) and, Andersen et al. (2005) develop volatility indices based on historical volatility. The major aim of this paper is not to introduce a new volatility measure for Turkish Electricity Market, rather to use available volatility measures to forecast optimal hedge ratio convenient for participants of Turkish Electricity Market to rely on risk management strategies. To the best of the authors' knowledge, no studies have been reported in the literature that quantifies the optimal hedge ratio for price volatility in the Turkish Electricity Market.

The rest of this paper is organized as follows: the major studies on electricity market prices and volatility spillover analysis between electricity markets and other financial and/or commodity markets are discussed in Section 2. The major facts and figures are given about the Turkish Electricity Market establishment and pricing rules and regulations in Section 3. The volatility measures and methodology employed in this work are described in Section 4. In Section 5, the presented measures and methodologies are applied to the Turkish Electricity Market prices and to the Future Crude Oil Contract prices and, the empirical findings are analyzed respectively. Section 6 summarizes the main findings of this empirical work with policy recommendations to market participants in order to consider for risk management and energy cost savings strategies.

2. Literature Review

There is plenty of historical volatility studies which are analyzed various electricity markets all over the world. Worthington et al. (2005) made a multivariate GARCH model analysis to examine the interrelationship among prices and price volatilities in the five Australian electricity markets. Dahlgren et al. (2001) use a value at risk methodology to study volatility of the Californian market prices. Benini et al. (2002) study the volatility of the electricity prices in the Californian, PJM, Spanish, and UK markets. The authors conclude that the Spanish and PJM electricity market prices were the least and most volatile, respectively. Li and Flynn (2004) also made volatility analysis on (14) electricity markets worldwide. In their paper, it is argued that there exists a widely varying price volatility behaviors being observed across different markets.

The concern in energy prices is not a latest incident. Rather, the global financial crisis and large fluctuations in energy prices have renewed concern on the dynamic relationship between markets and make it necessary to find optimum hedging instruments. There is an increasing trend in energy prices over the last 10 years, which is formed by the leading role of the upward trend in crude oil.
prices and, this trend was followed by a sharp decline when the global financial crisis occurred (Cevik and Sedik, 2011).

It is observed that in many countries electricity markets are getting liberalized in which large electricity purchasers need to contract the future expected electricity consumption (load) for their own company or for a pool of clients. This is achieved by managing a hedging portfolio of contracts in liberalized electricity markets by involving delivery of electricity in future time periods and/or financially settles the difference between a fixed and a variable price. There are examples of such contracts, namely day-ahead contracts, derivatives such as forwards, futures, swaps, variable volume or swing options and direct or indirect investments in energy production facilities. According to Huisman at al. (2009), there is a need for continuous assessment of (a) the types of instruments (contracts) to buy or sell and (b) at what moment the portfolio needs to be rebalanced according to the risks the electricity purchaser prefers to take in order to make a successful hedging portfolio. Basically, the objective of the purchaser is to incur the lowest expected costs for the expected electricity load, given a particular risk level.

Since the electricity cannot be stored in an efficient way, the electricity prices are observed to be volatile, and also seasonality frequently occurs. In order to overcome this problem and to support trading of energy contracts many countries have launched over-the-counter (OTC) and organized markets. There are two common markets known as the day-ahead and forward/futures markets. On the day-ahead market, traders can submit bids and offers for amounts of electricity to be delivered in the individual hours of the next day. This market is the closest equivalent to a spot market. Electricity purchasers use day-ahead markets for buying (a part of) their electricity consumption, but the amount of price variation in these markets is substantial.

The optimal portfolio selection depends on a risk assessment of the day-ahead market, an expectation regarding the expected price in the day-ahead market in the delivery period, the amount of risk premium needed to be paid depending on the appetite for taking risk. The major goal of a typical portfolio manager is to maintain such a portfolio that yields lowest expected costs for electricity consumption while respecting the risk appetite level of the organization.

In this paper we consider the original ideas from Markowitz (1952), who proposes a methodology to build an efficient investment portfolio based o maximizing the expected future returns given a certain level of risk. Several researchers have followed the Markowitz approach to study the hedging decision process. For instance Näsäkkälä and Keppo (2005) and Woo et al. (2004) focus on the interaction between stochastic day-ahead consumption volumes and forward contracts of electricity prices and these authors propose a mean-variance framework to determine optimal
hedging strategies. Näsäkkälä and Keppo (2005) apply static forward hedging strategies in a representative agent setting and discuss that agents who are confronted with high load uncertainties will postpone their hedging strategies in the expectation of load uncertainties resolving over time. The findings of their empirical work depend on the assumption on the correlation between forward prices and load estimates. According to Huisman at al. (2009), the relation between volumes, like load or demand, and prices is generally weak in electricity markets. On the other hand, the evidence in Mount et al. (2006) and Kanamura and Ohashi (2007), who demonstrate that only in extreme cases, where demand is extraordinarily high, that prices react significantly. In normal circumstances the impact of load on day-ahead electricity prices is statistically significant; however the economic significance of this result is limited.

It is a fact that these large fluctuations in the energy prices raised major questions waiting to be answered by the researchers. One such question is whether the fluctuations in electricity market prices lead to similar behavior in prices of future crude oil contracts, i.e. how is the volatility spillover mechanism between electricity spot prices and prices of future crude oil contracts. And if so, what is the structure and causality of this relationship? The answers to these questions are important for investors, traders and policy makers.

3. The Turkish Electricity Market Mechanism

The Turkish Electricity Market has not got a long history. The major reform steps are taken in the 2000’s to catch up the competitive market needs and expectation for the steadily growing Turkish Economy which are also essential for the harmonization with EU legislations and energy regulations. As an initial step to these reforms, the Turkish Electricity Generation and Transmission Co. (TEAS) was divided into three major organizations in 2001, namely Electricity Generation Co (EUAS), Turkish Electricity Trading and Contracting Co. (TETAS) and TEIAS (Turkish Electricity Transmission Co.) in order to serve for the functions of generation, wholesale and transmission, respectively. In addition, based on the Electric Power Sector Reform and Privatization Strategy Document, the Turkish Electricity Distribution Co. (TEDAS), the electricity distribution network administrating entity, was divided into (21) areas to be privatized in 2004. However, the privatization process could be physically launched in 2009, with the target of reduced costs due to the expected improvement of the pricing mechanisms, resulting in lower end-user prices. The period (2000 -2010) could be named as liberalization process in Turkish Electricity Markets as well.

The Turkish Wholesale Electricity Market currently consists of an organized day ahead market (DAM). This day ahead market (DAM) is operated by an official Market Operator, namely PMUM.
PMUM is a department inside TEIAS which is a real-time system balancing and operational mechanism operated by Turkish Electricity Transmission Corporation (TEIAS) as the Transmission System Operator. TEIAS also operates as a bilateral contracts market in Turkey. In addition, there is an organized market for procurement of ancillary services and the hourly settlement of imbalances has been done since December 2009. The Turkish wholesale electricity market is organized as a bilateral contracts market complemented by a balancing mechanism. The Turkish Day Ahead Market (DAM) became effective on 1st December 2012. DAM is established as an organized wholesale spot electricity market and the major responsibilities are delivering transactions of purchase and sale electricity in the day ahead on the basis of settlement period (1 Hour) and the system is operated by the Market Operator, namely PMUM. It gives the opportunity to the market participants to balance their electricity generations or/and consumptions and bilateral contract obligations. In this way the participants are supported to provide a balanced system to the system operator at day ahead stage. DAM is generally used in most of the European Countries and it is stated that Turkish DAM Day market design has common features compared to the energy market systems of Nordic countries, namely as Nordpool Spot which is the Market Operator and equivalent of MFSC (PMUM) in Norway, Sweden Denmark and Finland. The price determination process in Turkish DAM is executed daily, between 12:00 – 13:00 hours each day for each hour in the following day. The price determination process is basically based on matching the hourly purchase bids and sale offers for all trade zones and calculation of the Market Clearing Price by considering all bids/offers submitted. The Turkish Electricity market structure and the development process are shown at the Figure 1.
Figure 2: Turkish Electricity Market Development

Source: TEIAS

08.2006 – 11.2009
Transition Period

- Balancing Mechanism
- Monthly period settlement

Stage 1

- Day Ahead Planning
- Balancing Power Market
- Hourly Settlement

Stage 2

Stage 2 Final Situation

- Day Ahead Market
- Balancing Power Market
- Hourly Settlement
- Collateral Mechanism

Stage 2 Current Situation

- Day Ahead Market
- Balancing Power Market
- Hourly Settlement
- Collateral Mechanism

We use the period of December 2009- May 2012
The Data and Methodology

The following data is used in the model:

TER (Turkish Electricity Return): The daily average electricity settlement prices for the period Dec 2009 to May 2013 taken from TEIAS to calculate the return series.

BFR (Brent Futures Return): The Brent Futures prices for the Dec 2009 to May 2013 from web link of eia to calculate the return series.

We consider the day effect and use dummy variables to capture the day and shocks effects. Since electricity prices are in TL and Brent future prices are in USD, we use USD/TL exchange rates to suggest hedging strategy in the same monetary unit.

We use the below equation for calculating the return series.

\[ r_{g,t} = \log \left( \frac{P_{g,t}}{P_{g,t-1}} \right) \]  

(1)

\[ R_{H,t} = R_{S,t} - \gamma_t R_{F,t} \]  

(2)

where \( R_{H,t} \) is the return on holding the portfolio between t-1 and t,

\( R_{S,t} \) and \( R_{F,t} \) are the returns on holding spot and future positions between t and t-1,

\( \gamma_t \) is the hedge ratio; in other words the number of future contracts that the hedger must sell for each unit of spot commodity on which price risk is borne.

According to Johnson (1960), the variance of the returns of the hedge portfolio conditional on the information set available at time t-1 is given by:

\[ \text{var}(R_{H,t} | \Omega_{t-1}) = \text{var}(R_{S,t} | \Omega_{t-1}) - 2\gamma_t \text{cov}(R_{S,t}, R_{F,t} | \Omega_{t-1}) + \gamma_t^2 \text{var}(R_{F,t} | \Omega_{t-1}) \]  

(3)

The optimal hedge ratios are defined as the value of \( \gamma_t \) which minimizes the conditional variance (risk) of the hedge portfolio returns. By taking the partial derivatives of the equation with respect to \( \gamma_t \), setting it equal to zero and solving for \( \gamma_t \), gives the optimal hedge ratio available at t-1 (Baillie and Myers, 1991).
where returns are defined as the logarithmic differences of spot and futures prices. From the multivariate conditional volatility model, the conditional covariance matrix is obtained, such that the optimal hedge ratio is given as:

$$\gamma_t^* | \Omega_{t-1} = \frac{h_{SP,t}}{h_{F,t}}$$

(5)

Empirical Findings

The descriptive statistics of the data are examined and the results indicate that they are not normally distributed. In addition the unit root test results are shown at the below table (Table 1):

Table 1: Unit root test results of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF Unit Root Test with Constant</th>
<th>Philips Perron Unit Roots Test with Constant</th>
<th>Kwiatkowski-Phillips-Schmidt-Shin with Constant</th>
<th>Geweke Porter – Hudak Fractional Unit Root Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFR</td>
<td>-26.12*</td>
<td>-35.19*</td>
<td>0.73</td>
<td>0.44*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.00)**</td>
</tr>
<tr>
<td>TER</td>
<td>-5.01</td>
<td>-39.13</td>
<td>0.73</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.64)**</td>
</tr>
</tbody>
</table>

*%1 = 3.43, %5 = 2.86, %1 = 0.46, %5 = 0.34
**prob values

Starting with the seminal paper of Engle (1982), traditional time series tools such as autoregressive moving average (ARMA) models (Box and Jenkins, 1976) for the mean have been extended to essentially analogous models for the variance.

We observe that Autoregressive conditional heteroscedasticity (ARCH) models are frequently used to illustrate and forecast changes in the volatility of high frequency financial time series. For a

The common application of MGARCH (multivariate GARCH) models is based on the study of the relations between the volatilities and co-volatilities of several markets. We try various approaches namely diagonal BEKK (Engle and Kroner, 1995) CCC (Bollerslev, 1990), DCC (Engle, 2002 and Tse and Tsui, 2002), the dynamic equicorrelation -DECO (Engle and Kelly, 2008).

We finally decide to use the diagonal BEKK since it provides the only positive variance coefficients condition during the model estimation process.

Figure 2: Conditional Covariance – TER and BFR
### Table 2: Diagonal BEKK Model

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TER-SAT</td>
<td>-0.068804</td>
<td>0.014018</td>
<td>-4.908393</td>
<td>0.0000</td>
</tr>
<tr>
<td>TER-SUN</td>
<td>0.269861</td>
<td>0.015642</td>
<td>17.25197</td>
<td>0.0000</td>
</tr>
<tr>
<td>TER-MON</td>
<td>0.160290</td>
<td>0.020841</td>
<td>7.691030</td>
<td>0.0000</td>
</tr>
<tr>
<td>TER-TUE</td>
<td>0.069910</td>
<td>0.019390</td>
<td>3.605576</td>
<td>0.0003</td>
</tr>
<tr>
<td>TER-WEN</td>
<td>0.043370</td>
<td>0.020220</td>
<td>2.144915</td>
<td>0.0320</td>
</tr>
<tr>
<td>TER-THU</td>
<td>0.007277</td>
<td>0.013253</td>
<td>0.549129</td>
<td>0.5829</td>
</tr>
<tr>
<td>TER-FRI</td>
<td>0.028184</td>
<td>0.015633</td>
<td>1.802833</td>
<td>0.0714</td>
</tr>
<tr>
<td>EPDK</td>
<td>-0.051348</td>
<td>0.010522</td>
<td>-4.879958</td>
<td>0.0000</td>
</tr>
<tr>
<td>BFR-MON</td>
<td>0.001757</td>
<td>0.000855</td>
<td>2.054747</td>
<td>0.0399</td>
</tr>
<tr>
<td>BFR-TUE</td>
<td>0.000817</td>
<td>0.000810</td>
<td>1.009558</td>
<td>0.3127</td>
</tr>
<tr>
<td>BFR-WEN</td>
<td>0.001473</td>
<td>0.000785</td>
<td>1.877670</td>
<td>0.0604</td>
</tr>
<tr>
<td>BFR-THU</td>
<td>-0.003405</td>
<td>0.000857</td>
<td>-3.975581</td>
<td>0.0001</td>
</tr>
<tr>
<td>BFR-FRI</td>
<td>0.000291</td>
<td>0.002185</td>
<td>0.133136</td>
<td>0.8941</td>
</tr>
</tbody>
</table>

**Variance Equation Coefficients**

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\mu_{11})</td>
<td>0.012857</td>
<td>0.001670</td>
<td>7.696751</td>
<td>0.0000</td>
</tr>
<tr>
<td>(\mu_{22})</td>
<td>1.34E-06</td>
<td>5.66E-07</td>
<td>2.359843</td>
<td>0.0183</td>
</tr>
<tr>
<td>(\alpha_{11})</td>
<td>1.219305</td>
<td>0.029283</td>
<td>41.63871</td>
<td>0.0000</td>
</tr>
<tr>
<td>(\alpha_{22})</td>
<td>0.144859</td>
<td>0.012750</td>
<td>11.36151</td>
<td>0.0000</td>
</tr>
<tr>
<td>(\beta_{11})</td>
<td>0.612583</td>
<td>0.010583</td>
<td>57.88255</td>
<td>0.0000</td>
</tr>
<tr>
<td>(\beta_{22})</td>
<td>0.986314</td>
<td>0.002469</td>
<td>399.4087</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
Based on the below formula 6;

\[
\gamma_r^{\text{r}} | \Omega_{t-1} = \frac{\text{cov}(R_{s,t}, R_{F,t} | \Omega_{t-1})}{\text{var}(R_{F,t} | \Omega_{t-1})} \tag{6}
\]

the ratio of conditional covariances of TER and BFR (Cov TER, BFR) to Var (BFR), the optimal hedge ratio for Turkish Electricity Market prices is equal to 0.4844. There is a need for approximately 0.5 petrol future position to hedge every one unit electricity spot price.

Based on the below formula 775;

\[
w_{SF,t} = \frac{h_{F,t} - h_{SF,t}}{h_{S,t} - 2h_{SF,t} + h_{F,t}} \tag{7}
\]

the optimal hedge ratio for Turkish Electricity Market prices is equal to 0.000105. This indicates that the petrol futures are the right hedging instrument for Turkish Electricity Market prices by providing almost optimal efficiency.

Concluding Remarks

Based on a thorough liberalization process, the Turkish Electricity Market mechanisms are continually changing. The goal of Turkish Electricity Market liberalization is basically to increase

---

75 The equation is taken from the original article of Kroner and Ng (1995), p. 839.
the economic efficiency of the electricity supply industry. The introduction of competition in the generation and retail supply of electricity is expected to improve efficiency by minimizing operating costs. In addition, it is essential to use hedging instruments. We recommend for policy makers to consider this fact and establish energy futures market in Turkey shortly. Until that time, the petrol futures could be used as hedging instrument for Turkish electricity market.
References


USAID, USAID/CAUCASUS Office Of Energy And Environment, Turkish Electricity Market Review, November 30, 2012


The Impact of Financial Innovation on Firm Stability

Fabian Kuehnhausen

Abstract

In this paper, I evaluate the impact of competition on firm stability between financial agents who are able to invest in innovations to reap profits. Given a vast array of concerns and interconnections between financial innovations, financial distress of firms and financial crises provided by theoretical assessments, I analyze empirically the causal link between a financial agents’ innovativeness and stability.

Using a unique data set on financial innovations in the USA between 1990 and 2002, I can show that a larger degree of innovation negatively affects firm stability safe for the underlying firm characteristics. The results are robust against different modifications of innovation measures and against different fragility parameters indicating profitability, activity risk and risk of insolvency.

JEL Codes: G01, G11, G2, L11, O31

Keywords: Incentives to innovate, Financial Innovation, Fragility

1. Introduction

Numerous researchers have analyzed the causes for distress in the aftermath of the recent financial crisis starting in 2007. They came up with a variety of plausible reasons both through theoretical and empirical analyzes as well as stylized facts. These include panics of bank customers and major investors, shocks to money supply, debt financing and to the real economy, as well as the interconnectedness of banks and their complexity. A recent strand of literature76 tries to argue however, that a competitive financial system and the non-patentability of financial innovations (FI) can cause a financial crisis. These papers analyze the incentives to innovate and the relation to financial crises. Whereas theoretical setups mostly prevail, a few empirical studies have suggested great insights into the drivers for product development and competition in financial markets. This work tries to add to that insight.

76 Starting with Bhattacharyya/Nanda (2000). A more detailed literature review is given in Section 2. This also provides the theoretical underpinnings for the empirical analyses in Section 3.
In this paper, I follow the innovation-fragility view\textsuperscript{77} and explore whether more innovative financial systems are more prone to financial crises. To do so, I analyze the proposed causal and positive relationship between FI and incidents of a financial distress in an empirical setup with US data on agent-level. The precipitating question is who innovates in the financial market? Is the degree of innovativeness positively related to an agent’s profit volatility? Does innovative activity increase the risk of insolvency? In other words, is competition through innovations negatively related to stability? What are then possible regulatory interventions and policy implications?

I utilize count data and patents to measure FI on a micro level from Lerner (2006) and relate agent-level variations in innovativeness to profit volatility of financial institutions while controlling for institutional characteristics and time trends. Based on an empirical setup that corresponds to Hasan et al. (2009), Demirguc-Kunt and Huizinga (2010), Beck et al. (2012), and Lepetit and Strobel (2012), I investigate the link between profit volatility and FI in a dynamic panel model and find a significant positive relation which implies a negative impact on the stability of the financial system. Henceforth, I check my results against a number of different extensions. While the analysis of firm characteristics leads to ambiguous results, my findings are confirmed with different innovation measures and different fragility measures.

The paper is structured as follows. First, I regard previous literature in the area. In Section 3 I disclose the empirical analysis. It encompasses an explanation of the data and its description, the empirical strategy and the analytical results. Section 4 provides robustness checks. Section 5 then concludes the paper.

\textbf{2. Literature Review}

Exploring the impact of the FI on financial health draws from two distinct research areas. General surveys about research on financial agents with particular focus on asymmetries of information and security design are given by Allen and Winton (1995) and Duffie and Rahie (1995).

\textsuperscript{77} See Beck et al. (2012).
2.1 Financial Crises

Firstly, one field of research pertains to the origins and persistence of financial crises, or more particularly, the investigation of causes for financial distress of single agents providing any kind of financial services. In their seminal paper, Allen and Gale (2000) investigate possible contagion and bubbles in financial networks. They build a model of contagion with perfectly competitive banking and show that a first-best allocation of risk-sharing is possible, but fragility still persists. Subsequently, Allen and Gale (2004) analyze the relation between competition and financial stability. Here, they find a negative trade-off between both while considering a variety of different settings such as general equilibrium models, agency models, Schumpeterian competition and contagion. In a three-period model with risky and standard assets as well as timing incongruity, they find that greater competition is good for efficiency, but bad for financial stability. More recent work has been provided by Shleifer and Vishny (2010). They set up a behavioral finance model where they assume optimism of investors as stimulus for demand for new securities and pessimism as a shock leading to financial crises. Mispricing occurs herein. Depressed securities then have adverse welfare effects ex post as they cut off lending to new instruments. Overall, securitization raises the level of investment and cyclicality. Jeon and Nishihara (2012) extend Shleifer and Vishny’s (2010) model and allow agents to securitize risky assets with leverage and asymmetric information. They find that risk retention requirements imposed by governments reduce welfare.

Empirical assessments of financial crises can vastly be found in the literature, albeit with varying scope and different focus. I provide here one example on the link between theory and numerical evidence on the existence of financial crises. Upper and Worms (2004) confirm Allen and Gale’s (2000) model by empirically evaluating the risk of contagion and credit risk in the German interbank lending market. They use balance sheet data of German banks to estimate bilateral credit relationships. The analysis provides two results: First, credit risk may trigger domino effect in that there exists considerable scope for contagion even with safety mechanisms. Second, more concentrated structures can

---

78 This paper draws on the monthly balance sheet statistics (BISTA) provided by the German Bundesbank.
lower threshold for contagion. Allen et al. (2009) provide a thorough review on financial crises. They find that most financial crises arise from panics, business cycle fluctuations or contagion, and abstract from the evidence a common sequence of events: With surging money supply comes increasing asset prices and credit volumes which inevitably lead to a price bubble bound to burst. A banking crisis is then followed by an exchange-rate crisis and a substantial drop in real output. Brunnermeier (2009) prepares an overview on the development of the recent financial crisis and uses micro- and macro-level data to claim reasonable policy interventions.

2.2. Financial Innovations

Another strand of literature looks at the origins and existence of financial innovations. Tufano (2003), Frank and White (2009) as well as Lerner and Tufano (2011) provide overviews on innovations in the financial market. Tufano (2003) gives a seminal definition of FI: It is the creation of financial instruments (both product and process) by invention or diffusion of products, services or ideas. Furthermore, he stresses the need to develop a measure for FI and provides reasons for the existence of FI, namely, the incompleteness of markets, managing risk, pooling of funds and regulation. Frank and White (2009) review the technological changes and innovations in commercial banking over the last 25 years. They employ the same definition of FI as Tufano (2003) and argue that FI reduce costs and risks, and provide a tool to serve demands of investors. In addition, they survey the literature to illustrate innovation patterns over the investigated period. Lerner and Tufano (2011) disclose the differences between FI and manufacturing innovations, most notably stressing different dynamics and agency structures. They point out the problems of assessing FI in the rarity of R&D spending by financial agents, the infrequency or non-existence of financial patents and the intransparency of FI by private firms.

From a theoretical perspective, numerous papers provide arguments for the existence of innovations in financial markets. Most recently, Michalopoulos et al. (2011) link FI to the endogeneous growth theory while Carvajal et al. (2012) examine innovations in frictionless financial markets with short selling. They find incomplete markets even with costless innovation and competition. Ferreira et al. (2012) argue that the form of equity financing

---

79 Many more papers can be found which empirically analyze the causes for financial crises both at a micro- and macro-level. Since I want to focus on the distinct relationship between FI and financial health, an extended overview on that area of literature would be beyond the scope of this paper.
determines FI incentives. In their model, they suggest to go public for exploiting existing ideas and go private for exploring new, risky ideas. Song and Thakor (2010) and Shen et al. (2012) provide arguments for collateral-motivated FI and link possible innovation cycles in financial markets to government regulation such as Basel III. Their models exhibit heterogeneous beliefs as well as endogenous market structure and collateral requirements.

Empirical assessments of innovations in financial markets have started with research in the 1980s and 1990s80 In his early contribution, Tufano (1989) argues that FI provide first-mover advantages. He assesses the dynamics of innovations and competition by analyzing data on 58 publicly offered FI in the years 1974 to 1987 which raised USD 280 billion and providing cross-sectional regressions of the underwriting spread on firm characteristics.81 He finds that 20% of new securities being issued in 1987 have not been in existence in 1974 and that new product ideas diffuse rapidly across competitors so that banks do not enjoy monopoly pricing with innovations, but rather capture a larger market share with lower prices than their imitators. Lerner (2002) looks at financial patents during the period 1971 to 2000 and analyzes the impact of the State Street decision82 on the degree of innovation observable in the market. He used the classification of the US Patent and Trademark Office and the Delphion IP Network to identify 445 financial patents and found a surge in patenting filed mostly by large corporations. Frank and White (2004) survey empirical studies on FI. They utilize the same definition of FI as Tufano (2003) and point to the general scarcity in research, but do look at 39 empirical studies of FI over long time. Accordingly, they classify research on FI in broad areas concerned with environment conditions, customers, diffusion and welfare. More recent work has been done by Lerner (2006, 2010). First, he investigates the origins of innovations and develops a new measure for FI based on news stories from the Wall Street Journal during the period 1990 to 2002 which he links to additional information from the SEC, Compustat, finance journals as well

---

80 See e.g. Miller (1986, 1992) and Merton (1992), Frank and White (2004, 2009).
81 Tufano (1989) relied on three data sources: First, a literature search using ABI-Inform and Business Periodical Index. Second, interviews with investment bankers. Third, company data from SDC and IDDIS.
82 State Street Bank vs. Signature Financial Group was a 1998 decision by the US Court of Appeals for the Federal Circuit (CAFC) regarding the patentability of business methods. Herein, the CAFC rejected the notion of a business method exception and allowed the protection of an invention if it involved some practical application and some tangible result, which with regards to financial patents was deemed the pricing. However, the 2008 CAFC decision In re Bilski rejected the tangible result test as inadequate. The US Supreme Court affirmed this judgment in Bilski vs. Kappos. This leaves companies with great uncertainty over patentability of financial innovations.
as the US Patent and Trademark Office on innovativeness, firm characteristics and patenting.\textsuperscript{83} His regressions show that small, less profitable firms are more innovative with an additional agglomeration effect. Second, he inquires about litigation of patents on FI.\textsuperscript{84} He analyzes financial patent awards by the US Patent and Trademark Office between 1976 and 2003 in combination with firm-level data from public records. Negative binomial and Poisson regressions then unveil that patents on FI are litigated more often than normal patents, litigated patents are mostly from small firms or individuals and have more claims and citations than other financial patents as well as large firms are more often defendants in litigation. Finally, Boz and Mendoza (2010) examine the interaction of FI, learning and collateral constraints in a stochastic equilibrium model of household debt and land prices. They use an experimental setup with switching between high- and low-leverage regimes according to Bayesian learning and find that innovations in financial markets lead to boom-bust cycles.

2.3 Incentives to Innovate and Financial Crises

This paper makes use of a recent new strand of literature combining both aforementioned research fields. Most work hereby focuses on the innovation-fragility view coined by Beck et al. (2012) that innovations may have adverse effects on competition and stability. It begins with early theoretical work by Bhattacharyya and Nanda (2000). Their paper is the first to connect incentives to innovate and the analysis of financial crises in a theoretical setup. Because client characteristics, market structure and the volatility affect switching costs and costs of delayed adoption, banks with greater market power and more secure relationships with customers are more likely to innovate. More recently, Gennaioli et al. (2012) argue that FI cause crises because of neglected risks. Their research is an extension of the Shleifer and Vishny (2010) paper mentioned earlier whereby agents engineer securities perceived to be safe but exposed to neglected risks which leads to excessive security issuance. They apply a model of belief formation to relate FI, security issuance, risk perception and financial fragility. Also, Thakor (2012) analyzes the relation between incentives to innovate and financial crises. He makes use of Allen and Gale’s (2004) model with three periods where the distinction is not between standard and risky assets, but now between standard and innovative assets. Financial agents then face the trade-off between making profits from

\textsuperscript{83} See Lerner (2002) for his aforementioned earlier work on financial patents.

\textsuperscript{84} This again draws on Lerner (2002).
innovation and refinancing risks. In his model, the degree of innovativeness is positively related to the lack of familiarity and the refinancing risk which makes imitation less likely and drives up profits. Reasons for financial distress are then the competitive financial system and the non-patentability of FI.

Empirical assessments of the causal link between innovations and financial instability have been scarce. Henderson and Pearson (2011) show that investors can be exploited by innovative financial products. Their event study proposes that issuers innovate to sell new securities at a risk-adjusted premium to uninformed investors because innovativeness increases complexity and ambiguity. Subsequently, issuers exploit investors' misunderstandings of financial market. The authors provide reasons for excess demand in overconfidence, framing and loss aversion of investors. Beck et al. (2012) evaluate the bridge between FI, the real economy and crises. They assess the relationships between innovations and real sector growth, real sector volatility and bank fragility using bank-, industry- and country-level data from 32 countries during the period 1996 to 2006. Approximating Tufano’s (2003) definition of FI by financial R&D intensity obtained from the OECD, they analyze the innovation-fragility view on FI. Namely, they relate country-level variation in FI to bank-level variation in profits and volatility and find in their regressions that innovativeness leads to increasing risk taking, fragility, profit volatility and bank losses during crises. Heterogeneity is given in that smaller, fast growing banks are more fragile in countries with more FI while smaller, less leveraged banks are more effected by agglomeration effects.

3. Empirical Analysis

This section explores the relationship between FI and financial agents' fragility empirically. I first provide a description of the data and then disclose the empirical model specification. Results are summarized thereafter.

3.1 Data

The data set measures financial innovations in the USA from 1990 until 2002 via a unique counting mechanism. This is unbalanced panel data with 20,916 firm-year observations of

---

85 The data were kindly provided by Josh Lerner, Harvard Business School.
3,074 firms with either at least one innovation observed by the measure during the time period or being active in the SIC codes 60 through 64 and 67.  

The data set consists of four different groups of variables: First, firm characteristics such as age, assets, cash equivalents, cash flow, employees, leverage ratio, long-term debt, common market value, revenues and such are included to control for individual-specific effects. Secondly, performance measures like EBITDA, net income, retained earnings as well as returns on assets and on equity and thirdly, stability measures such as the capital-asset ratio, standard deviations of returns, the Sharpe ratio and other provide information about the competitive nature. Finally, innovation is measured by the count of patent applications, patents issued and stories on innovations per year and firm. The count data on innovations is drawn from articles issued in the Wall Street Journal or the Factiva database on technological inventions. Patent data comes from the US Patent and Trademark Office. All financial data is in million 2002 US Dollars and comes from Compustat whereby the database's proprietary identifier, the GVKEY, is used to match the data sets from the various sources. For a comprehensive exploration of the data set, see Lerner (2006). Like any other measure of FI, the count measure used here also has its limitations. It necessarily excludes private firms not listed in Compustat. Furthermore, the time period is rather limited and the methodology to source the counts of innovations from the articles is based on stylized facts of FI, not a structural model. However, given the problems of assessing FI in the rarity of R&D spending by financial institutions, the infrequency of financial patents and the intransparency of FI by private firms stressed by Tufano (2003), Frank and White (2004, 2009) and Lerner and Tufano (2011), it is reasonable to believe that this count measure introduced by Lerner (2006) and applied here to analyze financial fragility may be suitable.

3.2 Descriptive Statistics and Properties

Table 2 provides an overview of the summary statistics of the variables. It shows that there exists great heterogeneity among firms in terms of size and profitability. Stability measures are constructed from the firm characteristics to disclose a firm's insolvency risk and activity risk. Hereby, higher numbers for the Sharpe ratio and the Z-score emphasize less

---

86 These SIC codes include firms operating in the financial services business such as insurance, banking, financial advisory and so on except for real estate.

87 For complete descriptions of the variables used here, see Table 1 in the Appendix.
fragility. Moreover, the count data on FI includes a lot of zeros as indicated by the low means. I also include a measure for the agglomeration effect by counting the number of innovations by other firms within the same two-digit ZIP code area as a firm.

Observations are evenly distributed over the time period and firm characteristics exhibit a high degree of persistence, naturally. Figure 1 displays the evolution of these variables. Not surprisingly, there exists a general increase in the absolute values of these firm-specific variables. Figure 2 presents how the count of FI has developed over time. The notable peak towards the late 1990s is due to the aforementioned State Street decision. Overall, the number of observed innovations is rather low in comparison to the overall size of the data set so that this is one point of caution. Similar to Figure 1, Figure 3 presents the evolution of a firm's performance measures over the time period. There is no clear trend in rising or falling profitability of financial institutions. Figure 4 presents a comparison of fragility by grouping firms with measured innovation and with no count, respectively, and by plotting the evolution of both sets. No clear time trend is visible.

Figure 1

![Firm Characteristics](image)

Figure 2
Figure 3
Following the descriptives, a variety of univariate analyses provide a first glance at the variables' behavior and properties. Firm characteristics are correlated with each other and over time. This also drives autocorrelation in Z-scores by construction. Including lagged dependent variables captures most of the autocorrelation. While the FI measures are significantly correlated with each other, a F-test for joint significance cannot be rejected. However, fragility (Z-scores) and FI measures are significantly positively (negatively) correlated. Tests also show that the mean and variance of Z-scores are different with and without innovation. While multicollinearity seems no problem, omitted variable bias might be a problem so that a fixed-effects model specification seems feasible. A robust version of the Wu-Hausman test by Wooldridge (2002) shows that fixed-effects modeling is preferred over a random effects setup. Furthermore, a series of tests shows that the error terms are heteroskedastic and correlated with each other.
3.3 Empirical Strategy

This paper follows the recent strand of new literature on the relationship between incentives to innovate and financial instability and adds to earlier empirical work in assessing the innovation-fragility view quantitatively. Based on the micro-level database on FI in the US between 1990 and 2002 disclosed above, I relate agent-level variations in innovativeness to profitability and profit volatility of financial institutions while controlling for institutional characteristics and time trends.

I reflect Hasan et al. (2009), Demirguc-Kunt and Huizinga (2010), Lepetit and Strobel (2012), Beck et al. (2012) and Bertay et al. (2013) in my empirical setup. They analyze profits and fragility of financial institutions with a variety of different setups and also assess the reliability of the Z-score. Because of the properties the data exhibits disclosed above, my baseline model specification is as follows.

\[ Z_{i,t} = \rho Z_{i,t-1} + \beta X_{i,t} + \gamma Y_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t} \]

where indices \( i, t \) stand respectively for firm and time, \( Z \) is the Z-score per firm and period. The Z-score is a measure of bank solvency and corresponds to \( (ROA+CAR)/\sigma(ROA) \).\(^{88}\) It “indicates the number of standard deviations that a bank’s rate of return on assets can fall in a single period before it becomes insolvent. A higher Z-score signals a lower probability of bank insolvency” (Beck et al. 2012).\(^{89}\) \( X \) is the vector of firm characteristics for which data are available while \( Y \) is the vector of different financial innovation indicators. The regression model includes \( \alpha_i \) and \( \delta_t \) to account for omitted firm-specific and year fixed effects, respectively. The Newey-West-type robust error term \( \epsilon \) is clustered at firm-level and allowed to be heteroskedastic, autocorrelated and spatially correlated. Including lagged dependent variables allows me to account for the persistence of firm characteristics which also reflect in the Z-scores by construction and the general persistence over time.

\(^{88}\) Because the Z-score is highly skewed and to avoid truncation, I use \( \ln(1+Z\text{-score}) \) in the regressions.\(^{89}\) See Lepetit and Strobel (2013) for more information on firm’s insolvency risk and different approaches to time-varying Z-score measures. They provide a derivation of the Z-score and discuss several ways to estimate means and standard deviations of the variables used to calculate the measure.
3.4 Results

In a first step, I assess the validity of different model specifications to account for the data properties disclosed in section 3.2. To do so, I compare different versions of the dynamic panel model set up in section 3.3 which enhances the static linear fixed-effects model by including autoregressive coefficients for fragility. This allows me to capture feedback from current or past shocks to current values of the dependent variable. This specification is adequate in the presence of autocorrelated error terms and high persistence in the dependent variable which I have shown earlier. I furthermore use GLS estimation to account for the heteroskedasticity and autocorrelation.

Table 3 provides the overview of the different model specifications. Baseline innovative capacity in firms is captured by assets, profitability and leverage which Lerner (2006) has shown to be important drivers of incentives to innovate. In all regressions, I include firm characteristics, year fixed-effects and a constant but suppress their coefficients in the tables. Also, I employ the logarithm of all independent variables that are not ratios. In column 1 I use a pooled feasible GLS estimator with a panel-specific AR(1)-disturbance. I compare this to the Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) estimator in column 2 which also accounts for higher levels of autocorrelation in error terms. Column 3 to 5 disclose three firm fixed-effects models which capture the dynamics and heterogeneity to a different extent. The first is GLS estimation with fixed effects and AR(1)-disturbance. Secondly, I use the Arellano-Bond estimator by IV estimation of the parameters of the first-difference model using lags of regressors as instruments. Thirdly, I apply the Driscoll-Kraay (1998) estimator to account for heteroskedasticity, autocorrelation and spatial correlation. While the Driscoll-Kraay (1998) standard errors expand Newey-West HAC estimators to include correlation between panels, the estimator does not place restrictions on the limit behavior of the number of panels. Results show that indeed there exists a significant positive relation between FI and fragility (negative relation between FI and Z-scores) albeit small, but patenting seems to be no factor. The size of the coefficients however corresponds to the correlations from the univariate analyses in section 3.2. Surprisingly, the agglomeration effect is very weak.

In any estimation of fixed-effects models for short panels when lagged dependent variables are present, coefficients may be downwardly biased. This is called Hurwicz bias or Nickell
Bias and is given here by $O=1/T=1/13=0.07$. Thus, as $T \to \infty$ the bias disappears. That's why Table 3 includes a comparison between the Arellano-Bond estimator for IV estimation and the Driscoll-Kraay (1998) estimator. Two caveats arise from IV estimation in this case, namely that it greatly increases the mean squared error and that the errors are assumed to not be serially correlated, but the Arellano-Bond estimator is consistent. On the other hand, the Driscoll-Kraay (1998) estimator works with great precision although potentially biased. Thus, a trade-off between correcting biases against decreases in efficiency is inherent. Fundamentally, trading a small reduction in the bias for a large decrease in efficiency sounds questionable. Assuming the Hurwicz bias is negligible since $T=13$ is a reasonable time period and given the small coefficient for lagged $Z$-scores from Table 3, I further pursue the Driscoll-Kraay (1998) estimator with fixed-effects and lagged dependent variables in my analysis.

4. Extensions

Furthermore, I introduce some additional features to extend the initial model and check the robustness of my results.

First, I want to explore the differential relationship between innovation and fragility across firms with different characteristics. Thus, I generate interaction terms of the FI measures with assets, profitability and leverage. Table 4 provides the piece-wise inclusion of these interactions into the regression with the Driscoll-Kraay (1998) estimator assessed above. Column 1 and 4 show the effect of FI on fragility with heterogeneous firm size. The relationship is slightly stronger for larger banks but only for innovative activity captured through patenting. Overall, patenting improves fragility, however. Column 2 and 4 show that the effect of FI on fragility is ambiguous for different profitability levels. Finally, column 3 and 4 display the effect of FI on fragility with different leverage ratios. Surprisingly, the relation seems unaffected by changes in leverage but the coefficient turns significantly negative once all interaction terms are included. Across all models, the positive (negative) relation between innovation and fragility (stability) prevails, although the coefficients become insignificant.

Second, I investigate the robustness of my results from section 3.4 against modifications of innovation measures as depicted in table 5. Column 1 provides the regression results with
the Driscoll-Kraay (1998) estimator from Table 3. Subsequently, column 2 uses a weighting mechanism to account for sole or collaborative inventions, column 3 uses only highly innovative activities as classified by a three-part scheme introduced by Lerner (2006), column 4 provides a combination of 2 and 3 and finally, column 5 introduces R&D expenditures as a further control.\textsuperscript{90} Results are confirmed. The positive relation between innovation and fragility is persistent while patenting has no effect.

Third, I further explore the robustness of results by investigating the components of the Z-score and alternative measures for firm fragility in Table 6. Thus, I keep the right-hand side variables the same and compare different left-hand side variables. I respectively use ROA, ROE and the capital-asset ratio to assess profitability and capitalization, the volatility of ROA and volatility of ROE to measure a firm’s activity risk, and finally, the Sharpe ratio as an alternative measure for the risk of insolvency. Specifically, the Sharpe ratio describes how well the return compensates the investor for the risk taken. Column 2 and 3 show that profitability is positively affected by FI, especially patenting behavior, but surprisingly, the innovation coefficient is significantly negative although small. Capitalization in column 4 is on a small scale negatively affecting by patenting. Unusually, activity risk is not affected by a firm’s degree of innovation as depicted in columns 5 and 6. Lastly, innovation continues to positively relate to risk of insolvency although the coefficient becomes insignificant whereas unexpectedly patenting positively affects excessive returns as shown in column 7.

\textsuperscript{90} See Table 1 for a description of the exact modifications.
5. Conclusion

In this paper, I evaluate the relationship between financial innovations and the stability of financial institutions. I provide strong evidence of both theoretical and empirical nature for why financial crises exist and why firms engage in producing financial innovations. A recent strand of research tries to combine both areas and analyzes the impact of competition among financial agents who reap profits from innovations on an agent's fragility. Particularly, this literature predicts that the degree of innovation negatively affects firm stability.

I base my analysis on a unique data set that counts financial innovations in the USA between 1990 and 2002 provided by Lerner (2006) and augment it by performance and stability measures. Then, I expand empirical frameworks by Beck et al. (2012) and others to quantitatively assess the so called innovation-fragility view on a firm level. I can show that a larger degree of innovation positively affects firm fragility safe for the underlying firm characteristics. A couple of extensions to the initial model show that my results are quite robust. Different modifications of the innovation measures yield the same outcomes. Furthermore, I use different fragility parameters measuring profitability, capitalization, activity risk and risk of insolvency and find that the results support my argumentation.

Further research encompasses expansion of the work on dynamic panel modeling to account for the exhibited data properties. One specification could include VAR models that take greater account for the persistence in firm characteristics. Additionally, an analysis of firm characteristics by subsampling might disclose different effects of the drivers for innovation.
Appendix

Table 1: Overview of Variables, Definitions and Sources

<table>
<thead>
<tr>
<th>Variables</th>
<th>Definitions</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial innovation measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>apwt</td>
<td>Weighted patent applications per firm in a year where the sum of 1 (count) is divided among the firms mentioned in the article about the innovation.</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>innov</td>
<td>Count of stories from Wall Street Journal and the Factiva database on innovations per firm in a year.</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>innovwt</td>
<td>Weighted count of innovations (as above).</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>innovwtab</td>
<td>Weighted count of major innovations (as above).</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>otherinnovzip</td>
<td>Number of financial innovations in the same year by other firms with headquarters in the same two-digit zip code as the firm.</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
<td>Source</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>pat</td>
<td>Count of patents granted to a firm in a year with respect to the financial services area.</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>patwt</td>
<td>Weighted count of patents (as above).</td>
<td>Lerner (2006)</td>
</tr>
</tbody>
</table>

**Financial Institution's performance measures**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT</td>
<td>Earnings before interest and taxes per firm and year.</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>EBITDA</td>
<td>Earnings before interest, taxes, depreciation and amortization per firm and year.</td>
<td>Lerner (2006)</td>
</tr>
<tr>
<td>opprof</td>
<td>Operational profitability constructed as EBITDA / revenues (opprof = EBIT / revenues, whenever EBITDA is unavailable).</td>
<td>Computed</td>
</tr>
<tr>
<td>ROA</td>
<td>Return on assets constructed as net income / assets.</td>
<td>Computed</td>
</tr>
<tr>
<td>ROE</td>
<td>Return on equity constructed as net income / shareholders’ equity.</td>
<td>Computed</td>
</tr>
</tbody>
</table>
**Financial Institution's stability measures**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>Capital-asset ratio constructed as shareholders' equity / assets.</td>
</tr>
<tr>
<td>σ(ROA)</td>
<td>Standard deviation of ROA for each agent throughout the sample period.</td>
</tr>
<tr>
<td>σ(ROE)</td>
<td>Standard deviation of ROE for each agent throughout the sample period.</td>
</tr>
<tr>
<td>Sharpe</td>
<td>Sharpe ratio constructed as ROE/σ(ROE). Larger values imply less excessive risk for a certain return.</td>
</tr>
<tr>
<td>Z-score</td>
<td>Index of bank solvency constructed as (ROA+CAR)/σ(ROA). Higher Z-score implies lower probability of failure.</td>
</tr>
</tbody>
</table>

**Other agent-level variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>Age of firm in relation to its foundation or IPO.</td>
</tr>
<tr>
<td>assets</td>
<td>Total assets of each financial</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>emp</td>
<td>Employees per firm and year.</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Expenditures per firm for research and development in million 2002 USD in a year.</td>
</tr>
</tbody>
</table>
Table 2: Summary Statistics of Key Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>12232.173</td>
<td>56112.904</td>
<td>0</td>
<td>1097190.000</td>
<td>20842</td>
</tr>
<tr>
<td>Cash Flow</td>
<td>440.774</td>
<td>2391.125</td>
<td>-30929.010</td>
<td>41562.207</td>
<td>11056</td>
</tr>
<tr>
<td>Employees</td>
<td>9.154</td>
<td>39.399</td>
<td>0</td>
<td>761.400</td>
<td>14299</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.278</td>
<td>0.267</td>
<td>-0.190</td>
<td>0.999</td>
<td>18379</td>
</tr>
<tr>
<td>Market Value</td>
<td>2840.852</td>
<td>15300.155</td>
<td>0</td>
<td>535947.125</td>
<td>18690</td>
</tr>
<tr>
<td>Revenues</td>
<td>2501.371</td>
<td>11511.809</td>
<td>-205.980</td>
<td>186857.672</td>
<td>20529</td>
</tr>
<tr>
<td>EBITDA</td>
<td>562.078</td>
<td>2675.224</td>
<td>-5932.265</td>
<td>63323.199</td>
<td>18128</td>
</tr>
<tr>
<td>Net Income</td>
<td>125.702</td>
<td>1038.579</td>
<td>-98696.000</td>
<td>23657.889</td>
<td>20768</td>
</tr>
<tr>
<td>ROA</td>
<td>-0.114</td>
<td>9.503</td>
<td>-1302.000</td>
<td>235.667</td>
<td>20706</td>
</tr>
<tr>
<td>ROE</td>
<td>0.737</td>
<td>48.013</td>
<td>-168.803</td>
<td>4787.999</td>
<td>20689</td>
</tr>
<tr>
<td>CAR</td>
<td>-0.039</td>
<td>9.069</td>
<td>-589.731</td>
<td>3.414</td>
<td>20796</td>
</tr>
<tr>
<td>σ(ROA)</td>
<td>0.368</td>
<td>9.474</td>
<td>0</td>
<td>650.898</td>
<td>20704</td>
</tr>
<tr>
<td>σ(ROE)</td>
<td>1.716</td>
<td>43.961</td>
<td>0</td>
<td>2194.872</td>
<td>20689</td>
</tr>
<tr>
<td>Sharpe</td>
<td>3.496</td>
<td>8.483</td>
<td>-103.399</td>
<td>346.778</td>
<td>20548</td>
</tr>
<tr>
<td>Z-score</td>
<td>40.646</td>
<td>189.659</td>
<td>-87.697</td>
<td>12381.447</td>
<td>20567</td>
</tr>
<tr>
<td>Innovations</td>
<td>0.016</td>
<td>0.163</td>
<td>0</td>
<td>6</td>
<td>20916</td>
</tr>
<tr>
<td>Applications</td>
<td>0.030</td>
<td>0.422</td>
<td>0</td>
<td>21</td>
<td>20916</td>
</tr>
<tr>
<td>Patents</td>
<td>0.032</td>
<td>0.409</td>
<td>0</td>
<td>15</td>
<td>20916</td>
</tr>
<tr>
<td>FI by Others</td>
<td>2.452</td>
<td>3.447</td>
<td>0</td>
<td>12</td>
<td>20916</td>
</tr>
</tbody>
</table>
Table 3: Comparison of Model Specifications

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) PFGLS (AR(1))</th>
<th>(2) Newey-West</th>
<th>(3) GLS (AR(1))</th>
<th>(4) ABE</th>
<th>(5) Driscol-Kraay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-score$_t-1$</td>
<td>0.922***</td>
<td>0.927***</td>
<td>-0.065***</td>
<td>0.035</td>
<td>0.014*</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.030)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Log of assets</td>
<td>0.033***</td>
<td>0.038***</td>
<td>-0.104***</td>
<td>-0.119***</td>
<td>-0.137***</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.009)</td>
<td>(0.011)</td>
<td>(0.030)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>EBITDA/revenues</td>
<td>0.002***</td>
<td>0.002***</td>
<td>0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Leverage ratio</td>
<td>-0.044***</td>
<td>-0.029</td>
<td>-0.152***</td>
<td>-0.188***</td>
<td>-0.260***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.025)</td>
<td>(0.032)</td>
<td>(0.051)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Log of FI by others in 2-digit zip code</td>
<td>-0.007***</td>
<td>-0.008***</td>
<td>0.001</td>
<td>-0.004</td>
<td>0.010*</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.004)</td>
<td>(0.011)</td>
<td>(0.011)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Innovations</td>
<td>-0.018***</td>
<td>-0.041***</td>
<td>-0.022*</td>
<td>-0.017</td>
<td>-0.030**</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.016)</td>
<td>(0.013)</td>
<td>(0.014)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Patents</td>
<td>-0.009***</td>
<td>-0.007</td>
<td>0.004</td>
<td>0.004</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.005)</td>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Applications</td>
<td>-0.001</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.001</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.006)</td>
<td>(0.003)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Controls</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Firm FE</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Constant</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Observations</td>
<td>14,834</td>
<td>15,121</td>
<td>12,424</td>
<td>12,327</td>
<td>16,568</td>
</tr>
<tr>
<td>Number of groups</td>
<td>2,410</td>
<td>2,519</td>
<td>2,410</td>
<td>2,401</td>
<td>2,716</td>
</tr>
</tbody>
</table>

NB: dependent variable is ln(1+Z-score), robust standard errors clustered at firm-level in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 4: Interaction with Firm Characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Firm Size</th>
<th>(2) Profitability</th>
<th>(3) Leverage</th>
<th>(4) Compound Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-score_{t-1}</td>
<td>0.014*</td>
<td>0.014</td>
<td>0.014*</td>
<td>0.014</td>
</tr>
<tr>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Log of assets</td>
<td>-0.137***</td>
<td>-0.137***</td>
<td>-0.136***</td>
<td>-0.136***</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>EBITDA/revenues</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Leverage Ratio</td>
<td>-0.261***</td>
<td>-0.259***</td>
<td>-0.260***</td>
<td>-0.257***</td>
</tr>
<tr>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.023)</td>
<td>(0.022)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Log of FI by others in 2-digit zip code</td>
<td>0.010</td>
<td>0.010*</td>
<td>0.009</td>
<td>0.010</td>
</tr>
<tr>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Innovations</td>
<td>-0.213</td>
<td>-0.116</td>
<td>-0.027</td>
<td>-0.217</td>
</tr>
<tr>
<td>(0.169)</td>
<td>(0.075)</td>
<td>(0.036)</td>
<td>(0.148)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>Patents</td>
<td>0.084***</td>
<td>0.011</td>
<td>0.001</td>
<td>0.106***</td>
</tr>
<tr>
<td>(0.027)</td>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.024)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Applications</td>
<td>0.035**</td>
<td>0.007</td>
<td>0.004</td>
<td>0.023*</td>
</tr>
<tr>
<td>(0.014)</td>
<td>(0.008)</td>
<td>(0.004)</td>
<td>(0.014)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>Innovations x Assets</td>
<td>0.017</td>
<td>0.014</td>
<td>0.014</td>
<td>0.014</td>
</tr>
<tr>
<td>(0.015)</td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Patents x Assets</td>
<td>-0.008***</td>
<td>-0.010***</td>
<td>-0.010***</td>
<td>-0.010***</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Applications x Assets</td>
<td>-0.004**</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.001</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Innovations x EBITDA/revenues</td>
<td></td>
<td>0.278</td>
<td>0.273</td>
<td></td>
</tr>
<tr>
<td>(0.210)</td>
<td>(0.186)</td>
<td>(0.186)</td>
<td>(0.186)</td>
<td>(0.186)</td>
</tr>
<tr>
<td>Patents x EBITDA/revenues</td>
<td>-0.068*</td>
<td>-0.011</td>
<td>-0.011</td>
<td></td>
</tr>
<tr>
<td>(0.040)</td>
<td>(0.044)</td>
<td>(0.044)</td>
<td>(0.044)</td>
<td>(0.044)</td>
</tr>
<tr>
<td>Applications x EBITDA/revenues</td>
<td>-0.043</td>
<td>-0.026</td>
<td>-0.026</td>
<td></td>
</tr>
<tr>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>Innovations x Leverage Ratio</td>
<td>-0.003</td>
<td>-0.168***</td>
<td>-0.070</td>
<td></td>
</tr>
<tr>
<td>(0.084)</td>
<td>(0.070)</td>
<td>(0.070)</td>
<td>(0.070)</td>
<td>(0.070)</td>
</tr>
<tr>
<td>Patents x Leverage Ratio</td>
<td>-0.032</td>
<td>0.003</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>(0.033)</td>
<td>(0.026)</td>
<td>(0.026)</td>
<td>(0.026)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>Applications x Leverage Ratio</td>
<td>-0.046**</td>
<td>-0.029</td>
<td>-0.029</td>
<td></td>
</tr>
<tr>
<td>(0.024)</td>
<td>(0.028)</td>
<td>(0.028)</td>
<td>(0.028)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>Controls</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Constant</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Observations</td>
<td>16,568</td>
<td>16,568</td>
<td>16,568</td>
<td>16,568</td>
</tr>
<tr>
<td>Number of groups</td>
<td>2,716</td>
<td>2,716</td>
<td>2,716</td>
<td>2,716</td>
</tr>
</tbody>
</table>

NB: dependent variable is ln(1+Z-score), Driscoll-Kraay (1998) robust standard errors clustered at firm-level in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 5: Robustness against FI Measures

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Driscoll-Kraay</th>
<th>(2) Using weighted counts</th>
<th>(3) Using only major innovations</th>
<th>(4) Using weighted major innovations</th>
<th>(5) Using R&amp;D as control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-score_{t−1}</td>
<td>0.014*</td>
<td>0.014*</td>
<td>0.014*</td>
<td>0.014*</td>
<td>0.014*</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>Log of assets</td>
<td>-0.137***</td>
<td>-0.137***</td>
<td>-0.137***</td>
<td>-0.137***</td>
<td>-0.142***</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>EBITDA/revenues</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Leverage Ratio</td>
<td>-0.260***</td>
<td>-0.260***</td>
<td>-0.261***</td>
<td>-0.260***</td>
<td>-0.251***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Log of FI by others in 2-digit zip code</td>
<td>0.010*</td>
<td>0.010*</td>
<td>0.010*</td>
<td>0.010*</td>
<td>0.010*</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Innovation parameters</td>
<td>-0.030**</td>
<td>-0.046***</td>
<td>-0.028*</td>
<td>-0.051*</td>
<td>-0.028**</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.017)</td>
<td>(0.015)</td>
<td>(0.026)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Patent parameters</td>
<td>-0.005</td>
<td>-0.013</td>
<td>-0.005</td>
<td>-0.015</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.015)</td>
<td>(0.005)</td>
<td>(0.015)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Application parameters</td>
<td>-0.002</td>
<td>-0.006</td>
<td>-0.002</td>
<td>-0.006</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.015)</td>
<td>(0.005)</td>
<td>(0.015)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>R&amp;D/assets</td>
<td></td>
<td></td>
<td></td>
<td>0.953***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.146)</td>
<td></td>
</tr>
<tr>
<td>Controls</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Constant</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Observations</td>
<td>16,568</td>
<td>16,568</td>
<td>16,568</td>
<td>16,568</td>
<td>16,568</td>
</tr>
<tr>
<td>Number of groups</td>
<td>2,716</td>
<td>2,716</td>
<td>2,716</td>
<td>2,716</td>
<td>2,716</td>
</tr>
</tbody>
</table>

NB: dependent variable is ln(1+Z-score), Driscoll-Kraay (1998) robust standard errors clustered at firm-level in parentheses

*** p<0.01, ** p<0.05, * p<0.1
### Table 6: Robustness against Fragility Measures

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1) Z-score</th>
<th>(2) ROA</th>
<th>(3) ROE</th>
<th>(4) CAR</th>
<th>(5) $\sigma$(ROA)</th>
<th>(6) $\sigma$(ROE)</th>
<th>(7) Sharpe Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-score$_{-1}$</td>
<td>0.014*</td>
<td>-0.003*</td>
<td>-0.016**</td>
<td>0.013***</td>
<td>-0.000019</td>
<td>-0.000056</td>
<td>-0.016*</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.000012)</td>
<td>(0.000036)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Log of assets</td>
<td>-0.142***</td>
<td>0.018***</td>
<td>-0.137***</td>
<td>-0.047***</td>
<td>-0.000020</td>
<td>-0.000083</td>
<td>-0.300***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.006)</td>
<td>(0.021)</td>
<td>(0.006)</td>
<td>(0.000016)</td>
<td>(0.000066)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>EBITDA/revenues</td>
<td>0.000</td>
<td>0.000*</td>
<td>0.001***</td>
<td>0.000</td>
<td>0.000000</td>
<td>0.000000</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000000)</td>
<td>(0.000000)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Leverage Ratio</td>
<td>-0.251***</td>
<td>0.027***</td>
<td>-0.014</td>
<td>0.100***</td>
<td>-0.000010</td>
<td>-0.000159</td>
<td>0.163***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.013)</td>
<td>(0.032)</td>
<td>(0.006)</td>
<td>(0.000014)</td>
<td>(0.000131)</td>
<td>(0.053)</td>
</tr>
<tr>
<td>Log of FI by others in 2-digit zip code</td>
<td>0.010*</td>
<td>0.003</td>
<td>0.009</td>
<td>0.001</td>
<td>0.000038</td>
<td>0.000008</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.003)</td>
<td>(0.008)</td>
<td>(0.003)</td>
<td>(0.000034)</td>
<td>(0.000006)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Innovations</td>
<td>-0.028***</td>
<td>-0.004***</td>
<td>-0.003</td>
<td>-0.002</td>
<td>-0.000001</td>
<td>-0.00036</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.001)</td>
<td>(0.006)</td>
<td>(0.003)</td>
<td>(0.000004)</td>
<td>(0.000042)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>Patents</td>
<td>-0.006</td>
<td>0.002*</td>
<td>0.007*</td>
<td>-0.003***</td>
<td>-0.000002</td>
<td>-0.000002</td>
<td>0.018**</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.001)</td>
<td>(0.004)</td>
<td>(0.003)</td>
<td>(0.000002)</td>
<td>(0.000003)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Applications</td>
<td>-0.002</td>
<td>0.002***</td>
<td>0.008**</td>
<td>-0.002**</td>
<td>-0.000002</td>
<td>-0.000001</td>
<td>0.018***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.001)</td>
<td>(0.000001)</td>
<td>(0.000002)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>R&amp;D/assets</td>
<td>-0.953***</td>
<td>-0.369</td>
<td>-0.617</td>
<td>0.061</td>
<td>0.000151</td>
<td>-0.000005</td>
<td>-0.253**</td>
</tr>
<tr>
<td></td>
<td>(0.146)</td>
<td>(0.337)</td>
<td>(0.513)</td>
<td>(0.056)</td>
<td>(0.000143)</td>
<td>(0.000102)</td>
<td>(0.124)</td>
</tr>
<tr>
<td>Controls</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Constant</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Number of groups</td>
<td>2,716</td>
<td>2,802</td>
<td>2,798</td>
<td>2,814</td>
<td>2,816</td>
<td>2,815</td>
<td>2,701</td>
</tr>
</tbody>
</table>

**NB:** dependent variables are always ln(1+x), Driscoll-Kraay (1998) robust standard errors clustered at firm-level in parentheses

* **p<0.01, **p<0.05, * p<0.1
References


# Index of Authors

<table>
<thead>
<tr>
<th>Author</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmet DURAN</td>
<td>130</td>
</tr>
<tr>
<td>Ahmet Faruk AYSAN</td>
<td>1</td>
</tr>
<tr>
<td>Antonina WASZCZUK</td>
<td>34</td>
</tr>
<tr>
<td>Burhaneddin İZGİ</td>
<td>130</td>
</tr>
<tr>
<td>Chiara GUERELLO</td>
<td>82</td>
</tr>
<tr>
<td>Evren ARIK</td>
<td>66</td>
</tr>
<tr>
<td>Ferhat ARSLANER</td>
<td>121</td>
</tr>
<tr>
<td>Gültekin GÖLLÜ</td>
<td>1</td>
</tr>
<tr>
<td>Güzin Gülsun AKIN</td>
<td>1</td>
</tr>
<tr>
<td>Hamid MOHTADI</td>
<td>173</td>
</tr>
<tr>
<td>Levent YILDIRAN</td>
<td>1</td>
</tr>
<tr>
<td>M. Vedat PAZARLIOĞLU</td>
<td>196</td>
</tr>
<tr>
<td>Mehmet BALCILAR</td>
<td>142</td>
</tr>
<tr>
<td>Nuran ARSLANER</td>
<td>121</td>
</tr>
<tr>
<td>Orhan ERDEM</td>
<td>66</td>
</tr>
<tr>
<td>Riza DEMIRER</td>
<td>142</td>
</tr>
<tr>
<td>Sadettin Haluk ÇİTÇİ</td>
<td>110</td>
</tr>
<tr>
<td>Serkan YÜKSEL</td>
<td>66</td>
</tr>
<tr>
<td>Sezer Bozkuş KAHYAOĞLU</td>
<td>196</td>
</tr>
<tr>
<td>Stefan RUEDIGER</td>
<td>173</td>
</tr>
<tr>
<td>Süleyman Hilmi KAL</td>
<td>121</td>
</tr>
</tbody>
</table>