Journal of Applied Research in Finance

JARF
Journal of Applied Research in Finance

Volume I
Issue 2(2)

Bi-annually

Winter 2009


Journal
of Applied Research in Finance

Editorial Board

Editorial Advisory Board

Publisher:

Spiru Haret University
Faculty of Financial Management Accounting Craiova

European Research Center of Managerial Studies in Business Administration
Brazda lui Novac Street, no 4 Craiova, Dolj, Romania
Phone: +40 251 598265 Fax : + 40 251 598265
Email: jarf_secretary@yahoo.com
Web: www.jarf.reprograph.ro

ISSN 2066 - 5482

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The special issue contains papers selected from the International Conference organized by the *European Research Centre of Managerial Studies in Business Administration* (CESMAA) and Faculty of Financial Management Accounting Craiova in each October of every academic year. There will prevail the papers containing case studies as well as those papers which bring something new in the field. The selection will be made achieved by:

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Schedule

Deadline for Submission of Papers: 15th April 2010
Expected Publication Date: May (e-version) – June (hard-copy) 2010
E-mail: jarf_secretary@yahoo.com

Journal of Applied Research in Finance

ISSN 2066 - 5482

Table of Contents

GLOBAL FDI FLOWS UNDER THE PRESSURE OF FINANCIAL CRISIS

Laura **VASILESCU GIURCA**, Ana **POPA**
University of Craiova, **Romania**
Faculty of Economy and Business Administration
laura_giurca_vasilescu@yahoo.com, anapopa2005@yahoo.com

Abstract:

The present day international crisis is raising major concerns about the future of the world economic outlook, especially as it relates to international investment.

In the short term, the negative impact of the present economic recession on global FDI prospects seems to be the dominant one. Medium-term FDI prospects are more difficult to assess, due to the exceptional magnitude of the present crisis and to the fact that it could lead to major structural changes in the world economy. Nevertheless, there are some favourable factors for FDI growth (such as investment opportunities generated by low asset prices and industry restructuring, large amounts of financial resources available in emerging countries, quick expansion of new activities and industries) and some of them are even a consequence of the crisis itself. The exact moment date of this upward change depend on a series of uncertain factors such as the process of economic and financial recovery, the efficiency of public policy in addressing the causes of the present crisis, the return of investor confidence and the ability to prevent protectionist tendencies.

Keywords: ISD, financial crisis, mergers and acquisitions, drivers, economic growth

JEL Classification: F21, G01, H60, O16

1. Introduction

In the increasingly open world, foreign direct investment (FDI) has become an important driving force for economic development. FDI has enhanced the optimum distribution of global resources through transfers of general knowledge and specific technologies in production and distribution, generated industrial upgrading, introduction of modern management and accounting methods, establishment of finance related and trading networks, development of telecommunications services.

Different research studies [Lipsey, (2002); Blomström *et al.*, (2004); Blönigen, (2005)] underlined that FDI is generally attracted by several factors such as: market size and its potential development, the costs of production factors, especially labour cost, infrastructure reform, price liberalization, fiscal policy, institutional development, technological absorption capacity, external trade, etc. But the financial flows, and particularly FDI, show a different regional and country pattern because of various internal and external factors [Penalver, (2002)].

The recent international financial crisis proved that the external disturbing factors could play a major role. Nevertheless, the financial crisis, which began in mid-2007, and the resulting pessimistic forecasts in the world economic outlook have fuelled growing uncertainty and concerns about the future prospects of global investments. But the impact on FDI is different, depending on region and sector with consequences for the geographic pattern of FDI flows.

2. Recent evolution of the FDI at the global level

The unusual magnitude of the international financial crisis is raising major concerns about the future of the world economic outlook, especially as it regards the international investment.

The crisis appeared after a period with increasing trends for the foreign direct investment at the global level. Thus, during 2003–2007, FDI flows followed an upward trend, fuelled by steady world economic growth, ongoing liberalization in investment regimes and the implementation of large-scale internationalization strategies by a growing number of transnational corporations (TNCs). This led to an unprecedented level in FDI flows in 2007, with flows reaching a historic record of $1.8 trillion [UNCTAD, (2009)].

The financial instability generated by the United States subprime crisis which began in summer 2007 has led to a progressive deterioration of the investment situation. The international climate started to leave its first negative marks in investment programmes, including FDI, in early 2008. When

major United States financial firms, such as Lehman Brothers and AIG and then European financial institutions showed signs of insolvency became clear that this crisis was a symptom of a wider underlying malaise in the global financial services industry, reflecting in particular serious weaknesses in the regulatory system. The crisis then expanded in magnitude, affecting many developed and emerging economies. The crisis quickly spread far beyond the financial sector, with serious repercussions for the real economy.

It should be underlined that the current financial and economic crisis is different in nature and magnitude from the recent previous financial crisis, which originated in developing countries (such as the 1997 Asian crisis). In contrast, the current crisis began in the developed world, though it is rapidly spreading to developing and transition economies. Developed countries have thus been directly hit by the financial crisis, while its effects on developing economies have so far been indirect in most cases, with varying degrees of severity among regions and countries.

Among industries, FDI flows to financial services, automotive industries, building materials, intermediate goods and some consumption goods have been the most significantly affected by the financial crisis. But the consequences of the crisis are now quickly expanding to FDI in other activities, ranging from the primary sector to non-financial services.

The financial crisis reveals structural weaknesses and shortcomings in the regulation of the world financial system, such as lack of transparency and control mechanisms and the incapacity to prevent hazardous behaviours excessively focused on the search for short-term profitability. It might also reflect changes in economic power between the advanced economies – considerably affected by the crisis, including for inward FDI flows – and emerging and developing countries, the position of which in the world economic and financial system is presently strengthening. This has direct consequences on the geographical patterns of FDI inflows.

In the conditions of the global economic slowdown and recession in a number of major economies, tighter credit conditions, reduced market growth and declining profitability, many companies have announced plans to curtail production, reduce capital expenditure and lay off workers, all of which having implications for FDI. According to an estimation made by UNCTAD, the global FDI flows declined in 2008 by 21 per cent (Figure 1).

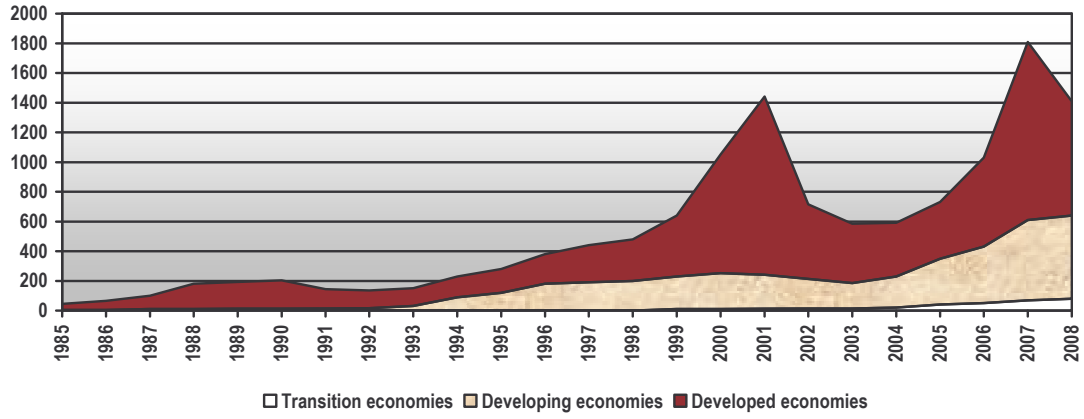

Figure 1. FDI inflows – by types of economies (billion of USD)

Source: UNCTAD, (2009) Assessing the impact of the current financial and economic crisis on global FDI flows

The impact of the crisis varies widely, depending on region and country, with consequences for the geographic pattern of FDI flows. Developed countries have so far been the most affected than the developing economies.

In many developed countries, in 2008, as a result of the deepening problems affecting financial institutions, as well as the liquidity crisis in the money and debt markets, FDI flows have fallen, leading to a decline of 33 % for this group of economies. Decreased earnings of developed-country

TNCs and a decline of syndicated bank loans have particularly limited financing for investment. A reduction in leveraged buyout transactions also dampened cross-border mergers and acquisitions (M&As), further depressing FDI flows. Cross-border M&A sales in developed countries decreased also with 33 per cent in 2008 (Table 1).

Table 1. Cross border M&As, by region and world economy, 2007 – 2008

Region/Economy	Cross-Border M&As		
	2007	2008	Growth rate (%)
Developed countries	1454,1	981,8	-32,5
- Europe	825,0	548,7	-33,5
- United States	379,4	314,9	-17,0
- Japan	21,4	19,1	-10,8
Developing countries	152,9	177,0	15,7
- Africa	10,2	26,3	157,0
- Latin America and Caribbean	30,7	29,5	-3,8
- Asia and Oceania	112,0	121,2	8,2
• West Asia	30,3	31,5	4,0
• South, East and South-East Asia	81,5	89,4	9,7
- Transition economies	30,1	25,0	-17,0
World	1637,1	1183,7	-27,7

Source: UNCTAD (2009), Assessing the impact of the current financial and economic crisis on global FDI flows

In developing and transition economies, FDI inflows have so far remained more resilient. The growth rate of FDI inflows to developing countries, while lower than in 2007 (when it exceeded 20 %) still reached an estimated 4%. Flows to Africa are expected to grow further to more than $60 billion, despite the slowdown in global economic growth. Flows to East, South and South-East Asia might rise, but by a slower rate compared with 2007 while West Asia is projected to register flows decline significantly due to the slower growth in oil demand, rising costs and lower funds from export proceeds. By contrast, FDI flows to Latin America and the Caribbean are expected to show significant resilience to the world economic slowdown, partly as a result of a strong rise in FDI flows to South America. However, Central America and the Caribbean – which are traditionally highly dependent on the United States economy – are most likely to register a decline. FDI flows to the transition economies of South-East Europe and the Commonwealth of Independent States (CIS) should maintain their upward trend despite the financial crisis and regional conflicts, registering an increase of about 6 per cent. In contrast to developed countries, M&As in developing countries rose by 16 % in 2008, particularly in Africa and Asia (Table 1).

On the global level, the cross-border M&As have already been sharply affected as a direct consequence of the crisis, with a 17 per cent decline in cross-border M&As in the first 10 months of 2008 as compared to the same period of 2007. This decline was due, among other factors, to the fact that leveraged buyouts have fallen considerably due to weakened world stock markets. The decline in cross-border M&As is of utmost importance for FDI flows, being connected.

3. Impact of the financial crisis on the FDI flows

The current global financial crisis influences firms' capacity to invest as a result of reduced availability of finance resource and the pessimistic economic and markets prospects.

An important factor which affects the FDI is the reduced access to finance**.** Financial factors have negatively affected TNCs' capacity to invest, both internally and externally, as tighter credit conditions and lower corporate profits affect the TNCs' financial resources for overseas and domestic investment projects. In the same time, a more than 40 % decline in stock markets worldwide has reduced TNCs' ability to turn to stock markets for financing purposes and to leverage their M&A activities using stock shares [WB, (2009)].

The evolution of markets, including the sharp economic recession worldwide and an increased appreciation of risk, has also reduced firms' propensity to invest for further expansion both domestically and internationally of production capacity. According to the latest IMF forecasts, world output is predicted to expand by only 2.2 per cent in 2009, a decline of almost three percentage points compared to 2007. Total output in advanced economies as a whole would decrease from 1.4 per cent in 2008 to -0.3 per cent in 2009 (Figure 2).

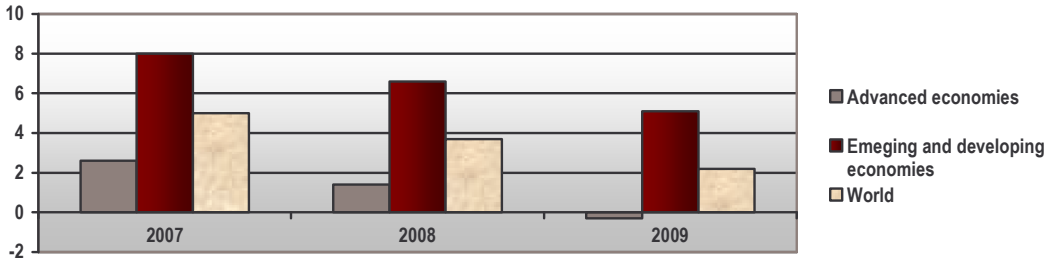

Figure 2. Forecasts regarding the yearly GDP growth (%), 2007-2009

Source: IMF (2008), World Bank (2009)

Risk aversion is another factor which should be considered when is analyzed the FDI. Companies' investment plans may also be scaled back due to a high level of perceived risks and uncertainties, in order to develop resilience to pessimistic scenarios regarding financial and economic conditions. As many available confidence indicators (such as the consumer confidence) have fallen to historical lows, a large percentage of companies might implement cost-cutting programmes (including divestments, layoffs, postponing or cancellation of investment projects).

The impact of these negative factors may vary significantly depending of the type of investment: market-seeking, efficiency-seeking and resources-seeking. All three types are impacted by the ongoing financial crisis, but with differences in magnitude and location pattern of impact.

The most directly affected types of investment so far have been market-seeking projects, especially those aimed at developed countries. As advanced economies might experience a negative growth in 2009, companies are restraining the launching of new projects aimed at increasing their market-oriented production capabilities there while they remain more committed to capacity expansion in emerging and developing economies.

The impact of the crisis on efficiency-seeking projects is more difficult to assess. On one hand, these projects will suffer globally from the decline in the companies' financial capabilities. On the other hand, many companies might be compelled by the ongoing crisis to restructure their international activities to cut cost and boost overall efficiency. This means closing or downsizing obsolete or non-cost-competitive facilities (often located in advanced economies), but also opening some new cost-efficient facilities, especially in emerging economies.

Finally, resource-seeking FDI projects could suffer, at least in the short-term, from the decline in world demand and consequently in prices, with particularly negative effects on resource-rich developing countries. It should be noted, however, that this setback in resource-seeking investment closely follows a period of euphoria, when quickly-rising world demand triggered imbalances in commodity markets, boosting prices and leading companies to launch many new projects.

The decline in the propensity to invest abroad can take various forms (including divestment and restructuring) and differ according to entry modes (e.g. M&As, greenfield investment).

The setback in FDI has particularly affected cross-border mergers and acquisitions, the value of which was in sharp decline in 2008 as compared to the previous year's historic high. It has also taken the form of a rising wave of divestments and restructurings, especially in the financial services, the mining industry, automotive industry, aircraft industry, building materials, consumer goods industry, steel industry. Companies indeed undertake divestments and make cuts in existing production capacity – either by shutting down plants or factory lines, or by selling some of their assets to other companies–

to restructure foreign operations, save costs, or improve their balance-sheet situation, especially through lowering the debt-equity ratio.

The preferred mode of entry by TNCs for their investments abroad may vary considerably depending on the host country. For instance, 83% of crossborder M&A transactions in value were undertaken in developed economies in 2006, while 56% of announced international greenfield projects were located in developing or transition economies [UNCTAD, 2008b)].

Greenfield investments (new investments and expansion of existing facilities) are preferred in developing economies, where the rapid growth of markets implies possibilities for an increase in production capabilities and where opportunities are limited for the purchase of existing local companies. M&As are more commonly used in developed countries, where market growth is slower and where a large stock of companies is available for buyouts. In the transition economies of South East-Europe and the CIS, the pattern of entry modes is closer to that of developing countries, with a slightly greater use of greenfield investments than M&As (Figure 3).

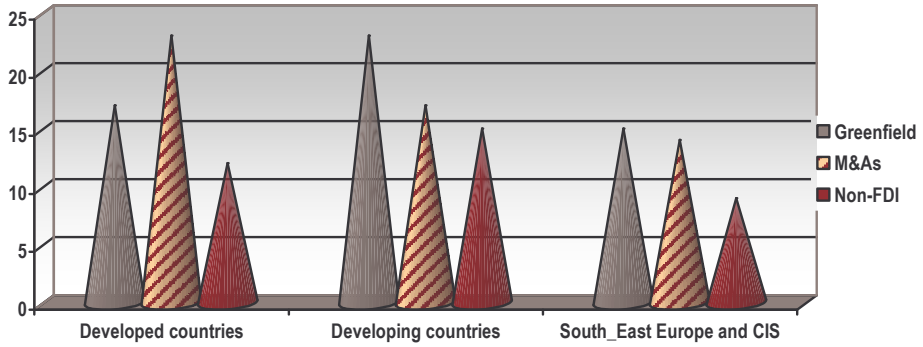

Figure 3. Entry modes on the host markets for TNC, 2008-2010

Source: UNCTAD (2008a), World Investment Prospects Survey 2008-2010

Non-FDI modes of entry (such as partnerships, agreements or licensing) rank last in all regions despite the growing importance of crossborder partnerships, especially in R&D and innovation-intensive projects (including also partnerships with universities), and projects involving high levels of investment risk (including private-public partnerships in infrastructure).

4. Perspectives regarding the FDI evolution at the global level

While the negative impacts of the financial and economic crisis on FDI will presumably remain dominant in 2009, there are various positive factors which can determine, sooner or later, a recovery of international investment flows.

First, a number of large emerging economies, such as China, India, Brazil, and the Russian Federation (the BRICS), have remained attractive to FDI, particularly to market-seeking FDI. accordingly with a UNCTAD survey (2008) (Figure 3).

The BRIC countries maintained relatively high economic growth rates compared to advanced economies in 2008 (such as 5.2 % for Brasilia and 9.7% for China) [FMI, 2008)]. As prospects continue to deteriorate in developed countries (more markedly than in developing ones), investors will favour the relatively more profitable options available in developing countries.

Second, financial crises and tough economic periods also offer opportunities to companies to buy assets at lower prices and take advantage of large-scale industry consolidation in some activities. For TNCs, the acquisition of undervalued assets may boost their investment in both developed and developing countries, depending on the circumstance and opportunities. Dramatic exchange rate and share price falls may lead to a round of acquisitions targeting bargain assets in a number of countries, and a possible wave of consolidations in certain industries, such as oil and gas, metal mining, automotive industry and financial services.

Third, companies are still committed to increasing their level of internationalization in the medium term**,** a finding which constitutes a significant indicator for a future upturn in FDI flows. As shown in the World Investment Prospects Survey, 2008–2010 [UNCTAD, 2008a)], large TNCs around the world still seem to be eager to pursue internationalization strategies and thus increase FDI expenditures in the medium-to-long term.

Fourth, new sources of FDI have emerged, especially from the South. Emerging economies and countries well-endowed with natural resources are becoming a growing source of FDI, either through the internationalization strategies carried out by their TNCs, or through the investment activities of their SWFs. TNCs from the South, in particular, are likely to continue to be active international investors.

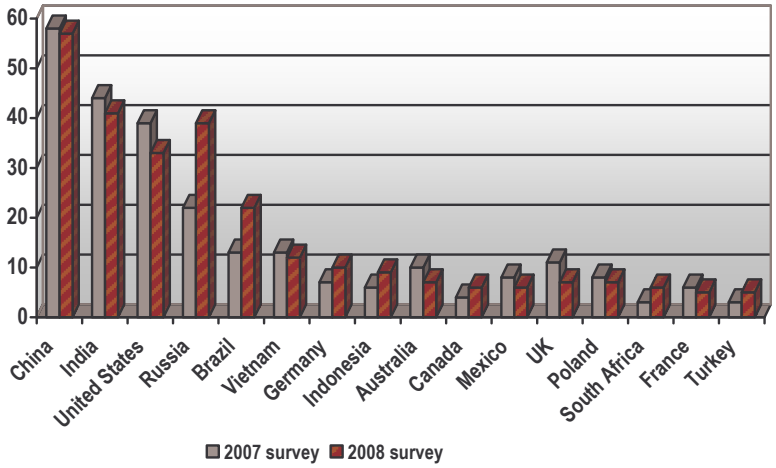

Figure 3. The most attractive economies for the location of FDI (% of responses to the UNCTAD survey)

Source: IMF (2008), World Bank (2009)

Future prospects seem bright for developing and transition economies. Accordingly to the UNCTAD *World Investment Prospects Survey 2008-2010,* the preference given by responding companies to South, East and South-East Asia, the new EU-12, South-East Europe and the CIS, Latin America, West Asia and North Africa is expected to increase further in the next three years. In contrast, little improvement is expected for the main developed regions, particularly the EU-15, other European and other developed countries (Figure 4).

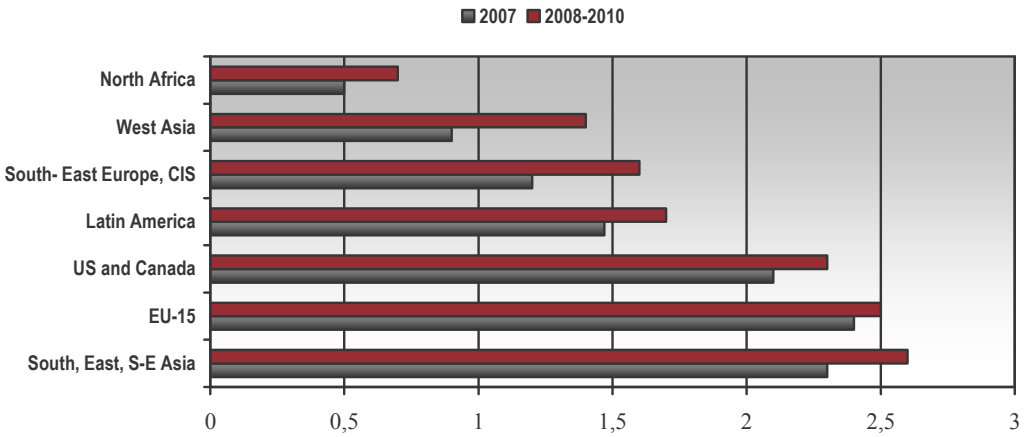

Figure 4. Investment preferences, by host region (average score: 0 = not all important, 4 = very important)

Source: UNCTAD (2008), *World Investment Prospects Survey* 2008 – 2010

Fifth, many quickly-growing industries are presently characterized, even in the midst of the present crisis, of the present crisis, by very promising FDI prospects. Among these, one could mention the following examples, sorted by type of industries: in life sciences (equipment and services for medical diagnosis biotechnologies, bio-cosmetics); in agro-food industries: intermediate food products, processed seafood, aquaculture products, high value added products); in transport equipment (automotive and aerospace electronics, hybrid motors); in business services: (customer service centres, R&D centres, technical engineering); in personal services (retail, care of senior citizens, health care, financial services); in information and communication technologies (micro and nano electronics, software for video games, interactive and virtual image technologies); in energy, chemistry, and environmental conservation; in other industries: technical textiles, robotics, etc. [UNCTAD, (2008a)].

Whether these positive factors will offset the impact of the financial constraints facing firms and the reduced demand and slower economic growth in many parts of the world remains an open question.

5. Conclusions

The present crisis may be a source of threats and incertitude regarding the evolution of FDI at the global level.

In the short term, the negative impact of the present economic recession on global FDI prospects should be the dominant one. Medium-term FDI prospects are more difficult to assess, due to the exceptional magnitude of the present crisis and to the fact that it could lead to major structural changes in the world economy. Nevertheless, there are some favourable factors for FDI growth, some of which are even a consequence of the crisis itself. Driving forces such as investment opportunities triggered by cheap asset prices and industry restructuring, large amounts of financial resources available in emerging countries, quick expansion of new activities such as new energies and environment-related industries and a resilient trend in the internationalization of companies will presumably trigger, sooner or later, a new pickup in FDI flows.

The exact date of this upward switch depend on a series of uncertain factors such as the speed of economic and financial recovery, the efficiency of public policy in addressing the causes of the present crisis, the return of investor confidence and the ability to prevent protectionist tendencies.

The crisis, however, also opens a chance to implement efficient global policy responses to enhance the stability of the financial system and stimulate economic growth [Stiglitz, (2008)]. This requires action at a coordinated international level to rebuild financial multilateralism, foster the stability and equity of the worldwide financial system, promote stronger transparency or disclosure standards, create guarantee funds to help emerging and developing countries to secure the debt of their corporations, and to reassess the importance of public policies and regulations.

In addition, at the country level, measures specifically aimed at stimulating investment could also be more extensively implemented. Investment promotion agencies could also play a key role in fostering after-care policies aimed at retaining existing activities by TNCs and in implementing targeted investment promotion programs on promising activities.

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MACRO - PRUDENTIAL MONITORING INDICATORS FOR CEMAC BANKING SYSTEM

Severin Yves **KAMGNA**, Nzesseu Jules **TINANG**, Kinfak Christian **TSOMBOU**
Direction of Studies
Bank of Central African States, **Republic of Cameroon**
kamgna@beac.int

Abstract

The main purpose of this paper is to determine the macro-prudential indicators of financial stability that can be used for supervising the banking system in the CEMAC zone. Going by a set of indicators drawn from similar works on macro-prudential supervision, and, more specifically, aggregate microeconomic variables of the banking sector, macroeconomic variables and combinations of the two, we were able to identify those that are relevant in analysing an imminent deterioration of the banking system in the subregion. At the end of this study, it was realised that claims on the private sector, foreign direct investments and the combination of exports and credits to the private sector, increase the risk of degradation of the banking system, while this risk is reduced by an increase in the exchange rate, increase in the internal resources of the banking system and inflation rate. The regulator should therefore bear this set of indicators in mind in order to facilitate a quick response to offset any potential banking crisis in the CEMAC region.

Keywords: banking system, macro-prudential indicators, weakness, degradation.

JEL Classification: C12, C13, G21, G28

Introduction

Analysing the stability of a financial system is of prime importance, given the likely adverse effects[1] that a financial crisis could have, not only at the level of economic activity but also at the social level. For some years now, we have been witnessing the development of a new analytical approach, referred to as the macro-prudential approach, for preventing crises in the banking system. Actually, the micro-prudential approach, which for long was the only method used as a crisis warning system, has today shown its limits[2], as it emerges from recent financial crises that it is not enough to monitor banking indicators to be able to make dependable forecasts on a failure of the system. Moreover, excessive recourse to micro-prudential rules can even compound the aversion of banks for risk-taking and lead to the bankruptcy of some institutions [Borio, (2003)].

The macro-prudential approach appears today to be an improvement in micro-prudential monitoring that helps to assess the global exposure of the banking system to a financial crisis. According to Sundararajan *et al*. (2002)[3], "macro-prudential analysis refers to the assessment and control of the strengths and weaknesses of a financial system in terms of macro-prudential indicators made up of indicators of financial soundness and other macroeconomic indicators, such as the GDP growth rate and inflation rate, with information on the structure of the financial system, qualitative information on the institutional and regulatory framework, in particular, by assessing consistence with international standards and codes, and the results of tension tests."

Therefore, macro-prudential analysis helps the regulator to have a holistic view of the banking system. Evans, (2000), in a comprehensive study, identified a set of macro-prudential indicators which he divided into two categories: aggregate micro-prudential indicators and macroeconomic indicators. However, the diversity of financial systems and the multiplicity of indicators identified require the local regulator to assess which indicators are relevant for a particular financial system.

In the late 1980s, the banking system of the CEMAC zone, under the supervision of BEAC, witnessed some shortcomings (individual bankruptcy, illiquidity situation, etc.) with negative consequences on economic

[1] The weaknesses of a banking system, be it in a developing country of in a developed country, can be a threat to financial stability both within the country and at the international level [Bále, (1997)]. Also see Borio (2003), Plihon *et al*. (2004), for a better understanding of the consequences of the instability of a financial system.

[2] Goodhart (2004) cites the case of Japan in 1998, where banks taken individually were financially strong, but all vulnerable to the crisis of the housing sector.

[3] Quoted by Yung Chul

activity in the sub-region [Djine and Tamba, (1995)]. This crisis was the result of the poor management of these financial institutions and the deteriorating terms of trade during those years. Today, globalisation and interconnexion of financial markets increase the probability of spillover effects that can lead to the "importation" of a banking crisis.

Consequently, it is today necessary to strengthen the supervision mechanism in order to take into account both the individual situations of banks and the overall resilience of the banking system, with a view to reducing the risk of banking crisis monitoring. A lot of efforts have been made to this end since the mid 1990s. Today, the authority in charge of ensuring financial stability works with a set of macroeconomic variables. However, it would be interesting for it to know precisely which variables are the most relevant for assessing the financial system. In other words, what will be the convincing power of each variable to forecast a degradation of the banking system? This approach seeks to significantly reduce the number of variables that could be used to predict a banking crisis and assess the predictive power of each of them, has a two-pronged advantage in terms of efficiency and cost. The regulator can easily read into the situation of a banking system, as it will no longer be necessary to attach the same importance to all the several indicators, but to concentrate on those which, if adjusted, can lead to an increase in the probability of predicting a failure in the system.

The purpose of this research paper is to determine the indicators of financial stability that could be used in monitoring the banking system in the CEMAC zone. Specifically, going by a set of indicators drawn from similar works on macro-prudential supervision, we intend to identify those that are relevant in analysing an imminent deterioration of the banking system in the sub-region.

This paper is divided into two parts. Part I examines banking system supervision by dealing with the micro-prudential approach in section (1) and the macro-prudential approach in section (2). Part II is a presentation of the methodology used and the results obtained first by indicating the theoretical analytical framework in section (3), and then by putting the theoretical framework into practical use and looking at the econometric model in section (4). In section (5) we attempt to propound the parameters of the model and analyze the results obtained.

I. Monitoring the banking system

According to the European Central Bank, financial stability refers to a situation in which the financial system is capable of resisting shocks without triggering adverse knock-on effects on the use of savings, investment and payments processing in the economy [Tordjman, (2007)]. The monetary authority has more reasons than one to be concerned with the stability of the banking system. Firstly, such stability can be considered a public good, meaning a good characterized by non-rivalry and non-exclusion. This is where the supervisory authority comes in to make it freely available to users (banks, households, etc.) and ensure its preservation. Secondly, banks are considered key players in the transmission of the monetary policy of the Central Bank [Landau, (2009)]. In case of a weakness in the banking system, it may be more costly for the Central

Bank to tighten its monetary policy [IMF, (2006)][4]. Finally, commercial banks represent a big share of the clientele of the Central Bank which must thus constantly seek to monitor their situation and solvency.

The banking system is generally exposed to two types of risk that could lead to a crisis situation. Firstly, internal or endogenous risk that comes from within each bank that makes up the system and which is seen in its income statement. This type of risk is examined mainly through the microprudential approach which assesses the weakness of banks, with such weakness being deduced from the bill of health of all the banks[5]. Secondly, external or exogenous risk of the bank which comes from two main sources: the contagion effect and the macroeconomic environment in which the bank operates. The macroprudential approach, with ultimate goal to assess the risk of generalized weakness

[4] Actually, the fragility of the banking system generally leads to panic among depositors who usually react by withdrawing their savings from banks. This could create the phenomenon of "bank runs" which devolves on the Central Bank which will then act as a last resort lender. This situation then increases the amount of liquidity circulating in the economy and could lead to inflation

[5] This approach is known as the Bottom-Top Approach

of the financial system and not only individual institutions will be used to cash this type of risk [De Bandt and Oung, (2004)].

1 The micro-prudential approach

1.1 Definition and objective

This approach, which entails the individual assessment (internal control) of each financial establishment, is in line with the recommendations of the Basel Committee on Banking Supervision. Here, the supervisory authority has to ensure that banks comply with the regulations relating to the management, caution and dissemination of information, in order to protect depositors and guarantee confidence in the banking system.

1.2 The tools used

Several authors [Shen and Hsieh, (2004); Cole and Gunther, (1998)] analyse two micro-prudential monitoring variants. The first one is based on a periodic audit of banks and the second on observing a set of financial stability indicators (FSIs) calculated using the data transmitted by banks.

Auditing a bank helps to control its financial situation in keeping with applicable regulations and ascertain the accuracy of the information it transmits to the supervisory authority. It thus helps the supervisory authority to have reliable information on each bank. However, this approach is quite costly both for the supervisory authority and for the bank. The number of audits should thus be few and far between, sometimes once a year. To ensure some level of continuity in control, the audit should be conducted using the data transmitted more regularly by banks, meaning that micro-prudential financial stability indicators[6] (FSIs) will be used.

FSIs are indicators which give information on the situation and stability of the financial institutions in a country, and on those of companies and households with which they interact [IMF, (2006)]. Determining the "FSIs" is of prime importance in ensuring efficient supervision of banks. Actually, FSIs can act as filters which retain only a few banks for in-depth assessment. These FSIs from the accounting situation of the bank can be transmitted to the supervisory authority on a regular basis. It can then use the information so received to determine the situation of the bank. FSIs can also be grouped into sectoral data, thereby facilitating a shift from the micro-prudential approach to sectoral monitoring.

For an institution, FSIs are generally got using the ratio of variables relating to its liabilities and assets, which give an idea of its solvency. In banking, these indicators are divided into two subgroups [IMF, (2006)]: central indicators which every banking system is required to produce, and complementary indicators which banking systems are encouraged to produce. Central indicators cover risks related to the adequacy of owners' equity, the quality of assets, profitability, liquidity and exchange rate. The supervisory authority summarizes the information provided by FSIs through a bank rating system that helps to classify banks. This ranking can be done using a discriminating analysis or a logit-probit model; meaning that the scores can be calculated and classification done automatically as soon as FSIs are received from banks[7].

1.3. Limits of the approach

In addition to the structural disadvantage of not considering the macroeconomic environment and the difficulty of aggregating the results obtained for each bank into the system, the micro-prudential approach has two other equally important shortcomings: firstly slowness in predicting banking system weakness and secondly difficulty in identifying threats to the system.

Indeed, even if we suppose that the problem of aggregation is solved, micro-prudential indicators reflect the situation of a bank at a given time. Considering fluctuations in economic activity, these indicators could be used to make forecasts of imminent crises (if we adopt a pessimistic attitude)

[6] The term micro is used as against the term macro which refers to the aggregation of these indicators to assess the stability of any banking system.

[7] In the early 1970s, the United States Federal Reserve developed a rating system that helped to determine the frailty of a bank. This system referred to as CAMEL is based on five criteria: capital adequacy, quality of assets, quality of management, profit level and liquidity level. In this rating system marks ranging from 1 to 5 are awarded to each bank, in increasing order of his fragility.

which never occur; or, if we adopt a cautious attitude, make very belated forecasts of crises which actually occur, for corrective measures to be taken.

Moreover, once banks are classified as weak or not, if the aggregation of this ranking betrays some frailty of the banking system, it will then become difficult for the supervisory authority to identify the sources of this systemic fragility such that the necessary macroeconomic measures can be taken[8].

Redressing the system could thus be done case by case. This has the disadvantage of being very costly for the regulator, encouraging moral hazard behaviours[9] and providing only tentative solutions.

2. The Macro-prudential approach

The need to be able to predict periods of instability in the banking system became crucial at the end of the period of the global crisis of the 1990s[10]. In the face of numerous economic and social costs caused by these different crises, the international community (policy makers, researchers, etc.) began to consider the manner to improve the mechanism used at the time to monitor the financial sector. One of the responses to this question happened to be what is today called "macro-prudential analysis of the stability of the financial sector". This section is entirely devoted to presenting this analytical approach. After defining the concept and outlining the composition of the macro-prudential indicators, we will then examine the application of this approach.

2.1. Definition

According to Borio (2008), it is not easy to find a universally accepted definition for the term "macro-prudential" because, even if the connotation to which it refers is directly recognizable, its meaning remains largely ambiguous. In our literature review therefore, we identified some approaches on how to define the concept. The approach adopted at the BIS[11] consists of defining the term "macro-prudential" using its opposite, the term micro-prudential. According to this conception, the macro-prudential approach is a (good) complement of the micro-prudential approach which helps (by taking into account macroeconomic factors) to perfect the banking system monitoring mechanism by taking into account not only the individual exposure of banking institutions but also that of the system as a whole.

Similarly, in their attempt to define macro-prudential indicators, Evans (2000), Hilbers *et al* (2000) state that these are pointers to the health and stability of the financial system which can be used to assess its vulnerability to shocks.

Comparing Macro and microprudential approaches

	Macroprudential approach	Microprudential approach
Operational objective	Reduce the risk of weakness of the entire system	Reduce the risk of bankruptcy
Ultimate objective	Avoid losses (in GDP points) due to a financial crisis	Ensure the protection of investors and creditors
Types of risk	(Partly) Endogenous	Exogenous
Correlation and contagion effects between institutions	Important	Not pertinent
Monitoring method	In terms of overall weakness of the system (top-bottom)	In terms of individual weakness (bottom-top)

Source: Borio, (2003)

[8] Individual bank fragility indicators can differ under the action of one and the same macroeconomic indicator which then constitutes the cause which must be tackled [Bernanke, (2008)].

[9] This means that a bank will take risks while counting on the regulator to take action in case of problems.

[10] Many regions of the world were affected, some of the most recurrently crises cited are the contagion effect in Latin America (1994) and Asia (1997).

[11] Bank of International Settlements (BIS).

The macro-prudential approach brings together a series of methods that can be used to assess the impact of a macroeconomic shock on the stability of the system by dint of the aforementioned indicators of weakness in the banking system. Unlike the micro-prudential approach, this approach attempts to assess the overall vulnerability of the system. The objective is, not to protect the deposits of bank customers, but rather to prevent a systemic crisis that can lead to high costs due to a drop in economic activity or the recapitalization of the banking system. Instead of attaching a lot of importance to each bank as an independent financial institution, the macro-prudential approach rather considers the contribution of the bank in terms of risk induced on the system [Crockett, (2000)].

Thus the take home message here is that the main aim of the macro-prudential approach of monitoring the financial system is to protect the entire system. It does this by putting in place an early warning system on the periods of weakness of the said system. The warning system should be based on information concerning the structure of the system, the observation of aggregate macroeconomic and microeconomic financial stability indicators (FSIs) [Cih´ak, (2005)]; with their evolution having been earlier compared to that of the system's vulnerability.

2.2. Composition of Macro-Prudential Indicators (MPI)

Macro-prudential indicators are generally made up of two main groups of variables: aggregate micro-prudential variables obtained by collating information on the individual viability of financial institutions, and macroeconomic variables which have a potential influence on the financial system. It would however be presumptuous to think that, on their own, the abovementioned variables are enough to help make dependable forecasts on the bill of health of the financial system. In this connection, Evans, (2000) notes that, in making an overall appraisal of the financial system, it would be advisable to consider the qualitative characteristics of the system[12].

2.3. Application of the macro-prudential analysis

According to the *Guide for establishing FSIs* prepared by the IMF (2006), the macro-prudential analysis is done by defining a reference framework including four elements:

- Assessing the risk of shocks on the financial system;
- Recourse to Financial Stability Indicators;
- Analysing micro-financial interactions;
- Monitoring the macroeconomic situation.

The macro-prudential approach therefore focuses on the factors of vulnerability of the financial system and the interaction between macroeconomic trends and financial stability. For example, this entails being able to detect the vulnerability factors of non-financial institutions in order to reduce credit risk which, if allowed to rise, could lead to an increase in the number of nonperforming loans and negatively affect the capacity of the banking system to honour its

II. Methodological Approach

3. Theoretical framework for analysing the banking system

3.1. Definition of concepts

Before analysing how weak a banking system is, we need to start by defining the various underlying concepts of the theoretical analysis. The outbreak of a banking crisis goes along some stages from the weakness of basic units, banks, to the fragility of the entire banking system coupled with successive periods of deterioration[13]. There is no consensus on the definition of the above-mentioned concepts among the different authors who have written on banking supervision.

[12] He makes mention among other things of "the structure of the financial system and markets; the regulation to lay down accounting standards and others as well as obligations to divulge information; rules governing the classification of loans, provisioning and income recognition and other prudential rules; the quality of monitoring exercised on financial establishments; the legal framework (especially with regard to bankruptcy and foreclosure);incentives, and safety nets as well as liberalization and deregulation movements ".

[13] The use of the terms fragility and deterioration, even though in a pejorative sense, is in line with the preoccupation of the regulator who attaches more importance to the risk of seeing the system collapse, considering the negative consequences of such an eventuality on the economy.

The various definitions are informed on earlier works [Hermosillo, (1999); Bhattacharyay, (2003); Shen and Hsieh, (2004)].

- **Weakness of a bank.**

A bank is said to be weak when it presents the risk of requiring external intervention to ensure its survival. Thus, the weakness of a bank refers to the risk for the bank to no longer be able to honour its short-term commitments (clients' deposits, loans from other institutions, etc.). Such failure of payment could then be passed on to other economic agents and upset the economic and social environment.

Shen and Hsieh (2004) identify three approaches used in defining bank failure. The first is to consider the periodic adjudications of bankruptcy by the supervisory authority. The second approach is that which better suits the definition of bank weakness. Here, the situation of bankruptcy is considered as "quasi-bankruptcy" and supposes the intervention of the supervisory authority in order to avoid the total closure of the bank which could be a bad sign for the market.

The third approach used by Hermosillo (1999) entails comparing the ratio of bank commitments coverage in relation to a given threshold.

As indicated above, the weakness of a bank can also be analyzed using the CAMEL rating.

- **Weakness of a banking system**

The weakness of the banking system can be seen as an aggregation of weaknesses of individual banks coupled with the resulting negative externalities. As of today, there is no universally accepted definition for the weakness of a financial system or even a banking system. However, there are generally three characteristics of the notion of financial vulnerability [Bhattacharyay, (2003)]:

- significant loss of confidence of economic agents in the financial system (financial institutions and financial markets);
- inability of financial institutions to efficiently play the role of intermediation;
- spreading of financial vulnerability to the entire economy.

As far is the regulator is concerned, this weakness can be seen as a risk for him to have to intervene in order to rescue a banking system. In this case, the degree of weakness is established using the cost of such an intervention. The advantages of this definition are: it is objective, based on individual quantifiable indicators and can be assessed. However, the difficulty with such an approach is how to aggregate the weaknesses obtained for each bank. Two approaches can thus be considered: approach by numbers and approach by costs of interventions.

- **Deterioration of the banking system**

The deterioration of the banking system is part of the dynamics of weakness. A banking system can thus be said to have deteriorated when it is more fragile at a particular period than at a previous one.

- **The crisis of the banking system**

This marks the outcome of the banking system deterioration process. It therefore becomes necessary for the regulator to intervene in order to reduce the magnitude of the damage caused by the crisis and boost banking activities.

3.2. Formalizing the notion of banking system weakness

To define the weakness of the banking system, we go by the hypothesis that the situation of a banking system depends only on the situation of all the banks. With this, we can then define the weakness of a banking system using all the banks. The macro-prudential approach is therefore aimed at assessing the impact of macroeconomic variables on this weakness.

In this sub-section, we present two methods for aggregating the individual weaknesses of banks into a systemic weakness. To this end, the following variables will be used:

$n1t$: number of banks ranked as weak under the rating system as of the date t;

$n2t$: number of banks classified as not weak under the rating system as of the date t;

$E1t$: sum of the net commitments of $n1t$ banks classified as weak as of the date t;

Ft: intervention funds available in the coffers of the regulator;

αt: level of weaknesses ranging from 0 to 1 as of the date t.

3.2.1. Approach by numbers

This is a direct approach which entails comparing the number of banks deemed weak by the rating system to the number of banks considered to be financially viable. Thus, by adopting the values above,

The banking system will be said to be weak if n1t > n2t

From this definition, the higher the number of weak banks in a banking system the weaker it is itself. But such a generalization of the concept of weakness has the disadvantage that it does not take into account the weight of individual banks[14].

3.2.2. Approach by cost of the regulator's intervention

For the regulator, in order to take on board the weight of banks in the weakness of the banking system, it would be advisable to consider the amount of injections necessary to revive it in case its weakness leads to a banking crisis. But, in the event of a crisis, the banks the regulator already considers to be weak will not be able to refund their debts, meaning that such debts will have to be covered by the monetary authority in order to avoid the total collapse of the banking system.

Therefore, the weakness of the system could then be assessed by comparing the cost of a rescue operation of the system in the event of a crisis with the funds available for such an operation. The cost of a rescue operation refers to the sum of net commitments (clients' deposits and debts of the bank minus owners' equity and reserves in the Central Bank[15]) of banks considered to be weak.

The degree of systemic weakness will then be defined as the relationship between these commitments and the funds available to the regulator. Let *nt* be the degree of weakness of the banking system as of the date *t*.

Therefore:

$$n_t = \frac{E_{1t}}{F_t} \tag{1}$$

and

The banking system is said to be weak if nt > αt.

3.3. Formalizing the notion of banking system deterioration

The deterioration of the banking system represents the evolution of its weakness and is thus part of a dynamic process. Therefore, the deterioration of a banking system at a given date is the growth rate of its weakness as of that date.

By considering the approach by numbers, a system can be said to have deteriorated if $n1t < n1t+1$.

With the approach by costs, if we let βt be the deterioration of the banking system as of the date *t*, using the values above, we have:

$$\beta_t = \frac{n_{t+1} - n_t}{n_t} = \frac{\Delta n_t}{n_t} \tag{2}$$

The financial system will be said to have deteriorated or not depending on whether βt is positive or negative. The rate of deterioration will be found using the absolute value of βt.

Let *dt* be the binary variable of deterioration defined by:

[14] For example, can it be said that a system with 10 % of weak banks representing 50 % in terms of market share, presents the same weakness as a system with 10 % of weak banks representing a 10 % market share? Thus, when assessing the weakness of a banking system, it would be advisable to take into account the weight of banks.

[15] We can also add the financial claims of the bank less its doubtful claims.

$$d_t = \begin{cases} 0 t_f \beta_t \leq 0 \\ 1 t_f \beta_t \rangle 0 \end{cases}$$

3.4. Another formula (considering all the banks)

Even though the formulae presented above all use the secondary information on the weight of weak banks, they have the disadvantage that they consider only such banks in determining the weakness coefficient. This other approach is based on two hypotheses:

- All the banks are presumed to be weak;
- *The contribution (weighting) of each bank to the weakness of the system increases with the risk they represent.*

These two assumptions help in finding the coefficient of weakness directly by using the score obtained during the rating. This has the advantage of eliminating the "differentiation" effect[16] which can be noticed by using classes of scores rather than the score itself.

Therefore, we are supposing that the score function is normalized and that it increases with the risk of weakness.

Note that:

s_{it} score obtained by bank i ($i = 1...p$) on date t;
E_{it} amount of commitments of bank i on date t;
F_t amount of funds the regulator has on date t to assist the system.

Then,

$$n_t = \frac{\sum_{i=1}^{p} s_{it} E_{it}}{F_t} \qquad (3)$$

In defining the weakness of a banking system, the regulator can decide to attach more importance to the weakest banks, by giving more weight to their commitments in the formula to find the degree of weakness. To this end, we can consider a transformation (f function) which increases the score value of the weakest banks and reduces that of the less weak. With this, we can rewrite the formula above as follows:

$$n_t = \frac{E_{i=1}^{p} f(s_{it}) E_{it}}{F_t} \qquad (4)$$

4. Application of the theoretical approach

The definitions and concepts presented above can be seen differently depending on the context of monitoring and the tools of the supervisory authority. In fact, following the characteristics of the banking system, the supervisory authority generally gathers a lot of information from banking institutions. It then uses such information to determine the indicators which will be used to monitor the stability of the system. For reasons of clarity, it is therefore important to establish metadata which help to give a good understanding of the indicators used. In this section, we identify the proxy variables that facilitate the application of the theoretical framework developed above to the case of CEMAC.

The database we have on all the banks in CEMAC is from SYSCO[17] and includes some twenty variables and concerns all the commercial banks of the sub-region. One of the variables is qualitative and shows a classification of banks into 7 groups[18], while the other variables (quantitative) are micro-

[16] If, for instance, we let the score used in defining class 1 to be between 0 and 10, and that used to define class 2 between 10 and 20, then two individuals having obtained 9.8 and 10.1 will fall under two different classes without however being essentially different.

[17] CEMAC bank rating system

[18] The classes are 1, 2, 3A, 3B, 3C, 4A, 4B

prudential variables recorded on a monthly basis. The database covers the period running from 31/01/2001 to 31/12/2005. Data is not available for some banks which either entered our sample after the starting date or for some other reasons.

According to the SYSCO rating, 67 % of the banks surveyed fall under classes 1 and 2. In order to ensure some fluctuation in the weakness variable, we will consider that groups 1 and 2 represent viable banks while the other groups are made up of banks considered to be weak.

4.1. Construction of a banking system weakness variable

For the construction of this variable, we need to know three elements: the banks considered to be weak during the period under review; the amount of commitments of these banks for each period and the amount of funds the regulator would be ready to inject in order to prevent the system from going bankrupt. Bearing in mind the weakness threshold allowed by the regulator for each period, we can define the binary variable of failure of a banking system.

The banks we have chosen to consider weak, following the SYSCO class distribution, are those of classes 3A and 4B. For each bank, commitments are defined by deposits which include public deposits and private deposits. Since we do not have the variable of the amount the regulator has, to rescue the system, we used the Demirgüç-Kunt and Detragiache crisis determinant (1997).

In fact, these authors define a crisis period as a period when the ratio of the cost of rescuing the banking system to GDP is higher than 2%. We suppose that the amount of funds the regulator has as of the date *t*, to rescue the system in the event of a crisis, is a fraction λ of the GDP which we put at 1%.

Thus, for each banking system, the variable "degree of weakness", was got by establishing a relationship between the monthly commitments of the banks of the system which are considered to be weak and 1% GDP of the corresponding quarter.

4.2. Construction of the banking system deterioration variable

Having an idea of the degree of weakness of a banking system is a key input used by the regulator to make decisions. However, it would be advisable for the regulator to buttress his choices with forecasts, on the strength of a limited number of indicators, of the probability of deterioration of the situation of the system. To develop such a forecasting mechanism, we had to assess the system dynamics by comparing successive situations. To this end, we used the weakness variable to build a new quarterly variable that reflects the deterioration of the system, also on a quarterly basis. Monitoring a banking system should be a permanent activity. With this, one of the qualities required of a good indicator is that it should be available within a relatively short period of time (at most quarterly). This variable will be used in the regression model which will be developed later. To uniform the frequency of variables used in the study, some macroeconomic variables presented in this paper were converted to their quarterly values when they were not available following the quarterly frequency. The method to get quarterly values as used here follows the Goldstein and Khan interpolation formula (1976)[19].

Since the objective of this study is to clearly identify the variables which can be used as advanced indicators of the deterioration of the CEMAC banking system, we thought it necessary, after defining the notion of deterioration, to indicate how in real economics we can examine each of its constituent elements. However, in order to ensure proper variability of the deterioration and considering the data at our disposal, we had to impose another small condition.

Therefore, the CEMAC banking system will be said to be deteriorating at the date *t* if the rate of variation of the degree of weakness between *t* and *t + 1* is higher than 25%;

This means that if:

$$\beta_t = \frac{\Delta n_t}{n_t} \rangle 25\% \qquad (5)$$

Therefore, we have

[19] Quoted by SIRI (2007).

$$d_t = \begin{cases} 1 if \beta_t \rangle 25\% \\ 0 if not \end{cases}$$

4.3. Presentation of other variables and data used

In this section we present all the explanatory variables of the model as well as the sources of the data we used to determine the coefficients of the model.

The approach adopted in the choice of indicators is that used by Shen and Hsieh (2004), which entails looking for the explanatory variables of the failings in the banking system among the aggregate micro-prudential variables, the macro-prudential variables and variables derived from micro-macro crossing.

Below are the variables most used and which we had at our disposal in this study. The explanatory variables of the final model will be chosen among this set of variables. Since the variable of interest here is binary, we will use the econometric of qualitative variables.

4.3.1. Aggregate micro-prudential variables

Apart from the SYSCO rating variable and the owners' equity variable, indicated above, we got all the micro-prudential variables for each bank from BEAC. These variables were used to determine which variables will be used as aggregate micro-prudential indicators[20]. The aggregate micro-prudential variables retained are:

- Ratio of owners' equity on total assets (*fp- ta*)

A high value of this ratio for each bank helps to increase resilience and thus reduces the weakness of the system. Setting the adequate level of owners' equity for banks should take into account the overall risk (credit risk and market risk) to which they are exposed as well as their general strategy [BIS, (2000)]. The expected sign of the coefficient of this variable is thus negative, as it is supposed to slow down the deterioration of the banking system.

- Ratio of bad debts on owners' equity (*credou-fp*)

With this ratio we can assess the quality of the banks' assets. Thus, a high value of this ratio means that the banking system is exposed to an illiquidity risk and increases its weakness.

- Other micro variables tested

We used other micro-prudential variables in order to adopt the suitable model. They are: the ratio of bad debt over total debts, the ratio of loans over deposits, ratio of public receivables over total receivables, ratio of cash surpluses/deficits over owners' equity.

4.3.2. Macro-prudential variables

The macroeconomic data used is drawn from two sources: the World Development Indicator (WDI-2007) of the World Bank for GDP variables and foreign debt, on the one hand, and from the International Financial Statistics (IFS) database of the IMF for the other variables. The variables from WDI are annual and had to be converted into their quarterly values. Some variables got from the IFS are quarterly variables while others are annual.

- GDP growth rate (*tcpib*)

An increase in production leads to an increase in incomes and thus enhances the ability for economic agents to meet their commitments. Thus, an upward movement in GDP is supposed to contribute to an improvement of the situation of the banking system. The expected sign for this variable is thus negative.

[20] This calculation was done by finding the sum, firstly for a given month, of all the values observed for all the banks, and the interest variable. Then, the aggregate and quarterly micro-prudential variable was calculated using the quarterly average of previously obtained values.

- Rate of increase of the Dollar-CFA exchange rate (*tctc*)

Since the countries of the CEMAC sub-region are price-takers, an increase in the exchange rate, all others things remaining equal, leads to an increase in export earnings expressed in the local currency. Since most of the goods imported into the CEMAC region come from Europe, they are not really affected by this increase in the exchange rate. The impact on the banking system should therefore be positive. Consequently, the expected sign for this variable is negative.

- Foreign Direct Investment-GDP Ratio (*fdi-pib*)

With the 1997 Asian crisis, it was realised that foreign capital, which was considered to be a strong contributor to economic growth, could actually lead to a systemic financial crisis.

However, there is no doubt that an increase in FDIs has a positive impact on the stability of the financial system. Therefore the sign expected for this variable is negative.

- Inflation (*inflation*)

Generally, one of the objectives of the Central Bank is to ensure price stability. Even though the adverse effects of a high level of inflation are known, the effects of a moderate level of inflation are rather mixed [Cordeiro, (2002)]. Thus, the impact of the inflation rate on the risk of deterioration of the banking system will depend on the average inflation level. Therefore we cannot express any opinion on the expected sign for this variable.

- Other macro variables tested

Many other macroeconomic variables were tested for the development of the final model. We have such macroeconomic variables as the export/GDP ratio, the foreign debt/foreign exchange reserves ratio, spread (difference between the lending rate and the borrowing rate), money supply/foreign reserves ratio.

4.3.3. Variables obtained from the micro-macro combination

- Ratio of credit to the private sector/GDP of the previous period (*creasp-pib*)

To get this ratio, we divided the claims of the banking system over the private sector for the preceding period by the GDP of that period. This ratio shows the risk taken by the banking sector in intermediation activities. Some works published by the Bank of International Settlements have shown that the ratio of credit to the private sector over GDP is a good indicator of financial instability [Pollin, (2001)]. The expected sign is positive. Actually, an increase in this ratio reflects an increase in risk taking by banks and worsens the deterioration of the system.

- The Credit-Export Product (*cre-export*)

To find this variable, we multiplied the export/GDP ratio by the ratio of credit to the private sector over total credits to the economy. Considered individually, these two variables are supposed to have contrasting effects on the deterioration of the banking system. In fact, an increase in credit leads to the taking of further risk and thus compounds the weakness of the system, while an increase in exports enhances the capacity of some beneficiaries of bank loans to meet their commitments and thus reduces the deterioration of the banking system.

- Other micro-macro variables tested

We also tested other combinations of micro and macro-prudential variables, notably: the product of the owners' equity variable and the inflation rate variable, the product of the bad debts variable and the GDP growth rate variable.

4.3.4. Choice of the final model

To adopt a final model, we sought to have the most suitable model that can be adapted to our data (without considering groupings by countries) in the light of AIC and BIC information criteria.

The procedure we used is the "Backwise" procedure which entails using a logit model containing all the potential explanatory variables, and then successively eliminating those that are less significant. Since we had a model with a range of significant variables to a certain level (10%), the choice of the final model was made by comparing the information criteria of the various models. The model we adopted is as follows:

$$fs = g(fp\text{-}ta, tctc, fdi\text{-}pib, inflation, creasp\text{-}pib, cre\text{-}export) \quad (6)$$

5. The Econometric Analysis

5.1. The approach adopted

Most studies carried out on this topic end up by making estimates of the data panel; with the panel being made up of either banks or countries (banking sub-system). Given that our study had to cover a set of 6 (six) banking sub-systems, we therefore had to adopt an approach whose outcome could be an estimation on panel data. However, to do this (make estimates on panel data), we needed to clearly specify the model, particularly with regard to uniformity between countries.

"From the econometric point of view, this means testing the equality of the individual coefficients of the model under study. At the economic level, specification tests entail determining if it is right to suppose that the theoretical model under study is perfectly similar for all the countries, or if on the contrary there are peculiarities that are unique to each country." [Hurlin, (2003)]

The initial model we had in mind can be summarized in the following formula[21]:

$$yit = g(xit\beta i + ci) + Eit \quad (7)$$

where $i = 1..N$ (country index), and $t = 1..T$ (time index), Eit follows a logistic law.

At the end of the test procedure, there are three possible scenarios:

- **Estimating individual models for each country.**

This case arises where the procedure being used rejects the hypothesis that the coefficients of the explanatory variables for all the countries are equal. Therefore the data generating process is not identical for all the countries. With this, we had to estimate the coefficients of the explanatory variables for each country taken individually.

- **Estimating a common model for all the countries.**

This case arises where it is accepted that the coefficients of explanatory variables and those of constants for each country are equal. The data is got from the same generating process and can thus be brought together for estimation purposes. In this case, we use the ordinary assessment parameters for an equation.

- **Estimating a model on panel data.**

This is some sort of an intermediate situation between the two other scenarios presented above. Here, the testing procedure admits the equality of explanatory variables coefficients between countries, but rejects the equality of constants for the countries. This situation denotes the presence of unobservable individual effects for countries, notwithstanding an identical response in terms of the explanatory variables being considered. The parameters are then assessed using panel techniques with the first stage being to determine whether the unobservable individual effect is a random or fixed value.

Therefore, the next stage of the approach strongly depends on the outcome of the testing procedure presented above. That is why we will start by carrying out this testing procedure in order to determine the assessment technique which will later be used.

We have now come to the extreme case which stipulates that there is a perfect heterogeneity between CEMAC countries in view of the variables under consideration. With this, we have to assess the coefficients of each country taken individually.

At the end of this series of assessments of individual equations, we keep in mind that, on the whole, the model adopted turned to be significant at 5% for three countries (Cameroon, Equatorial Guinea and Central African Republic). In these three countries, the effect of the variables considered in the model seems to be virtually the same. The deterioration of the banking system will be reduced with an increase in the resources generated by the system itself, increase in the exchange rate and,

[21] This is certainly a "strong" hypothesis we are making here, but it is generally admitted in the study of time series, whereby the coefficients obtained remain stable over time.

paradoxically[22], an increase in inflation. The factors that cause the deterioration of the banking system are: claims over the private sector and foreign direct investments. However, almost all the coefficients obtained are non significant at 5%. This would probably be due to limited number of observations available for each country given the high number of parameters to be assessed.

Not being satisfied with the results obtained while assessing the individual equation for each country, we will now develop an alternative model to that of the uniformity tests which we applied in section (5.2).

5.2. Developing a panel data model

The model we are going to develop is a one-factor panel model generally expressed by the equation:

$$yit = g(xit\beta + ci) + Eit \qquad (8)$$

where

xit is a $1 \times K$ order matrix of explanatory variables, $i = 1...N$, $t = 1...T$.

N refers to the number of individuals (in our case N is CEMAC countries) and T, the number of periods.

ci, $i = 1...N$ represent unobserved individual effects.

Eit represent the terms of supposedly independent and identically distributed (i.i.d) errors.

The application of this assessment technique is done using the hypothesis that the individuals put together have common characteristics (similar reaction to the variables considered), even though they may possibly have peculiarities. Therefore, we suppose that the coefficients βk, $k = 1…K$ are identical for all the countries and ci, $i = 1...N$ are unobservable effects, that are specific to each country.

5.2.1. Fixed individual effects or random individual effects

The assessment method of this model entails that it should first be determined whether these unobservable individual effects are random or fixed. Actually, choosing one of the models (with random effects or fixed effects) is guided by the assumption that is made on the correlation between the explanatory variables (xit) and the individual effects (ci).

In the literature review, the Hausman test is generally used to choose a model with random or fixed individual effects by comparing the indicators obtained in the two cases. The most obvious hypothesis is to assume the random effects. Assuming the random individual effects could find justification in the fact that not all the variables that can be used to explain the interest variable are taken into account (case of omitted variables) [Hurlin, (2003)]. This test is based on Fisher's statistics, with the null hypothesis being the equality of the coefficients obtained by the random and fixed individual effects models. With this test, we were able to validate the choice of a random individual effects model ($p - value = 0.36 > 0.05$).

5.2.2. Assessing and interpreting the model

The model is globally significant at 5%, the coefficients of the model are almost all significant at this threshold. The contribution of individual effects to the variance of errors is null ($\sigma u \approx 0$ and $\rho = 0$); which does not exactly correspond to the expectations following the results obtained during the uniformity test. The average probability of the deterioration of the CEMAC banking system is estimated at 0.29. This probability is calculated by taking into account the average levels of the explanatory variables used. The marginal effects of these variables will later be interpreted in relation to this reference position.

[22] In theory, inflation constitutes a threat to monetary stability, and maintaining a low and relatively stable level of inflation seems to be the aim of many Central banks including that of CEMAC. This effect could however be justified as we indicated earlier (4.3.2) by a low level of inflation (0.76 on average with a standard deviation of 2.06 over the period under review).

The model reveals that claims over the private sector for a particular period, have a positive impact on the probability of deterioration of the banking system for the following period.

Therefore, a 1% increase in claims over the private sector in relation to their average value will lead to a 12% increase in the probability of deterioration of the banking system when compared to the reference risk, during the following period.

The risk of deterioration of the banking system is equally an increasing function of foreign direct investments (FDIs) and the combined trend of credits to the private sector and exports. This means that an increase in FDIs will lead to an increase in the risk of failure of the banking system, and a combined increase in credits to the private sector and exports. Thus, an average 1% increase in FDIs will lead to a 0.18% increase in risk of deterioration; a 1% joint increase in credits to the private sector and exports will lead to a 0.76% increase in the deterioration risk.

The risk of deterioration of the banking system is reduced by owners' equity, exchange rate variations and inflation. Therefore, a 1% increase in the internal resources of the banking system will reduce its deterioration probability by 14.78%; a 1% increase in the exchange rate will reduce the risk of deterioration of the banking system by 0.07%; finally, a 1% increase in the inflation rate will reduce the probability of failure of the banking system by 0.32%.

5.3. Developing a common model for all the countries

This assessment method supposes that all the data is got using the same generating process. The assessment is thus made using data that has been collated irrespective of countries. It was done on the assumption that the error distribution is that of the logistic law[23]. On the whole, the model is significant at 1% and presents a reclassification power of about 72%. We realised that the coefficients obtained are identical to those obtained by assessment through panel data, thereby confirming the results obtained by the assessment using panel data, especially with regard to the nullity of unobservable individual effects noticed during the assessment.

These two models would thus entail perfect homogeneity between CEMAC countries in terms of variables considered. This seems possible with CEMAC, although it is contrary to the results obtained during the uniformity tests procedure.

6. Conclusion

The aim of this study is to provide the regulator of the banking system in the CEMAC region with a limited number of macro-prudential monitoring indicators in order to enhance the efficiency of the supervision of the banking system, through permanent monitoring of the dynamics of its weakness, and reduce its costs. To this end, we:

- Started by presenting the concept of macro-prudential monitoring which sees the monitoring of the system from a standpoint different from that of micro-prudential monitoring which was hitherto used by central bank managers. The macro-prudential approach pays particular attention to the factors that make a financial system vulnerable and the interaction between macroeconomic trends and financial stability, while the micro-prudential approach seeks to protect clients' deposits by assessing the solvency of each bank.
- And then, we presented the theoretical analytical framework by defining the concepts of weakness and deterioration. Through the application of this theoretical framework, we were later able to develop an econometric model that could be used to identify the indicators which can be used to predict a possible deterioration in the situation of the banking system.
- At the end of this analysis, it emerges that the regulator needs to pay particular attention to six variables, coming from all the macroeconomic variables (foreign direct investments, exchange rate and inflation), all the aggregate micro-prudential variables (claims over the private sector and owners' equity), and from the combination of these two (the junction of increase in credits to the private sector and exports). Thus, from a reference situation defined by the average level of model variables and a 29.1% risk of deterioration, a 1% GDP increase in claims over the private sector would lead to a 12.1% increase in the risk of deterioration of the banking system. While a 1% increase in the internal

[23] Generally, the choice is made between a probit model and a logit model. We came to this conclusion by using the AIC and BIC information criteria, which considers the model having the smallest criterion value as the best

resources of the banking system as a percentage of total assets, would lead to a 14.8% reduction in this risk. These two variables stand out from the rest through the magnitude of their impact on the risk of deterioration of the CEMAC banking system.

With this study, we were able to identify a set of aggregate micro-prudential variables, macro-prudential variables and other variables drawn from a combination of micro-macro indicators, which can be used to predict a deteriorating situation in the CEMAC banking system. By determining the marginal effects of each of the variables on the probability of deterioration of the banking system, we were able to establish a hierarchy of variables, with regard to the importance we think the regulator should attach to them. Through some routines, this forecasting model could easily be automated such that, at any one time, it can readily give the regulator the probability of deterioration of the banking system. In fact, the marginal effects of the model variables could be assessed for the current situation of banking system, that is, on the date t[24].

With this, once the values of the model variables have been found in t+1, we can find the probability of deterioration in the system for that date. Thus, such a mechanism will be used not only to monitor the evolution of the banking system but also to simulate the scenarios of situational changes and observe their repercussions on the stability of the baking system.

The main shortcoming of this study is in the number of variables initially taken into account. The cumulative marginal effect of model variables which have a positive impact on the probability of deterioration is only about 14% while that of variables with a negative impact is about 18%.

Several other macroeconomic variables on which we did not have any data over the period under review, could be included in the analysis, and among them, some could even turn out to be important for predicting the deterioration of the banking system. Moreover, the model does not take into account some characteristics that are specific to the banking system which could be considered as qualitative variables, especially those relating to regulation and structuring of the system.

Having in mind the abovementioned observations and considering the dynamism of the economy of the sub-region, we recommend that this study should be repeated, this time with a broader database to verify the accuracy of the results obtained, and updated on a regular basis in order to identify new warning variables and eliminate those which may become unrealizable in their forecasts.

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PREDICTING CONOCOPHILLIPS AND EXXON MOBIL STOCK PRICE

Ivan **KITOV**
Russian Academy of Sciences, Moscow, **Russia**
Institute for the Geospheres' Dynamics,
ikitov@mail.ru

Abstract

Exxon Mobil and ConocoPhillips stock price has been predicted using the difference between core and headline CPI in the United States. Linear trends in the CPI difference allow accurate prediction of the prices at a five to ten-year horizon.

Key words: stock price, Exxon Mobil, ConocoPhillips, prediction, CPI.

JEL classification: G1, E3

1. Introduction

The future of stock market is unpredictable. This is a well-known motto of market participants, who are definitely convinced that all available information is already priced in. Otherwise, one would be able to use such unaccounted information and outperform the market. It looks in line with common wisdom, but such logic is a faulty one. From the scientific point of view, we are always aware that there exists something real that we do not know yet. Accordingly, there exist market features and processes currently inaccessible, but fully objective and describing the evolution of prices far beyond contemporary paradigm.

There are several models and infinite number of tools related to stock pricing. For our purposes they are all inapplicable because limited by the convention of unpredictability. To the extent we know, the concept proposed in this paper has no link to the current understanding of stock market. Also, we borrow no ideas or techniques from available models and tools. Therefore, we omit usual review of the literature devoted to stock markets.

The main goal is to demonstrate that stock prices, at least for some companies, are governed by forces with predictable future. As an example, two large energy-related companies have been selected from the S&P 500 list: Exxon Mobil Corp. (XOM) and ConocoPhillips (COP). (Historical data were retrieved from http://finance.yahoo.com.) The former has the largest weight in the list – around 4.4%, and the latter has an input of 0.85% at the 27th place. This choice is not random. First, we have studied the short- and long-terms behaviour of the consumer and producer price index for energy, and thus oil-related subcategories, in tiny details [1-4]. Second, it is likely that stock prices of energy-related companies are driven by the deviation of the headline CPI (with energy included) from the core CPI. In other words, the change in XOM and COP stock price) are proportional to the change in the pricing power of energy relative to other goods and services. It is likely that the same relation is valid for similar companies as well.

The remainder of this paper is organized as follows. Section 1 presents linear trends in the difference between the core and headline CPI observed in the past and predicts the evolution at a several year horizon. In Section 2, COP and XOM price is predicted as a linear function of the above difference.

2. The model and data

There exist linear trends in consumer and producer price indices, as derived and validated in [1-4]. It was found that the difference between the core CPI, *cCPI*, and the headline CPI, *hCPI*, can be approximated by a simple time function:

$$dCPI(t) = cCPI(t) - hCPI(t) = A_1 + B_1 t \qquad (1)$$

where $dCPI(t)$ is the difference, A_1 and B_1 are empirical constants, and t is the elapsed time. Therefore, the distance between the core CPI and the headline CPI is a linear function of time, with a positive or negative slope B_1.

This difference provides an appropriate demonstration of the presence of linear trends. (Both variables are seasonally adjusted ones and borrowed from web-site of the *Bureau of Labor Statistics*:

http://www.bls.gov/data.) Figure 1 displays this difference from 1960 to 2009. There are three distinct periods of linear dependence on time: from 1960 to 1980, from 1980 to 1998, and from 2002 to 2008. The second period is characterized by a linear trend with slope B_1=+0.66, and the third one has a larger negative slope of B_1=-1.59. There are also two turning points or short time intervals - between 1980 and 1981, and from 1999 to 2002, where the trends undergo major changes. Since 2008, the difference has been passing third turning point accompanied by very high volatility. Similar effect was observed between 1999 and 2002. In the past, the trends were very strong attractors to all deviations. Therefore, it is likely that in the near future a new linear trend will emerge, which will repeat the previously observed duration and slope. In Figure 1, green solid line represents the trend between 2009 and 2015 predicted as a mirror reflection of the previous trend between 2002 and 2008. Basically, the difference will grow from 1 unit of index in 2009 to 11 units in 2015.

Our pricing model is trivial. We assume the presence of a linear link between stock price, *sp* (=*XOM* or *COP*), and the difference between the core and headline CPI,

$$sp(t) = A_2 + B_2 dCPI(t + t_2) \qquad (2)$$

where A_2 and B_2 are empirical constants, t is the elapsed time, and $t_2 \geq 0$ is the time delay between the stock and the CPI changes, i.e. the CPI may lag behind the price. Constants in (2) are determined for all linear trends. This implies the possibility of structural breaks in relationship (2) due to the turn to a new trend.

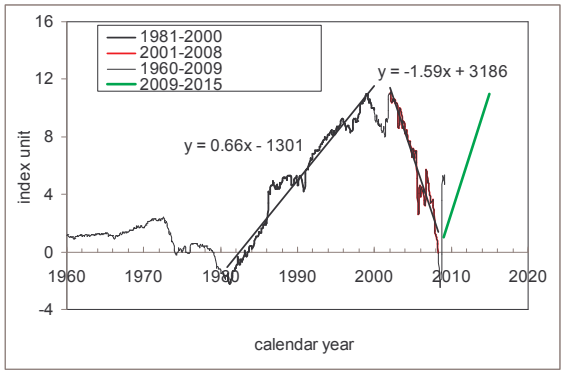

Figure 1. The difference between the core and headline CPI as a function of time. One can distinguish three periods of quasi-linear behavior with two distinct turning points. For second and third periods, linear regression lines are characterized by slopes B_1=+0.66 and B_1=-1.59, respectively. Green solid line represents the trend between 2009 and 2015 predicted as a mirror reflection of the previous trend.

3. COP and XOM price

To begin with, ConocoPhillips stock price is modelled as a linear function of the core and headline CPI difference. Trial-and-error method is applied to obtain the best visual fit between the COP (monthly close) price and the *dCPI(t)*. Left panel in Figure 2 illustrate the fit between the actual price and that predicted using the following coefficients throughout the whole period between 1982 and 2009: A_2=90, B_2=-4, t_2~2 months or 1/6 year. The time lag of approximately 2 months gives the best fit for the most recent segment of the actual price curve when the price has been undergoing a severe fall. This lag is the same for all predicted curves in this study. The slope of -4 implies that an increase by 4% in the COP price is followed by a 1% decrease in the *dCPI* in two months. The actual and predicted curves rapidly diverge back in the past since 1998.

The monthly close price demonstrates a spike near 2005. This sharp tooth was induced by a stock split, i.e. is of artificial character. So, it is better to model the close price adjusted for dividends and splits. Right panel in Figure 3 displays corresponding curves. The predicted curve is obtained using the following relationship:

$$COP(t) = (-6)*dCPI(t+1/6) + 80 \qquad (3)$$

Therefore, the change in the adjusted price is about 50% larger than that in the regular close price.

In the right panel, there is no fit before 1999 as well. At first glance, one might suggest that the *dCPI* provides no information about the evolution of the COP price. Surprisingly, this is not a right assumption. Figure 1 shows that the linear trend before 1999 was positive and after 2002 – negative. In terms of econometrics, there was a structural break in the behaviour of the *dCPI*. In other words, the set of long-term economic bounds between goods and services, comprising the CPI and defining the linear trend in the *dCPI* between 1982 and 1999, underwent a three-year-long transition to a new set. In turn, the new set defined the trend observed from 2002 to 2008. So, it is reasonable to assume that the sign of slope in (2) should change to an opposite one. Since the positive slope between 1981 and 1999 is only about a half of that between 2002 and 2008, one can expect that coefficient B_2 before 1999 should also be divided by a factor of 2. Free term in (2) is another issue – it must change in a way to retain the continuity of the predicted price function. After reversing the sign and calibrating relevant amplitude and level between 1982 and 1998 (we included the transition into the second segment) we have obtained a much better fit as depicted in Figure 3 using the following function:

$$COP(t) = (+3)*dCPI(t-2) - 10;\ 1980<t<2002 \qquad (4)$$

Finally, a complete prediction of the COP price between 1982 and 2009 is obtained. Before 1987, the predicted curve in Figure 3 sinks below the zero line. There is no special need to describe the price in the early 1980s using the CPI difference. As shown in [1,2], all subcategories of the consumer price index, except the index for energy, are parallel before 1982. Therefore, the difference between any two indices, including the headline and core CPI, is constant, i.e. it contains no information on the changes in stock prices. In any case, accurate prediction of the past is of lower interest than prediction of the future.

Similar procedures have been applied to Exxon Mobile stock price adjusted for dividends and splits. Figure 4 summarizes most important findings. In general, the evolution of XOM price is very similar to that of COP. A minor deviation consists in a slightly bigger free term of 90. This might result from the usage of the trial-and-error method with visual fit. It is really crude and does not provide accurate estimates of coefficients in (2). The similarity of the COP and XOM time series allows suggesting that other large oil companies in the S&P 500 list also obey relationship (2). We leave it to the reader to conduct comprehensive research.

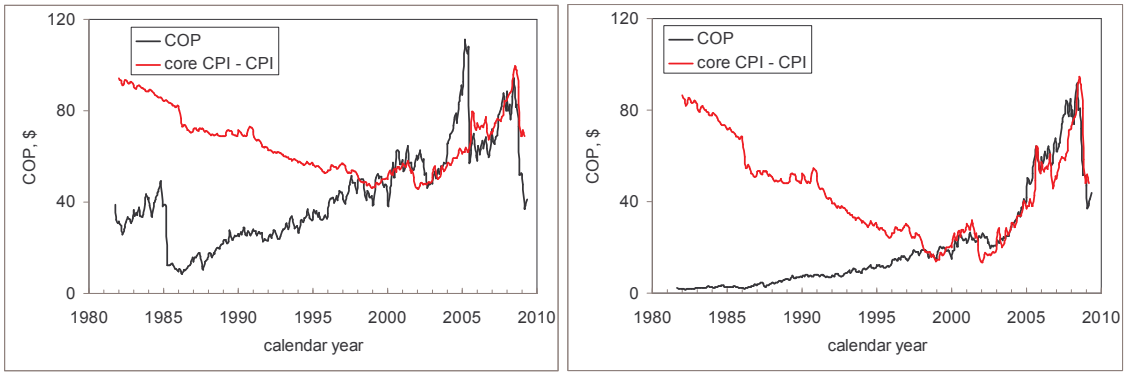

Figure 2. Historical (close) prices for COP (black line) and the scaled difference between the core CPI and the headline CPI (red line) from 1982 to 2009. *Left panel*: Close price. A_2=90, B_2=-4. Notice two splits in 1985 and 2005. *Right panel*: Close price adjusted for dividends and splits. A_2=80, B_2=-6.

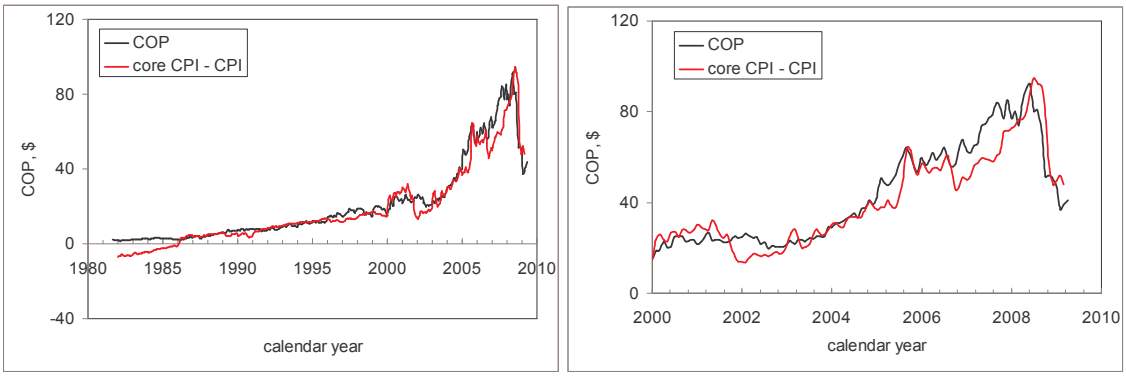

Figure 3. The observed and predicted COP price: A_2=-10, B_2=3 (1982-1998); A_2=80, B_2=-6 (1999-2009)

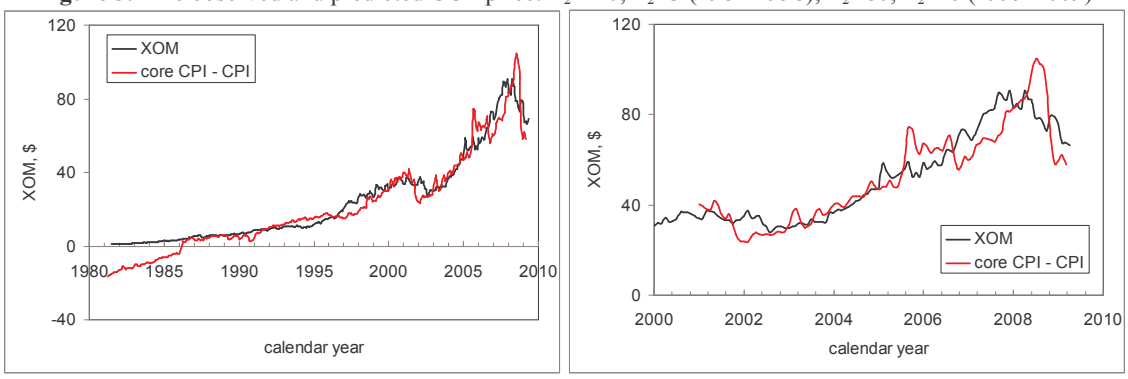

Figure 4. Same as in Figure 3 for XOM. A_2=-10, B_2=3 (1980-1998); A_2=90, B_2=-6 (1999-2009).

Now, if XOM and COP stock price will follow the new trend in the *dCPI* (green line) in Figure 1, as is did between 1985 and 2008, one will be able to predict the "trend price" at any given time before 2015. Large deviations from this trend price are likely in the future because they were observed in the past. Even when random, these deviations contain crucial information on the change in relevant stock prices. Any deviation from the trend must be compensated in the short run by an adequate deviation with an opposite sign to retain the price near the trend in the long run. Physically, it sounds like the action of restoring force returning a pendulum in the equilibrium position. Figure 5 displays absolute and relative difference between the observed and predicted time series for ConocoPhillips. Both differences demonstrate substantial amplitudes. A remarkable feature of the difference is that any deviation is compensated in the short-run. Hence, the larger is a given deviation from the zero line the higher is the return from the next compensating movement. It is a matter of time only, but the probability of such event was 100 per cent.

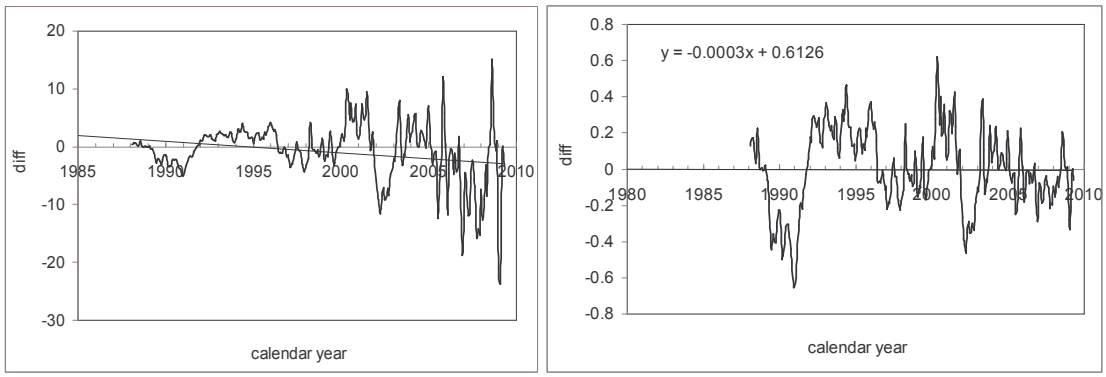

Figure 5. Absolute (left panel) and relative (right panel) difference between the observed and predicted time series. Both differences demonstrate substantial amplitudes. A remarkable feature of the difference is that any deviation is compensated in the short-run. Hence, the larger is a given deviation from the zero line the higher is the return from compensating movement.

4. Conclusion

This paper presents preliminary results of a feasibility study. By no means, this is a comprehensive investigation of the CPI and its components as a predictor of stock prices. All empirical constants were estimated by very crude visual fit. So, we do not recommend the usage of our quantitative results for actual evaluation of investment strategy.

At the same time, there is enough information for several basic conclusions. In general, the difference between the core and headline CPI provides a good approximation of the evolution of the price for energy-related stocks. However, there are short periods of rapid and deep fall in stock price associated with the change in linear trends. The fall is likely induced by higher volatility in the CPI during the transitions. Conditions of low confidence and high risk associated with elevated volatility might be easily transformed into mass panic.

Between 1999 and 2002, the functional dependence of XOM and COP price on the *dCPI* underwent a transformation from positive factor B_2=+3 to negative factor B_2=-6. Within the uncertainty of relevant estimates, the ratio of these factors (-6/3)=-2 is close to the ratio of the slopes in corresponding linear trends (-1.57/0.66)~-2.4. Hence, one can expect that B_2 for the new trend will be proportional to its slope. Inevitably, Exxon Mobil and ConocoPhillips stock price will be growing after the end of the current transition period. This will happen despite the fact that the price index for energy (and thus oil price) will be growing at a lower rate than the core CPI.

A new rally with known B_2 is likely to start in 2010, after the end of the current transition period. In five to ten years, the difference between the core and headline CPI will reach the next turning point. Then XOM and COP price will suffer a sudden drop again.

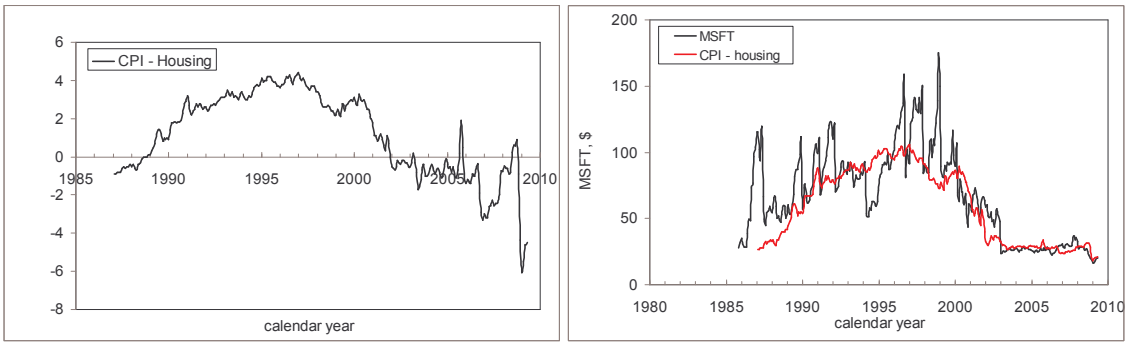

Figure 6. *Left panel*: the evolution of the difference between the headline CPI and the price index for housing. After 2003, the difference is practically parallel to the x-axis. *Right panel*: Monthly (unadjusted) close price of MSTF stock and the price predicted using the difference in the left panel with the following coefficients: A_2=40, B_2=15 (before 2003); A_2=30, B_2=2 (after 2003).

In a sense, company name is irrelevant under the framework developed in this paper. The evolution of stock price for any company can be modelled and thus the time when the price will go up or down can be predicted. However, it is possible that some companies from the S&P 500 list cannot be represented as a function of the *dCPI*. Then other difference between various subcategories of the CPI could be tested as a predictor. Figure 6 depicts preliminary results of the modelling of MSFT stock price using the difference between the headline CPI and the index for housing, *H(t)*: *hCPI(t)-H(t)*. The overall dependence is split into two segments with different coefficients: before and after 2003. This is the year when the difference turned to a constant line with high volatility. This is a preliminary model and much more work is needed to obtain a consistent model. Even a crude forecast of general trends in stock prices at a five-year horizon is a valuable piece of information.

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EXCHANGE RATE AND INTEREST RATE IN THAILAND: A LOOK AT TRADITIONAL AND REVISIONIST VIEWS

Ibrahim H. **MANSOR**
University Putra Malaysia, **Malaysia**
Faculty of Economics and Management
mansorhi@econ.upm.edu.my

Abstract:

In this paper, we analyze the traditional-revisionist debate on whether high interest rate can defend the downfall in currency values by allowing for asymmetric responses of exchange rate to positive and negative changes in the interest rate using Thailand data. Applying an EGARCH specification with long span of data, we find evidence in support of the revisionist view. Namely, while the decline in the interest rate may lead to currency depreciation, we find no evidence that high interest rate appreciates the currency. Instead, albeit small in magnitude, high interest rate tends to lead to further depreciation. Thus, the policy of high interest rate to defend the currency can be futile and costly.

Keywords: interest rate, exchange rate, Thailand, EGARCH.

JEL Classification: E52, F31

1. Introduction

Whether tight monetary policy or increasing interest rate can reverse or stem further currency depreciation during crisis episodes is a contentious issue among proponents of traditional and revisionist views. According to the traditional view, high interest rates can stabilize exchange rates by making domestic assets more attractive, reducing capital flights and discouraging speculation [Dekle *et al*. (2002)]. By contrast, as argued by the revisionist view, a rise in interest rates may lead to further decline in currency values due to increasing default probabilities amidst financial panic [Radelet and Sachs, (1998)]. Moreover, as noted by Drazen and Masson (1994), the increase in interest rates may not be sustainable due to the macroeconomic costs associated with the need to sustain high interest rates. As a consequence, the policy lacks credibility and, therefore, is futile.

In the context of 1997/1998 Asian crisis, existing empirical studies have provided mixed supports for both traditional and revisionist views. For instance, looking at the experiences of Korea, Malaysia and Thailand, Dekle *et al*. (2002) find limited support for the traditional view. While they note the ability of high interest rates to appreciate the exchange rates in these countries, their estimates are too small to be important. In a similar vein, Baig and Goldfajn (2002) find no evidence that high interest rates lead to further exchange rate depreciation as argued by the revisionist view for five Asian countries – Indonesia, Korea, Malaysia, the Philippines and Thailand. However, most recently, Choi and Park (2008) conclude that high interest rates are not effective in stabilizing the exchange rates for the cases of Indonesia, Korea, Malaysia and Thailand. These still conflicting results, thus, open room for further empirical investigation.

In this paper, we add to this line of research by focusing specifically on the experience of Thailand, a country first hit by speculative attack and crisis and adopted sustained increase in nominal interest rates from May 1997 to March 1998 [Baig and Goldfajn, (2002)]. We distinguish the paper from the aforementioned studies in three aspects[1]. First, instead of looking at data from only the Asian crisis episode or its aftermath, we examine the relation between exchange rate and interest rate using longer time period, namely from 1985 to 2007. Normally, during financial turbulences, noise-to-signal ratio tends to increase and thus may cloud out the true relations between the two variables. Moreover, despite the need to pinpoint the effectiveness of high interest rate policy during the crisis, it is also of paramount importance to a country like Thailand to understand whether it can stabilize the exchange rate during the normal time. This arises from their heavy dependence on international trade. Lastly, by

[1] The common feature of the aforementioned studies is the use of vector autoregressive (VAR) model to assess the causal patterns between high frequency exchange rate and interest rate series over the Asian crisis period.

using a longer time span, we would also be in a position to better estimate their relation provided the independent effect of the crisis is properly accounted for.

Second, we make use of an EGARCH model for our analysis. Despite the well-noted presence of leptokurtic or excess kurtosis property in high frequency data, known as ARCH effect, it has not been accounted for. Cheung *et al*. (2007) note that, in the presence of ARCH effect, the right-hand-side variables and error term are not independent leading to invalid statistical tests and inferences. Indeed, the test performance can be considerably improved by explicitly allowing for the ARCH effect [Cheung and Fujii, (2001)]. Lastly, the central question in the traditional-revisionist debate is whether a rise in interest rates can stabilize declining currency values. Both views, however, are silent or implicitly in agreement for the case of interest rate decline. In other words, positive and negative interest rate changes may have differential effects on the currency values. While no argument is raised on whether a decrease in interest rates depreciates the currency, the rise in the interest rate also has the possibility to depreciate or at least has no significant effect on the exchange rate. In light of this, we allow for asymmetric responses of exchange rate to interest rate changes.

The paper's organization is as follows. In the next section, we present the empirical framework. Then, section 3 describes the data and discusses estimation results. Finally, section 4 concludes the paper.

2. Empirical Approach

In assessing the causal influences of interest rate on exchange rate, we begin with the following autoregressive distributed lags specification:

$$\Delta e_t = \alpha + \beta z_t + \sum_{i=1}^{p} \phi_i \Delta e_{t-i} + \sum_{i=1}^{q} \theta_i \Delta r_{t-i} + u_t \tag{1}$$

where e is the exchange rate, r is the interest rate, z is the Asian crisis dummy to capture its independent influences on the exchange rate, Δ is the first-difference operator, and p and q are optimal lag orders. These lags are chosen based on the Akaike information criterion (AIC). From (1), whether changes in the interest rate are causally prior to changes in the exchange rate can be evaluated by testing the joint significance of the lagged changes in interest rate coefficients.

While the above specification has generally been employed in a VAR setting to assess the dynamics of exchange rate and how it is related to the interest rate, it may not be adequate. In the literature, there is ample evidence suggesting leptokurtic property or highly-peaked and fat-tailed distribution of exchange rates. Thus, the error term in (1) may exhibit this so-called autoregressive conditional heteroskedasticity (ARCH) effect. As noted, the presence of ARCH effect needs to be properly accounted for such that the test performance can be improved [Cheung and Fujii, (2007)] and inferences made are not spurious [Cheung *et al*., (2007)]. In addition to this ARCH effect, it is reasonable to believe that the changes in the interest rate may have asymmetric effect on the exchange rate. The asymmetric effect of monetary policy is well-rooted in the literature where tightening of monetary policy or rise in the interest rate is argued to have larger impacts on key macroeconomic variables such as output than easy monetary policy of the same magnitude does. Accordingly, there may be asymmetric responses of exchange rate to monetary policy. Moreover, in our context, the traditional-revisionist debate seems to admit asymmetry in the responses of the exchange rate, the possibility that worth exploring.

In light these, we extend the above specification by allowing for asymmetric responses of the exchange rate to positive and negative interest rate changes and for the ARCH effect using an EGARCH (1, 1) model as:

$$\Delta e_t = \alpha + \beta z_t + \sum_{i=1}^{p} \phi_i \Delta e_{t-i} + \sum_{i=1}^{q} (\theta_i \Delta r_{t-i} + \theta_{1i} \Delta r_{t-i} \cdot d_{t-i}) + u_t \tag{2}$$

$$u_t \mid I_{t-1} \sim GED(0, h_t, v) \tag{3}$$

$$\log h_t = \omega + \varphi_1 \left| \frac{u_{t-1}}{\sqrt{h_{t-1}}} \right| + \varphi_2 \frac{u_{t-1}}{\sqrt{h_{t-1}}} + \gamma \log h_{t-1} \quad (4)$$

where $d_t = 1$ if $\Delta r_t > 0$ and 0 otherwise. The differential effect of positive changes in monetary policy is captured by the coefficients, $\sum \theta_{1i}$, which can be tested using the standard F test. Thus, the effect of interest rate reduction on the exchange rate is given by the significance of $\sum \theta_i$ while that of the interest rate increase is $\sum (\theta_i + \theta_{1i})$. If $\sum \theta_{1i}$ is not significantly different from 0, then equation (2) collapses to (1) suggesting symmetric effect of easy and tight monetary policies.

Two technical notes are in order for the above EGARCH model. First, conditional on the information set available up to time t -1, the error density function is the generalized error distribution with mean 0, variance h_t, and measure of tail thickness v. Such studies as Lee at al. (2001) and De Santis and Imrohoroglu (1997) demonstrate the ability of GED to capture leptokurtic properties of financial series. Moreover, it nests other distributions as special cases. These include the normal distribution ($v = 2$), Laplace distribution ($v = 1$) and uniform distribution ($v \rightarrow \infty$). And second, in line with many studies on speculative prices [Lobo, (2000), Koutmos *et al*., (2006), and Baharumshah and Wooi, (2007), to name a few], we allow positive and negative shocks to have asymmetric influences on exchange rate volatility using EGARCH instead of the normally-used GARCH specification. Indeed, the latter is the special case of EGARCH when $\varphi_2 = 0$. Note that if $\varphi_2 > 0$, depreciation shocks are associated with higher exchange rate volatility.

3. Data and Results

The data are monthly from January 1985 to June 2007, a total of 270 observations. The exchange rate is the Thai baht vis-à-vis the US dollar, expressed in natural logarithm. Meanwhile, the interest rate is represented by the money market rate. These data are sourced from the IMF's International Financial Statistics (CD-ROM version). Table 1 provides descriptive statistics of the two series in first differences. As may be noted from the Table, both series exhibit excess kurtosis and are positively skewed. The Jarque-Bera statistics soundly suggests deviations from the normal distribution for both variables. These statistics indicate the applicability of GARCH-type specifications to model dynamic behaviour of exchange rate changes. We also subject each time series to the standard augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. From the test, the interest rate is stationary in level. Meanwhile, the exchange rate is found to be integrated of order 1. With these disparate stochastic properties of the two variables, we express both variables in their first-differences in our subsequent analysis.

Table 2 presents results of the estimation. For comparative purposes, three models are estimated. Model I is the linear equation model as stated in (1) while models II and III allows for autoregressive conditional heteroskeadsticity (ARCH) effect via EGARCH specification. Take note that model III also incorporate asymmetric responses of exchange rate to positive and negative interest rate changes. We also present in the Table diagnostic statistics as indication of model adequacy. These include the Ljung-Box Q statistics for autocorrelation of the residuals (LB) and squared residuals (LB^2) up to lag orders of 6 and 12 and the LM ARCH test for the ARCH effect up to lag order of 6. As may be noted from the Table (Model I), while the OLS error term of the linear regression is serially uncorrelated, the null hypothesis of no serial correlation in the squared error term is rejected. Likewise, the ARCH test indicates the presence of time-varying volatility of the exchange rate series. However, allowing for time-varying volatility via an EGARCH specification is able to capture this ARCH effect as the noted diagnostic statistics indicate no ARCH effect left in the standardized residuals. In other words, the GARCH-type specification is superior in capturing dynamic behaviour of the exchange rate, collaborating existing studies on exchange rate volatility.

Table 1. Descriptive Statistics

	Δe	Δr
Mean	0.0009	-0.028
Median	0.000	0.030
Maximum	0.218	13.010
Minimum	-0.247	-11.490
Std. Dev.	0.030	1.978
Skewness	0.322	0.3494
Kurtosis	34.366	15.041
Jarque-Bera	11072.82	1636.69
Probability	0.000	0.000
Observations	270	270

Table 2. Regression Results

Estimated	Models		
Coefficients	I	II	III
	(i) Mean Equation		
α	-0.0003	-0.0008**	-0.0022***
β	0.0170**	0.0270***	0.0243***
ϕ_1	0.2548***	0.0705*	0.2029***
ϕ_2	-0.1671***	-0.0183	-0.0285
ϕ_3	0.0806	0.0217	0.0669**
ϕ_4	-0.1865***	-0.1209***	-0.1109***
ϕ_5	0.1571***	-0.0449*	-0.0185
θ_1	-0.0027***	-0.0004**	0.0005***
θ_2	0.0038***	0.00004	-0.0007***
θ_3	0.0024**	-0.00002	-0.0008***
θ_{11}	--	--	-0.0010***
θ_{12}	--	--	0.0006*
θ_{13}	--	--	0.0023***
	(ii) Variance Equation		
ω	--	-0.2925**	-0.7285***
φ_1	--	0.1358**	0.5001***
φ_2	--	0.1273**	-0.0854
γ	--	0.9775***	0.9516***
ν	--	0.7656	0.7433
	(iii) Diagnostic Statistics		
Log Likelihood	585.201	795.138	792.945
LB(6)	1.799	2.987	3.887
LB(12)	14.650	5.455	8.504
$LB^2(6)$	41.499***	0.078	0.141
$LB^2(12)$	107.58***	0.092	0.418
ARCH(6)	28.984***	0.037	0.136

***, **, and * denote significance at 1%, 5%, and 10% respectively.

In model II, we find limited evidence suggesting the appreciating effect of the interest rate increase. Namely, only once-lagged change in the interest rate is significant but its coefficient estimate

seems marginal. Thus, we turn our focus to model III, our main model for the analysis. To summarize model III estimation results, we present in Table 3 tests of various hypotheses. In line with conventional wisdom, we find the coefficient sum of negative interest rate changes to be negative. It is estimated to be -0.001 and is significant at better than 1% significant level. Thus, as the interest rate declines, the exchange rate tends to depreciate. However, we also document evidence that the increase in the interest rate is likely to result in exchange rate depreciation since the coefficient sum of lagged positive changes in the interest rate is positive, i.e. 0.002. The test statistics as reported in Table 3 further indicates differential effect of positive and negative interest rate changes.

In sum, while negative changes in the interest rate depreciate the currency value, we obtain no evidence to support the traditional view that high interest rate has the ability to stem further exchange rate depreciation. Instead, as argued by the revisionist view, it may exacerbate the situation. This finding tends to contradict Dekle *et al*. (2002), who find limited support for the traditional view. Note that, like Dekle *et al*. (2002), we find the estimated coefficients to be small. Despite the support for the traditional view, Dekle *et al*. (2002) caution against the use of high interest rate to defend the currency as the macroeconomic costs of sustained high interest rate can be substantial. We strengthen this conclusion by stating that high interest rate may not work in the first place, in support of the revisionist view.

Table 3. Tests of Hypotheses

Hypotheses	Coefficient Sums	F-Statistics (p-value)
Negative changes in the interest rate do not change the exchange rate, $\sum \theta_i = 0$	-0.001	8.349 (0.000)
Positive changes in the interest rate do not change the exchange rate, $\sum (\theta_i + \theta_{1i}) = 0$	0.0009	8.364 (0.000)
Symmetric effect of changes in the interest rate on change in the exchange rate, $\sum \theta_{1i} = 0$	0.0020	12.378 (0.000)

Note: numbers in parentheses are p-values.

4. Conclusion

The debate as to whether high interest rate can reverse declining currency value is empirically evaluated for the case of Thailand. In the analysis, we make use of a longer time span and apply an EGARCH model to assess whether negative changes and positive changes in the interest exert symmetric effect on currency value. We find the EGARCH specification to be adequate in capturing the dynamics of the exchange rate and, thus, raise serious doubts on existing studies that implicitly assume constant variance or volatility of the exchange rate over time. From the estimation, we document no evidence that positive changes in the interest rate are causal prior to appreciation of the Thai baht. Instead, albeit small in magnitude, the currency tends to depreciate further in response to increase in the interest rate. Accordingly, in support of the revisionist view, high interest rate policy to stop further decline in the exchange rate is more likely to be futile. Moreover, with the well-noted economic costs of high interest rate to especially highly-leveraged firms and consumers, the policy can be costly.

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EFFECTS OF FISCAL POLICY SHOCKS IN THE EUROPEAN TRANSITION ECONOMIES

Rajmund **MIRDALA**
Faculty of Economics,
Technical University of Košice, **Slovakia**
rajmund.mirdala@tuke.sk

Abstract:

EU member countries are currently exposed to negative implications of the economic and financial crisis. In connection with this problem arises the question of an anti-cyclic role of an economic policy or more precisely the (regulatory) role of the government in the economy that seems to be the centre of discussions in the academic as well as economic policy sphere. The problem of a permanent deficiency of the general government budget stresses many "old" as well as "new" EU member countries. It significantly reduces an expansionary potential of the national fiscal policies. Because the economic crisis seems to be a very difficult problem due to its specific and complex features, it is necessary for the EU member countries to coordinate the process of the national stimulatory actions approving that would help the countries to avoid an undesired reallocation of resources outside the EU single market as well as the negative common competitive effects.

In the paper we analyze the effects of fiscal policy shocks in the Czech Republic, Hungary, Poland, the Slovak republic, Bulgaria and Romania in the period 2000-2008. Our objective is to estimate the effects of discretionary changes in fiscal policy (associated with an increase in government expenditures) as well as the role of automatic stabilizers (associated with an increase in tax revenues). To meet the objective we estimate vector autoregression (VAR) model. To check the robustness of the results we implement an identification scheme based on two approaches. The first, recursive approach, is based on the Cholesky decomposition of innovations that allows us to identify structural shocks hitting the model. The second approach, structural VAR approach, is based on applying long-run restrictions to the reduced-form VAR model. From both identified true models we compute impulse-response functions to estimate the responses of real output, inflation and short term interest rates to the government expenditure and tax revenue shocks.

Keywords: fiscal policy, government expenditure, tax revenue, unrestricted VAR, Cholesky decomposition, SVAR, structural shocks, impulse-response function.

JEL Classification: C32, E62

1. Introduction

European Union member countries are currently exposed to negative implications of the economic and financial crisis. In connection with this problem arises the question of an anti-cyclic role of an economic policy or more precisely the (regulatory) role of the government in an economy that seems to be the centre of discussions in the academic as well as economic policy sphere. At the same time the economic crisis seems to be a very difficult problem due to its specific and complex features that we may conclude as follow:

- European Union countries don't seem to be affected by the economic crisis with the same intensity. There are also differences in the size of casualties the economic crisis causes in the individual branches and sectors of the national economies.
- Economic crisis affects both supply and demand sides of the aggregate markets. At the same time it quickly spreads among countries of the single European Union market using different transmission channels.
- Efficiency of national stimulatory actions seems to be reduced due to high economic interconnections among individual European Union countries.
- Selective stabilisation and stimulation actions (with a national as well as international radius) produce market distortions in an individual country or even the whole European Union market. As the result we might expect that the more protectionist are the actions the governments take in fighting the economic crisis the more they reduce the overall allocation and stimulation functions of the markets.

Considering a complexity of the economic crisis it seems to be crucial to emphasize not only direct effects of the stabilizing actions but also their indirect and side effects. Because the economic crisis doesn't affect the supply and demand side of the individual markets of the European Union member countries with the same intensity, it seems to be rather difficult to precisely estimate the

potential inflationary effects of the economic crisis that the countries are going to experience during the process of economic recovery (despite of the disinflationary pressures that we might currently observe). Nevertheless the economic crisis that followed the financial crisis originated in the U.S. subprime mortgage crisis, the potential (dis)inflationary or even deflationary pressures in the European Union member countries can't be considered as a purely monetary phenomenon. Downward pressures to the interbank money market interest rates followed by the European central bank's monetary policy softening may stamp on the precautious lending policy of commercial banks. As the result the overall supply of new loans to the private sector wouldn't necessarily increase. In a situation when the agents face a higher uncertainty on the international financial markets it would also lead to an increased volatility in the short-term capital and its inconvenient reallocation outside the single market of the European Monetary Union. The capabilities of monetary authorities to eliminate the negative effects of the economic crisis seem to be rather limited. Moreover the overall effects of the lower retail interest rates wouldn't necessarily be beneficial in the same manner in all Euro-area countries especially due to differing exposure of the countries to the crisis effects.

Economic crisis has spread across the single market of the European Union in the period of the continuous monetary integration. The loss of the monetary sovereignty of the Euro-area member countries focuses an attention of politicians and economists again to the discussion about an importance of coordination and cooperation in the selected areas of fiscal policy. We assume it is one of the greatest challenges the European Union and individual member countries representatives currently face.

It is also necessary to emphasize that the common Euro-area monetary policy performed by the European central bank had typical stabilization and anti-cyclic features of let's say the common economic policy of the European Monetary Union since the beginning (1999). On the other hand national fiscal policies significantly miss this feature. It is especially caused by permanent deficits in many European Union countries during the period 2000-2008 that have markedly reduced the overall flexibility of national fiscal policies as well as their anti-cyclic potential if we also consider that a main operational framework for these countries is shaped by the Growth and Stability Pact. Quite similar trend we might observe in the group of six countries (Czech Republic, Hungary, Poland, Slovak republic, Bulgaria and Romania) that were in the centre of our research. In the Euro-area candidate countries fiscal policy framework is strengthened by the Maastricht nominal convergence criteria.

The problem of say about a permanent deficiency of the general government budget stresses many "old" (Austria, France, Greece, Germany, Great Britain, Italy, Portugal) as well as "new" (Cyprus, Czech republic, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic, Slovenia) European Union member countries (of course we consider the period before the economic crisis put a stress on revenue and expenditures sides of national fiscal budgets). It significantly reduces an expansionary potential of the national fiscal policies. At the same time both the European Union as well as the European Monetary Union records permanent fiscal deficits as a whole since 2000. As traditional examples of a positive fiscal development we can mention Scandinavian countries (Denmark, Finland, Iceland, Ireland, Norway and Sweden) and Luxemburg. From the group of the new European Union member countries we can mention Bulgaria (but only till 2004) and Estonia.

Figure 1 shows a development of main fiscal policy parameters in our group of six transition economies in the period 2000-2008. In all countries (except Hungary) the share of government expenditures and government revenues was around 40 percent during the whole period. Except the Slovak republic and partially Poland (since 2007) we didn't experience any significant reduction in the government's involvement in the national income redistribution. All countries (except Bulgaria, excluding period 2004-2007) record a permanent fiscal deficit during the whole period. Despite a negative trend in the government deficit development, the overall public debt has moderately increased only in Hungary. The Slovak republic, Bulgaria and Romania were even able to continuously reduce its share of the total output.

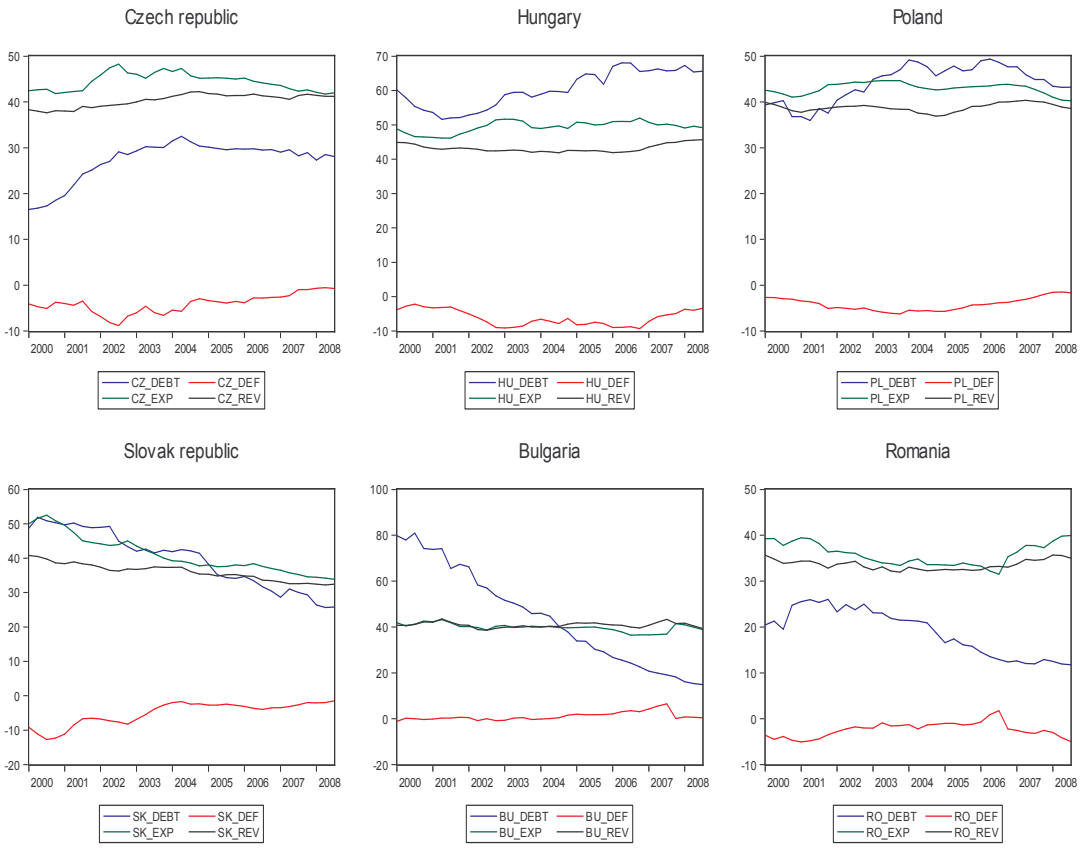


Figure 1. Fiscal policy parameters

Source: [1], [11] **Note:** All fiscal indicators are expressed as a percentage share on the national output.

The overall effects of the economic crisis on the general government budgets of the European Union member countries can be demonstrated in two areas. (1) Slow down of a real economic growth as well as an increase of unemployment due to a strong negative demand (domestic as well as foreign) shock put negative pressures on the revenue side (a decrease in tax and other fiscal contributions) as well as the expenditure side (an increase in social transfers related to a rise of an unemployment) of national fiscal budgets. Consequently an economy recession forces countries (especially those with permanent fiscal deficits) to break a limit for fiscal deficit specified in the Stability and Growth Pact. An individual country can avoid a sanction procedure if an excessive fiscal deficit is the result of a negative real gross domestic product development trend. On the other hand if a recession does less damage to the real output, the country cannot avoid sanctions in case the European Commission doesn't soften conditions in the Stability and Growth Pact. (2) As the second channel of transmitting the negative impulses from the economic crisis to national fiscal budgets we consider the packages of recovery actions that national governments approves in order to eliminate the negative impacts of the crisis to national economies. We assume these recovery actions burden especially expenditure side of national fiscal budgets. If we put these actions under a critical revision, we can only accept stimulatory actions with wide area effects that should help to eliminate undesired structural deformations leading to decreased allocation effectiveness of the domestic markets. Governments should also avoid approving too selective actions focused on the small target groups or areas of national economies. Much higher accent should be given to the systematic actions with significant multiplicative effects.

Even though we expect governments presumably avoid approving stimulatory actions affecting revenue sides of fiscal budgets, reduction of tax burden seems to be great challenge especially for some old European Union member countries (France, Germany, Italy, and Great Britain). Another challenging task is to coordinate the process of the national stimulatory actions approving that would

help the countries to avoid an undesired reallocation of resources outside the European Union single market as well as the negative common competitive effects.

In the paper we analyze the effects of fiscal policy shocks in the Czech Republic, Hungary, Poland, the Slovak republic, Bulgaria and Romania in the period 2000-2008. Our objective is to estimate the effects of discretionary changes in fiscal policy (associated with an increase in government expenditures) as well as the role of automatic stabilizers (associated with an increase in tax revenues). To meet the objective we estimate vector autoregression (VAR) model. To check the robustness of the results we implement an identification scheme based on two approaches. The first, recursive approach, is based on the Cholesky decomposition of innovations that allows us to identify structural shocks hitting the model. The second approach, structural VAR approach, is based on applying long-run restrictions to the reduced-form VAR model. From both identified true models we compute impulse-response functions to estimate the responses of real output, inflation and short term interest rates to the government expenditure and tax revenue shocks.

2. Overview of the literature

Effects of fiscal policy shocks are well documented especially on a sample of developed countries. Blanchard and Perotti (1999) used mixed structural VAR/event study approach to identify the automatic responses of taxes and government spending to economic activity. They also argued that positive government spending shocks have a positive effect on output, and positive tax shocks have a negative effect, while the multipliers for both spending and tax shocks are typically small.

Perotti (2002) implemented SVAR approach in order to analyze the effect of fiscal policy on GDP, prices and interest rates in five OECD countries. The results we may conclude as follows: 1) The effects of fiscal policy on GDP and its components have become substantially weaker in the last 20 years; 2) The tax multipliers tend to be negative but small; 3) Once plausible values of the price elasticity of governments spending are imposed, the negative effects of government spending on prices that have been frequently estimated become positive, although usually small and not always significant; 4) Government spending shocks have significant effects on the real short interest rate, but uncertain signs; 5) Net tax shocks have very small effects on prices; 6) The U.S. is an outlier in many dimensions; U.S. responses to fiscal shocks are often not representative of the average OECD country included in this sample.

Giuliodori and Beetsma (2004) also implemented few identifications schemes using VAR methodology to analyze the (spill-over) effects of fiscal policy shocks in European economies. Their analysis is focused on the indirect channel of transmitting the fiscal policy shocks that affect an import of the country. They also emphasized a necessity of enhanced fiscal coordination at the macroeconomic level.

Romer and Romer (2007) analyze the causes and consequences in the levl of taxation in the postwar U.S. Their results indicate that tax changes have very large effects on output. At the same time output effects are very persistent. Authors argue it is due to the strong response of investments to the tax burden decrease.

Caldara and Camps (2008) provide empirical evidence on the response of key macroeconomic variables to government spending and tax revenue shocks for the U.S. over the period 1955-2006. Authors implemented four approaches (the recursive approach, the Blanchard-Perotti approach, the sign-restrictions approach and the event-study approach) to identify their system based on the VAR methodology. While there is the empirical evidence that the positive responses of private consumption and the real wage are very persistent, authors argued that the most current-generation DSGE models consistent with an increase in these variables predict that the responses turn negative already about one year after the government spending shock occurs. They also find strongly diverging results as regards the effects of tax shocks depending on the identification approach used, with the estimated effects of unanticipated tax increases ranging from non-distortionary to strongly distortionary.

3. Econometric model

An approach we use in our analysis to estimate the effects of fiscal policy shocks (government expenditure shock, tax revenue shock) is based on the vector autoregressive (VAR) methodology. In order to recover the structural shocks that affect the endogenous variables of the model we implement two identification approaches. First approach is based on the recursive Cholesky decomposition of the

variance-covariance matrix of the model residuals. The recursive identification approach also considers the causal ordering of the variables. Second approach is based on the identification scheme that imposes long-run restrictions on the variance-covariance matrix of the model residuals. Nevertheless both approaches uses different scheme to recover structural shocks we expect they both provide comparable results of the effects of the fiscal policy shocks in the selected group of transition economies.

True model is represented by the following infinite vector moving average representation:

$$A_0 Y_t = A(L)Y_{t-1} + B\varepsilon_t \quad (1)$$

where Y_t is a N x 1 vector of the endogenous macroeconomic variables, $A(L)$ is a polynomial variance-covariance matrix (represents impulse-response functions of the shocks to the elements of Y) of lag-length l, L is lag operator and ε_t is a (k x 1) vector of identically normally distributed, serially uncorrelated and mutually orthogonal white noise disturbances (vector of true structural shocks in elements of Y):

$$E(\varepsilon_t) = 0, \; E(\varepsilon_t \varepsilon_t') = \sum_{\varepsilon} = I, \; E(\varepsilon_t \varepsilon_t') = [0]_{\forall t \neq S} \quad (2)$$

The vector Y_t of the endogenous variables of the model consists of the following five elements: government expenditures (g), real output (y_r), inflation (p), tax revenues (t) and short-term interest rates (i). In our five-variate model we assume five exogenous shocks that determine endogenous variables - government expenditures shock (ε_g), demand shock (ε_y), inflation shock (ε_p), tax revenues shock (ε_t) and monetary policy shock (ε_i).

By multiplying equation (1) by an inverse matrix A_0^{-1} we obtain the reduced-form of the VAR model (this adjustment is necessary because the model represented by the equation (1) is not directly observable and structural shocks cannot by correctly identified):

$$Y_t = A_0^{-1} A(L) Y_{t-1} + A_0^{-1} B\varepsilon_t = C(L)Y_{t-1} + u_t \quad (3)$$

where $C(L)$ is again a matrix representing the relationship among variables on the lagged values and u_t is a N x 1 vector of normally distributed shocks (shocks in reduced form) that are serially uncorrelated but can be contemporaneously correlated with each other:

$$E(u_t) = 0, \quad E(u_t u_t') = \sum_{u} = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{12} & \sigma_1^2 & \sigma_{23} \\ \sigma_{13} & \sigma_{23} & \sigma_1^2 \end{pmatrix}, \; E(u_t u_s') = [0] \quad \forall t \neq s \quad (4)$$

Equation (3) reveals the relationship between reduced-form VAR disturbances ut and structural disturbances εt, that is given by

$$u_t = A_0^{-1} B\varepsilon_t \text{ sau } A_0 u_t = B\varepsilon_t \quad (5)$$

As we have already mentioned we implement an identification scheme based on two approaches. The first, recursive approach, is based on the Cholesky decomposition of innovations that allows us to identify structural shocks hitting the model. Cholesky decomposition of variance-covariance matrix of VAR residuals defines the matrix A_0 as a lower triangular matrix and matrix B as k-dimensional identity matrix.

The lower triangularity of A_0 implies a recursive scheme among variables that has clear economic implications and has to be empirically tested as any other relationship. Identification scheme of the matrix A_0 implies that some structural shocks have no contemporaneous effects on some endogenous variables given the ordering of the endogenous variables.

At the same time the off-diagonal elements of B are all zero, implying that we do not allow for the structural shocks to be mutually correlated. This assumption is consistent with empirical results - the correlation between government spending and tax revenue shocks is not statistically different from zero.

The equation (5) we can now rewrite to the following form:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_{g,t} \\ u_{y,t} \\ u_{p,t} \\ u_{t,t} \\ u_{i,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{g,t} \\ \varepsilon_{y,t} \\ \varepsilon_{p,t} \\ \varepsilon_{t,t} \\ \varepsilon_{i,t} \end{bmatrix} \quad (6)$$

The ordering of the variables reveals following relations among them:

- Government expenditures don't respond contemporaneously to the shock from any other endogenous variable of the model.
- Real output doesn't respond contemporaneously to inflation, tax revenues and interest rates shocks, while it is contemporaneously affected only by the government expenditure shock.
- Inflation doesn't respond contemporaneously to the tax revenues and interest rates shocks, while it is contemporaneously affected by the government expenditure and the real output shocks.
- Tax revenues don't respond contemporaneously to the interest rates shock, while it is contemporaneously affected by the government expenditure, the real output and tax revenues shocks.
- Interest rates are contemporaneously affected by the shocks from all of the endogenous variables of the model.

It is also necessary to emphasize that after the initial period the endogenous variables of the model can interact freely without any restrictions.

The second approach, structural VAR (SVAR) approach, is based on decomposing a series into its permanent and temporary components. It imposes long-run restrictions to the reduced-form VAR model. Identification scheme in the SVAR models reflects a long-run neutrality assumption so that we expect the cumulative effect of a certain shock on the certain endogenous variable development is zero. The equation (5) we can now rewrite to the following form:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & a_{24} & 0 \\ a_{31} & 0 & 1 & a_{34} & 0 \\ 0 & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_{g,t} \\ u_{y,t} \\ u_{p,t} \\ u_{t,t} \\ u_{i,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{g,t} \\ \varepsilon_{y,t} \\ \varepsilon_{p,t} \\ \varepsilon_{t,t} \\ \varepsilon_{i,t} \end{bmatrix} \quad (7)$$

In order to correctly identify the model we impose following long-run restrictions:

- Government expenditures do not have a permanent effect on tax revenues.
- Real output does not have a permanent effect on government expenditures and inflation.
- Inflation does not have a permanent effect on government expenditures and real output.
- Tax revenues do not have a permanent effect on government expenditures.
- Interest rates do not have a permanent effect on any other endogenous variable of the model.

Both systems are now just-identified and can be estimated using vector autoregression. From both identified true models we compute impulse-response functions to estimate the responses of real output, inflation and short term interest rates to the government expenditure and tax revenues shocks.

3. Data and results

In order to estimate our model represented by five endogenous variables for each country from the group (the Czech republic, Hungary, Poland, the Slovak republic, Bulgaria and Romania) we used the quarterly data ranging from 2000Q1 to 2008Q4 (32 observations) for the government expenditures, real gross domestic product, inflation, tax revenues and short term interest rates (Figure 2). Time series for the main fiscal parameters were drawn from Eurostat's Government Finance Statistics. Data for core inflation, nominal and real gross domestic product were taken from OECD's Frequently Requested Statistics Database. Finally, short-term money market interest rates were drawn from the national central bank's websites.

Time series for the quarterly government expenditures, real gross domestic product and tax revenues were seasonally adjusted. Time series for the nominal government expenditures and tax revenues were deflated using gross domestic product deflator. As an inflation indicator we used core inflation without food and energy. As a short-term interest rates indicator we used national interbank offered rates for the deposits with 3 months maturity.

Before we estimate the model it is necessary to test the time series for stationarity and cointegration. The augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were computed to test the endogenous variables for the existence of unit roots. Both ADF and PP tests indicate that all variables are non-stationary on the values so that the null hypothesis of a unit root cannot be rejected for any of the series. Testing variables on the first differences indicates the time series are stationary so that we conclude that the variables are I(1).

Because all endogenous variables have a unit root on the values it is necessary to the test the time series for cointegration using the Johansen cointegration test. The test for the cointegration was computed using two lags as recommended by the AIC (Akaike Information Criterion) and SIC (Schwarz Information Criterion). The results of the Johansen cointegration tests confirmed the results of the unit root tests. Both trace statistics and maximum eigenvalue statistics (both at 0.05 level) indicate that there is no cointegration among the endogenous variables of the model. The results of unit root and cointegration tests are not reported here to save space. Like any other results, they are available upon request from the author.

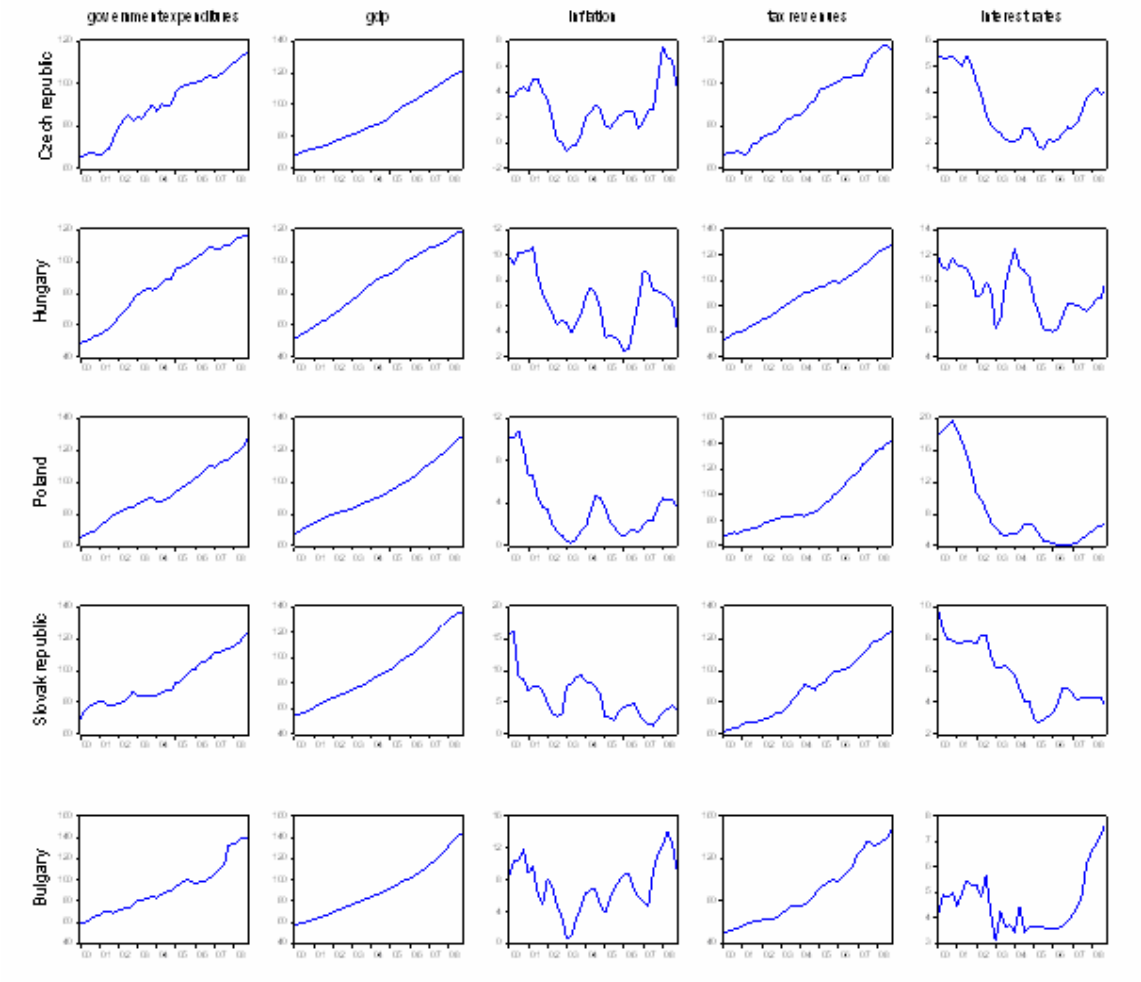


Figure 2a. Variables (2000-2008)

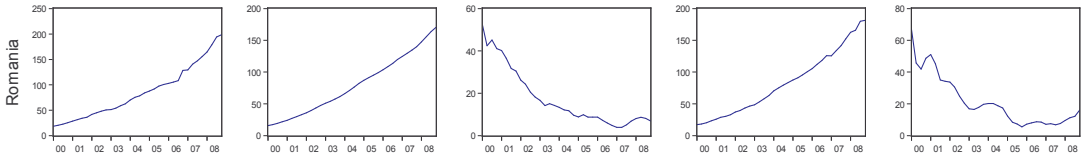


Figure 2b. Variables (2000-2008)

Source: [1], [11]
Note: Inflation and interest rates are expressed in percentage, government expenditures, real gross domestic product and tax revenues are expressed as an index (2005 = 100).

To test the stability of the VAR model we also applied a number of diagnostic tests. We found no evidence of serial correlation, heteroskedasticity and autoregressive conditional heteroskedasticity effect in the disturbances. The model also passes the Jarque-Bera normality test, so that errors seem to be normally distributed. The VAR models seem to be stable also because the inverted roots of the model for each country lie inside the unit circle (Figure 3).

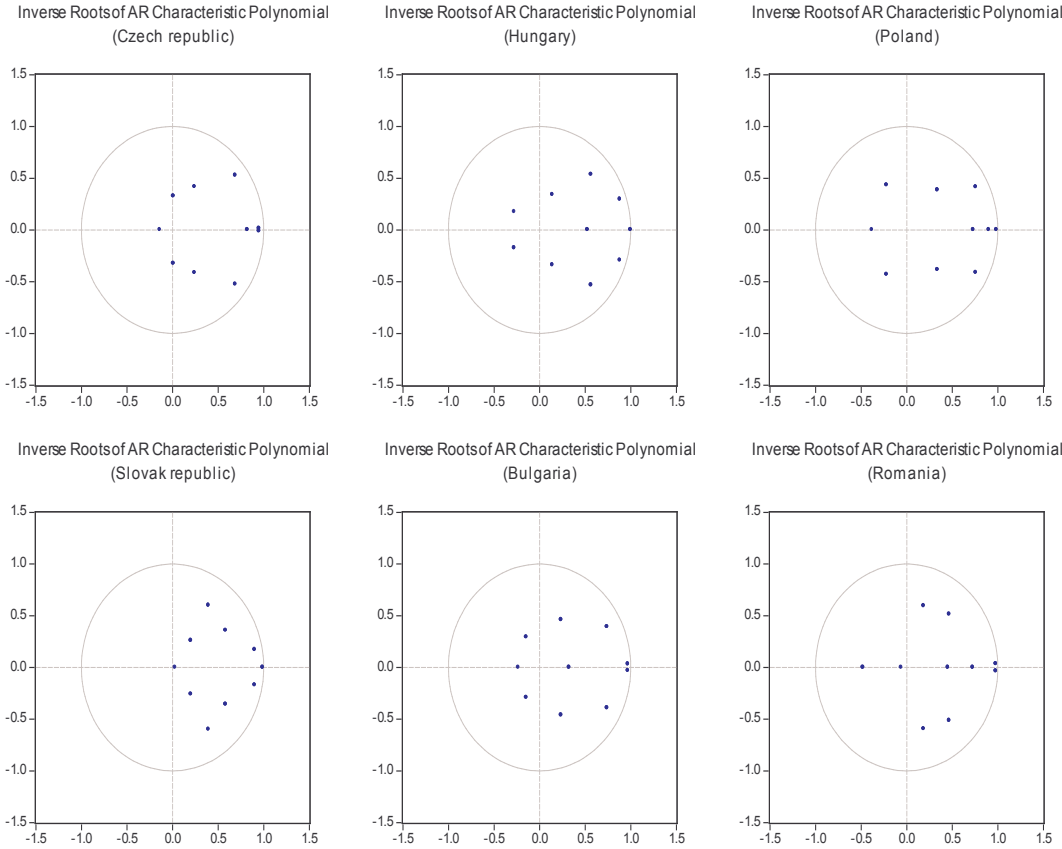


Figure 3. VAR stability condition check
Source: Author's calculations.

Following the results of the stationarity and cointegration tests we estimate the model using the variables in the first differences so that we can calculate impulse-response functions of endogenous variables of the model (responses of endogenous variables to one standard deviation government expenditures and tax revenues shocks) for each country from the selected group. In figures 4 (recursive approach) and 6 (SVAR approach) we summarize the responses of endogenous variables to the government expenditure shock. In figures 5 (recursive approach) and 7 (SVAR approach) we summarize the responses of endogenous variables to the tax revenues shock.

The impulse-response functions that show the responses of the endogenous variables to the government expenditure shock (Cholesky identification scheme) are shown in the figure 4. Under the above Cholesky identification structure, the real government spending is not contemporaneously (within the same quarter) affected by the changes in the real economic activity. That is the reason why we consider government expenditure shock as a discretionary change in fiscal policy represented here by the deliberate change in the government expenditures. In this regard we assume that there is no institutional setting to believe that any spending component reacts automatically to real activity changes.

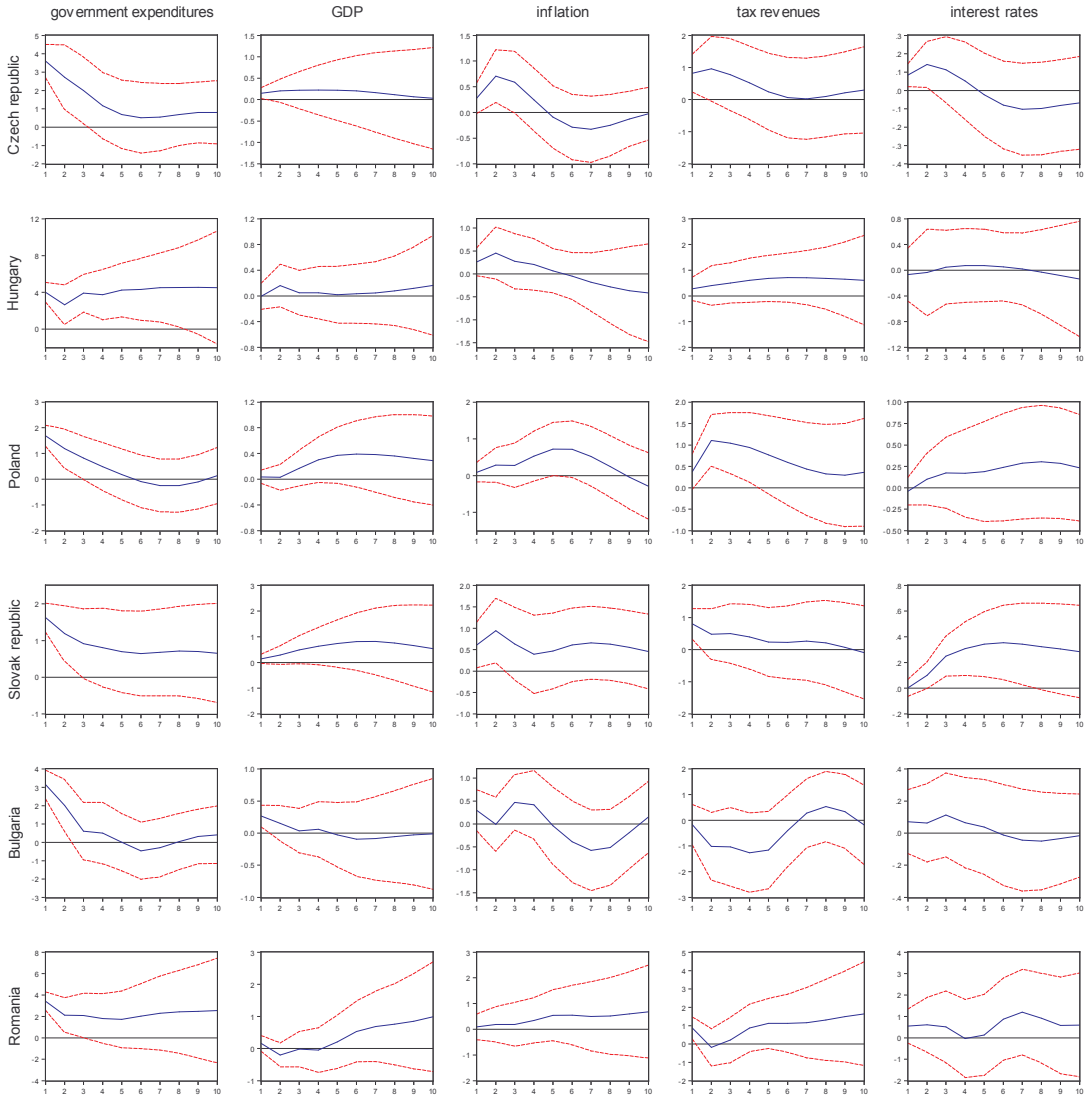


Figure 4. Response of endogenous variables to the government expenditure shock (recursive Cholesky approach)

Source: Author's calculations.

After a positive government expenditure shock the real output responded in a rather different way in the selected group of countries. Real output increased markedly immediately after the shock only in Bulgaria followed by the Czech Republic. Moderate but slightly gradual increase of the real output we observed in Hungary and the Slovak republic. In Poland and Romania the positive impact of the government expenditure shock on the real output development appeared with a lag. When we focus on an intensity in which the government expenditure shock affected the real output we also investigate rather differing results among countries. In Hungary and Bulgaria the government

expenditure shock affected the real output only for a short period (three respectively four quarters) and then died. In the Czech Republic and the Slovak republic the immediate positive effect of the government expenditure shock accelerated the real output in about three respectively four years until it died. Despite the initial one quarter lag the real output in Poland responded to the government expenditure shock quite similar to the scenario in the Slovak republic even thought the overall effect of the shock died about one year later. While in Romania the real output responded to the government expenditure shock with a significant lag of one year its intensity was the strongest in comparison with other countries. Additionally its positive effect died after rather long period (7 years).

After the initial government expenditure shock the inflation increased in all countries (here again with rather differing intensity). An upward inflation pressure is the most clearly visible in the Slovak republic as the inflation decreased (after an initial increase) only very slowly. In the Czech republic, Hungary and Bulgaria the overall effect of the government expenditure shock on the inflation is more like destabilizing than strictly increasing. In Poland inflationary pressure of the government expenditure shock died after two years. In Romania an inflation increase seems to be persisting even in the short run and died only in the long period.

In the Czech Republic, Hungary, Poland, the Slovak republic and with three quarters lag in Romania the positive government expenditure shock forced an increase in the tax revenues. We observed that only in Bulgaria the increased government expenditures produced typical deficit-financed expansionary effect.

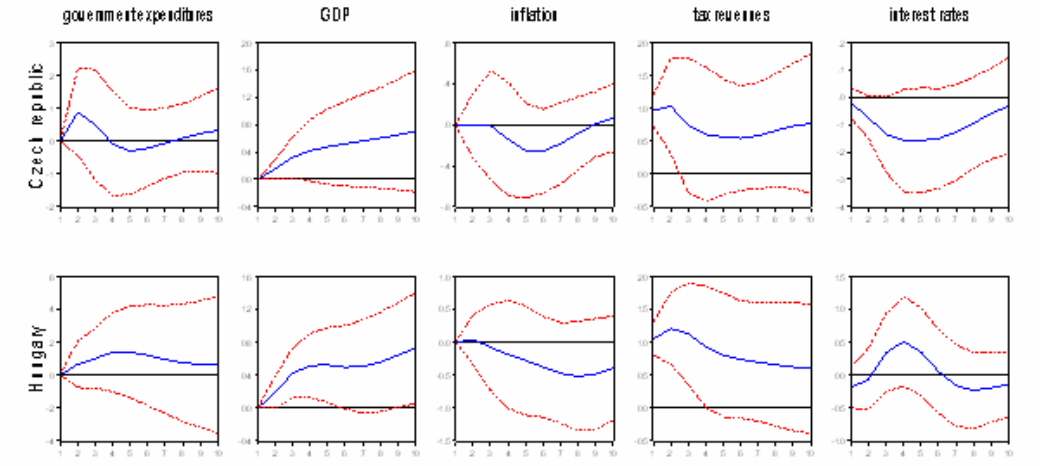
Finally, the positive government expenditure shock increased the short-term interest rates (with differing intensity and durability) in all countries except Hungary because the interest rates seem to be rather neutral to this shock.

The impulse-response functions that show the responses of the endogenous variables to the tax revenue shock (Cholesky identification scheme) are shown in the figure 5.

Under the above Cholesky identification structure (due to an integrated recursive principle the causal ordering of the variables is considered), the real tax revenues are contemporaneously (within the same quarter) affected by changes in the government expenditures, the real economic activity as well as the inflation. That is the reason why we consider the tax revenues shock as an automatic stabilizer in the fiscal policy represented here by the automatic adjustment in the tax revenues. In this regard we assume that there is a logical institutional setting to believe that the tax revenues react automatically to the real economic activity changes. After the initial real output shock the tax revenues increased in all six countries (the impulse-response functions of the real output is not presented here, like any other results, they are available upon request from the author).

Considering the internal logic of the recursive approach we assume that the government expenditures, the real output and the inflation doesn't respond to the tax revenue shock within the initial period while these variables can interact freely without any restrictions after the initial period.

Since the second quarter the government expenditures increases after the tax revenues shock. Despite the differences in the intensity as well as durability of the tax revenue shock we can conclude that this shock doesn't generate the sufficient condition to improve the fiscal budget balance in all countries.



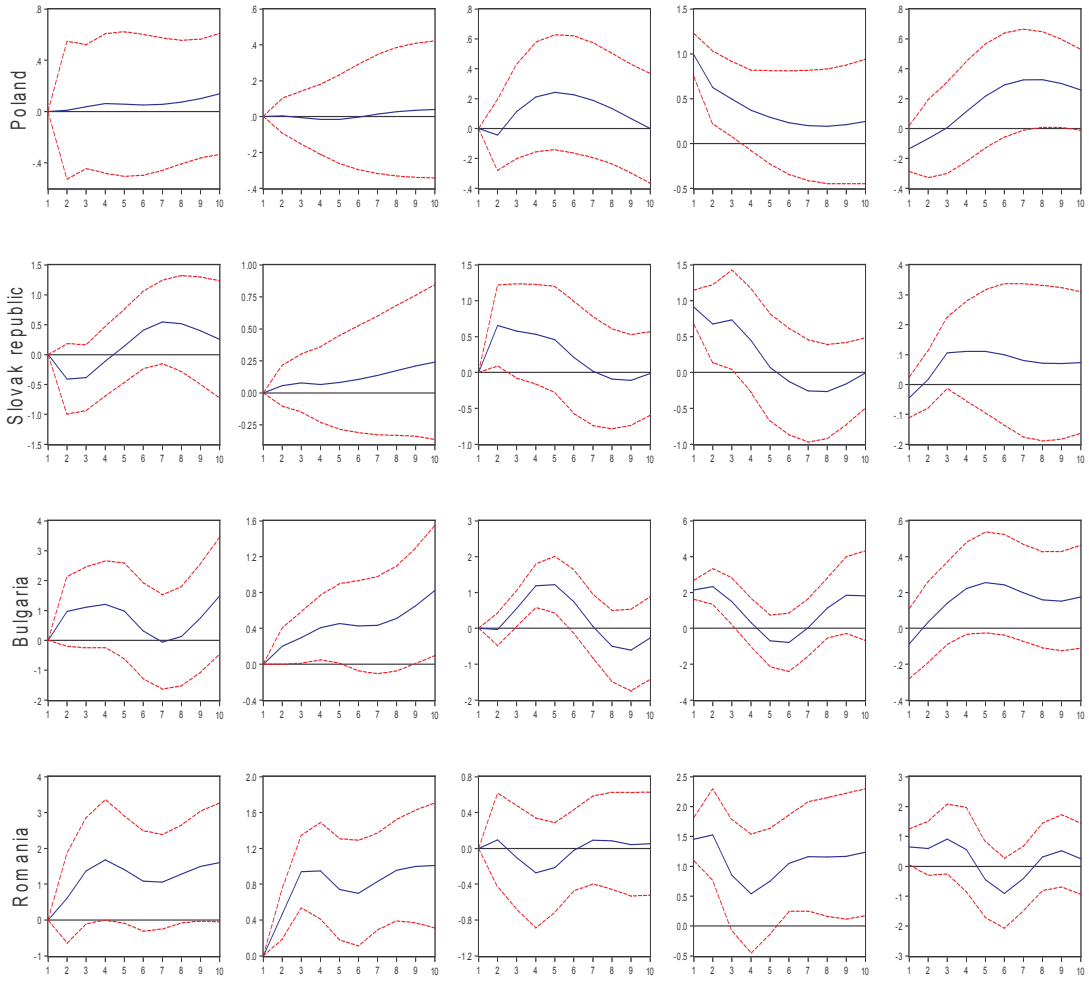


Figure 5. Response of endogenous variables to the tax revenues shock (recursive Cholesky approach)
Source: Author's calculations.

After the initial tax revenues shock the real output responded since the second quarter differently in all countries. The response of the real output in all transition economies (except Poland) seems to be rather interesting an in general contrary in comparison with other research studies focusing on the western developed countries. In the Czech Republic, Hungary, the Slovak republic, Bulgaria and Romania the real output increased after the tax revenue shock (with differing intensity and durability). Because we considered the tax revenues as the automatic stabilizer we expected that the real output should decrease in response to the positive tax revenue shock. On the other hand as the increase in the tax revenues must not necessarily be associated with increased tax rates we assume that higher tax revenues shouldn't inevitably slow down the economy. Higher real national income can thus increase the tax revenues without subsequent harming effect on the economic growth. At the same time the real output in Poland seems to be neutral to the tax revenues shock.

In Poland, the Slovak Republic and Bulgaria the positive tax revenues shock increased the rate of inflation (with differing intensity and durability). On the other hand in the Czech Republic, Hungary and Romania the positive tax revenues shock decreased the rate of inflation (with differing intensity and durability). Rather inconsistence results we address to the assumption of an uncertain wealth effect (it definitely affects the consumption preferences as well as the core inflation shifts) that is associated with the tax revenues increase.

Tax revenues shock increased the short-term interest rates in all countries (except the Czech Republic) with differing intensity and durability. As we have already mentioned the tax revenues must

not necessarily be associated with an increased tax burden. At the same time we revealed that the tax revenues don't prove well as the automatic stabilizer in the fiscal policy. An increase in the short-term interest rates simply confirms this suggestion.

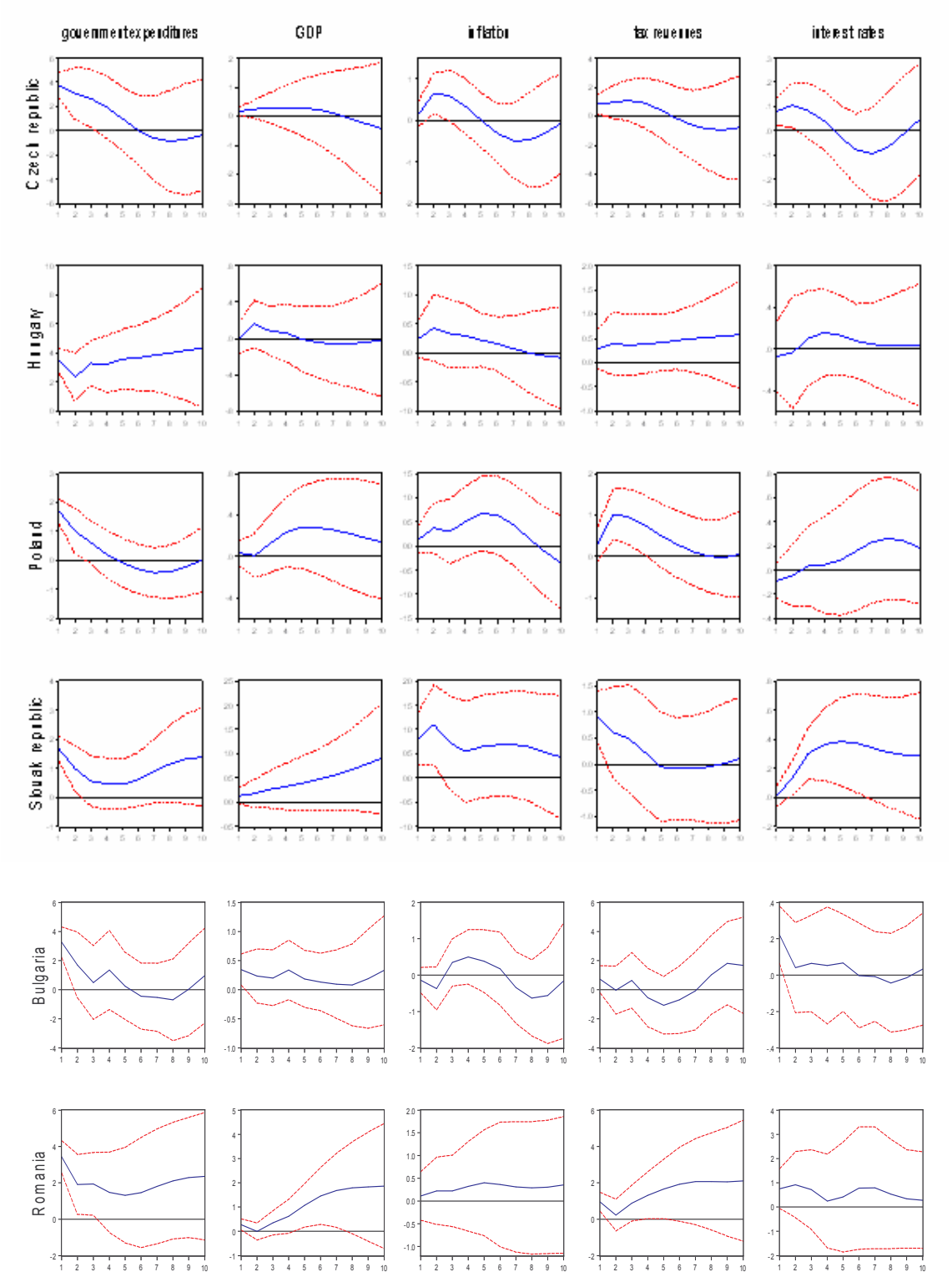


Figure 6b. Response of endogenous variables to the government expenditure shock (SVAR approach)

Source: Author's calculations.

The impulse-response functions that show the responses of the endogenous variables to the government expenditure shock (SVAR identification scheme) are shown in the Figure 6.

Comparing figures 4 and 6 we may conclude that different approach to identify the variance covariance matrix of reduced form residuals doesn't have any significant influence on the estimated impulse-response functions of the government expenditure shock. Indeed there are minor differences in the intensity as well as durability of the government expenditure shock but in general the direction in which endogenous variables respond to the shock is identical. Such an investigation reflects a high accuracy of our results.

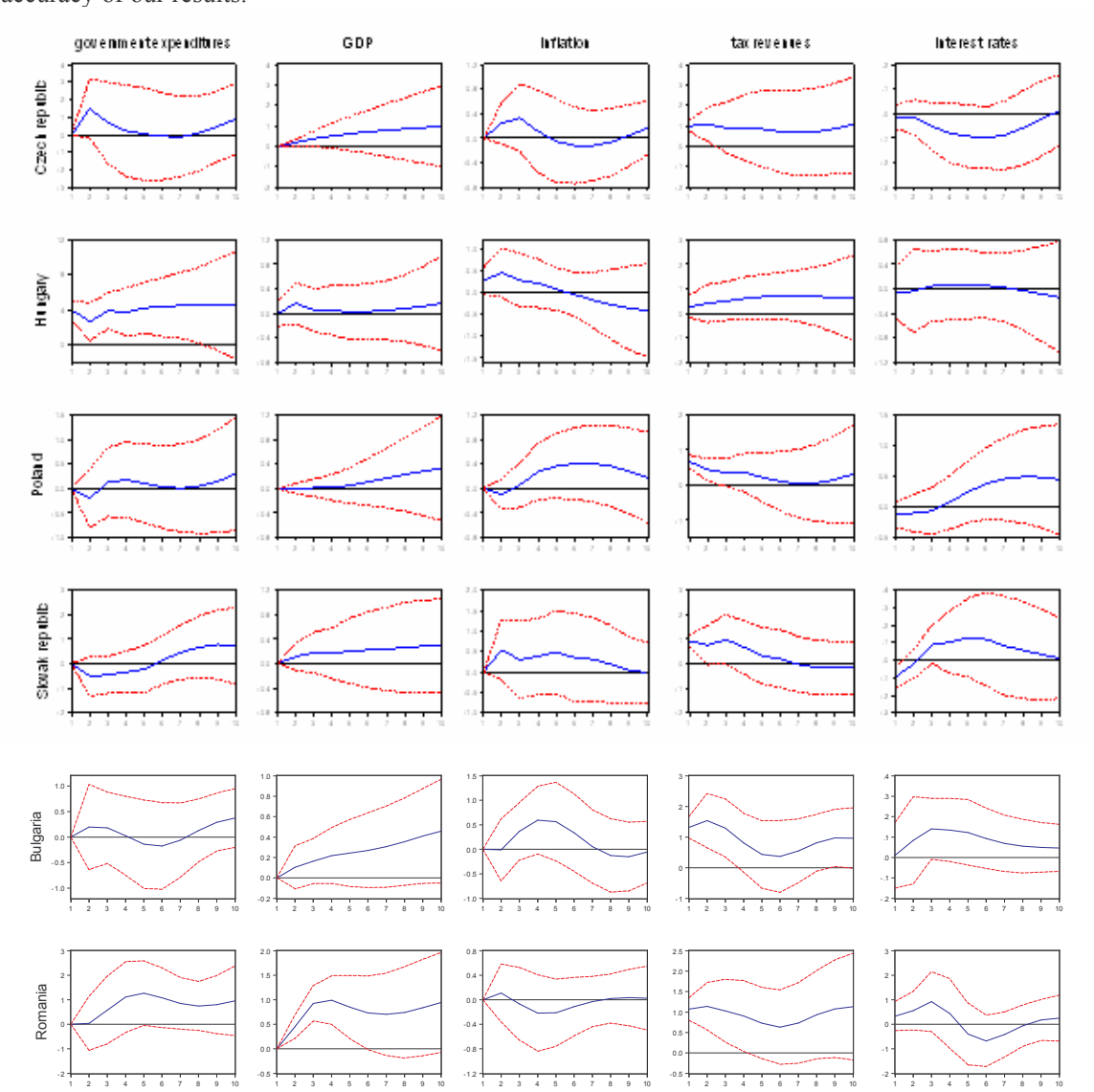


Figure 7. Response of endogenous variables to tax revenues shock (SVAR approach)

Source: Author's calculations.

The impulse-response functions that show the responses of the endogenous variables to the tax revenue shock (SVAR identification scheme) are shown in the figure 7.

Comparing figures 5 and 7 we may conclude that different approach to identify the variance covariance matrix of reduced form residuals doesn't have any significant influence on the estimated impulse-response functions of the tax revenue shock. Indeed there are minor differences in the intensity as well as durability of the tax revenues shock but in general the direction in which

endogenous variables respond to the shock is identical. Such an investigation reflects a high accuracy of our results.

4. Conclusion

In the paper we have estimated VAR model for the six countries in order to analyze the effects of fiscal policy shocks in the Czech Republic, Hungary, Poland, the Slovak republic, Bulgaria and Romania in the period 2000-2008. Our objective was to estimate the effects of discretionary changes in fiscal policy (associated with an increase in government expenditures) as well as the role of automatic stabilizers (associated with an increase in tax revenues). We implemented an identification scheme based on two approaches. The first, recursive approach, is based on the Cholesky decomposition of innovations that allows us to identify structural shocks hitting the model. The second approach, structural VAR (SVAR) approach, is based on applying the long-run restrictions to the reduced-form VAR model. From both identified true models we compute impulse-response functions to estimate the responses the real output, inflation and short term interest rates to the government expenditure and tax revenue shocks.

After the government expenditure shock the real output increased markedly only in Bulgaria followed by the Czech Republic. Moderate but slightly gradual increase of the real output we observed in Hungary and the Slovak republic. In Poland and Romania the positive impact of the government expenditure shock on the real output development appeared with a lag. When we focus on an intensity in which the government expenditure shock affected the real output we also investigate rather differing results among countries. In Hungary and Bulgaria the government expenditure shock affected the real output only for a short period (three respectively four quarters) and then died. In the Czech Republic and the Slovak republic the immediate positive effect of the government expenditure shock accelerated the real output in about three respectively four years until it died. Despite the initial one quarter lag the real output in Poland responded to the government expenditure shock quite similar to the scenario in the Slovak republic even thought the overall effect of the shock died about one year later. While in Romania the real output responded to the government expenditure shock with a significant lag of one year its intensity was the strongest in comparison with other countries. Additionally its positive effect died after rather long period (7 years).

After the initial tax revenues shock the real output responded since the second quarter differently in all countries. The response of the real output in all transition economies (except Poland) seems to be rather interesting an in general contrary in comparison with other research studies focusing on the western developed countries. In the Czech Republic, Hungary, the Slovak republic, Bulgaria and Romania the real output increased after the tax revenue shock (with differing intensity and durability). Because we considered the tax revenues as the automatic stabilizer we expected that the real output should decrease in response to the positive tax revenue shock. On the other hand as the increase in the tax revenues must not necessarily be associated with increased tax rates we assume that higher tax revenues shouldn't inevitably slow down the economy. Higher real national income can thus increase the tax revenues without subsequent harming effect on the economic growth. At the same time the real output in Poland seems to be neutral to the tax revenues shock.

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EXCHANGE RATE CHANGES AND PRICE DYNAMICS IN THE TRIAD COUNTRIES

Piotr **MISZTAL**
The *Radom Technical* University, **Poland**
misztal@msg.radom.pl

Abstract:

The phenomenon of incomplete exchange rate pass-through to prices has become one of the key research areas within so-called New Open Economy Macroeconomics. This theme is widely analyzed mainly in the American literature at macroeconomics as well as on microeconomics levels. The main aim of the article is to present the influence of exchange rate changes on the price dynamic the Euro-Zone, USA and Japan. The knowledge concerning the level of exchange rate pass-through to prices allows assessing how exchange rates affect on inflation and monetary policy in these countries.

The article consists of two parts. The first part deals with theoretical analysis of the phenomenon of incomplete exchange rate pass-through to prices, including reasons and factors determining the range of this phenomenon. Moreover, in this part, there is made a brief overview of theoretical researches involving this subject. In the next part of article, there is analyzed the range of exchange rate pass-through to prices in the "Triad countries" by using the Vector Autoregression Model (VAR). There are estimated coefficients of exchange rate pass-through to import, producer and consumer prices on the base of impulse response function. Then, there is made decomposition of the price index variance in order to assess the degree of price determination by exchange rate changes. The summary of theoretical and empirical analysis is presented in the last section of the article.

Keywords: exchange rate, transmission mechanism, pass-through to prices.

JEL Classification: (F3) International Finance

1. Introduction

An exchange rate pass-through is defined as a total percentage response of prices to a one percent shock in the exchange rate. For a long time the literature on the topic had assumed a complete pass-through of such changes to prices in conformity with the law of one price and purchasing power parity. Only in the 1980s empirical analyses revealed that it is rather an incomplete exchange rate pass-through of into domestic and foreign prices which is a common phenomenon. Such a situation is a result of a specific market structure (perfect or imperfect competition), the occurrence of individualized products, activities of transnational corporations and the occurrence of different types of barriers in foreign trade.

One of the first economists analyzing the phenomenon of incomplete exchange rate pass-through to prices was Krugman and Dornbush (1987). They came to a conclusion that pricing to market is an important factor determining deviations from the law of one price [Krugman, (1987); Dornbush (1987)]. On the other hand, Taylor (2000) indicated also a different factor determining the degree of exchange rate pass-through to prices, which is the rate of inflation. He proves that a low inflation rate leads to a lower degree of exchange rate pass-through to domestic prices [Taylor, (2000)]. The situation is reverse in the countries of a low inflation rate [Choudhri, Hakura, (2001)].

2. VAR model of exchange rate pass-through to prices

This paper analyses exchange rate change pass-through to prices in the Triad countries using the vector autoregression (VAR) model put forward by Sims in 1980. This approach was used for the first time by McCarthy (1999) who analyzed the phenomenon of exchange rate pass-through to prices in the OECD (Organization of Economic Co-operation and Development) member countries [McCarthy, (1999)]. In the VAR method the phenomenon of exchange rate pass-through to prices is analyzed with the use of a set of equations, which at the same time eliminates the problem of exogenous explanatory variables [Sims, (1980)]. Then the estimation of the exchange rate effect on particular price aggregates

in the model is isolated from the effect of other factors which the exchange rate may be correlated with.

The starting point for the model of exchange rate pass-through to prices in the Triad countries is an analysis of the so called distribution chain proposed by Blanchard (1982). The distribution chain is a series of economic shocks (chain links) between which a cause and effect relation occurs over the same time unit in which the shock occurred [Blanchard, (1982)]. Naturally this type of approach must be revised and in the VAR model an appropriate lag length between variables must be taken into account as in economy there is no immediate cause-and-effect relation and the effect always occurs with some lag in relation to the moment at which a given economic shock appears. In the analyzed VAR model, the distribution chain looks as follows.

$$s \rightarrow imp \rightarrow ppi \rightarrow cpi \tag{1}$$

where:

s – exchange rate;
imp – import price;
ppi – producer price index;
cpi – consumer price index.

Another stage of the analysis is a measurement of the strength of the exchange rate change pass-through to domestic prices. The so-called impulse response function is used to this purpose, that is a function of a given price aggregate (import prices, producer prices, consumer prices) response to an impulse in the form of the exchange rate change. The index of exchange rate change pass-through to prices after the period *t* is defined by the following equation [Cholewiński, (2008)].

$$PT(z)_t = \frac{\sum_{i=1}^{k} \Delta z_{t-i}}{\sum_{i=1}^{k} \Delta s_{t-i}} \tag{2}$$

where:

Δz_{t-i} – change of given price index (import price, producer price, consumer prices), in the period form „*t-i*" to „*t*";

Δs_{t-i} – change of exchange rate, in the period form „*t-i*" to „*t*".

Changes in a given price aggregate equal the values of the impulse response function of the analyzed aggregate to the exchange rate shock, and changes in the exchange rate equal the impulse response function of the exchange rate to the exchange rate shock. Shock occurrence is connected with each of the distribution chain links. However, only in the case of the first chain link (exchange rate) the original shock occurs and in subsequent links the shock results from the transmission of shocks in the former links. Hence, the shock occurring in subsequent chain links can be decomposed into an autonomous part (occurring in a given chain link) and the one transmitted from earlier links. Chain link decomposition is accomplished with the use of Cholesky decomposition matrix. Establishing the strength of the shock transmission is indispensable to analyze the phenomenon of exchange rate pass-through to prices in a more detailed way.

On the basis of the distribution model presented earlier, a VAR model was constructed which analyzes the phenomenon of exchange rate pass-through to prices. This model is a set of 4 equations and it looks as follows:

$$\Delta s_t = \sum_{i=1}^{k} \gamma_{11}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{12}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{13}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{14}^{i} \Delta cpi_{t-i} + \varepsilon_{1t} \quad (3)$$

$$\Delta imp_t = \sum_{i=1}^{k} \gamma_{21}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{22}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{23}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{24}^{i} \Delta cpi_{t-i} + \varepsilon_{2t} \quad (4)$$

$$\Delta ppi_t = \sum_{i=1}^{k} \gamma_{31}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{32}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{33}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{34}^{i} \Delta cpi_{t-i} + \varepsilon_{3t} \quad (5)$$

$$\Delta cpi_t = \sum_{i=1}^{k} \gamma_{41}^{i} \Delta s_{t-i} + \sum_{i=1}^{k} \gamma_{42}^{i} \Delta imp_{t-i} + \sum_{i=1}^{k} \gamma_{43}^{i} \Delta ppi_{t-i} + \sum_{i=1}^{k} \gamma_{44}^{i} \Delta cpi_{t-i} + \varepsilon_{4t} \quad (6)$$

where:

s – seasonally adjusted logarithm of nominal, effective exchange rate index (previous quarter = 100);

imp – seasonally adjusted logarithm of import price index (previous quarter = 100);

ppi – seasonally adjusted logarithm of producer price index (previous quarter = 100);

cpi – seasonally adjusted logarithm of consumer price index (previous quarter = 100);

yt – given period;

k – lag length (in quarter).

All the above mentioned time series have a quarterly frequency. In the case of the Japan and the USA they cover the period from the first quarter of 1990 to the third quarter of 2008 and in the Euro-zone the period from the first quarter of 1999 to the third quarter of 2008. Logarithming of particular model variables aimed at elimination of possible regression between variables. Before the model structural parameters were estimated, it was necessary to isolate a seasonal factor from the time series. The occurrence of the seasonal factor in the time series could lead to difficulties in interpreting changes in a given phenomenon in the analyzed period. To purge the time series from seasonal fluctuations, the X12-ARIMA procedure was applied.

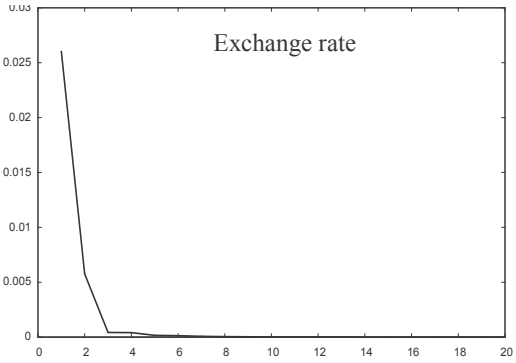
This paper analyzes the phenomenon of exchange rate pass-through to domestic prices of imported, production and consumer goods over a short period of time (after 1 quarter) and over a long period of time (after 4 quarters). For the purposes of the analyses, one lag period (one quarter) between explanatory variables was adopted. The choice of lag lengths is in line with results of the information criteria of the Akaike, Schwartz-Bayesian and the Hannan-Quinn models. According to these criteria, a model with one lag length is characterized by the biggest information capacity.

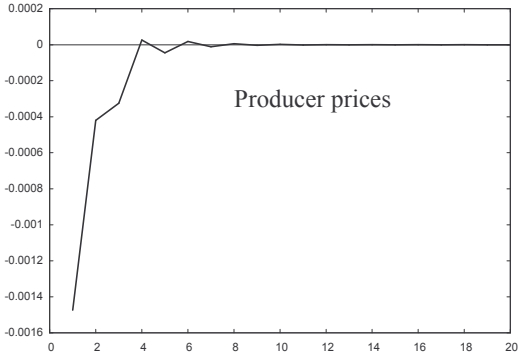
Before the VAR model estimation it was necessary to specify stationarity of the analyzed time series. To this purpose the Augmented Dickey-Fuller Test (ADF) was used. The last stage of the analysis of time series was co-integration estimation. Having a set of integrated variables of order 1, a co-integration test was carried out according to the method put forward by Johansen (1988). The choice of the lag lengths for co-integration testing was made on the basis of the earlier mentioned results of the Akaike, Scwartz-Bayesian and Hannan-Quinn information criteria.

3. Exchange rate pass-through to import, producer and consumer prices in the Triad countries

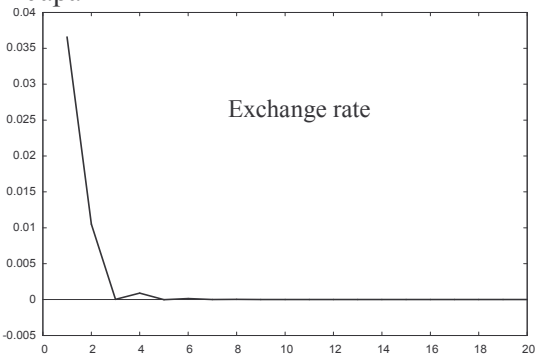
The next stage of the analysis was an estimate of structural parameters of the VAR model. Results of the parameter estimate of the VAR model consisting of 4 equations are in the Appendix. Below one can see respective graphs of the impulse response functions of exchange rate, import prices and consumer prices to a one-time unit change of the exchange rate in the Euro-zone, the Japan and the USA.

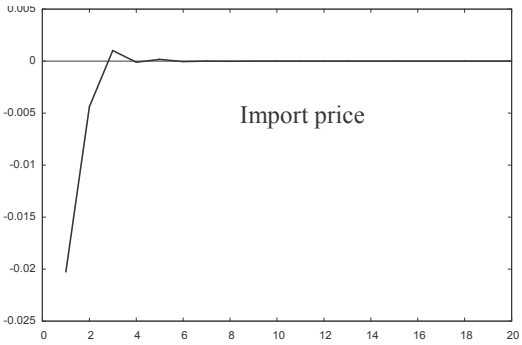
Euro-zone

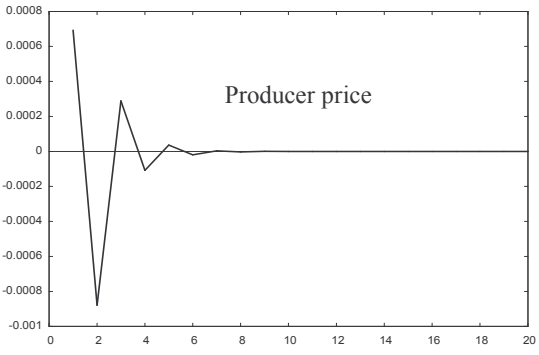


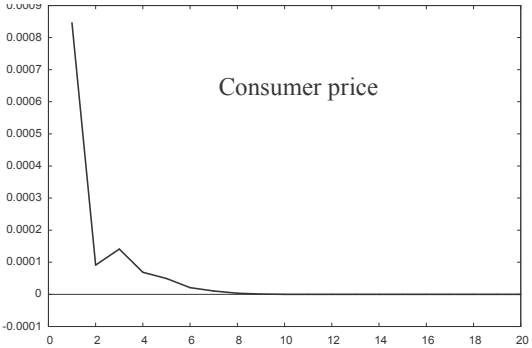


Japan









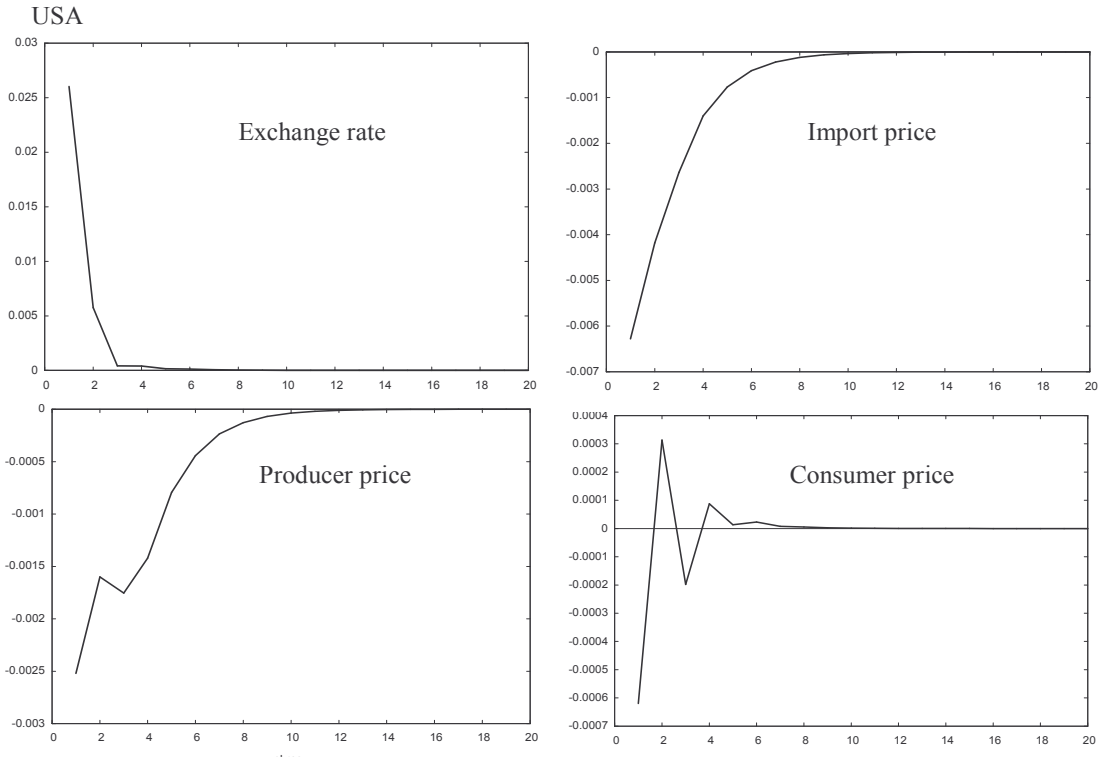


Figure 1. Impulse response function of exchange rate, import price, producer price and consumer price to a one shock in exchange rate

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

Eventually the magnitude of indices of the exchange rate pass-through to consumer prices is smaller than it is indicated by the analysis of the above drawings because changes in the exchange rate paralleled changes in consumer prices.

Table 1. Indexes of exchange rate pass-through to import prices, producer prices and consumer prices in the Triad countries

The number of quarter after shock	Import prices	Producer prices	Consumer prices
Euro-zone			
1	53,9%	6,7%	4,5%
2	67,2%	6,7%	1,4%
3	75,5%	7,3%	2,1%
4	74,7%	7,2%	1,6%
5	76,0%	7,3%	1,8%
6	75,4%	7,2%	1,7%
7	75,8%	7,3%	1,8%
8	75,6%	7,2%	1,7%
Japan			
1	55,4%	1,9%	2,3%
2	52,3%	0,4%	2,0%
3	50,1%	0,2%	2,3%
4	49,4%	0,0%	2,4%
5	49,1%	0,1%	2,5%
6	49,1%	0,0%	2,5%

7	49,1%	0,0%	2,6%
8	49,1%	0,0%	2,6%
USA			
1	24,1%	9,7%	2,4%
2	32,9%	13,0%	1,0%
3	40,7%	18,2%	1,6%
4	44,5%	22,4%	1,3%
5	46,6%	24,7%	1,2%
6	47,7%	25,9%	1,2%
7	48,3%	26,6%	1,1%
8	48,6%	27,0%	1,1%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

It is obvious that import prices respond more rapidly to changes in the exchange rates than producer and consumer prices [Hüfner, and MSchröder, (2002)]. The average level of exchange rate pass-through to import prices stood in the Euro-zone, Japan and USA, respectively at 53.9%, 55.4% and 24.1% in the short-term. However, after one year only 74.7%, 49,4% and 44,5% of exchange rate changes were passed through to import prices. Producer prices responded less to changes in the nominal, effective exchange rate. The average level of the exchange rate pass-through index to producer prices in the Euro-zone, Japan and USA amounted to respectively 6.7%, 1.9% and 9.7% in the short-run. However, after one year only 7.2%, 0.0% and 22.4% of exchange rate changes were passed through. The least affected by exchange rates, both in the short- and long-term, were consumer prices (with the exception of Japan). The average level of exchange rate pass-through to consumer prices reached in the Euro-zone, Japan and USA respectively 4.5%, 2.3% and 2.4% in the short-term. However, after one year only 1.6%, 2.4% and 1.3% of changes in the exchange rate were passed through to consumer prices.

The last stage of the analysis is the residual component variance decomposition of subsequent price aggregates. This procedure specifies the contribution of the exchange rate shock affecting each of the price variables in accounting for the variances of the individual model variables (price aggregates).

Table 2. The ***error variance decomposition*** in the import price equation

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
Euro-zone				
1	10%	90%	0%	0%
2	12%	82%	4%	3%
3	12%	80%	5%	3%
4	12%	80%	5%	3%
5	12%	79%	5%	3%
6	12%	79%	5%	3%
7	12%	79%	5%	3%
8	12%	79%	5%	3%
Japan				
1	40%	60%	0%	0%
2	36%	59%	4%	2%
3	36%	59%	4%	2%
4	35%	58%	4%	2%
5	35%	58%	4%	2%

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
6	35%	58%	4%	2%
7	35%	58%	4%	2%
8	35%	58%	4%	2%
USA				
1	16%	84%	0%	0%
2	18%	82%	0%	0%
3	18%	81%	0%	0%
4	18%	81%	0%	0%
5	19%	81%	0%	0%
6	19%	81%	0%	0%
7	19%	81%	0%	0%
8	19%	81%	0%	0%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

Table 3. The ***error variance decomposition*** in the producer price equation

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
Euro-zone				
1	7%	2%	91%	0%
2	7%	3%	90%	1%
3	7%	3%	90%	1%
4	7%	3%	90%	1%
5	7%	3%	90%	1%
6	7%	3%	90%	1%
7	7%	3%	90%	1%
8	7%	3%	90%	1%
Japan				
1	3%	23%	74%	0%
2	6%	19%	73%	2%
3	6%	18%	73%	2%
4	6%	18%	73%	3%
5	6%	18%	73%	3%
6	6%	18%	73%	3%
7	6%	18%	73%	3%
8	6%	18%	73%	3%
USA				
1	4%	68%	29%	0%
2	4%	76%	21%	0%
3	5%	76%	19%	0%
4	5%	76%	18%	0%
5	5%	76%	18%	0%
6	5%	76%	18%	0%

7	5%	76%	18%	0%
8	6%	76%	18%	0%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

Table 4. The ***error variance decomposition*** in the consumer price equation

The number of quarter after shock	Exchange rate	Import prices	Producer prices	Consumer prices
Euro-zone				
1	14%	1%	40%	46%
2	14%	1%	42%	43%
3	14%	2%	42%	43%
4	14%	2%	42%	43%
5	14%	2%	42%	43%
6	14%	2%	42%	43%
7	14%	2%	42%	43%
8	14%	2%	42%	43%
Japan				
1	5%	0%	13%	82%
2	4%	6%	11%	78%
3	4%	10%	11%	75%
4	4%	11%	11%	74%
5	4%	11%	11%	74%
6	4%	11%	11%	74%
7	4%	11%	11%	74%
8	4%	11%	11%	74%
USA				
1	4%	47%	6%	43%
2	4%	45%	13%	39%
3	4%	44%	13%	39%
4	4%	44%	13%	39%
5	4%	44%	13%	39%
6	4%	44%	13%	39%
7	4%	44%	13%	39%
8	4%	44%	13%	39%

Source: Own calculations on the basis of *International Financial Statistics*, (2008).

On the basis of the data from the above Table it can be noted that changes in the nominal effective exchange rate accounted for 10%, 40% and 16% of the price variances in the Euro-zone, Japan and USA in the short-run. In the long-run relative importance of exchange rate changes was greater. However, the effects exchange rate changes on producer price variances in the short- and long-term were significantly smaller. In the short-run as well long-run, ca. 7%, 3% and 4% of producer price changes in the Euro-zone, Japan and USA could be accounted by a change in the nominal, effective exchange rate.

The role of exchange rate in accounting for consumer price variances in the short- and long-term was even smaller (with exception to the Euro-zone). In the Japan and USA less than 5% of

consumer price changes could be accounted for by changes in the nominal effective exchange rate in the short-and long-run. In the Euro-zone, change in the nominal effective exchange rate accounted for 14% of consumer price changes in the short- and long-run.

4. Conclusion

The paper performed an empirical analysis of transmission mechanism of exchange rate changes to import, producer and consumer prices in the Triad countries. I found, that there are exist in the phenomenon of incomplete exchange rate pass-through to import, producer and consumer prices in the short-run as well in the long-run.

The results of the conducted research are conformable with theoretical arguments and indicate that in general the degree of exchange rate pass-through to prices declines across the pricing chain, i.e. it is lower on consumer prices than on import prices. There is also evidence of low exchange rate pass-through for the most developed economies, particularly in the case of the USA and for producer prices, in Japan. In line with previous studies exchange rate pass-through is found to be somewhat higher in the euro area than in the USA, both for import and consumer prices.

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Appendix

Results of the parameter estimate of the VAR model – Euro-zone

Ordinary least squares (OLS) estimates using 40 observations 1998:4-2008:3, 1 quarter lag
Log. likelihood = 519,87175
Covariance matrix = 6,0426982e-017
Akaike Information Criterion (AIC) = -25,1936
Schwartz Bayesian Criterion (BIC) = -24,5180
Hannan-Quinn Criterion (HQC) = -24,9493
Test Portmanteau: LB(10) = 192,819 (df = 144, p-value 0,004120)

Equation: s

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,444963	0,162884	2,7318	0,00970
imp_1	0,0826025	0,0941151	0,8777	0,38594
ppi_1	1,13399	0,850499	1,3333	0,19080
cpi_1	0,854656	1,55847	0,5484	0,58681

Equation: imp

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	-0,475831	0,27826	-1,7100	0,09587
imp_1	-0,297316	0,16078	-1,8492	0,07265
ppi_1	2,52361	1,45293	1,7369	0,09095
cpi_1	-3,53259	2,66238	-1,3269	0,19291

Equation: ppi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	-0,0405024	0,0423777	-0,9557	0,34557
imp_1	-0,003186	0,0244859	-0,1301	0,89720
ppi_1	-0,128107	0,221275	-0,5790	0,56623
cpi_1	-0,245353	0,405467	-0,6051	0,54890

Equation: cpi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	5,19482e-05	0,0199788	0,0026	0,99794
imp_1	-0,00464363	0,0115438	-0,4023	0,68987
ppi_1	-0,0327015	0,104319	-0,3135	0,75573
cpi_1	-0,49984	0,191156	-2,6148	0,01296

Source: Own calculations by using GRETL.

Results of the parameter estimate of the VAR model – Japan

Ordinary least squares (OLS) estimates using 72 observations 1990:4-2008:3, 1 quarter lag
Log. likelihood = 910,23246
Covariance matrix = 1,2282841e-016
Akaike Information Criterion (AIC) = -24,8398
Schwartz Bayesian Criterion (BIC) = -24,3339
Hannan-Quinn Criterion (HQC) = -24,6384
Test Portmanteau: LB(18) = 312,998 (df = 272, p-value 0,044121)

Equation: s

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,209101	0,14551	1,4370	0,15530
imp_1	-0,00944981	0,181088	-0,0522	0,95854
d_ppi_1	2,61481	1,07695	2,4280	0,01784
cpi_1	0,995953	1,1469	0,8684	0,38824

Equation: imp

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,187414	0,128128	1,4627	0,14815
imp_1	0,452062	0,159456	2,8350	0,00603
d_ppi_1	-1,31326	0,948308	-1,3848	0,17063
cpi_1	-1,37835	1,0099	-1,3648	0,17680

Equation: ppi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,0115959	0,0163647	0,7086	0,48100
imp_1	0,0411957	0,020366	2,0228	0,04703
d_ppi_1	-0,417408	0,121119	-3,4463	0,00098
cpi_1	-0,211868	0,128986	-1,6426	0,10509

Equation: cpi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,02064	0,0150363	1,3727	0,17436
imp_1	0,0446081	0,0187127	2,3838	0,01993
d_ppi_1	-0,0983466	0,111287	-0,8837	0,37996
cpi_1	0,363962	0,118515	3,0710	0,00307

Source: Own calculations by using GRETL.

Results of the parameter estimate of the VAR model – USA

Ordinary least squares (OLS) estimates using 72 observations 1990:4-2008:3, 1 quarter lag
Log. likelihood = 958,8517
Covariance matrix = 3,1825054e-017
Akaike Information Criterion (AIC) = -26,1903
Schwartz Bayesian Criterion (BIC) = -25,6844
Hannan-Quinn Criterion (HQC) = -25,9889
Test Portmanteau: LB(18) = 387,196 (df = 272, p-value 0,000005)

Equation: s

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,206931	0,132464	1,5622	0,12289
imp_1	0,217751	0,385209	0,5653	0,57374
ppi_1	-0,351166	0,407683	-0,8614	0,39206
cpi_1	-1,37913	0,93258	-1,4788	0,14380

Equation: imp

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	-0,0306693	0,0809945	-0,3787	0,70612
imp_1	0,595348	0,235534	2,5276	0,01381
ppi_1	-0,0718953	0,249276	-0,2884	0,77391
cpi_1	-0,288953	0,570222	-0,5067	0,61398

Equation: ppi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,0633094	0,0662133	0,9561	0,34239
imp_1	0,46413	0,19255	2,4104	0,01864
ppi_1	0,121387	0,203784	0,5957	0,55338
cpi_1	0,0440643	0,466158	0,0945	0,92497

Equation: cpi

	Coefficient	*Standard error*	*t-ratio*	*p-value*
s_1	0,00801301	0,0165485	0,4842	0,62979
imp_1	0,0635906	0,0481235	1,3214	0,19080
ppi_1	-0,0960527	0,0509312	-1,8859	0,06358
cpi_1	-0,422814	0,116506	-3,6291	0,00055

Source: Own calculations by using GRETL.

CAPM WITH INFORMATION COST

Hachicha **NIZAR**
University of Economics and Management of Sfax, **Tunisia**
hachicha_nizar@yahoo.fr

Abstract

This study investigates a simple theoretical model that explains how asset prices are affected by information risk and voluntary dissemination. Within this framework, we search for testing the impact of introducing disclosure risk on asset pricing model. The model offers a unified theoretical frame that can elicit the empirical findings that return sensitivity to market information is priced. We conclude that the expected stock return depends not only on information itself but also on the correlation between its return and the market disclosure.

Keywords: disclosure risk, disclosure-adjusted CAPM, information cost, equilibrium model.

JEL Classification: G12 G14 C02 C52

1. Introduction

The market efficiency debate has enthused literally thousands of studies attempting to verify whether specific markets are in fact "efficient. Hence, many studies do indeed point to evidence that supports the efficient market hypothesis, for example, see Eugene Fama's (1970) influential survey article, "Efficient Capital Markets."

Therefore, the efficient market hypotheses, thereafter EMH, asserts that financial markets are "efficient" or that prices on traded assets already fully reflect all available information and consequently are unbiased in the sense that they reflect the collective beliefs of all investors about future prospects. Information in the EMH is defined as anything that may affect stock prices that is unknowable in the present and appears randomly in the future. This random information will be the cause of future stock price changes. Sharpe (1964), Mossin (1966), and Litner (1965) brought us the first asset-pricing models based on EMH assumptions. Their work resulted in the capital asset pricing model, thereafter CAPM, which specifies the relationship between financial security return and risk. The line that is thereby described is labelled the security market line. This relationship denotes that at equilibrium the rate of return of every asset is equal to the rate of return of the risk-free asset plus a risk premium. Via the CAPM terminology, the premium is equal to the price of the risk multiplied by the quantity of risk. The price of the risk is defined as the difference between the expected rate of return for the market portfolio, and the return on the risk-free asset. The quantity of risk (beta) is consequently equal to the covariance of a security's historical return series with that of a representative risky market proxy, divided by the variance of the market portfolio.

When the actual security prices diverge from the prices which would obtain if all available information were incorporated into the prices and in an unbiased fashion, abnormal returns are observed. One makes sure that the existence of abnormal return can be at the centre of a non specification of the CAPM to evaluate stock return. This original version of the CAPM is based on assumptions that the financial markets do not fully respect. This first formula was pursued by several other versions, which allowed the realities of the market to be taken into account to a greater degree.

Several explications are given to explain the existence of abnormal return and the inability of the CAPM to assess the expected stock return. We can refer either to psychological bias or to econometrical model specifications. Micro-structural reasons can also trigger abnormal returns.

A generation ago, research on asset pricing has based on fundamental, firm-specific, and economy-wide factors that affect asset prices. Recently, on the other hand, some researchers have turned to investor psychology to explain asset-price behaviour. It was previously presumed that there is a kind of correlation among the sentiments of investors. The differing sentiments accordingly compensate each other and there is no resulting effect on market prices. If, on the other hand, there is enough of a compromise among investors, their perspectives will not offset and will instead become an integral part of the price-setting process. In fact, some researchers [e.g., Eichengreen and Mody (1998)] suggest that a change in one set of asset prices may, especially in the short run, trigger changes elsewhere because such a change engenders shifts in the market's attitude towards risk (i.e., because

there is a change in investor sentiment). Such shifts in risk attitudes may explain short term movements in asset prices better than any other set of fundamental factors [see, e.g., Baek, Bandopadhyaya and Du, (2005)]. Other studies have also recognized that investor sentiment may be an important component of the market pricing process [see Fisher and Statman, (2000) and Baker and Wurgler, (2006)]. It's commonly agreed that disclosure is one of the most important factors that influences the efficient implementation of any stock exchange. For this reason, many researchers have tried to determine firms' characteristics that may affect disclosure policy.

Until and unless a general method of assessing the trading costs can be agreed and implemented, the issue is ultimately not resolvable. Within this study, we denote a new explanation of the inability of the classic CAPM to assess the asset return. Our methodology starts with the definition of EMH presented above which requires the incorporation of relevant information into the stock return. Since prices are influenced solely by new economic events and new information, the existence of abnormal return can be explained as follow: either a part of information attributed to a specific stock is omitted or other pointless information is taken into account in the asset pricing model. These two prepositions lead to explicate the problems addressed to the efficiency market by the bias of information. This information us it constitutes a cost on one hand, it generate a risk in the other hand. Thus the capital asset pricing model has to take into account either the systematic risk given by the standard version of the CAPM, the disclosure risk attributed to the information.

This paper presents a simple theoretical model that helps explain how asset prices are affected by information risk and commonality in disclosure. The model provides a unified theoretical framework that can explain the empirical findings that return sensitivity to market information is priced .that average information is priced, and that disclosure commoves with returns and predicts future returns. In our model, risk-averse agents in an overlapping generation's economy trade securities whose disclosure varies randomly over time. We solve the model explicitly and derive a disclosure-adjusted capital asset pricing model (CAPM). Our model of information risk complements the existing theoretical literature on asset pricing with constant trading frictions [see, for instance, Amihud and Mendelson, (1986); Constantinides, (1986); Vayanos, (1998); Vayanos and Vila, (1999); Duffie *et al*., (2000); Huang, (2003); Garleanu and Pedersen, (2004)]. In the disclosure-adjusted CAPM, The model has a good fit for portfolios sorted on disclosure, uncertain information, and rationality irrationality reaction of investor from financial and non financial information.

An interesting result that emerges from our empirical exercises based Internet reporting index is calculated using the unweighted sum of selected items. Spero (1979) argues that attaching weights to disclosure items is irrelevant because companies that tend to be more forthcoming with less important information also tend to be more forthcoming with more important information.

So, in this paper we investigate how investors react strategically to disclosure policies. As such, it is related to literature that examines the link between investor sentiment and corporate policies such as those involving acquisitions, financing and investments [Shleifer and Vishny, (2003); Baker and Wurgler, (2000); Baker, Stein and Wurgler, (2003)].

Our model of information risk complements the existing theoretical literature on asset pricing with constant trading frictions [see, for instance, Amihud and Mendelson, (1986); Constantinides, (1986); Vayanos, (1998); Vayanos and Vila, (1999); Duffie *et al*., (2000), (2003); Huang, (2003); Garleanu and Pedersen, (2004)]. The model has a good fit for portfolios sorted on disclosure, uncertain information, and Rationality irrationality reaction of investor from financial and non financial information.

A main result of our empirical exercises based on Internet Reporting Index is computed using the un-weighted sum of selected items. As cited by Patrícia and al (2007), Spero (1979) argues that attaching weights to disclosure items is irrelevant because companies that tend to be more forthcoming with less important information also tend to be more forthcoming with more important information.

The remainder of the paper is organized as follows. Section 2 surveys the related theoretical and empirical literature of capital asset pricing models and information cost in order to develop an information cost-adjusted capital asset pricing model. Our model sketches how information cost predicts and commoves with returns. Section 3 contains the empirical and theoretical implications of our adjusted capital asset pricing model. Section 4 presents the empirical results. Section 5 summarizes the main findings of the paper. Proofs are in the Appendix.

2. The model

2.1. The market design

In this model, we suppose a simple overlying generation economy. Securities are indexed by i (i = 1; …; I) and S^i enumerates the sum of shares of each security i. At time t, security i pays a dividend of D_t^i; has an ex-dividend share price of P_t^i; and has information cost of F_t^i (D_t^i and F^i_t are random variables). F_t^i is modelled just as the per-share prices of selling security i. Section 2.3 is interested in quantifying and decomposing F_t^i. Therefore, agents can buy at P_t^i but must sell at $P_t^i + F_t^i$ (there is no short-selling). The related uncertainty to information cost is what generates informational risk in our model. Specifically, we assume that D_t^i and F_t^i are AR (1).

We relay on strong assumptions referring to the presence of agents, preferences, and dividends. These assumptions imply natural closed-form results for prices and expected returns. They are made for tractable reasons. Rationality represents the main guidelines of our modelling based in the information. Information is risky and so we refer to the uncertainty, the complexity and the reasoning of participants as key words of disclosure risk. The powerful assumption may be the one saying that investors need to sell all their securities after one period (when dying). Indeed, to develop general assets valuation model with time varying information is a hard task especially when it is about a more general setting with endogenous holding periods. Although our model appears to be redolent, it is so practical since it proposes rules concerning the first-order consequence of disclosure risk, illustrating which risks are priced.

2.2. Information Cost and capital asset pricing model

The EMH suggests that, in equilibrium, stock prices only react when important information is entering the efficient market [Beaver (1968); Ball and Brown (1968)]. Nevertheless, a basic shortcoming of this theory is that it is a pure exchange theory and therefore ignores how information is formed, obtained, and treated by investors, firms, and experts [Ball; (1992)]. Hence, "information" is an intangible concept. It can't be directly observed but rather has some aspects that may not be detected using a single measure. The disclosure of financial and accounting information either via traditional communication (e.g. annual report) or modern communication (e.g. web sites), permits the decrease of the uncertainty concerning information. Investors, privileged users, can not exercise their power of control on firms until they set up specific information' about the firm management system and its financial situation, mainly throughout unstable economic environment.

Nowadays, Internet has an important role in information disclosure, and it represents an informational resource whose place is improved among the various sources of information [Khlifi and Bouri, (2007)]. Marston (1996) defines Internet reporting as the relationship between a firm and the financial community, where the first will provide information to help the second to evaluate company. As the Web site constitutes a *nonofficial* support of communication, then all information diffused via this channel is considered as a voluntary disclosure. Leftwich *et al.* (1981) show that voluntary disclosure of significant information, financial or non-financial, will add value to the information that is legally required for disclosure to the public.

So, the Internet dissemination of accurate information adds more stabilization for stock prices and increase investors' confidence. The growing importance of Internet modifies many aspects of investor relations activities. Thompson (2002) notes that Internet financial reporting has a major role in reducing investors' risk by providing obvious and understandable information with the aim of full and fair disclosure.

Hence, the websites can be considered as an alternative distribution canal for corporate information with the quality of joining cost reductions for the reporting corporation with additional benefits for the target groups (e.g. by providing balance sheets and income statements in spreadsheet software-compatible format).

Recently, there is a growth literature that examines voluntary corporate reporting[1]. This literature exposes the benefits of voluntary disclosure. Christian and Thomas (2006) study if the level

[1] For more detail about this empirical literature see Healy, P., Palepu, K., 2001. «A review of the empirical disclosure literature», *Journal of Accounting and Economics*, Vol. 31, pp. 405–440. The authors provide a broad review of the empirical disclosure literature.

of voluntary disclosure affects information asymmetry for industrial companies listed on the Copenhagen Stock Exchange. They found that voluntary disclosure is negatively associated with proxies for information asymmetry.

Providing accurate information reduces the information asymmetry between investors and managers, which in turn, affects the cost of equity capital [Botosan, (1997)], cost of debt capital [Sengupta, (1998)], firm value [Frankel *et al.* (1999)] and market liquidity [Welker, (1995)]. Hunton *et al*. (2006) state that "transparent financial disclosure as those from which needed information can be more easily extracted and more effectively used to understand firm economics". In this way, Internet financial reporting, a form of voluntary disclosure, permits giving better information to agents and shall spell more impact on stock prices. Information disclosed through web sites, it is immediately available to all investors, so reducing information asymmetry and information accessibility delay.

Ryder and Regester (1989) suggest that Internet reporting has strategic importance and allow creating a connection between firms and investors. They propose that Internet reporting activities must focus on three basic principles. Firstly attain and preserve the highest-possible stock price. Then, obtain investor and creditor confidence, where in return future cost of financing might be decreased. Finally, defend the requirements of major shareholders and also to attract institutional and foreign shareholding investment in the companies.

Lev (1992) states that delivering information to shareholders on the company's activities can reduce uncertainty, thus minimizing negative impacts on the share prices. Consequently, the Internet Financial Reporting, thereafter IFR, can be seen as a key influence in restoring investors' confidence.

Relating to the liaison between systematic risk and disclosure level, Leuz and Verrecchia (2000) note that "... a relation between the firm's disclosure and its beta factor has little support in theory." Earlier empirical studies on the consequences of disclosure, understand beta as an explanatory variable [Debreceny *et al*., (2002); Marston and Polei, (2004)]. From our point of view, disclosure can directly influence both the beta and the market portfolio. But, based on a sample of German companies, Marston and Polei (2004) show that systematic risk appears to be insignificant predictors for the IFR practices. Also Debreceny *et al.* (2002) provide no support for this relationship.

From the above discussion, we conclude that, due to differences in practising IFR, the market is inefficient. The current study mainly focuses on the development of a new CAPM adjusted to information cost.

2.3. Measurement of information cost

There are several methods to measure the level of IFR. Past empirical studies employ a binary measure (disclose or not financial information through websites) or calculate a firm based score. In our study, we measure the quantity or the level of IFR via a disclosure index. Our methodology consists of three steps:

Step 1: select a study period and the document to be analyzed

Before calculating the IFR level it is indispensable to choose the document to be analysed. In this paper, the corporate Web sites considered as a communication tool are analyzed during the period of data collection. Our empirical research is based on a sample of 250 French companies listed in SBT 250 index (see appendix 2). Using a search engine "www.euronext.com), we locate web sites of each company in the sample.

During a month (from 15th December 2007 to 15th January 2008), Web sites are saved using the 'Web Archive, single file (*mht)' featured in the Web browser. Nevertheless, this information collection method presents the risk that firms can change their Web sites over the study period. To remedy this problem, the data was collected using the software Offline Explorer (a Windows offline browser). It permits downloading an unlimited number of websites for later offline viewing, searching, browsing or updating.

Step 2: choose the method of measuring the level of on-line corporate reporting

Basing on previous studies in the filed of IFR (Andrea and Yang, 2008), 25 points are selected and categorized into two groups: Financial and non-financial attributes.

For each disclosure item we use a binary score: '1' for present and '0' for absent. We measure Internet reporting index using the simple sum of selected items. Patrícia *et al.* (2007), Spero (1979) argues that using a weighted sum is irrelevant because companies that tend to be more forthcoming with less important information also tend to be more forthcoming with more important information.

The IFR index is calculated as follow:

$$IFR_i = \frac{\left[\sum_{t=1}^{n} iT_{ti}\right]}{n_i} \quad (1)$$

where:

IFR_i : is the level of Internet financial reporting for the company i .

T_{ti} : is the information item disclosed by company i .

n_i : is the maximum number of items expected to be disclosed by a company i .

$i = 1.....40;\ t = 1....$

We decompose the equation (1) into two scores:

$$\text{Total IFR score} \begin{cases} FSCORE_i = \dfrac{\sum_{t=1}^{15} T_{ti}}{n_i} \\ NFSCORE_i = \dfrac{\sum_{t=16}^{25} T_{ti}}{n_i} \end{cases}$$

where:

FSCORE is a financial score,
NFSCORE is a non- financial score.

Step 3: develop of our checklist tool

The employed information cost measure is the monthly ratio of absolute stock return reported to its disclosure measure, averaged over some period. It can be interpreted as the monthly price response associated with one unit disclosure, thus serving as a rough measure of price impact.

Information cost is calculated as follows:

$$F_t^i = \frac{IFR_t^i}{P_t^i} \quad (2)$$

Where:

F_t^i : is the information cost of the company i at time t

IFR_t^i : is the quantity of information disclosed by the company i over the period of the study.

P_t^i : is the stock price at time t

2.4. Information Cost adjusted capital asset pricing model

The standard capital asset pricing model defines the stock and market returns as follow:

$$r_t^i = \frac{D_t^i + P_t^i}{P_{t-1}^i} \quad (3)$$

$$r_t^M = \frac{\sum S^i D_t^i + P_t^i}{\sum S^i P_{t-1}^i} \quad (4)$$

Where r_t^i represent the return of stock i at the date t and r_t^M represent the market return at the date t.

Considering a competitive equilibrium of the model, agents select consumption and portfolios in the way that maximize their expected utility taking prices as given, when prices are determined such that markets clear.

We argue that the equilibrium prices in the original economy are identical to those of the imagined frictionless economy. This result from two facts: (i) all investors in the imagined economy hold a long position in the market portfolio and a (long or short) position in the risk-free asset; and, (ii) the net return on a long position is the same in both economies. So, an investor's equilibrium return in the frictionless economy is applicable in the original economy, and is also optimal, given the more restricted investment opportunities due to the short-selling constraints.

According to these arguments, the CAPM in the frictionless economy can be considered as a CAPM in net returns for the original economy adding information costs. Rewriting the one-beta CAPM in net returns in terms of gross returns, we obtain information cost-adjusted CAPM for gross returns.

In the unique linear equilibrium, the conditional expected net return of security i is:

$$E_t\left(r_{t+1}^i + F_t^i\right) = r^f + E_t\left(r_{t+1}^M + F_t^M - r^f\right)\frac{\mathrm{cov}_t\left(r_{t+1}^2 + F_t^2, r_{t+1}^M + F_t^M\right)}{\mathrm{var}_t\left(r_{t+1}^M + F_t^M\right)} \tag{5}$$

Developing of the formula 6, we get the conditional expected return in the following form: (Appendix 2)

$$E_t\left(r_{t+1}^i\right) = r^f - E_t\left(F_t^i\right) + E_t\left(r_{t+1}^M + F_t^M - r^f\right)\frac{\mathrm{cov}_t\left(r_{t+1}^t, r_{t+1}^M\right)}{\mathrm{var}_t\left(r_{t+1}^M + F_t^M\right)} + E_t\left(r_{t+1}^M + F_t^M - r^f\right)\frac{\mathrm{cov}_t\left(F_t^i, F_t^M\right)}{\mathrm{var}_t\left(r_{t+1}^M + F_t^M\right)}$$
$$+ E_t\left(r_{t+1}^M + F_t^M - r^f\right)\frac{\mathrm{cov}_t\left(r_{t+1}^i, F_t^M\right)}{\mathrm{var}_t\left(r_{t+1}^M + F_t^M\right)} + E_t\left(r_{t+1}^M + F_t^M - r^f\right)\frac{\mathrm{cov}_t\left(F_t^i, r_{t+1}^M\right)}{\mathrm{var}_t\left(r_{t+1}^M + F_t^M\right)} \tag{6}$$

As in the standard CAPM, the required return on an asset increases linearly with the market beta, that is, covariance between the asset's return and the market return. This model yields eight additional effects which could be regarded as eight forms of information risks.

- $\mathrm{cov}_t\left(F_t^i, F_t^M\right)$: The second effect is that the return increases with the covariance between stock and market information cost. This is because investors desire to compensate when purchasing a security with higher information cost is than the average of the market. The possible empirical meaning of this pricing inference follows from the presence of a time-varying common factor in information cost. If there is a variation between the two information costs, investor requires a higher hoped yield. If there is no difference, investor supposes that the information cost is included in the market return and consequently in the systematic risk. Therefore, investors will require a return premium for assets with positive covariance. The effect of unity in information cost on asset prices is only empirically studied
- $\mathrm{cov}_t\left(r_{t+1}^i, F_t^M\right)$: The third effect is that the return increases with the covariance between stock return and market information cost. This is because investors desire to balance when purchasing a security with higher market information cost in t. If there is an important market information cost, investor requires a higher hoped yield but if there is no, investor supposes that the all information cost is included in the market return and consequently in the systematic risk.
- $\mathrm{cov}_t\left(, F_t^i r_{t+1}^M\right)$: The forth effect is that the return increases with the covariance between stock information cost and market return. This effect triggers from the motivation of investors to accept a higher expected return on a security that present a high information cost according to market return.

Some disclosure components have taken more attention in the empirical disclosure literature such as financial and non financial scores. We will consider that each measure of disclosure represents one study.

3. Theoretical implication of the model

This model reflects a lot of simplicity and originality. It states that the expected excess return is the expected relative rational and irrational information cost $E_t(RIC_t^i + IRIC_t^i)$. These costs must be included in the computation of the expected return; plus nine betas (or covariance's) time the risk premium. These nine betas depend on the asset's payoff and information uncertainty (risk).

So we consider three types of disclosure which are:

- Total score of disclosure (IFR),
- Financial disclosure (FS),
- Non financial disclosure which incorporates both strategic and governance scores (NFS).

So:

$$IFR_t^i = FS_t^i + NFS_t^i \tag{7}$$

This decomposition enables us to formulate the information cost by the following form:

$$\mathrm{F^i_t} = \frac{\mathrm{FS_t^i}}{\mathrm{P_t^i}} + \frac{\mathrm{FS_t^i}}{\mathrm{P_t^i}} = RIC_t^i + IRIC_t^i \tag{8}$$

where:

$RIC_t^i = \dfrac{\mathrm{FS_t^i}}{\mathrm{P_t^i}}$: Rational information cost.

$IRIC_t^i = \dfrac{\mathrm{NFS_t^i}}{\mathrm{P_t^i}}$: Irrational information cost.

On the relative market information:

$$\mathrm{F_t^M} = \frac{\sum S^i F_t^i}{P_{t-1}^{\ i}} \tag{9}$$

Equally, the market information cost can be divided into two types: the rational cost and the irrational cost. This decomposition can be represented by the following formulation:

$$\mathrm{F^M_t} = RIC_t^M + IRIC_t^M$$

where

$RIC_t^M = \dfrac{\sum \mathrm{S^i\ FS_t^i}}{\mathrm{P_{t\text{-}1}^{\ i}}}$: Rational market information cost.

$IRIC_t^M = \dfrac{\sum \mathrm{S^i\ NFS_t^i}}{\mathrm{P_{t\text{-}1}^{\ i}}}$: Irrational market information cost.

Our model can arise as follows:

$$E_t(r_{t+1}^{\ i}) = r^f - \mathrm{E_t^1} + \mathrm{E_t^2}\beta_t^1 + \mathrm{E_t^2}\beta_t^2 + \mathrm{E_t^2}\beta_t^3 + \mathrm{E_t^2}\beta_t^4 + \mathrm{E_t^2}\beta_t^5 + \mathrm{E_t^2}\beta_t^6 + \mathrm{E_t^2}\beta_t^7 + \mathrm{E_t^2}\beta_t^8 + \mathrm{E_t^2}\beta_t^9 \tag{10}$$

To facilitate presenting our model we suppose: where: Appendix 2

$$\mathrm{E}_t^1 = E_t(RIC_t^i + IRIC_t^i), \mathrm{E}_t^2 = E_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M - r^f), \beta_t^1 = \frac{\mathrm{cov}_t(r_{t+1}{}^i, r_{t+1}{}^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}$$

$$\beta_t^2 = \frac{\mathrm{cov}_t(RIC_t^i, RIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}, \beta_t^3 = \frac{\mathrm{cov}_t(RIC_t^i, IRIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}, \beta_t^4 = \frac{\mathrm{cov}_t(IRIC_t^i, RIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}$$

$$\beta_t^5 = \frac{\mathrm{cov}_t(IRIC_t^i, IRIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}, \beta_t^6 = \frac{\mathrm{cov}_t(r_{t+1}{}^i, RIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}, \beta_t^7 = \frac{\mathrm{cov}_t(r_{t+1}{}^i, IRIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}$$

$$\beta_t^8 = \frac{\mathrm{cov}_t(RIC_t^i, r_{t+1}{}^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}, \beta_t^9 = \frac{\mathrm{cov}_t(IRIC_t^i, r_{t+1}{}^M)}{\mathrm{var}_t(r_{t+1}{}^M + RIC_t^M + IRIC_t^M)}$$

We do this by running cross-sectional regressions on our test portfolios using a GMM framework that takes into account the pre-estimation of the betas (Cochrane, 2001). Standard errors are computed using the Newey and West (1987) method with two lags. Our point estimates are the same as those derived using OLS (either in a pooled regression or using the Fama and MacBeth (1973) method), and our standard errors correspond to those of Shanken (1992) except that the GMM method also takes serial correlation into account. Information cost and σ (information cost) portfolios. The potential effect of information cost and information cost risk is, of course, detected by considering portfolios that differ in their measure information attributes. Hence, we consider first the information-adjusted CAPM (12) for portfolios sorted by information cost and the information cost variation. To impose the model-implied constraint that the risk premium of the different betas is the same, we define for ‘‘net beta’’: Total net beta $\beta_t^{TNB,p}$; Rational net beta $\beta_t^{RNB,p}$; Irrational net beta $\beta_t^{IRNB,p}$ and $\beta_t^{HNB,p}$ Heterogeneous net beta.

Where:

$$\beta_t^{TNB,p} = \beta_t^1 + \beta_t^2 + \beta_t^3 + \beta_t^4 + \beta_t^5 + \beta_t^6 + \beta_t^7 + \beta_t^8 + \beta_t^9$$

$$\beta_t^{RNB,p} = \beta_t^2 + \beta_t^2 + \beta_t^8 \quad (11)$$

$$\beta_t^{IRNB,p} = \beta_t^5 + \beta_t^7 + \beta_t^9 \quad (12)$$

$$\beta_t^{HNB,p} = \beta_t^2 + \beta_t^4 \quad (13)$$

$$\beta_t^{TNB,p} = \beta_t^{1,p} + \beta_t^{RNB,p} + \beta_t^{IRNB,p} + \beta_t^{HNB,p} \quad (14)$$

According to this definition, the information cost-adjusted CAPM becomes

$$E_t\left(r_{t+1}^i - r^f\right) = E_t^2 \beta_t^{TNB,p} - E_t^1 \quad (15)$$

And

$$E_t\left(r_{t+1}^i - r^f\right) = E_t^2 \beta_t^{1,p} + E_t^2 \beta_t^{RNB,p} + E_t^2 \beta_t^{IRNB,p} + E_t^2 \beta_t^{HNB,p} - E_t^1$$

4. Empirical implication of our model

4.1. Information cost

The diffusion of financial and accounting information via traditional or modern communication (e.g. annual report or web sites), reduces uncertainty and assure investors satisfaction. The investors, privileged users, can not exercise their power of control on firms that when they occur information about the management of the firm and on its financial and economic situation, especially during the uncertainty of the economic environment.

The Internet plays a major role in the production and the propagation of information, and it constitutes an informational resource whose place is enhanced among the various sources of information [Khlifi and Bouri, (2007)]. Internet reporting is defined by Marston (1996) as the relationship between a company and the financial community, where the company will provide information to help the financial community and public investor in evaluating company. Therefore, the

use of internet in the disclosure of accurate information contributes in stabilization of stock prices and improves investors' confidence. The increasing significance of Internet alters many aspects of investor relations activities. Thomson (2002) noted that IFR has a significant role in minimizing investors' risk by providing obvious and comprehensible information with the aim of full and fair disclosure.

Thus, the websites can be seen as an alternative distribution channel for corporate information with the quality of combining cost reductions for the reporting corporation with additional benefits for the target groups (e.g. by providing balance sheets and income statements in spreadsheet software-compatible format).

Ryder and Regester (1989) suggest that Internet Reporting has strategic importance and allow creating a linkage between firms and investors. They have suggested that Internet Reporting activities must focus on three basic principles:

- to achieve and maintain the highest-possible share price;
- To create investor and creditor confidence, where in return future cost of financing might be decreased;
- To protect the needs of major shareholders and also to attract institutional and foreign shareholding investment in the companies.

According to Lev (1992) ongoing information to shareholders on the company's activities can minimize uncertainty among investors, thus minimizing has a negative impacts on the share prices. Consequently, IFR can be seen as a key influence in restoring investors' confidence.

In our study, first the Web sites are located and saved for each company in the sample.

Finding Web Sites: we used the search engine at 'www.euronext.com' to find address of Websites of our sample.

In this empirical research, we use a sample of 250 French firms listed on SBF 250 index.

4.2. Information collection and period of study

Over a period of one month, from the January 2004 to December 2008, the investor relation Web sites of each company in the sample is saved using the 'Web Archive, single file (*mht)' featured in the Web browser. The web document gets saved in the Multipurpose Internet Mail Extension html (mhtml) format with a (.mht) file extension. All relative links in the Web page are remapped and the embedded content is included in the .mht file, rather than being saved in a separate folder (as the case is with "Web Page, complete (*.htm, *.html)"). This method of information collection takes the risk that firms could have changed their Web sites over the data collection period..

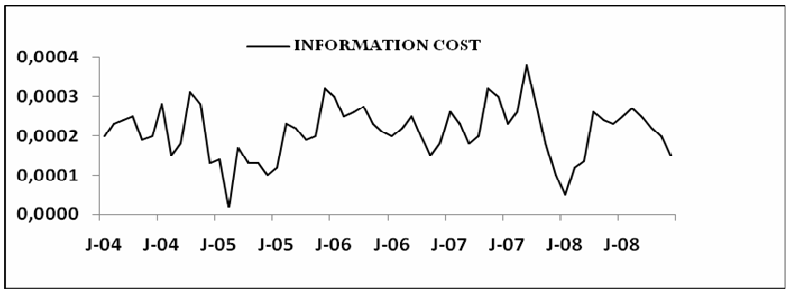

Figure 1: Standardized market information cost

4.3. Descriptive statistic of information risk

In this section, we present the descriptive statistics of informational risk, measured by the betas $\beta_t^2, \beta_t^3, \beta_t^4, \beta_t^5, \beta_t^6, \beta_t^7, \beta_t^8$ and β_t^9. The eight betas for each portfolio are calculated as per Equations. At first, we employ to test the co linearity of the disclosure risk measures relying on the correlation among betas. Table 1 reports this test. In the second place and using the entire monthly time-series from 1990 to 2000, where the rational and irrational information costs are computed as described in Section 2.3, we pre-estimate betas (Table 2). The regressions that follow use the coefficients in these tables as explanatory variables.

We employ monthly return data from Paris stock exchange during January 2004 to December 2008 until 2008 all common shares listed on SBF 250 value-weighted index of all EURONEXT

stocks. We form a market portfolio for each month *t* during this sample period based on stocks with at least 15 days of return data in that month. We form 25 portfolios for each year.

At last, we compose 25 portfolios sorted in size and B/M. These portfolios are the intersection of five book-to-market quintiles and five size quintiles within the book-to-market groups comprising securities listed in SBF 250 index of EURONEXT. This sample is limited to stocks with book-to-market data in year *y-1*. Once allowing for the portfolio properties, we refer to the year *y* book-to-market, averaging across stocks with available book-to-market data in that year.

The month by month return portfolio as well as the market return is computed as given by equation 16:

$$r_t^{\,p} = \sum w_t^{\,ip} r_t^{\,i} \tag{16}$$

Where the sum is taken over the stocks included in portfolio *p* in month *t* , and where $w_t^{\,ip}$ are either equal weights or value-based weights, depending on the specification.

Likewise, the normalized information cost of each portfolio is calculated following equation 17:

$$\mathrm{F_t^{\,p}} = \sum w_t^{\,ip} F_t^{\,i} \tag{17}$$

Where: $w_t^{\,ip}$ are either equal weights or value-based weights, depending on the specification.

The model's results are expressing in terms of value-weighted returns and value weighted information cost for the market portfolio. Computing the market return and information cost as equal-weighted averages is a way of recompensing for the over-representation in our sample of large information cost securities. The eight betas triggered from the Disclosure-adjusted CAPM give rise to three categories of risks. At this level, we opt for testing the co linearity of these risks before moving to the cross-sectional regressions.

Table 1: Beta correlation in aggregation state

	$\beta_t^{\,TNB,p}$	$\beta_t^{\,1,p}$	$\beta_t^{\,RNB,p}$	$\beta_t^{\,IRNB,p}$	$\beta_t^{\,HNB,p}$
$\beta_t^{\,TNB,p}$	1.00	0.044	0.929	0.129	0.760
$\beta_t^{\,1,p}$		1.00	0.851	0.236	0.902
$\beta_t^{\,RNB,p}$			1.00	0.097	0.811
$\beta_t^{\,IRNB,p}$				1.00	0.912
$\beta_t^{\,HNB,p}$					1.00

Notes: This table reports the correlation of $\beta_t^{TNB,p}$, $\beta_t^{RNB,p}$, $\beta_t^{IRNB,p}$ and $\beta_t^{HNB,p}$ for the 25 value-weighted portfolios formed for each year during

The collinearity of measures of disclosure risk induces to eliminate two betas namely $\beta_t^{RNB,p}$ and $\beta_t^{HNB,p}$. The last version of our model is given by the systematic risk "Beta" and the Irrational Net Beta as it described in equation 18.

$$E_t\left(r_{t+1}^{i} - r^{f}\right) = E_t^2 \beta_t^{TNB,p} - E_t^1 = E_t^2 \beta_t^{1,p} + E_t^2 \beta_t^{IRNB,p} - E_t^1 \tag{18}$$

The rational beta is excluded from our model because the systematic risk certainly includes the rational aspect of the market. The Heterogeneous risk is expelled since it includes the rational and irrational risk. Indeed, the rational aspect is present in systematic risk. However, the irrationality is precisely enacted in the Irrational Net Beta. We end up with two risks greatly in accordance with the literature review. We conclude that the market inefficiency is not due the rational information non-included in the assets pricing models but it is owed to the irrational information which disrupts the

market. To cheek the robustness of our model, our empirical studies look for testing the disclosure-adjusted CAPM model given by Equation 12 with the two risks.

4.4. Empirical study Design

In order to emphasize the empirical validation of our model, we opt for comparing our information cost model (Equation 18) to the CAPM as well as the Fama and French three-factor model given below by equations 19 and 20. Fama and French (1992, 1993, 1995, and 1996) document that size and book-to-market equity must proxy for two underlying risk factors if stocks are priced rationally. Fama and French (1992) used data covering the period July 1963 to December 1990. The success of this model triggers different questions and leads to different explanations. After that paper was published, there was considerable discussion about whether their successful results were due to data dredging and also whether the CAPM anomalies they outlined would persist or would the anomalies disappear subsequently.

Our model updates Fama and French (1992) study by the use of portfolios sorted in size (market equity ME) and book-to-market (book equity divided by market equity BE/ME). The underling risks are implicitly integrated to our model. All information cost measures; monthly portfolios returns as well as market returns were found from EURONEXT website covering the period from January 2004 to December 2008.

$$TheCAPM: R_{i,t} - r_f = +\beta_{i,M}\left[R_{M,t} - r_f\right] + \varepsilon_{i,t} \quad (19)$$

$$TheFandFthreefactors: R_{i,t} - r_f = +\beta_{i,M}\left[R_{M,t} - r_f\right] + \beta_{i,s}SMB_t + \beta_{i,h}HML_t + \varepsilon_{i,t} \quad (20)$$

To appraise the three rival approaches, the overall sample is divided into two parts: within-sample and out-of-sample. The within-sample period is applied to gauge time-series estimates of each model's parameters. These estimates are then used in cross-section regressions to test the competing models' explanations of portfolio out-of-sample average excess returns.

Recently and from day to day, information disclosure will be more and more complex and the information mass will be too. As a result, the starting point of our empirical test is the 21th century, i.e. 2004 because this allows these issues to be addressed during the current investigation.

Thus the (initial) within-sample estimation period is from January 2004 to June 2006 (30 months). However, the out-of-sample period covers the remaining months: January 2001 to December 2008 (30 months). All the 60 months of the within sample period were used to estimate portfolio information cost coefficient, CAPM betas, and three factor sensitivities for each of the 25 portfolios.

4.4.1. Within-Sample Estimates.Betas, Factor Sensitivities and the information cost Coefficient

Panel A of Table 2 contains the average monthly percentage excess returns on the 25 value-weighted portfolios for the within-sample period from January 2004 to june 2006. Panel B contains the traditional CAPM beta estimates. A portfolio's CAPM beta is the slope from the regression of its monthly excess returns on the market proxy's monthly excess returns. Likewise, Panel C contains the Irrational Net Beta calculated according to (10). As well, Table 4 reports within-sample estimates of the factor sensitivities from the three-factor time-series regression (22). The regressions that follow use the coefficients in these tables as explanatory variables.

Table 2: Within-Sample Average Monthly Percent Excess Returns and CAPM betas for 25 Fama and French portfolios formed on Size and BE/ME

	Book-to-Market Equity (BE/ME) Quintiles				
	Low	**2**	**3**	**4**	**High**
	***Panel A:* Average percent excess returns**				
Small	0.273	0.672	0.723	0.91	1.03
2	0.381	0.673	0.879	0.944	1.04
3	0.412	0.701	0.689	0.86	0.924
4	0.53	0.387	0.621	0.824	0.936
Big	0.374	0.387	0.45	0.559	0.598
	***Panel B:* CAPM betas**				

	Book-to-Market Equity (BE/ME) Quintiles				
	Low	**2**	**3**	**4**	**High**
	***Panel A:* Average percent excess returns**				
Small	1.328	0.998	0.897	0.968	1.069
2	0.987	1.128	0.725	0.939	0.584
3	1.248	1.048	1.026	0.868	0.421
4	1.232	1.028	0.623	0.857	0.968
Big	1.112	1.101	0.512	0.728	0.748

Notes: The within-sample period is from January 2004 until june 2006. Calculations are based on monthly excess returns (from French) for 25 Fama and French portfolios formed on size and book-to-market equity from EURONEXT stocks. A portfolio's average monthly percent excess return is the average of its monthly excess returns over the within-sample period. A portfolio's CAPM beta is the slope from the regression of its monthly excess returns on the market's monthly excess returns, where the market's excess return is the difference between the return of the SBF 250 value-weighted index of all EURONEXT stocks and the one-month Treasury bill rate (from French).

Table 3: Within-Sample Irrational Net betas for 25 Fama and French portfolios formed on Size and BE/ME

		Book-to-Market Equity (BE/ME) Quintiles				
		Low	**2**	**3**	**4**	**High**
		***Panel C:* Irrational beta**				
Small	Beta 5	2.62	5.95	5.79	5.21	9.66
	Beta 7	1.31	2.98	2.90	2.60	4.83
	Beta 9	3.92	8.92	8.69	7.81	14.48
2	Beta 5	2.43	4.12	8.17	7.99	8.89
	Beta 7	1.21	2.06	4.09	4.00	4.44
	Beta 9	3.64	6.17	12.26	11.99	13.33
3	Beta 5	3.73	5.59	5.46	6.34	7.42
	Beta 7	1.87	2.80	2.73	3.17	3.71
	Beta 9	5.60	9.39	8.19	9.50	11.12
4	Beta 5	3.13	3.32	7.04	5.30	5.90
	Beta 7	1.56	1.66	3.62	2.65	2.95
	Beta 9	4.69	4.98	10.56	7.95	8.85
Big	Beta 5	2.36	2.46	4.12	4.16	0.321
	Beta 7	1.18	1.23	2.06	2.08	0.161
	Beta 9	3.54	3.69	6.18	6.24	0.481

Notes : $E_t\left(r^i_{t+1} - r^f\right) = E^2_t \beta^{1,p}_t + E^2_t \beta^{IRNB,p}_t - E^1_t$ This table reports the three estimate beta given by the cross-sectional regressions for the Disclosure-adjusted CAPM. The portfolio's average monthly percent excess return is represented by line three (*Panel A:* Average percent excess returns) for 25 Fama and French portfolios formed on size and book-to-market equity from EURONEXT stocks.

Table 4: Within-Sample Three-Factor Sensitivities from Time-Series Regressions for 25 Fama and French portfolios formed on Size and BE/ME

	Book-to-Market Equity (BE/ME) Quintiles				
	Low	**2**	**3**	**4**	**High**
			b_i		
Small	0.875	1.236	1.141	0.938	1.229
2	1.093	0.997	0.987	1.088	1.069
3	1.111	1.109	0.857	1.133	0.856
4	0.965	1.212	1.099	0.884	0.941
Big	1.023	0.745	0.779	0.968	1.109
			s_i		
Small	2.112	1.975	1.231	1.332	1.097
2	0.987	0.875	0.745	0.642	0.688
3	0.512	0.477	0.398	0.212	0.158

4	0.122	0.089	-0.012	-0.087	-0.187
Big	-0.191	-0.223	-0.254	-0.287	-0.314
			h_i		
Small	-0.698	-0.097	-0.008	0.412	0.701
2	-0.451	-0.075	-0.002	0.448	0.711
3	-0.395	-0.041	0.178	0.587	0.707
4	-0.273	-0.029	0.267	0.657	0.741
Big	-0.177	-0.012	0.378	0.687	0.755

Notes: $R_j = r_f + b_j[R_{M,t} - r_f] + s_j SMB_t + h_j HML_t + \varepsilon_{i,t}$ In the time-series regressions, a portfolio's monthly excess return is regressed against R_M . r_f, *SMB* and *HML* for the within-sample period from January 2004 to June 2006. $R_M - r_f$ is the difference between the return of the SBF 250 value-weighted index of all EURONEXT stocks and the one-month Treasury bill rate, and *SMB* and *HML* are the Fama and French factor returns (from French): small minus big and high minus low.

4.4.2. Out-of-Sample Tests

In order to elucidate the predominance of our model, Figure 1 draws observed risk premiums (the 25 out-of-sample average excess returns) against within-sample CAPM beta estimates, and against within-sample Disclosure adjusted CAPM beta coefficient estimates. Given that these coefficients are only estimates, and that the asset pricing models are only one-period models that model expectations not sample averages, we should not expect estimates to fall perfectly on a straight line. Rather, if a model is the correct one then we should expect its estimates to fall approximately on a straight line (with positive slope) when observed risk premiums are schemed against that model's coefficients estimates. Figure 2 illustrates that the CAPM fails this informal test, at least relative to the highest performance of Disclosure-adjusted CAPM approach. The better performance of the Disclosure-adjusted CAPM approach is verified in the following regressions tests (table 5). The lowest performance of the CAPM in explaining the cross-section of average returns just adds to the already strong empirical evidence against the CAPM [Fama and French, (2004)].

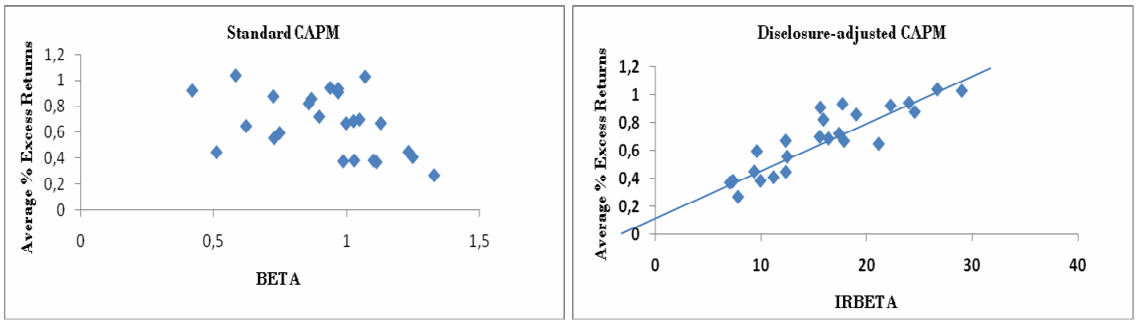

Figure 2. Comparaison between standard CAPM and Disclosure-adjusted CAPM

Cross-section regressions are used to test the three competing explanations for portfolio average excess returns. These explanations are based on (21), (22) and (23). For portfolio *j*'s *ex-ante* average excess returns (denoted $\overline{R_j} - \overline{r_f}$), the alternative models are: where the averages are calculated over the out-of-sample period.

- **The CAPM:** $\overline{R_{i,t}} - \overline{r_f} = +\beta_{i,M}\left[\overline{R_{M,t}} - \overline{r_f}\right] + \overline{\varepsilon_{i,t}}$ (21)
- **The F & F three factors:** $\overline{R_{i,t}} - \overline{r_f} = +\beta_{i,M}\left[\overline{R_{M,t}} - \overline{r_f}\right] + \beta_{i,s}\overline{SMB_t} + \beta_{i,h}\overline{HML_t} + \overline{\varepsilon_{i,t}}$ (22)
- **Disclosure – adjusted CAPM:** $\overline{R_{i,t}} - \overline{r_f} = +\beta_{i,M}\left[\overline{R_{M,t}} - \overline{r_f}\right] + \beta_{i,M}^{IRNE}\left[\overline{R_{M,t}} - \overline{r_f}\right] + \overline{\varepsilon_{i,t}}$ (23)

The standard cross-section regression methodology is employed. Estimates of betas and factor sensitivities are the explanatory variables in these regressions.

Table 4 illustrates results for the regressions of out-of-sample average excess returns on within-sample estimates of Heterogeneous coefficient, CAPM beta and factor sensitivities. The coefficient

entries for a particular model in the table are estimates of the relevant out-of-sample averages for that model as described by (21), (22) or (23).

Each coefficient entry is also the average slope on the same explanatory variable from the corresponding month-by-month Fama-Macbeth regressions, and each *t*-statistic is the average slope divided by its time-series standard error from the month-by-month Fama-Macbeth regressions.

Table 5. Out-of-Sample Cross-sectional-regression of 25 Fama and French portfolios formed on Size and BE/ME

The dependent variable used in these regressions is portfolio time series average monthly excess return for the period from 2006 to 2008. Each reported coefficient is the average slope from the corresponding month by month cross-section-regressions.

Regression models	c	Systematic risk	F&F			Irrational beta			R-adjusted
			b_j	s_j	h_j	β^5	β^7	β^9	
CAPM + c	-0.87	0.64							**0.12**
	(-2.64)	(5.23)							
F&F + c	-0.74		0.67	0.94	0.78				**0.45**
	(-3.01)		(2.98)	(4.11)	(1.23)				
Disclosure-CAPM + c	-0.93	0.82				1.03	0.98	2.13	**0.51**
	(0.71)	(2.42)				(5.26)	(4.11)	(6.15)	
CAPM		0.87							**0.08**
		(4.56)							
F&F			0.81	1.12	0.88				**0.33**
			(3.03)	(4.51)	(1.09)				
Disclosure-CAPM						1.51	1.03	2.78	**0.56**
						(6.02)	(4.62)	(8.23)	

Notes: The t-statistic **(t*)** is the average slope divided by its time-series Standard error from the month-by-month regression. The dependent variable used in these regressions is portfolio time series average monthly excess return for the period from 2006 to 2008. Each reported coefficient is the average slope from the corresponding month by month cross-section-regressions.

4.4.3. Interpretation of the results

The empirical advantage the Disclosure adjusted CAPM model has over the three-factor model may be partly due to the way the two approaches deal with interactions between size and book-to-market effects. The obvious dominance of our model compared to standard CAPM and Fama and French three factors is justified in the six cross sectional regressions, with and without intercept. In the other hand evaluating standard CAPM to Fama and French three factors demonstrates the supremacy of the second compared to the former (adjusted *R*-squared CAPM = 0.12 and adjusted *R*-squared F&F = 0.45). Interactions between size and book-to-market effects are automatically incorporated into the portfolio beta estimates in the Heterogeneous pattern. In contrast, the three-factor model uses separate size and book-to-market factors, and so is less able to take account of such interactions. The next three regressions in the table make the situation clearer. Without the added intercept, although the coefficient in the CAPM regression is highly significant when there is no intercept, its goodness of fit is considerably worse especially with the high significance of the constant in the model(adjusted *R*-squared pass from = 0.18 to 0.08). This can be interpreted as an absence of different aspect omitted in the standard CAPM. In all the six regressions, the coefficient on the market beta is significant. The specific risk non-diversified is present in all circumstances. Moreover, our model presents the fruitful importance in the two cases: the presence or the intercept in our model is poorly significant. This model captures the majority of risk especially when introducing the irrationality aspect. Its adjusted *R*-squared value is about 0.51 without the intercept (up to 0.56 by excluding the constant). In the latter regression, the Disclosure adjusted CAPM beta is highly significant (the three irrational beta are

highly significant in the two regressions) while the large adjusted R-squared value is enhanced by the removal of the intercept.

The poor performance of the CAPM in explaining the cross-section of average returns just adds to the already strong empirical evidence against the CAPM (see, for example, Fama and French, 2004). The empirical advantage the Disclosure adjusted CAPM model has over the three-factor model may be partly due to the way the two approaches deal with interactions between size and book-to-market effects. Interactions between size and book-to-market effects are automatically incorporated into the portfolio beta estimates in the Heterogeneous approach. In contrast, the three-factor model uses separate size and book-to-market factors, and so is less able to take account of such interactions.

There is another reason why the Disclosure adjusted CAPM model may give better results than those provided by estimating more-specialized models of expected returns. As long as the ratios of portfolio risk premiums to the market risk premium are reasonably stable through time, the Disclosure adjusted CAPM model ought to produce acceptable results. Such stability could have a rational or an irrational basis.

5. Conclusion

Currently, the finance literature seems to produce many return anomalies. Subjected to scrutiny, nevertheless, the evidence does not imply that market efficiency should be abandoned. According to the market efficiency definition, the anomalies are chance results, apparent overreaction of stock prices to information is about as common as under-reaction. The first definition of market efficiency given by Fama (1965), a market is reputed efficient if and only if price includes instantaneously all available information. Fama announces that an "efficient" market for securities, that is, a market where, given the available information, actual prices at every point in time represent very good estimates of intrinsic values. We rely on this definition to find a new vision to interpret, analyze and evaluate the market inefficiency. Our methodology consists of explaining the deviation of security value to its fundamental value computed from CAPM model by others information non-included in the price. We find a new measure of information cost relying in the disclosure literature review. This measure is divided into two components: the rational information cost, generally the financial information, and the irrational information cost referred to governance firm system. This added risk, i.e. the lack of information, lead to a new asset valuation model with rational information risk, irrational information cost and the heterogeneous information risk. The empirical test leads to eliminate two risks already included in the systematic risk and the irrational information risk. The supremacy of our model compared to the standard CAPM and Fama and French three factors seems clear through the out of the sample tests.

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Appendix 1

Internet financial reporting score

Disclosure items(*)

FINANCIAL INFORMATIONS (15 items)

1. Current year's annual report
2. Performance overview
3. Earnings estimates
4. Recent monthly financial data
5. Recent financial news releases
6. Same-day stock prices
7. Information regarding a dividend reinvestment plan
8. Dividend history
9. Historical stock prices
10. Information about the firm's stock transfer agent
11. The advantages of holding the firm's stock
12. Important financial ratios
13. Company's investments
14. Analyst ratings
15. Auditor's report

NON-FINANCIAL INFORMATIONS (10 items)

1. Organizational Structure
2. Human Resources Information
3. Members of the Board of Directors
4. Corporate governance principles/guidelines
5. Charters for the audit committee
6. Links to product and sales information
7. Internal search engines
8. Frequently Asked Questions (FAQs)
9. Calendar of events of interests to investors
10. Direct e-mail to investor relations

(*)A score of 1 (for present) and 0 (for absent) was assigned to each disclosure item.

Appendix 2:

While replacing F_t^i by its value we obtain:

$$E_t(r_{t+1}^{\ i}+RIC_t^i+IRIC_t^i)=r^f+E_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M-r^f)\frac{\mathrm{cov}_t(r_{t+1}^{\ i}+RIC_t^i+IRIC_t^i,r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}{\mathrm{var}_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}$$

While replacing F_t^M by its value we obtain:

$$E_t(r_{t+1}^{\ i})=r^f-E_t(RIC_t^i+IRIC_t^i)+E_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M-r^f)\frac{\mathrm{cov}_t(r_{t+1}^{\ i}+RIC_t^i+IRIC_t^i,r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}{\mathrm{var}_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}$$

$$+E_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M-r^f)\frac{\mathrm{cov}_t(r_{t+1}^{\ i},r_{t+1}^{\ M})}{\mathrm{var}_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}+E_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M-r^f)\frac{\mathrm{cov}_t(RIC_t^i+IRIC_t^i,F_t^M)}{\mathrm{var}_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}$$

$$+E_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M-r^f)\frac{\mathrm{cov}_t(r_{t+1}^{\ i},RIC_t^M+IRIC_t^M)}{\mathrm{var}_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}+E_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M-r^f)\frac{\mathrm{cov}_t(RIC_t^i+IRIC_t^i,r_{t+1}^{\ M})}{\mathrm{var}_t(r_{t+1}^{\ M}+RIC_t^M+IRIC_t^M)}$$

The development of this formulation allows us to present the conditional expected return is in the following form:

$$E_t(r_{t+1}{}^{i}) = r^f - E_t(RIC_t^i + IRIC_t^i) + E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(r_{t+1}{}^{i}, r_{t+1}{}^{M})}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} +$$

$$E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(RIC_t^i, RIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} + E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(RIC_t^i, IRIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} +$$

$$E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(IRIC_t^i, RIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} + E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(IRIC_t^i, IRIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} +$$

$$E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(r_{t+1}{}^{i}, RIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} + E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(r_{t+1}{}^{i}, IRIC_t^M)}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} +$$

$$E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(RIC_t^i, r_{t+1}{}^{M})}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)} + E_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M - r^f)\frac{\mathrm{cov}_t(IRIC_t^i, r_{t+1}{}^{M})}{\mathrm{var}_t(r_{t+1}{}^{M} + RIC_t^M + IRIC_t^M)}$$

CHARACTERISTICS OF JAPAN'S COMMODITIES INDEX AND ITS CORRELATION WITH STOCK INDEX*

Yamori **NOBUYOSHI**
Nagoya University, **Japan**
Graduate School of Economics,
yamori@soec.nagoya-u.ac.jp

Abstract

The commodity indexes associated with Japan's commodity-futures markets were formed in 2008 and publicized by the Tokyo Commodity Exchange and the Tokyo Grain Exchange. In this paper, I used these indexes to analyze the properties of Japan's commodity futures as portfolio investments, and could confirm that they possess investment characteristics that differ from stocks, and that commodity investors can enjoy favorable "diversified investment" effects if leveraged skilfully.

Keywords: commodity futures, index, stock, Japan

JEL Classification: G10, G13.

1. Introduction

In Europe and the U.S., private financial institutions and other organizations publish their own commodity indexes, which have been used in the real world as well as for research purposes. Some of these include the *Goldman Sachs Commodity Index* (GSCI), *Dow Jones AIG Commodity Index* (DJ-AIGCI), *Deutsche Bank Liquid Commodity Index*, *Rogers International Commodity Index*, *Standard & Poor's Commodity Index*, and the *Reuters Commodity Research Bureau Index*[1].

Conversely, in Japan there is little interest in commodity markets, and the notion of using a commodity index in terms of portfolio investment decision has never taken hold. The result has been a lack of popularity for commodity indexes on Japan's commodity-future markets, in sharp contrast to its stock markets, which have been using indexes for decades.[2] Nevertheless, the Tokyo Commodity Exchange and the Tokyo Grain Exchange started publishing their own commodity indexes in 2008[3].

In this paper I will introduce these indexes and analyze their co-movement with stock indexes in an effort to confirm the properties of commodity investments as an alternative investment vehicle.

2. The Tokyo Commodity Exchange's TOCOM Commodity Index[4]

(1) Overview of the TOCOM Commodity Index (TOCOM_INDEX)

The TOCOM Commodity Index is calculated based on the prices of all commodities based on the precious-metals, aluminium, crude-oil, and rubber markets listed on the Tokyo Commodity Exchange. It comprehensively shows the price level for all the markets of the Tokyo Commodity Exchange, and since June 2008 it has calculated all figures retroactively to May 31, 1986.

[1] Büyükşahin et al.(2008), Edwards and Caglayan (2001), and Jensen et al.(2000) are examples using various commodity indexes.

[2] One exception is the commodity index published by the *Nikkei Shimbun*. This index covers not only commodities listed on the commodity futures markets, but a wider range of commodities.

[3] Gorton *et al*., (2007) use U.S. commodity future indexes and Yen-dollar exchange rates, and construct Yen-denominated commodity future indexes.

[4] Based on the Tokyo Commodity Exchange for Industry website: http://www.tocom.or.jp/jp/souba/tocom_index/index.html

The TOCOM_INDEX changed its name on April 1, 2009, to the Nikkei-TOCOM Commodity Index. The period covered by the data used in this paper, however, is still under the old name.

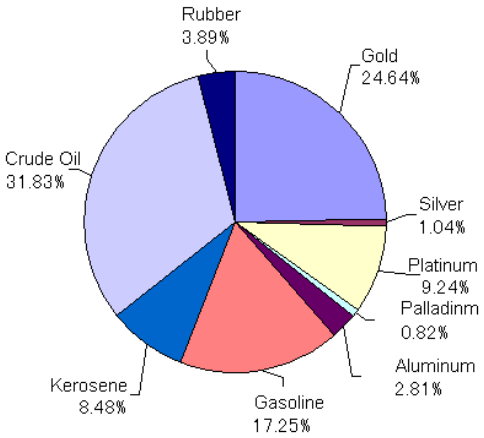

Figure 1. Weight percentage (June 2009 to May 2010)

(2) Transition of the TOCOM_INDEX and TOPIX

Previous research has indicated that commodity markets and stock markets do not demonstrate co-movement. Let's compare the TOCOM_INDEX to a stock index (the Tokyo Stock Exchange's TOPIX).

The analysis covered the time period between May 31, 1986 and December 28, 2007, using 5,376 daily data published in the commodity index. First, the transition of the TOCOM_INDEX and TOPIX is presented in Figure 2. We can see that the TOPIX (i.e., stock price) fluctuates far more than the TOCOM_INDEX (i.e., commodity price).

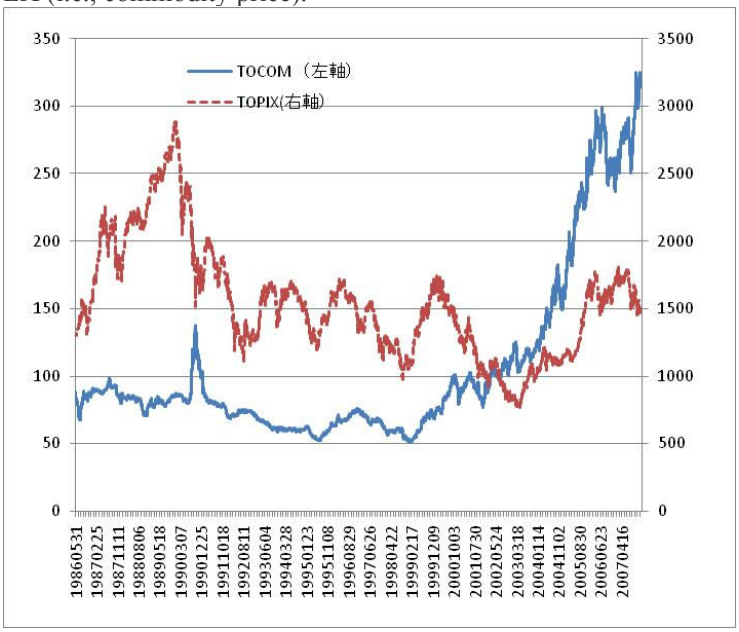

Figure 2. Comparison of TOPIX and TOCOM_INDEX

(3) Distribution of daily return of the TOCOM_INDEX and TOPIX

In this paper, the daily return is defined as the difference between the natural logarithms of the indexes. With the index day t as $X_{\square}$ and index t-1 day as $X_{t-\square}$, the daily return of day t is $\log(X_t)$-$\log(X_{t-1})$.

The distribution is shown in Figure 3. The portion for TOCOM_INDEX greater than 0 and 0.01 or less is the highest and, compared to TOPIX, the distribution is centred. To confirm this point, I checked the basic statistical quantities; the results are as shown in Table 1. This reveals that the average value and median of TOCOM are larger than those of TOPIX; the standard deviation of TOPIX, however, is larger. In short, stocks have a lower return and larger volatility.

Since skewness is a measure that shows the extent to which the data is not distributed symmetrically around the average, it is zero for a normal distribution. Because both are negative values, it shows that both distributions are slanted to the right. But the degree is striking for TOPIX. In other words, very unfavorable circumstances are bound to happen with stocks.

Since kurtosis is a measure that shows the extent to which the data is collected around the average, a value higher than 3 would result in a distribution with fatter tails than a normal distribution. The TOPIX has a distribution with a fatter tail than the TOCOM_INDEX.

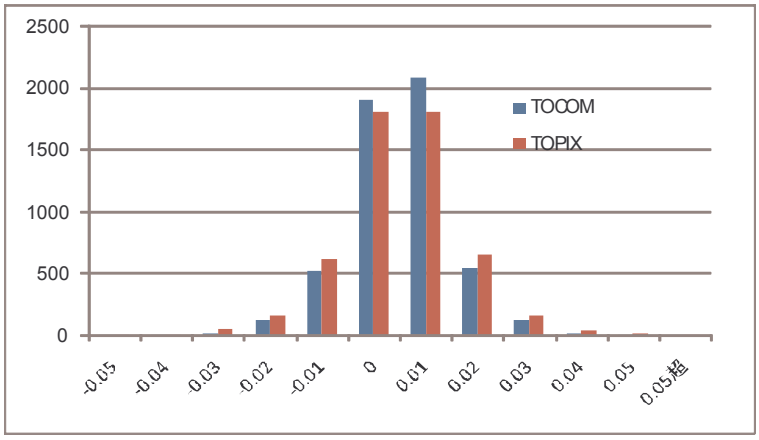

Figure 3. Daily return distribution of the TOCOM_INDEX and TOPIX

Table 1. Basic statistical quantity of the TOCOM_INDEX and TOPIX daily returns

	TOCOM	TOPIX
Average	0.000245	0.000023
Median	0.000445	0.000068
Maximum	0.082186	0.091158
Minimum	-0.089858	-0.158102
Standard deviation	0.010227	0.012397
Skewness	-0.046834	-0.293312
Kurtosis	8.356623	11.51472
Number of samples	5375	5375

*Covering a period from May 31, 1986 to December 28, 2007

(4) Correlation between the daily returns of TOCOM_INDEX and TOPIX

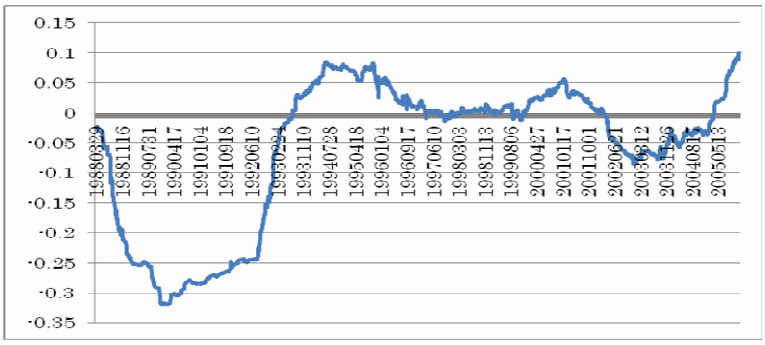

Figure 4. Transition of recursive correlation coefficients of the TOPIX and TOCOM_INDEX

The correlation between the two indexes is crucial for the portfolio investment decision. A calculation of the correlation coefficient gives -0.0327, a negative correlation. Therefore, when commodities rise, stocks fall. Although this correlation is statistically significant, it is not that strong. The correlation coefficient may fluctuate depending on the sample period. I calculated the correlation

coefficient for a period of 500 days before and after a certain day (for a total of 1001 days), that is, for the period from day_{t-500} to day_{t+500}. Then, I conducted the same for the next day.

The results (Figure 4) reveal that around 1993 the correlation coefficient drastically changed from minus to plus. Then, after a period during which it stayed close to positive 0.1, we see that from 1997 to 2000 there was almost no correlation. The correlation between 2002 and 2004 was negative; after 2005, it was positive. In light of this, perhaps it is more appropriate to consider not a negative correlation but a weak correlation. Therefore, the important fact for the portfolio diversification is that commodity does not have a strong positive correlation with the stock market.

(5) Return of the TOCOM_INDEX on a day of significant decline of the TOPIX

When looking to hedge downside risk, it is important to know how the prices of commodities fluctuate in times of great drops in stock prices. Therefore, I checked the TOCOM_INDEX fluctuation on days when stocks fell considerably.

The most significant drop during the period of analysis is on October 20, 1987. The TOPIX fell close to 16% on that day, but the return of the TOCOM_INDEX was positive. Of the five worst TOPIX decline days shown in Table 2, only on one day did the TOCOM_INDEX also decline. On all of the three worst days, a positive return was recorded. This means that, compared to a portfolio with only stocks, having commodities in the portfolio softens the blows of great declines in those markets.

Conversely, the behaviour of the TOPIX on days of great TOCOM_INDEX declines is shown in Table 3. The most significant rate of decline was 9% on January 1, 1991. This period was marked by confusing information concerning the Gulf War, which caused stock prices to rise. Actually, on all five of TOCOM's worst days, the TOPIX was up.

Table 2. TOCOM_INDEX return on worst five TOPIX days

	Closing price		Return	
	TOCOM	TOPIX	TOCOM	TOPIX
19871020	93.32	1793.90	0.00580	-0.15810
19900402	85.64	2069.33	0.00410	-0.07365
20010912	92.00	990.80	0.02811	-0.06574
20000417	72.02	1552.46	-0.01297	-0.06317
19900823	117.93	1829.25	0.04474	-0.05869

Table 3. TOPIX return on worst five TOCOM_INDEX days

	Closing price		Return	
	TOCOM	TOPIX	TOCOM	TOPIX
19910118	88.28	1736.74	-0.08986	0.01427
19910117	96.58	1712.13	-0.07113	0.03844
19900828	111.86	1947.51	-0.06682	0.02228
19901022	115.75	1858.30	-0.05709	0.02287
19901203	105.65	1671.22	-0.05649	0.01156

(6) Correlation between the stock price of individual companies and the TOCOM_INDEX

Instead of trading directly by commodity futures, could one trade the stock of related companies to produce the same effect?

In an effort to find the correlation with TOCOM_INDEX returns, I calculated the individual earnings ratio of stocks listed on the first section of the TSE that were traded on all the trading days between January 6, 1997 and December 28, 2007. I excluded those companies whose stock prices were discontinuous due to IPOs or mergers, as well as stocks not traded every day. Using this sample-selection rule resulted in 578 sample company stock prices to compare with the TOCOM_INDEX in hopes of finding a correlation. Because there are those with correlation coefficients large and small, I listed the top ten companies in Table 4. The company with the largest correlation coefficient was Kanto Natural Gas Development Co., Ltd., an entity mainly engaged in the development and extraction of natural gas dissolved in water in Chiba Prefecture. As I predicted, the companies with the

strongest correlation with the TOCOM_INDEX are Cosmo Oil, Nippon Oil Corporation and Showa Shell Oil—all petroleum distributors. On the other hand, low correlations were seen with food companies, which all had negative correlation coefficients.

Table 4. Correlation between the TOCOM_INDEX and individual company stocks

	Companies with little correlation		Companies with significant correlation	
1	-0.0531	Gunze	0.1282	Kanto Natural Gas
2	-0.0510	Morinaga Milk	0.1032	Cosmo Oil
3	-0.0477	Prima Meat	0.1029	Nippon Oil
4	-0.0403	Miyoshi Oil & Fat	0.0894	Showa Shell
5	-0.0355	Taiyo Ink	0.0850	Mitsui & Co.
6	-0.0349	Takara Holdings	0.0818	Olympus
7	-0.0328	Yamazaki Baking	0.0816	Mitsubishi Corporation
8	-0.0322	Mercian	0.0633	Hitachi Construction
9	-0.0315	Nisshinbo	0.0630	SMC
10	-0.0301	Nippon Valqua	0.0613	Yamaha Motor

*Correlation coefficients from January 6, 1997 to December 28, 2007.

3. The Tokyo Grain Exchange's TG Index

(1) Overview of the Tokyo Grain Exchange's TG Index

The Tokyo Grain Exchange started publicizing its TG Index on June 16, 2008, in order to present fluctuations in domestic grain prices and serve as a benchmark for investments in grain. There are ten component commodities of the TG Index: eight listed commodities, such as corn and soybean, and two commodities, rice and wheat, whose listing is under consideration. Their weights are determined based on the domestic demand for grain, and yen-denominated futures prices are used as reference prices.

(2) Comparing the TG Index to the TOCOM_INDEX and TOPIX

The Tokyo Grain Exchange has been compiling and publicizing the TG Index since March 31, 2003. Table 5 shows the correlation between the TG Index, TOCOM_INDEX and the TOPIX from April 1, 2003 to December 28, 2007.

The correlation between the TG Index and the TOCOM_INDEX is relatively high at 0.367. The correlation between the TG Index and the TOPIX is 0.148, which is higher than that between the TOCOM_INDEX and the TOPIX. This shows that grain prices have a much stronger correlation with industrial products, which are also traded in commodities markets, than with stock prices.

Table 5. Correlation between the returns of the TG Index, TOCOM_INDEX and TOPIX

	TOCOM	TOPIX
TG Index	0.367	0.148
TOCOM		0.066

*Correlation coefficients for April 1, 2003 to December 28, 2007.

(3) The TG Index when stocks plunge

Table 6 shows the TG Index and TOCOM_INDEX on the largest decline days of the TOPIX between April 1, 2003 and December 28, 2007. On the worst stock-price day, May 10, 2004, the TG Index rose along with the TOCOM_INDEX.

Table 7 shows the TG Index and TOPIX on the largest decline days of the TOCOM_INDEX. There is a high correlation between the TOCOM and the TG Index, and when the TOCOM suffers great declines, the TG also goes down.

Table 6. TG Index and TOCOM_INDEX during great declines of the TOPIX

	TG	TOCOM	TOPIX
20040510	0.0029	0.0066	-0.0254
20070817	-0.0156	-0.0160	-0.0248
20031023	0.0098	0.0031	-0.0236
20050418	-0.0050	-0.0095	-0.0158
20060118	-0.0046	0.0044	-0.0154

Table 7. TG Index and TOPIX during great declines of the TOCOM_INDEX

	TG	TOCOM	TOPIX
20061004	-0.0024	-0.0164	-0.0043
20070817	-0.0156	-0.0160	-0.0248
20071112	-0.0099	-0.0160	-0.0112
20051216	-0.0095	-0.0148	-0.0008
20070305	-0.0115	-0.0143	-0.0151

(4) Comparison of the TG Index with stock prices of grain companies

I calculated the correlation between the TG Index and stocks of companies that are listed on the TSE in agricultural, fisheries, forestry, and food industry and whose stock prices are available on all trading days between April 1, 2003 and December 28, 2007. The results are shown in Table 8. Although the stocks of these industries are expected to have a relatively high correlation with the TG Index, the result reveals a slight 0.1 correlation, meaning that these stocks do not provide a sufficient hedge against agricultural-product price-fluctuation risk.

Table 8. Comparison of the TG Index with the stock of agricultural product companies

	Companies with little correlation				Companies with significant correlation			
		TG	TOCOM	TOPIX		TG	TOCOM	TOPIX
1	Ariake Japan	-0.026	-0.016	0.252	Nagatanien	0.096	0.027	0.395
2	JT	-0.024	-0.009	0.096	J Foods	0.096	0.034	0.294
3	House Foods	-0.023	0.024	0.472	Kyodo Shiryo	0.095	0.055	0.495
4	Fuji Oil	-0.017	-0.006	0.360	Miyoshi Oil & Fat	0.090	0.016	0.423
5	Toyo Suisan	-0.016	0.009	0.207	First Baking	0.085	0.013	0.347

4. Conclusion

Although I believe that investments in commodities are desirable for a long-term individual portfolio, they are almost left unused in Japan. For this reason, the performance of commodities investments has never been adequately analyzed. Fortunately, the Tokyo Commodity Exchange and the Tokyo Grain Exchange have recently begun publicizing independent commodity indexes.

In this paper, using these indexes, I sought to define the properties that commodity futures have as an alternative investment. I was able to confirm that they have investment characteristics different from stock investments, and that if leveraged skilfully, they could be expected to provide favourable diversification effects to a stock-only portfolio. However, the crash of the commodities markets in the fall of 2008 and beyond (in concert with the stock markets) may have altered their innate properties. This will be the subject of future research.

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INFORMATION AVAILABILITY AND COMPETENCE EFFECTS IN COMMODITY INVESTING

Christof **SIGL-GRÜB**; Dirk **SCHIERECK**
Department of Finance, Accounting and Real Estate. European Business School, **Germany**;
Tech University Darmstadt, Chair of Corporate Finance,
schiereck@bwl.tu-darmstadt.de

Abstract

A number of studies suggests the availability of information as a possible explanation for the home bias in international stock portfolios. They argue that competence effects play a prominent role in the evaluation of domestic stocks and consequently lead to a bias in stock return expectations. We apply a similar framework to commodities and conduct a survey on expected return distributions of six commodities with varying degrees of media coverage.

Our two major findings are: First, the perception of competence in assessing future price developments of a commodity is related to the degree of media coverage of this particular commodity. Second, the shape of expected return distributions is in turn linked to the subjective feeling of competence: There is strong evidence that commodity investments associated with a high perception of competence are expected to generate substantially higher returns. Furthermore, high media coverage may improve the actual forecasting ability. Nevertheless, we show that the feeling of competence is not a good indicator for the true ability to forecast.

Keywords: commodities, information asymmetry, competence effect.

JEL classification: D80, G11

1. Introduction

After a long period of disregard, investing in commodities has experienced a renaissance in recent years, with financial investors allocating substantially higher volumes in commodities. Evidence of this trend is provided in Figure 1, which shows the estimated volume invested in the major tradable commodity indices as of June 2006. The growth is tremendous, having risen by about five times over the last three years. Reasons for the rekindled interest in commodities as investment opportunities are manifold. Their low correlations with traditional asset classes such as stocks and bonds may play a role. In the end, the growing appetite for resources of emerging countries like China and India may be an additional factor.

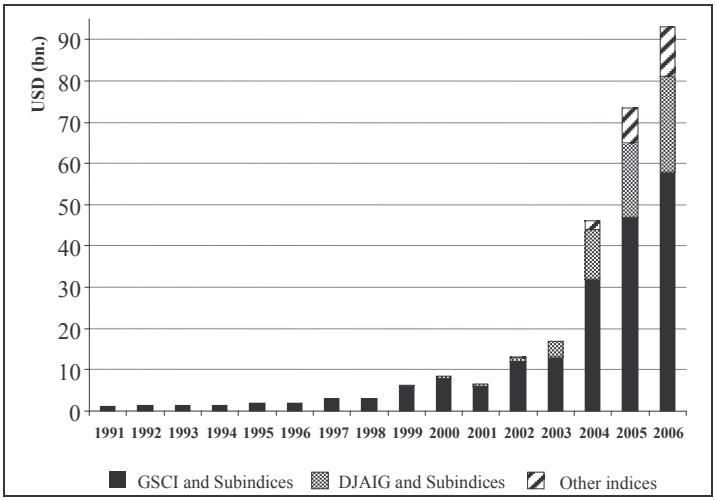

Figure 1. Volume Invested in Commodities, **Source:** Goldman Sachs

Diversifying traditional stock and bond portfolios with commodities seems indeed advantageous for the risk-return ratio. Previous research underscores the benefits of including commodities in one's portfolio, e.g. Greer (1978), Bodie (1983), Irwin and Landa (1987), Jensen and Johnson (2000),

Jensen, Johnson and Mercer (2002). The explanation usually offered is that commodities provide a hedge against inflation. Stocks and bonds, on the other hand, are reported to show poor performance during times of increasing inflation. Garrett and Taylor (2001) document that over particular periods, US investors would have been wise to invest even a large portion of their assets in commodities to increase their expected utility.

The increasing popularity of commodities as own investment class is accompanied by growing attention to them on the part of the media. Thereby, media interest is not limited to specialist and investor-related publications. Widely read daily newspapers and magazines also dedicate more room to commodity-related topics than they did some years ago. Remarkably, however, it may be observed that media coverage concentrates on only a small fraction of all commodities, i.e., energy commodities such as crude oil and precious metals such as gold receive far more attention than other types of commodities such as cotton and tin, for example.

This paper examines the effects of these information asymmetries on the return expectations of investors. This issue can be related to a well-documented phenomenon among stock investors: the home bias. At least since the work of Levy and Sarnat (1970) we now that investors tend to utilize the diversification potential of their portfolios rather poorly, i.e. domestic investors generally hold a far smaller proportion of foreign assets than traditional portfolio theory would predict. More recent studies document its persistence, e.g. French and Poterba (1991), Cooper and Kaplanis (1994) and Tesar and Werner (1995).

Much research has been done to derive a cogent explanation for this behavior. Among the explanations proposed is the quest for protection from home country-specific risks. Lewis (1999) and Strong and Xinzhong (2003) give an overview of recent literature. Another branch of research takes a behavioral finance perspective and bases its explanations on the asymmetric information investors perceive about domestic and foreign assets and the effect it may have on the investors' expectations regarding the utility of various assets. On this basis, French and Poterba (1991) and Statman (1999) show particularly in relation to US investors that their more optimistic expectations regarding their home markets may offer an explanation. Similar observations were made among investors of different countries. Shiller, Kon-Ya and Tsutsui (1996) document quarterly forecasts of US and Japanese investors for one-year returns on the Nikkei 225 and the Dow Jones Industrial Average. They find investors in both countries to be more optimistic about stock market performance in their home markets. Strong and Xinzhong (2003) confirm this view by evaluating statements by fund managers from the US, Continental Europe, and Japan.

Kilka and Weber (2000) in Germany and the US investigate whether stock return expectations expressed by probability judgments reveal systematic asymmetries in expected risk and return between the respective domestic and foreign markets. The results document that investors feel significantly more competent regarding domestic stocks than with respect to foreign assets. Furthermore, their individual perception of their own competence in turn seems to have a systematic influence on their expectations regarding the risk and return of stocks. Return expectations are higher and return dispersions lower the higher the competence perceptions are. Panzer, Rhode, Schaier and Schiereck (2002) come to similar findings in their investigation of fashion and alcohol stocks. Kleidt, Mayer-Fiedrich and Schiereck (2005) extend the research of the competence effect on the assessment of German and US defence stocks by military personnel and by civilians before and during the second war in Iraq. Although they overall confirm the findings of Kilka and Weber (2000), they find no significant difference between the various groups they examined. Actual competence, therefore, seems not to play an important role in the occurrence of any competence effect.

This study focuses on the role played by the availability of information in the formation of expectations regarding future commodity prices. Particularly, we ask whether the personal perception of competence is related to felt asymmetries in the availability of information on various commodities and furthermore, whether investors' assessments of future commodity prices are biased by a consequent competence effect analogous to the one described above. In this context, commodities are not referred to as "domestic" or "foreign", but media coverage is used as a proxy for the availability of information. We adopt the framework mentioned above and conduct a survey in the style of Kilka and Weber (2000). We measure risk and return expectations, and compare these with regard to participants' perception of competence. The commodities were chosen to include some with a high degree of media coverage and some for which the media showed relatively little interest.

The structure of the paper is organized as follows: Section 2 describes the theoretical framework and hypotheses and presents the data of the survey. Section 3 then presents and discusses the results in relation to the stated hypotheses. Section 4 contains the conclusion.

2. Design of Analysis

2.1 Hypotheses

As mentioned in the previous section, one possible explanation for the preference of domestic stocks over foreign assets is the greater availability of information on domestic companies. They are more easily perceived as possible investments and preferred over other, less publicized stocks. This has been discussed broadly, for instance in Plous (1993) or Kahnemann and Tversky (1973). The success of such stock picking is thereby questionable, as Gadarowski (2002) has shown.

The application of this framework to commodities necessitates some adjustments, as one cannot distinguish between domestic and foreign commodities. We are solely interested in the availability of information about them. A proxy for that is the coverage of commodities in a broad variety of media. Figure 2 shows the absolute number of citations relating to six different commodities in about 5.000 English and German-language media. The underlying figures are obtained from CONQUEST Investment Advisory AG.

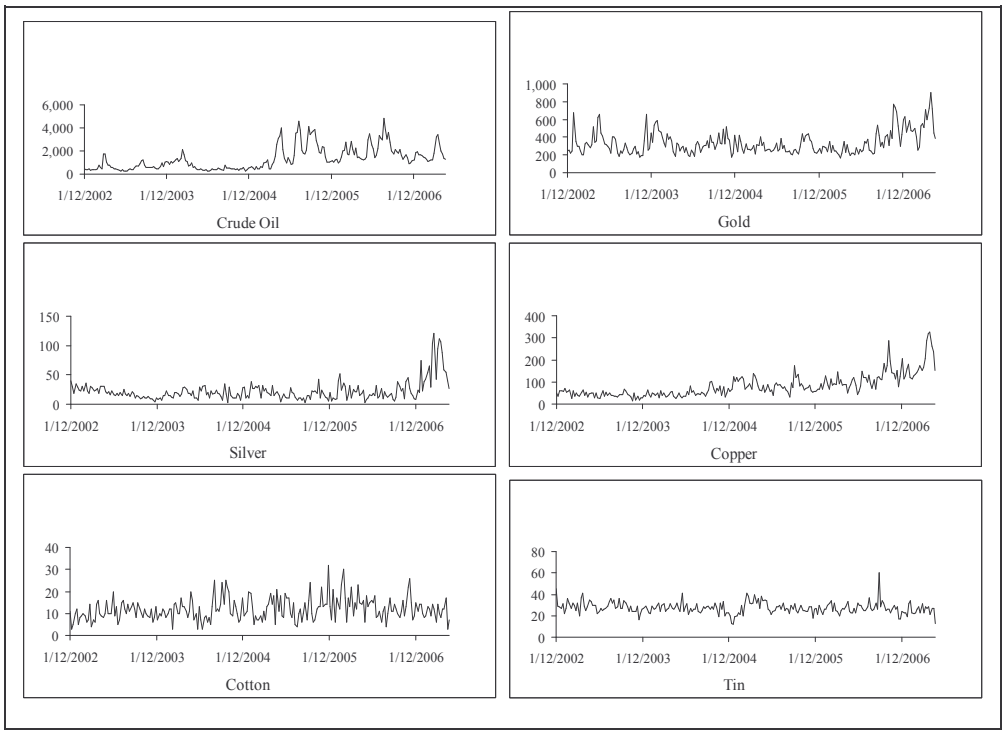

Figure 1: Media Coverage of Six Different Commodities,
Source: CONQUEST Investment Advisory AG

Note: The charts depicts the absolute number of citations of six different commodities in English and German-language media per week.

The depictions show two things: First, the coverage of crude oil, gold, silver and copper has increased in the last several years. Second, there is a strong asymmetry in media coverage. Crude oil and gold provoke a much greater attention compared to cotton and tin. At least in the case of crude oil, this can be justified by its vital importance for the welfare of any economy. Additionally, gold has always been recognized as "save haven" investment. Cotton and tin are materials that generate very little public interest. We therefore added them as media neglected counterparts to the analysis. For the purpose of comparison, we also included silver and copper as commodities receiving moderate coverage. Based on the above considerations as especially the results of Kilka and Weber (2000), we formulate the following research hypotheses.

Hypothesis 1

Investors feel more competent about commodities that experience intensive coverage by the media than about others.

A feeling of greater competence could in turn lead investors to consider the future price development to be less risky, i.e. the dispersion of the assumed probability distribution of the expected price would in this case be less marked.

Hypothesis 2

Investors have less dispersed return expectations concerning a commodity when they feel more competent in their assessment.

Additionally, a feeling of greater competence could also cause a systematic shift in the distribution of expected returns:

Hypothesis 3

Investors expect higher returns from a commodity when they feel more competent in its assessment.

Finally, it is of interest to examine the accuracy of investor forecasts. In this framework, it is not possible to evaluate the relation between the degree of media coverage and actual forecasting ability, since a cross-commodity comparison would be necessary. This could introduce a bias, as the difficulty of making forecasts may vary with the nature of specific commodities. It is therefore not feasible to evaluate whether intensive news coverage improves forecasting ability with this data set. However, for each commodity, we examine whether investors who feel competent make more accurate forecasts than those who consider themselves less competent. We do not expect to yield a significant correlation.

Hypothesis 4

Investors who feel competent regarding a commodity do not make more accurate price forecasts than investors who consider themselves less competent.

2.2 Data

On January 24, 2006, we conducted a survey among 65 German graduate students of business administration in a finance course at the University of Osnabrueck. Most of the participants had a personal long-run investment experience. The design follows in large part Kilka and Weber (2000). Participants were asked to fill in a four-page questionnaire. Each participant was to judge the three-month performance of six different commodities. Table 1 provides an overview together with the prices one day before the survey was conducted. This information was also available to the participants. To avoid possible influences through a size effect in actual prices [as detected by Panzer et al. (2002)], we transformed the prices given to the participants to lie between 50 and 1,000, if necessary. Thus, we quoted the price of copper and tin at one tenth of their actual values, and silver at 100 times its actual value. This was noted on the price sheet.

Table 1. Commodities Included in the Survey

Commodity	*Price 01/23/06*	
Cotton	56.57	US-cents/pound
Crude Oil	66.85	USD/barrel
Gold	557.55	USD/troy ounce
Copper (1/10)	476.15	USD/ton
Silver (x100)	894.00	USD/troy ounce
T in (1/10)	713.75	USD/ton

Note: Commodities used in the survey together with the price of the nearby future on 01/23/2006. To avoid possible biases the price of copper and tin was adjusted to 1/10 of its actual price, the price of silver was adjusted to 100 times of its actual price.

For each of the six commodities, participants were asked to assess their personal competence in estimating the price after three months, i.e., on April 30, 2006, on a seven-point scale from 0 (not competent at all) to 6 (highly competent). Since each participant might perceive the distances between the points of the scale differently, participants were additionally requested to rank their feeling of competence regarding the commodities from rank A (highest perceived competence) to rank F (lowest perceived competence).

In the next section, participants were asked to make probability judgments about the price changes between January 24 and April 30, 2006, denominated in the relevant unit. Here, two different elicitation methods were employed in order to be able to check the plausibility of the collected data. Firstly, like in earlier studies, we requested participants to assess for each commodity the subjective probability distribution of the price, applying the design by Yates, McDaniel and Brown (1991), Muradoglu and Önkal (1994) and Önkal and Muradoglu (1995). In particular, participants were to estimate the probability p_j that the price change will fall into range j for each of six ranges j = 1,…, 6. This ranges partition the return continuum (in other words, they were asked for their judgment that the price will decrease by more than 10%, decrease between 5% and 10%, decrease between 0% and 5%, increase between 0% and 5%, increase between 5% and 10%, and increase more than 10%). Participants were reminded that the total of all probabilities for each commodity should equal 100%. Secondly, we requested participants to forecast the prices on April 30, 2006. Specifically, we asked them for the 0.5 quantile, the 0.1 quantile and the 0.9 quantile of the price distribution. The prices of January 23, 2006 were provided as reference points.

In summary, a complete data set of person s with regard to commodity i consists of the following judgments: absolute competence $C_{s,i}$, competence rank $R_{s,i}$, price change probabilities $p_{j,s,i}$ for the intervals j = 1,…, 6 and values $X_{q,s,i}$, of the three quantiles q = 0.1, 0.5, 0.9 of the expected price distribution.

3. Results

3.1 Hypothesis 1 – Feeling of Competence

We first evaluate Hypothesis 1 which states that investors feel more competent regarding commodities that are given intensive media coverage than about others. Table 2 presents mean and standard deviation of the absolute judgments and the ranks of the competence felt, ordered according to the competence level.

Overall, participants estimate their own level of competence in evaluating commodity investments to be rather low. The average of all judgments is 1.72. Only 61 or about 15% of all estimates were above three. Both the means of the absolute competence estimation as well as those of the rankings indicate that participants judge themselves most competent with regard to crude oil and gold and least competent with regard to cotton and tin. Note that within the ranking, a low number refers to a high relative competence. Competence levels regarding silver and copper are perceived somewhere in between, as expected. Dispersions seem more or less stable across all values, indicating that there seems to be no dependence on the commodity involved or the level of competence.

Table 2. Average Perceived Competence for each Commodity

	Absolute Compentence		*Competence Rank R*	
	Mean	*Standard deviation*	*Mean*	*Standard deviation*
Crude oil	3.000	1.212	1.646	1.178
Gold	2.554	1.447	2.000	0.791
Silver	1.600	1.412	3.569	1.060
Copper	1.246	1.263	4.000	1.016
Cotton	1.000	1.104	4.354	1.525
Tin	0.954	1.292	5.431	0.847

Note: Mean and standard deviation of all six commodities on the basis of direct judgments and rankings. Note that a low rank number indicates high competence

To assess the actual difference between commodities given intensive coverage and those given little coverage, we calculate the equally weighted average for crude oil and gold, and cotton and tin, respectively. Table 3 shows the results.

Table 3. Average Perceived Competence for Intensively Covered and Little Covered Commodities

	Absolute Competence C		Competence Rank R	
	Mean	Standard deviation	Mean	Standard deviation
Average of crude oil and gold	2.777	1.142	1.823	0.471
Âverage of cotton and tin	0.977	1.055	4.892	0.616

Note: Equally weighted average of subjective competence for the two commodities with the most intensive coverage (crude oil and gold) and the least coverage (cotton and tin).

There is a clear difference between the absolute values. The Wilcoxon rank sum tests performed to determine whether both samples stem from the same population are rejected in every case with a p-value of nearly zero. Since all participants are small private investors, it is not surprising that no one had superior knowledge on crude oil or gold, i.e. the feeling of competence is not influenced by being employed in or otherwise connected to any commodity-related industry. We therefore find strong support for Hypothesis 1. On average, people feel more competent with regard to commodities that receive intensive media coverage.

3.2 Hypothesis 2 – Expected Dispersion

To assess differences in the expected return variations, suitable measures for the dispersion are needed. Since only certain quantiles of each return distribution are known and since the distribution may vary with participants and across commodities, it seems appropriate to adhere to nonparametric measures. To derive them, we again follow previous research by Kilka and Weber (2000) and Panzer *et al*. (2002).

Firstly, we use the set of probabilities $p_{j,s,i}$ for the intervals j = 1,.., 6 for each participant s and each commodity i to derive a measure for the deviation from a uniform, purely flat distribution, i.e. the equal probability $\overline{p}_{s,i}$ of 1/6 for each interval j, according to

$$Std(Prob)_{s,i} = \sqrt{\sum_{j=1}^{6}(p_{j,s,i} - \overline{p}_{s,i})^2 \cdot 1/6} \ . \qquad (1)$$

For the case of a normally shaped distribution, the value of *Std(Prob)* is higher the smaller the standard deviation is.

Secondly, also from the set of probabilities $p_{j,s,i}$, we calculate the standard deviation of returns. Assuming a uniform distribution within each interval, each interval can be fully described by the individual probability judgment and its central point r_j[25]. The standard deviation of returns is then calculated according to

$$Std(Return)_{s,i} = \sqrt{\sum_{j=1}^{6}(r_j - \overline{r}_{s,i})^2 \cdot p_{j,s,i}} \qquad (2)$$

with the expected mean return

$$\overline{r}_{s,i} = \sum_{j=1}^{6}(r_j \cdot p_{j,s,i}) \qquad (3)$$

Thirdly, we use the direct forecasts of the median $X_{0.5,s,i}$ and the quantiles $X_{0.1,s,i}$ and $X_{0.9,s,i}$ of the expected price distribution. First, price estimates are divided by the actual price S_i at the time of the survey to obtain returns. Then, the standard deviation is calculated using standard variance formula

[25] The midpoints for the inner intervals are -7.5%, -2.5%, 2.5%, and 7.5%. For the two outer intervals, we follow previous studies and chose -12.5% and 12.5% arbitrarily. The choice of the absolute values of these numbers seems not to be crucial since we are interested in the relative differences between judgments.

together with the three-point approximation by Megill (1977) in the extension of Keefer and Bodily (1983) according to

$$Std(Point)^{KB}_{s,i} = \left[0.3 \cdot \left(\frac{X_{0.1,s,i}}{S_i} \right)^2 + 0.4 \cdot \left(\frac{X_{0.5,s,i}}{S_i} \right)^2 + 0.3 \cdot \left(\frac{X_{0.9,s,i}}{S_i} \right)^2 - \left(0.3 \cdot \frac{X_{0.1,s,i}}{S_i} + 0.4 \cdot \frac{X_{0.5,s,i}}{S_i} + 0.3 \cdot \frac{X_{0.9,s,i}}{S_i} \right)^2 \right]^{0.5}. \quad (4)$$

Overall, it should be borne in mind that these three values have a different meaning and were created using different elicitation methods. While $Std(Prob)_{s,i}$ measures the deviation from a uniform distribution and is therefore a reciprocal measure for the concentration of a probability distribution, $Std(Return)_{s,i}$ and $Std(Point)^{KB}_{s,i}$ capture the actual standard deviation of the returns. Therefore, a low dispersion results in a high $Std(Prob)_{s,i}$, low $Std(Return)_{s,i}$ and low $Std(Point)^{KB}_{s,i}$. While $Std(Prob)_{s,i}$ and $Std(Return)_{s,i}$ are based on the set of probabilities $p_{j,s,i}$, $Std(Point)^{KB}_{s,i}$ is based on the direct assessment of the prices $X_{q,s,i}$.

To relate the dispersion measures to the perception of competence, we rely exclusively on the competence ranking, rather than the absolute values of competence because participants may interpret the differences between absolute scale points differently and because we are predominantly interested in the relative difference between competence levels.

Table 4. Measures of Dispersion for Ranks

	N	***Rank A***	***N***	***Rank F***	***p-value***
Std (Prob)	52	0.1955	52	0.1490	0.0000
Std (Return)	52	0.0438	52	0.0513	0.0076
Std (Point) ^{KB}	44	0.1034	41	0.0743	0.0148
Std (Point) ^{DC}	44	0.0963	41	0.0710	0.0261
	N	***Rank AB***	***N***	***Rank EF***	***p-value***
Std (Prob)	101	0.1877	102	0.1518	0.0001
Std (Return)	101	0.0441	102	0.0509	0.0028
Std (Point) ^{KB}	87	0.0762	85	0.0609	0.0605
Std (Point) ^{DC}	87	0.0714	85	0.0579	0.0554
	N	***Rank ABC***	***N***	***Rank DEF***	***p-value***
Std (Prob)	151	0.1820	152	0.1568	0.0002
Std (Return)	151	0.0451	152	0.0501	0.0015
Std (Point) ^{KB}	127	0.0641	128	0.0598	0.9250
Std (Point) ^{DC}	127	0.0601	128	0.0570	0.9953

Note: Different measures for the dispersion, based on probability and direct price forecasts and for different combinations of ranks. Note that a low dispersion results in a high *Std(prob)*, low *Std(return)* and low *Std(point)KB/DC*

Table 4 shows the average of all the above measures for the ranked commodities. The results are overall in line with previous findings. All measures that are based on the set of probabilities confirm Hypothesis 2. Throughout all combinations of ranks, the dispersions for the higher ranks are considerably smaller. P-values of the nonparametric Wilcoxon rank sum test confirm the difference. Nevertheless, the approximation measures based on the direct price assessments show generally only insignificant results.

For further investigations, we additionally calculate the standard deviation according to the two-point approximation by Moder and Rodgers (1968) in the modified version of Davidson and Cooper (1976):

$$Std(Point)^{DC}_{s,i} = \left(\frac{X_{0.1,s,i}}{S_i} - \frac{X_{0.9,s,i}}{S_i} \right) \; / \; 2.65 \qquad (5)$$

In the numerical comparison by Keefer and Bodily (1983), both measures performed reasonably well in the case of unimodal density functions that are not highly skewed or sharply peaked. Table 4 also contains these values. The picture remains the same. Measures derived from the set of probabilities confirm Hypothesis 2, while direct price assessments remain insignificant.

One possible problem, which we did not yet control for, but which could influence the results is that participants might discriminate between commodities in their assessment of risk. For example, crude oil and gold appear more often in the ranks indicating higher competence. If these two commodities are generally perceived to be different from the other commodities in terms of risk, these differences would be captured in the above measures. Therefore, we concentrate on individual commodities in the next step. To obtain a high-competence and a low-competence subsample for each individual commodity, we extract two subgroups according to a ratio based on the absolute perception of competence regarding a commodity *i* relative to the average of all absolute competence judgments of a person:

$$CompetenceRatio_{s,i} = \frac{C_{s,i}}{\frac{1}{6}\sum_{m} C_{s,m}} \qquad (6)$$

The competent subgroup consists of the 25 participants with the highest competence ratio, while the subgroup lacking competence consists of the 25 participants with the lowest competence ratio. Table 5 reports the means of the dispersion measure for the whole sample and for these subgroups. Looking at the complete sample, the measures based on the set of probabilities reveal almost no differences between the various commodities.

Table 5. Measures of Dispersion for Commodities

	Complete Sample	**Group with Subj. Competence**	**Group without Subj. Competence**	
Crude oil	*Mean*	*Mean*	*Mean*	*p-value*
Std (Prob)	0.1915	0.2096	0.1948	0.4558
Std (Return)	0.0446	0.0381	0.0459	0.1695
Std (Point) ^{KB}	0.1192	0.1017	0.1491	0.1470
Std (Point) ^{DC}	0.1112	0.0960	0.1381	0.2038
Gold	*Mean*	*Mean*	*Mean*	*p-value*
Std (Prob)	0.1735	0.1636	0.1569	0.7214
Std (Return)	0.0465	0.0489	0.0505	0.9672
Std (Point) ^{KB}	0.0337	0.0347	0.0465	0.2451
Std (Point) ^{DC}	0.0318	0.0332	0.0437	0.3008
Silver	*Mean*	*Mean*	*Mean*	*p-value*
Std (Prob)	0.1679	0.1647	0.1813	0.5812
Std (Return)	0.0469	0.0467	0.0444	0.7060
Std (Point) ^{KB}	0.0277	0.0327	0.0212	0.0743
Std (Point) ^{DC}	0.0264	0.0310	0.0202	0.0800
Copper	*Mean*	*Mean*	*Mean*	*p-value*
Std (Prob)	0.1519	0.1373	0.1742	0.4366
Std (Return)	0.0517	0.0568	0.0461	0.2285

Std (Point) ^{KB}	0.0442	0.0447	0.0440	0.5462
Std (Point) ^{DC}	0.0419	0.0423	0.0415	0.5326
Cotton	*Mean*	*Mean*	*Mean*	*p-value*
Std (Prob)	0.1748	0.1652	0.1486	0.4535
Std (Return)	0.0465	0.0472	0.0544	0.2580
Std (Point) ^{KB}	0.0934	0.0982	0.1093	0.2221
Std (Point) ^{DC}	0.0892	0.0928	0.1050	0.1911
Tin	*Mean*	*Mean*	*Mean*	*p-value*
Std (Prob)	0.1525	01382	0.1332	0.8606
Std (Return)	0.0506	0.0537	0.0562	0.6818
Std (Point) ^{KB}	0.0427	0.0461	0.0331	0.3389
Std (Point) ^{DC}	0.0407	0.0437	0.0316	0.3381

Note: P-values are from the Wilcoxon rank-sum test. *N* represents the number of data points.

Particularly crude oil and cotton exhibit substantially greater dispersion, whereas silver and gold exhibit the least. A straightforward explanation would be an influence of the level of prices on the absolute dispersion measures. Nevertheless, this seems not to be prominent in this case. By examining the sugroups with and without competence, minor differences between the means become obvious. However, we are unable to report any significant divergences according to the Wilcoxon rank-sum test. Calculating the relative competence according to other measures, for example by calculating the average from all commodities, brings no improvement.

Overall, the measures based on probability assessments for the ranked commodities yield the expected picture of less dispersion for more highly ranked commodities. Hypothesis 2 is supported.

3.3 Hypothesis 3 – Expected Return

In order to assess possible shifts in the probability distributions, we derive two measures for the mean. Firstly, from the set of probabilities $p_{j,s,i}$ for the intervals $j = 1,...,6$ and for each participant s and each commodity i, we calculate the mean return, again assuming a uniform distribution within each of the intervals, according to

$$Mean(Return)_{s,i} = \sum_{j=1}^{6} (\&_j \cdot p_{j,s,i}) \tag{7}$$

Secondly, from direct forecasts of the price quantiles $X_{q,s,i}$ we obtain the expected mean return again by employing the three-point approximation of Keefer and Bodily (1983). To arrive at returns, we once more divide price estimates by actual prices S_i.

$$Mean(Point)_{s,i} = 0.3 \cdot \frac{X_{0.1,s,i}}{S_i} + 0.4 \cdot \frac{X_{0.5,s,i}}{S_i} + 0.3 \cdot \frac{X_{0.9,s,i}}{S_i} - 1 \tag{8}$$

Table 6 reports the results for different combinations of ranks. All measures show a systematically higher return assessment of highly ranked commodities. These findings lend great support to Hypothesis 3. Compared to expectations regarding stock price development, this result is in line with most of the previous research on stock investments cited above.

Table 6. Measures of the Mean

	N	*Rank A*	*N*	*Rank F*	*p-value*
Mean (Return)	52	0.0396	52	0.0034	0.0000
Mean (Point)	44	0.0463	41	0.0032	0.0005
	N	*Rank AB*	*N*	*Rank EF*	*p-value*
Mean (Return)	101	0.0283	102	0.0058	0.0000
Mean (Point)	87	0.0245	85	0.0057	0.0032
	N	*Rank ABC*	*N*	*Rank DEF*	*p-value*
Mean (Return)	151	0.0246	152	0.0086	0.0000
Mean (Point)	127	0.0189	128	0.0069	0.0037

Note: P-values are from the Wilcoxon rank-sum test.

3.4 Hypothesis 4 – Accuracy of Forecasts

In the last step of the analysis, we investigate the ex-post accuracy of the forecasts. This allows examining the relationship between participants' subjective feeling of competence and their actual ability to forecast prices. As mentioned previously, this kind of analysis can only be done for each commodity separately, because a cross-commodity comparison presumes that it is equally difficult to make forecasts for each commodity, which may not be the case. To measure the overall accuracy of probability judgments, we follow other studies and employ the probability score of multiple events (*PSM*). This is a form of the quadratic scoring rule introduced by Brier (1950), which is known as Brier Score. It is calculated according to

$$PSM\ (p_{s,i}, h_i) = \sum_{j=1}^{6} (p_{j,s,i} - h_{j,i})^2 \qquad (9)$$

with $p_{j,s,i}$ as the set of probabilities and $h_{j,i} = h_{1,i}, h_{2,i}, \ldots, h_{6,i}$ as the values of the outcome index vector h, which has the value 1 at the position of the interval in which the actual price change falls and the value 0 at all other positions. Therefore, h may be interpreted as the forecast of a clairvoyant. Forecasts of an individual facing uncertainty about the real outcome are considered accurate according to their approximation of the outcome vector. Consequently, the *PSM* measures the deviation from the outcome vector over all intervals. Generally, a lower *PSM* signifies a better forecast, while $0 \leq PSM \leq 2$. For a further description in the context of stock price forecasts, see, for instance, Yates, McDaniel and Brown (1991) and in the context of a repeated evaluation of single events, for instance, Wallstein, Budescu, Erev and Diedrich (1997)[26].

Table 7 presents the values of the *PSM* for the complete sample as well as for the groups with and without competence for each commodity. First, all values are comparably far from being zero, indicating that the participants' overall forecasting performance with regard to any of the commodities is rather poor[27]. In addition, the high standard deviation of the *PSM* values indicates a wide range of individual *PSM* values.

Table 7. Accuracy of Probability Judgments

	Complete Sample Mean (Std. Dev.)	**Competent Group** Mean (Std. Dev.)	**Not Competent** Group Mean (Std. Dev.)	p-value	**Historic**
Crude Oil	0.8552 (0.4545)	0.8344 (0.4153)	0.9605 (0.5471)	0.5048	0.9134
Gold	1.2340	1.1532	1.2345	0.4426	1.1038

[26] Despite the name, most studies apply the probability score of multiple events in a simple single period design, see Kilka and Weber (2000).

[27] In the context of medical prognostic models, for example, values of 0.25 and above for the PSM are described as 'useless', see Steyerberg, Marinus, Eljkemans, Harrell and Habbema (2001).

	(0.3393)	(0.3602)	(0.2806)		
Silver	1.2671 (0.3052)	1.2317 (0.2100)	1.3244 (0.3500)	0.6485	0.8503
Copper	1.1845 (0.3342)	1.1064 (0.3088)	1.2826 (0.3645)	0.2403	0.7314
Cotton	1.1742 (0.3745)	1.1369 (0.3550)	1.0379 (0.3172)	0.5970	0.9803
Tin	1.2350 (0.2816)	1.1786 (0.2217)	1.1688 (0.2560)	0.7036	0.8270

Note: The p-values refer to the Wilcoxon rank-sum test. The far righside repors PSM values for a simple historic extrapolation

If we now consider the subgroups with and without competence and compare their performance to each other, we find no significant difference for even a single commodity. In addition, the standard deviations continue to be high and do not differ greatly among the subgroups. Higher competence perceptions did not lead to more accurate forecasts.

For further investigations, we calculate PSM values of forecasts based on the extrapolation of historical returns for each commodity. To obtain these, we first calculate the relative frequencies of actual returns for the six return intervals used in the questionnaire. The relative frequencies we obtained from historical returns using quarterly non-overlapping periods for the time January 1986 to December 2004. In the next step, we compute PSM values of forecasts based on the historical return distribution. They are presented on the right hand side in Table 7. Again, except for crude oil, they show that a forecast based on simple return extrapolation would have systematically yielded better results.

Table 8. Measures of Mean and Dispersion – Average Judgment and Historical Data

	Complete Sample Mean (Return) Std (Return) Std (Prob)	**Historical** Mean (Return) Std (Return) Std (Prob)
Crude Oil	0.0474 0.0446 0.1915	0.0156 0.0936 0.0602
Gold	0.0143 0.0465 0.1735	0.0038 0.0580 0.1205
Silver	0.0080 0.0469 0.1679	-0.0006 0.0762 0.0749
Copper	0.0162 0.0517 0.1519	0.0107 0.0845 0.0477
Cotton	0.0068 0.0465 0.1748	-0.0050 0.0904 0.0477
Tin	0.0076 0.0506 0.1525	0.0038 0.0803 0.0702

We also calculate values of the previously used measures for the mean, *Mean(Return)*, and for the dispersion, *Std(Prob)* and *Std(Return)*. Table 8 shows that the average judgment is far too narrow and too optimistic. Kilka and Weber (2000) have arrived at similar results for stock return judgments.

4. Conclusion

This study is based on survey data from 65 German private investors and their estimates on commodity investments. Overall, our results underline once again and in this case for commodity

investments that small private investors are influenced in their decision making by availability heuristics.

We show that marked public interest in certain commodities, i.e., greater availability of information via the media, is linked with a subjective perception of higher competence in predicting future price movements of the commodities under consideration. Second, we document the existence of a competence effect in investors' forecasts. As shown in the case of stocks, we find that price and return forecasts are more positive when investors feel highly competent. Additionally, the correlation between the perception of competence and the dispersion of the expected returns is overall negative. Investors' expectations regarding future return distributions are much narrower and much more positive than the distributions are in reality.

Acknoledgment

We thank Anke Königs and Conrad Mattern for valuable comments and insights. We are also grateful for the input of conference participants at the 34th Annual Meeting 2007 of the Academy of Economics and Finance (AEF) in Jacksonville, Florida, USA. All errors are our sole responsibility

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OUTPUT GAP MEASURES FOR PAKISTAN: METHODOLIGIES AND CHALLENGES FOR THE MONETARY POLICY

Sarfaraz **SYED,** Ali **SHAH**
Université des Sciences et Technologies Lille, **France**
Faculté des Sciences Economiques et Social, Laboratoire EQUIPPE,
sas.syed@ed.univ-lille1.fr

Abstract:

This study estimates the output gaps for Pakistan, using both the statistical and the structural methods and comparing their results. Though they show some degree of association, the measures reveal inherent differences in the measures of output gap. Based on the annual data of GDP (1951-2007) for Pakistan the output gap reflects that Pakistan economy has been observing cyclical episodes of excess supply followed by excess demand in the period of analysis. Furthermore, evidence suggests that Pakistan economy is currently experiencing rising demand pressures since FY05. The study is also extended to the use of output gap in a simple Taylor equation to have a glance of the monetary policy. Examining the data for various scenarios the results indicate that the central bank has over most of the time adopted an accommodative monetary policy not following Taylor's rule but a policy where besides inflation other objectives including the output growth was also taken into consideration.

Keywords: Taylor rule, potential output, output gap.

JEL Classification: E47, E31, E52, C22, C53, E37

1. Introduction

Potential output, the associated output gap, the sacrifice ratio and the natural rate of unemployment are the concepts that gained importance over the past few years among researchers both in academia or central banks. The importance of these concepts surfaced due to growing fame of the Inflation-Targeting Policies, Speed-Limit policies[2], notably the policies in which the measures of potential output and output gap are useful to identify the scope for sustainable non-inflationary growth and to allow an assessment of the stance of macroeconomic policies. It is said that, ceteris paribus, if the actual output is greater than the potential, or the output gap is positive for long time, it will raise inflation to respond to the demand pressures in the economy, and vice versa. Thus, from the point of view of policy makers, the importance of the output gap estimation is fundamental.

Output gap is the difference between the actual and the potential output in any economy; it shows the divergence (if any) from the potential output. At any point of time it gives an assessment of the excess demand or the spare capacity in the economy. However estimating output gap requires information on potential output, which is normally unobserved, and even contradictory in its definition. Whether the potential output is the potentially attainable output or the maximum level of output that an economy already does attain without driving the inflation? – The level of economic activity which is consistent with no inflation pressures in the economy.

The expression 'potential output' has received different definition. From an academic point of view it is the level of output that could be attained by utilizing all the available resources, i.e., full employment [Okun, (1962)]. However, the understanding of potential GDP has changed during the last decades, and at present the practitioners and also some of the academicians define potential output as per definition of de Masi, who defined potential GDP as "the maximum output an economy can sustain without generating a rise in inflation" [De Masi, (1997)].

The importance of prior knowledge of output gap is twofold. It has relevance to the fiscal policy and to the monetary policy as well. As an excess demand in the economy would be a signal that inflationary pressures are strengthening, while if he economy is operating below its capacity it indicates the presence of deflationary pressures that can lead to recession. For instance the indication of over or underutilization of resources would pose a question on the ongoing monetary and fiscal policies.

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While from the fiscal side, the government revenues and expenditure are also affected by the cyclical position of the economy [Donders and Kollau, (2002)]. The potential output and the output gap can give a measure of the government structural fiscal position while adjusting for the surpluses and deficits due to the cyclical up-downs, thus determining the cyclically adjusted budget, which would be equal to the budget in case the actual output was equal to the potential.

Unstable inflation and the fluctuating output in Pakistan economy makes it even more important that the inflation dynamics to be studied in the backdrop of output gap. While monitoring a developing country, one of the main objectives of the central bank of Pakistan is to support output growth in the economy without allowing general price level to rise substantially. While keeping in mind the negative relationship of output growth and inflation, the knowledge of potential output appears crucial from the point of view of any central bank. So far, there is no published official data series of output gap in use either by the central bank or the academia, so this gives ample motivation to serve the existence of the purpose behind this study.

This study is thus an attempt to estimate the potential output and subsequently the output gap by using different methodologies, and on the basis of those results I attempt to assess the so far stance of the monetary policy using Taylor's equation. The paper is organized in such a way that the next section 2 presents various methodologies that have been used so far by different researchers and the central banks for the estimation of potential output; section 3 comprises a review of literature on the subject; section 4 describes the results of the estimation for Pakistan. In section 5 I use the output gap estimates to compute the Taylor rule based interest rates, so as to have a comparative picture of the central bank's policy; and section 6 concludes.

2. Potential Output and Output Gaps: An overview of the Methods.

In the literature there are several different ways to estimate the potential output. However, still there is no consensus on which method to be preferred and why? Being an estimation of the unobserved part of the output, it is always done with doubts. It has been observed that it can lead to different results, even for the same data, depending on the methodology of estimation. While there is a rich literature regarding the estimation methodologies of potential output, the researchers have different opinions on the merits and demerits of different estimation techniques.

	Non-Structural Methods		Multivariate Methods		Structural Methods		Direct Measure
1	Peak-to-peak Method	1	Beveridge Nelson's Multivariate Decomposiion Method	1	Okun's Law	1	Capacity Utilization Method
2	Linear Detrending	2	Multivariate Filter by Hodrick Prescott	2	Production Function Approaches		
3	Robust Detrending			3	Long-run Restriction Models		
4	Phase Average Detrending						
5	Hodrick Prescott Filter Method						
6	Beveridge Nelson Decomposition Method						
7	Method of Estimating Unobservable Components						
8	Band-Pass Filter Method						

Figure 1. Different Methods of Output Gap Estimation[3]

Potential output is often regarded as representing the trend of the actual output, thus the researchers have developed de-trending methodologies, estimating the trend and the cycles and

[3] Adopted from Chagny and Dopke (2001)

besides other econometric tools, the filters have also been in exclusive use. The most widely used univariate technique is the Hodrick-Prescott (HP) filter. Like the other univariate techniques, the HP filter uses only information included in the actual output series to derive the potential output measure. Other univariate techniques include the Beveridge-Nelson (1981) method, the Band-Pass (BK) filter proposed by Baxter and King (1995), the "Running Median Smoothing" (RMS) algorithm of Tukey (1997) and the so-called "wavelet filters" [Scacciavillani and Swagel, (1999)].

These univariate techniques have been criticized, amongst other things, for their inability to properly distinguish between the underlying permanent and transitory components of the time series considered [Dupasquier, *et al*., (1997)]. Partly in response to this critique, a variety of multivariate methods have been proposed. These include the multivariate extensions of the Beveridge-Nelson method (MBN) [Evans & Reichlin, (1994)], Watson's (1986) unobserved-components model, the multivariate (MV) model by Laxton and Tetlow (1992) and the extended multivariate filter (EMV) by Butler (1996).

Finally, a number of researchers in recent years have made use of structural vector autoregression models (SVAR's) to determine potential output and output gaps. These include Dupasquier *et al*. (1997) and Scacciavillani and Swagel, (1999).

2.1. Peak-to-Peak De-trending Method:

Peak-to-peak method, often referred to as trend line through peaks is a time series technique, involves filtering linear trends between the cyclical peaks in the output series. This approach does not assume the constant growth of potential output and is simple; however, it defines potential output as the maximum attainable level of output in the short-run, which is against the idea of the long-run sustainability.

2.2. Linear De-trending or the Deterministic Trend

This is one of the simplest methods of computing potential output and subsequently the output gap. This method assumes that output may be decomposed in linear trend and the cyclical component, as per the following equation.

$$Y_t = \beta_0 + \beta_1 t + \varepsilon_t \qquad (2.1)$$

Here Y_t is the log of (real) GDP, while *t* is the trend. The fit of this equation is the potential GDP, while the residual ε_t is the estimated output gap.

Though the simplicity of this method makes it very easy to estimate the output gap and the potential output, it has some limitations that need to be taken into account while drawing inferences on the basis of these estimates. For instance, this method forces a trend to the output series, which if not there, may distort the results. Secondly, this methodology fails to capture the impact due to structural and technological changes in the economy overtime, and the impact when the economy is facing high inflation. Finally the most important shortcoming of this method is that the results vary with the same time series over different ranges.

2.3. Moving Average

This method attempts to decompose the logarithm of output into a trend component and a cyclical component.

$$y_t = \tau_t + c_t \qquad (2.2)$$

Here y_t is the log of output, c_t is the output gap, while τ_t is the moving average of output, i.e,

$$\tau_t = (y_t + y_{t-1} + y_{t-2} + y_{t-3})/4 \qquad (2.3)$$

Though simple in estimation, this method has various limitations. Notably it accounts for the moving averages of the actual GDP and thus it is not free of the end-sample biases. While in most of the work the interest is usually in the recent observations or estimations, this method fails to provide

the recent figures. Secondly, the arbitration in taking the range of moving average also exposes it to doubts, as the results change with change in number of years to be taken as range for the moving average.

2.4 Hodrick-Prescott Filter (HP)

HP filter [Hodrick and Prescott, (1997)] has become popular method of de-trending the economic time series. The reason is that it is flexible in tracking the characteristics of the fluctuations in trend output; the simplicity of its calculation and also its implementation in virtually any econometric software package. De Masi (1997), de Brouwer (1998), Scacciavillani & Swagel (1999), Cera & Sawena (2000), Gounder & Morling (2000), Chagny *et al*. (2003), Cotis *et al*. (2004), Bjornland *et al*. (2005) and Njuguna *et al*. (2005) have used this method in their estimation of potential output and the subsequent output gap. HP filter assumes the smoothness of the growth components overtime. According to this framework a time series y_t can be expressed as the sum of potential output y_t^* and the cyclical component c_t, which is actually the difference of output and its potential.

$$y_t = y_t^* + c_t \tag{2.4}$$

Minimization of the following assumption gives the potential output:

$$\{y_t^p\}_{t=1}^T = \min \sum_{t=1}^T (y_t - y_t^p)^2 + \lambda \sum_{t=2}^{T-1} [(y_{t+1}^p - y_t^p) - (y_t^p - y_{t-1}^p)]^2 \tag{2.5}$$

Here y_t^p is the output trend derived by using HP filter, which minimizes a combination of gap between actual output y_t , trend output and the rate of change in trend output for the whole sample of observations, T. Here λ is the 'smoothing parameter' which softens the fluctuations in the growth component. The larger is the value of λ , the smoother is the growth component and more variable is the output gap. The value of λ for quarterly data is 1600, while for the annual data it is different and not fixed[4]. Once the y_t^p (potential output – trend output) is estimated, the output gap is then calculated by subtracting it from the actual output as per following equation:

$$\{y_t^g\}_{t=1}^T = \{y_t - y_t^p\}_{t=1}^T \tag{2.6}$$

Like other methodologies, HP filter also contains certain serious limitations. Firstly and the more important one is the doubts due to the smoothing parameter λ . As stated earlier that usually it has the values 1600 and 100 for quarterly and annual data respectively; however any change in this value plays important role in the results for potential output.

Second problem arises due to the symmetric trending of this method, which results in end-sample biases. Due to this weakness the recent data of the series, cannot be taken into account for drawing conclusions. Moreover, HP filter also ignores the impact of structural changes in the economy overtime.

2.5 The Band-pass-filter

Band-pass-filter developed by Baxter and King (1995), commonly known as BK filter is another important method of computing the cyclical component of the macroeconomic time series. For fixed-length symmetric filter, the weight matrix is of dimension 1× (q+1), q where is the user-specified lag length order. For these filters, the weights on the leads and the lags are the same, so the returned matrix contains only the one-sided weights.

$$Z_t = \sum_{c=1}^{q+1} w(1,c) y_{t+1-c} + \sum_{c=2}^{q+1} w(1,c) y_{t+c-1} \tag{2.7}$$

where t = q+1,.....n-q.

[4] Maravall, Agustín, and Ana del Rio (2001)

However, as this technique estimates the potential output (trend) using the moving average, which according to the standard setting of Baxter and King is set to count at least six quarter longer fluctuations, which from both ends make it lose the twelve quarters from the overall series. The issue becomes more serious if the data is annual, as the trend for the first 3 and the last 3 years will be missing, which makes it less useful as compared to even the simple methods of estimation of output gap.

3. Review of Literature

Researchers have estimated potential output and the output gap using various statistical and econometric techniques. Every method has advantages and disadvantages, but still as output gap cannot be observed, application of a combination of different methodologies to estimate the gap and then to have a critical comparison can lead to some reliable inferences. For instance, Dupasquier *et al*. (1997 & 1999) surveyed some of the techniques to measure the trend component of output (potential output). They focus on three simple multivariate methodologies: the multivariate Beveridge-Nelson methodology (MBN), Cochrane's methodology (CO), and the Structural Vector Autoregression (SVAR) methodology with long-run restrictions applied to output (LRRO). They used the variables of quarterly GDP, real consumption comprising of non-durables and services and the federal funds rate when a third variables added, money and inflation is also tried in the place of federal fund rate. According to the authors the LRRO estimates provide significant evidence of a diffusion process for shocks to potential output. This suggests that permanent shocks have more complex dynamics than a random walk, which is the basic assumption of the CO and MBN approaches. However, they found that the estimation of the output gap on the basis of an estimated VAR was imprecise, which is consistent with results obtained by Staiger, Stock and Watson (1996) with a different methodology. The spectra of the transitory components (output gaps) resulting from the empirical applications of the CO, MBN and LRRO methodologies differ from one another.

De Masi (1997) addressed the same question in a different and notably more convincing way. The author classifies different methods according to the different categories of the economies. For the industrial countries he used the Production function approach and its further extensions by accounting explicitly for the relationship between wage and price inflation, potential output and the natural rate of unemployment in the a consist framework. In terms of unemployment additional variables were introduced, which include: unemployment insurance, replacement ratio, unionization rate, payroll taxes, minimum wages, and various demographic characteristics such as the age composition of the population. Specifically, this study estimates the potential output for industrial countries through the Cobb Douglas form production function, while for the developing countries, it is done through univariate detrending technique, univariate detrending technique over the production function and HP filter.

Over the medium term, potential output for the seven major industrial countries is projected to be in the range of 2 to 2.5 percent. For Germany and France potential output growth is projected to be 2.25 to 2.5 percent, which is a decline particularly in Germany as compared to the late 1980s owing to the more recent slowdown in investment. The growth rate of potential output is expected to pick up slightly to 2.25 to 2.5 percent in the United Kingdom and Canada. In Italy, the growth rate of potential is expected to remain at about 2 percent, and in the United States to remain at about 2.5 percent.

De Brouwer (1998) reviews five methods of estimating potential output for Australian GDP data. Unlike Dupasquier *et al*. (1997, 1999) he also used the statistical methods, including linear time trends, Hodrick-Prescott (HP) filter trends, multivariate HP filter trends beside the unobservable components models and a production function model.

Importantly, his estimates of the output gap show that they vary with the method used and are sensitive to changes in model specification and sample period. While gap estimates at any particular point in time are imprecise, the broad profile of the gap is similar across the range of methods examined. Inflation equations are substantially improved when any measure of the gap is included, and output gaps generally explain innovations in inflation better than output growth.

Scacciavillani and Swagel (1999) estimated the potential output for Israel, using the methodologies of aggregate production function, Univariate filters [(i) HP filter (ii) Running medium smoothing (iii) Wavelits filters] and Structural Vector Autoregression (SVAR). They used GDP, price

level, stock of physical capital and the labour force and TFP estimates. Like De Brouwer (1998), their output gaps estimates also vary by methodology.

In his study Kichian (1999) used the general form of the State Space Framework to estimate the potential output and the gap, using quarterly real output, inflation rate, expected inflation rate, nominal trade weighted exchange rate, and nominal oil prices. According to this estimate, there have been three important periods of excess supply in Canada around the dates of 1977, 1982 and 1991, the second being the most pronounced. The average duration of these downturns has been a little above four years.

Cerra and Saxena (2000) reviewed a number of methods which can be used to estimate potential output and output gap: the HP filter; the unobserved components method; the structural VAR approach by Blanchard and Quah; the production function approach; demand side model; system estimates of potential output and the NAIRU, GDP, GDP (Private and public), domestic inflation, unemployment, real exchange rate, relative output, relative price level, private capital stock, estimates of trend labour input, TFP estimates, NAWRU estimates, time dummies and import prices. Although the various methods produce a range of results for the output gap, the evidence also suggests that at least part of the large jump in unemployment occurring in conjunction with this recent recession has become permanent. And a future upswing in the business cycle may not be sufficient to restore unemployment to earlier levels; instead, structural policies to encourage a flexible and well-functioning labour market will likely be required.

Gounder and Morling (2000) reviews four methods to estimate potential output and the output gap, including linear trends, Hodrick-Prescott (HP) filters, aggregate production functions, and structural vector autoregressions. They used actual Output, Labour Force, Capital Stock, TFP, Inflation, Output Gap and TFP as variables. Their results reveal that measures of the output gap were imprecise and could give deceiving indications of the degree of slack in the economy.

Denis *et al*. (2002) used the Cobb-Douglas production function to extract the potential output. This methodology involves extracting the structural component of labour potential and TFP, while the potential employment is extracted from NAIRU estimates. When comparing the growth contributions of labour, capital and TFP in the Euro15/Euro Zone over the last two decades compared with the experience of the US over the same period, they found striking differences. They found that the US boom in the 1990s is clearly driven by capital formation and an acceleration of TFP, with the annual average growth rate increasing from 2.75 percent over the period 1991-1995 to 3.5 percent for the period 1996-2000. The figures for Europe are clearly less impressive in terms of the overall growth rate acceleration and the compositional changes are also different to that of the US. While growth accelerated in both the EU15 and the Euro Zone in recent years, when one looks at period averages one sees that for 1996-2000 the potential growth rate averaged 2.2-2.3 percent in both areas which is virtually identical to the outturn achieved for 1991-1995. In terms of the composition of potential growth, both the EU15 and the Euro Zone both witnessed an improvement of about a 0.25 of a percent point in the contribution of labour to growth over 1996-2000, with this gain being largely offset by small declines in the remaining components of growth.

Gosselin and Lalonde (2002) used eclectic approach to decompose potential output through the components of full employment labour input and average labour productivity at equilibrium. Disaggregating potential output into several components helps better identify its sources of fluctuation. The filter generating trend labour productivity is conditioned by the results of two SVARs. The first identifies trend labour productivity in the non-farm sector. This SVAR is based on a cointegration relationship between real wages and average non-farm labour productivity. The second SVAR estimates the gap between the output level of the manufacturing sector and no accelerating inflation capacity (i.e., the non-accelerating inflation capacity utilization rate, NAICUR). The labour input depends on five SVARs - two to identify the NAIRU and three to identify the equilibrium participation rate. To account for demographic changes, they estimate an SVAR for the equilibrium unemployment rate of the labour force less than 25 years of age and another for those aged 25 and over. The NAIRUs generated by these two SVARs are then combined to yield a NAIRU for the labour force as a whole. The NAIRU thus obtained conditions the filter applied to the unemployment rate. Similarly, authors estimate an SVAR for the trend participation rate of those under 25, another for women 25 and over, and a third for men 25-plus. The results of these three SVARs are then combined to produce an equilibrium participation rate for the entire population. This participation rate conditions

the filter generating the trend participation rate. Note that some determinants of the trend participation rate differ from one age group to the next. They used as variables the trend productivity, trend labour input, population, participation rate under-25 cohort trend participation rate, women's trend participation rate, men's trend participation rate, non-farm trend productivity. As expected, the year-over-year profile of potential output obtained by the eclectic approach is very smooth. It shows an acceleration in the pace of potential output growth during the period 1995–99, peaking at 4.0 per cent in 1997.

Filho (2002), through Aggregate Production Functions technique used the variables of actual GDP, labour force, capital stock, technology, capacity utilization, and natural rate of unemployment, for Brazil. The study found that, in the 1980-2000 period, most of the time, the Brazilian economy was below its potential.

Gradzewicz and Kolasa (2003) estimated the output gap using two methods: a method based on a two factor dynamic production function (estimated in the cointegrated VECM system, in which the potential GDP is calculated as the product resulting from maximum (in the Okun sense) level of production inputs. Second the GDP Permanent Transitory Decomposition, using long-term restrictions in the vector error correction model (VECM) imposed in an endogenous way by cointegrating relationships (GDP, Labour and Capital as inputs).

Chagny *et al*. (2003) in their paper assessed the statistical reliability of different measures of the output gap - the multivariate Hodrick-Prescott Filter, the multivariate unobserved components method and the structural vector autoregressive model - in the Euro area. Three criteria are used: the consistency of descriptive statistics, the forecasting performance in terms of inflation and some measures of uncertainty. They used the variables of GDP real, inflation rate (consumer price deflate), unemployment rate, capacity utilization, relative import price and NAIRU estimates. The results show that the output gap estimates could be improved further with the use of additional economic information; the results may differ across the different methods and within a given method with different specifications and that the multivariate UC models performs better than HPMV models in relative terms in order to reduce the filtered, smoothed uncertainty or quasi-real time estimates. However, it is difficult to conclude that a multivariate detrending method outperforms the others.

Rennison (2003) used the HP filter and two multivariate techniques: the Blanchard - Quah (1989), SVAR approach and the multivariate extensions of the HP filter (MVF). This study also considers an estimator that weighs a portfolio of inputs to estimate the output gap. This study shows that the favourable results for the combined approach at the end of sample are due in part to misspecification and parameter uncertainty in the SVAR. Two additional results have been reported: (i) relative to other estimation methodologies, the SVAR is surprisingly robust to violations in its identifying assumptions, and (ii) in terms of the absolute accuracy of an estimator at the end-of-sample, the costs associated with imposing an arbitrary smoothing restriction can be high.

Cotis *et al*. (2004) provides a critical review of variety of methods used in the literature [(1) Trend-Linear and Split, (2) Univariate Filters- Hodrick Prescott, Baxter-King filter, Beveridge Nelson decomposition, Kalman filter, 3) Multivariate filters- Hodrick Prescott, Beveridge Nelson decomposition, Kalman filter, 4) Full structural model, Production function with exogenous trends, structural VAR]. While they did not provide firm conclusions as to which method was preferable from a policymaker viewpoint, nonetheless highlights some important points: Although it is difficult to give a universal ranking of the methods, the statistical methods (trend and univariate filters) seem to be having more shortcomings than the economic methods (particularly, multivariate filters and production function approaches). This is particularly so on the 'consistency with priors' and the 'difference between real-time and final estimates' criteria. Amongst the multivariate filters, the Kalman filter appears to pass most of the criteria but it is not the most transparent method and, when used as a two-sided filter, is affected by the end point problem. By contrast, the production function approach is somewhat more transparent and has no direct end-point problem, but does not provide information on uncertainties. Moreover, there is an issue as to how inputs to this approach are constructed. As a result, the choice between these methods will depend on the priors and priorities of the user. Whatever method is used, it is necessary to make a critical and a non mechanical use of it (in particular, it is important to bear in mind its underlying assumptions and its shortcomings). Most methods provide estimates with a similar overall profile of potential output and, to some extent output gaps, but there are large divergences on the assessment of the magnitude of the output gap.

Cayen and Norden (2004) investigate the reliability of current estimates of the output gap in Canada. They begin by assembling a new data base of quarterly real-time output estimates which spans the post-WWII period and contains data vintages dating back to 1972. The univariate and multivariates methods used include; Deterministic Trends, Mechanical Filters, the Beveridge-Nelson Decomposition, Unobserved Component Models, Unobserved Component Models with a Phillips Curve and the Structural VAR Approach. The nature and sources of these revisions are used to draw conclusions about the overall measurement errors associated with current estimates of the output gap.

They used the variables of real GDP, consumer price index and interest rate. This study assembled and analyzed a new database of real-time estimates of Canadian output. Revisions to the level of GDP are highly persistent; in contrast, revisions to 1-quarter changes are negatively autocorrelated. Mean revisions are positive, implying that GDP figures have historically tended to be revised upwards. Results from a variety of measures and a broad range of output gap estimates suggest that measurement error in Canadian data may be more severe than previously thought. Most Real-Time estimates have a less than 50 percent correlation with their corresponding final estimates, for most models these two gap estimates have opposite signs more than 40 percent of the time, and the noise-to-signal ratios for the Real-Time gaps are generally above 1. Further analysis of output gap forecasts and of model risk is not conclusive and results vary considerably from model to model.

Filho (2004) presents the basic definitions used in growth accounting and the methods used for measuring labour, capital and the output gap. He also analyzes the determinants of potential output under the assumption of fixed coefficients of production and describes the disaggregated input-output estimates of capacity utilization and employment rates derived from a Leontief production function. Further he analyzes the determinants of potential output under the assumption of flexible coefficients of production and describes the basic steps involved in growth-accounting exercises based on a Cobb-Douglas production function. In the next step it shifts the investigation to the main statistical filters used to estimate trends and cycles in univariate economic time series and discusses how this a-theoretical approach can substitute, or be combined with, theoretical approaches based on production functions. Then it merges theory and econometrics in a comparative analysis of recent estimates of the potential growth rate of Brazil. His variables are the GDP(gross and net), intermediate consumption, labour estimates and labour productivity estimates, capital and capital productivity estimates, unemployment, inflation rate, interest rate, capacity utilization, total imports, total exports, input-output estimates, average years of schooling, aggregate and disaggregate growth accounting estimates, per capita income, TFP estimates, and NAICU (non accelerating inflation rate of capacity utilization) estimates. The main conclusions are: (1) the annual potential growth rate of Brazil's GDP varies substantially depending on the method and hypotheses adopted and, what is most important, potential GDP is not separable from effective GDP in the long-run; (2) growth-accounting and time-series studies of Brazil result in low potential-output growth rates because they extrapolate the slow growth of 1981-2003 to the future; (3) capital seems to be the main constraint on growth in Brazil and, therefore, a demand-led increase in investment can raise both its effective and potential output levels; (4) however, because of the slow adjustment of the capital stock, an investment boom can also hit a supply constraint before the stock of capital has time to adjust to the growth rate of investment; and (5) aggregate measures of potential output do not carry much information about the economy and, therefore, they should be complemented by sectoral estimates of capacity utilization to identify the bottlenecks in inter-industry flows and the corresponding demand pressures on inflation.

Bjornland *et al*. (2005) in their study present a set of internationally recognized and commonly used methods, then estimate alternative output gaps using Norwegian data and compare the different methods. Univariates methods include Hodrick-Prescott filter (HP), Band-pass filter (BP), Univariate "unobserved component" methods (UC) and Multivariate methods include Production function method (PF), Multivariate unobserved component method (MVUC), and Structural Vector Autoregression (SVAR) model. The study used the variables of GDP, domestic inflation and unemployment, potential levels of work hours, total factor productivity, capital and unemployment gap. Different calculation methods, however, often produce different values for the output gap. In this article, a set of alternative methods for estimating the output gap are presented and compared. The different methods show a consistent pattern for the output gap, but there are also important differences. This study shows that if the assessment of economic pressures is solely based on developments in the output gap as measured by one method; there is a risk of misjudging the

economic situation. Assessments of the output gap must therefore also be based on professional judgment and supplementary indicators.

Njuguna *et al*. (2005) classified the different approaches to estimating potential output into two: statistical detrending and estimation of structural relationships. The difference is that the former approach attempts to separate the process into permanent and cyclical components while the latter isolates the effects of structural and cyclical influences on output using economic theory [Cerra and Saxena (2000)]. Some of the detrending methods include the Hodrick-Prescott filter and the unobserved components methods (univariate, bivariate, and common permanent and cyclical components). The approaches for estimating structural relationships include the linear method, structural vector autoregression (VAR) method and production function method. The variables incorporated are the GDP, private consumption, time trend, labour employed, and capital stock. This study attempts to estimate Kenyan potential output and output gap using different methods namely the linear time trends, HP method, univariate and multivariate Beveridge-Nelson, the structural VAR and the production function approach. Each method has advantages and disadvantages as discussed. The estimation results for the values of potential output level and its growth, and the output gap vary from method to method.

It is not surprising that alternative methods lead to different estimates of the output gap. As in case of Dupasquier *et al*. (1997, 1999), De Brouwer (1998), Scacciavillain & Swagel (1999), Gounder & Morling (2000) the results vary with the methodologies used for estimation.

Furthermore, none of the studies have yet decided about the preferability of any of the measure(s) over the other. While some support the structural methods, the statistical methods were also found useful by others, and vice versa. Therefore, in view of relatively strong assumptions made during the estimation process and time relationships analysis, caution is recommended while drawing any conclusions.

4. Estimation & Results

This section deals with the estimation of potential output and the subsequent output gap for Pakistan, by using different statistical and structural methods. However, before proceeding further to the estimation and the results thereof, it is pertinent to describe that I have used annual GDP (gross domestic product – real) data for the period 1951 – 2007. It is observed that usually the quarterly data has been used for such estimation; however, as the output data is compiled on annual basis in Pakistan, therefore no official quarterly series is available to serve the purpose.

4.1. Linear De-trending or the Deterministic Trend

I have used the following equation for estimating the linear trend and the cycles of actual output series.

$$Y_t = \beta_0 + \beta_1 t + \varepsilon_t \qquad (4.1)$$

Here Y_t is the log of (real) GDP, while t is the trend. The fit of this equation is the potential GDP, while the residual ε_t is the estimated output gap.

$$Y_t = 12.5 + 0.05*t \qquad (4.2)$$

$R^2 = 0.99$ DW= 0.23

Based on the annual data of real output, it is found that the coefficients of the equation are highly significant, and the regression line is near to a perfect fit; however the Durbin-Watson statistics reveal the presence of autocorrelation in the residuals, which implies the misspecification of the model.

The results show different episodes of spare capacity and that of excess demand as well. For instance during 1998 – 2007 the economy had a spare capacity, however after 2003 it shows a recovery (for detail see Figure 1).

4.2. Moving Average

In this method it is attempted to decompose the logarithm of output into a trend component and a cyclical component.

$$y_t = \tau_t + c_t \tag{4.3}$$

Here y_t is the log of output, c_t is the output gap, while τ_t is the moving average of output. As described in section 2, one of the main weaknesses of this method remained the end-sample biases, due to the use of moving averages; however, I have attempted to resolve this issue by taking the backward moving average.

$$\tau_t = (y_t + y_{t-1} + y_{t-2} + y_{t-3})/4 \tag{4.4}$$

Like the previous estimation, the results show that the coefficients of the equation are highly significant, and the regression line is near to a perfect fit; however the Durbin-Watson statistics show some evidence of autocorrelation in the residuals, which implies the misspecification of the model (for details see Figure 1).

4.3. Hodrick-Prescott Filter (HP)

Three different scenarios are estimated for the Hordick-Prescott Filter method. As discussed earlier that λ is a 'smoothing parameter' which softens the fluctuations in the growth component. The larger is the value of λ, the smoother is the growth component and more variable is the output gap. Usually the value of λ for quarterly data is 1600, while for the annual data it is not fixed. Therefore, three different values for the λ were taken into account: 10, 100 and 100000.

The results of the HP filter method obviously differ from that of the earlier estimations. All the scenarios of λ have resulted in the same trend of the output gap, yet with different magnitudes. Where $\lambda = 100000$ has recorded more variance as compared to those computed by using the smaller value of λ. It was found that since 2005 the economy was at over capacity, similarly during the periods of 1985 – 1997, 1965 – 1976 (with exception of 1973) were the periods of excess demand. Here I confirm de Brouwer (1998), that the cycles in output are sensitive to the smoothing weight.

4.4. The Band-pass-filter

The output estimates by the Baxter & King method also show different episodes of spare capacity and excess demand in the economy with rather more fluctuations than that of the other estimates. It has also been observed that the first and the last 3 values are missing.

In general it can be concluded that the results vary with the methodology adopted; however, taking into account the recent past (2000 – 2007), it is observed that although the economy has excess capacity in the start, but later on in 2003 it records an upward trend. High demand pressures in the economy pushes the negative output gap upward, even it remains negative under some methodologies, yet with an upward trend (see Figure 1).

5. Taylor Rule for Pakistan

This section deals with the estimation of Taylor rule for Pakistan economy. There is ample debate on the selection of either rules or discretion while framing the policies, in particular the monetary policy. However, there is huge support for a rules backed policy over the recent years i.e., Taylor (1993), Kydland & Prescott (1977), and Barro & Gordon (1983) etc.

Here an attempt has been made to find out if the central bank of Pakistan has been observing the Taylor rule what would the policy implications be resulting thereof. While having various measures of output gap in hand, it could lead to interesting results. Taylor rule can be described by the following equation:

$$i_t = r^* + \pi_t + \alpha_1 y_t + \alpha_2(\pi_t - \pi^*) \tag{5.1}$$

Here i_t is the Taylor interest rate, r^* is the long run equilibrium interest rate, π_t is the corresponding inflation rate, π^* is the target inflation rate, y_t is the output gap at time *t*.

In the Taylor rule it is assumed that the central bank has the information on the current output and inflation, while other parameters in the equation have fixed values:

$r^* = \pi^* = 2$; $\alpha_1 = \alpha_2 = 0.5$.

In case of Pakistan economy I estimate the Taylor interest rate by using the same value of the coefficients as assumed by Taylor (1993); however with different inflation targets. Actually we have used the same range of inflation targets that has been estimated as a threshold level of inflation for the developing economies by Khan & Senhadgi (2001). For the long run equilibrium interest rate, as the average interest rate over the period of estimation (1973 – 2007) remained around zero with negligible variance, so it has been considered zero. Thus with these assumptions the Taylor rule equation can be reduced as:

$$i_t = -3.5 + 0.5y_t + 1.5\pi_t \qquad (5.2)$$

(Target inflation = 7%)

The computed, rule based interest rates, through the above equation, using all the output gap estimates show somewhat similar results. The results reveal that the central bank of Pakistan has not been following Taylor rule while making changes in the interest rates. In the overall data it is observed that the monetary policy for most of the time remained accommodative, and an aggressive stance of inflation management was not found.

However, in the perspective where central bank of Pakistan has never claimed to have adopted a monetary policy aimed at inflation targeting, the results are understandable (For details see Figures 3, 4, 5, 6, 7).

6. Conclusion

Central banks are today more responsible than before with the growing debate of autonomy and independence across the board. However, many banks, particularly those of the developing countries still lack expertise and required skills while framing economic policies. For the central banks to be effective in their monetary action, besides other things, credibility is one of the major inputs. For this purpose modern banking has been supported by vast research in different areas of interest. Measurement of potential output, the subsequent output gap, macroeconomic forecasting models are the approaches that can be helpful for the central bankers in adjusting the monetary policy to achieve the objectives of low inflation and stable output growth. However, in the absence of complex macroeconomic models the output gap measures and that of the potential output could better give a rough picture of the economy and the future trends.

This study estimates the output gap and in the latter section it was utilized to estimate the rule based interest rates for the Pakistan economy. Although the interest rate estimated by Taylor rule shows large differences from that of the actual one, it can be justified on the basis that the central bank of Pakistan has not yet claimed to be targeting inflation, rather the promotion of output growth has remained one of the main objectives of the bank. Still it can be suggested that in the absence of complex and reliable macroeconomic models the central banks in the developing countries can use the Taylor rule as a nominal anchor to probe the future trends of inflation, output gap and interest rates.

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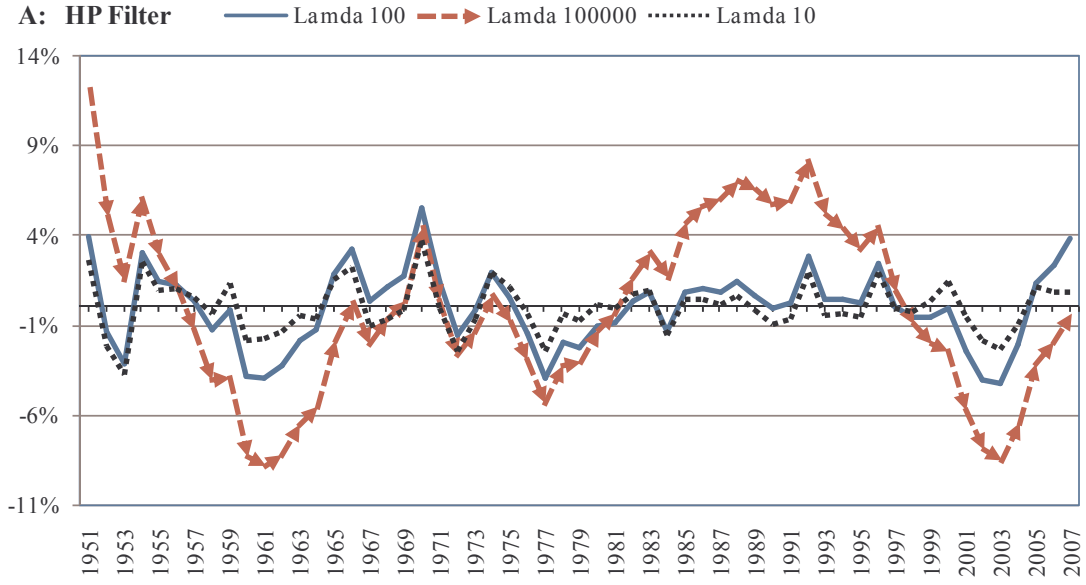
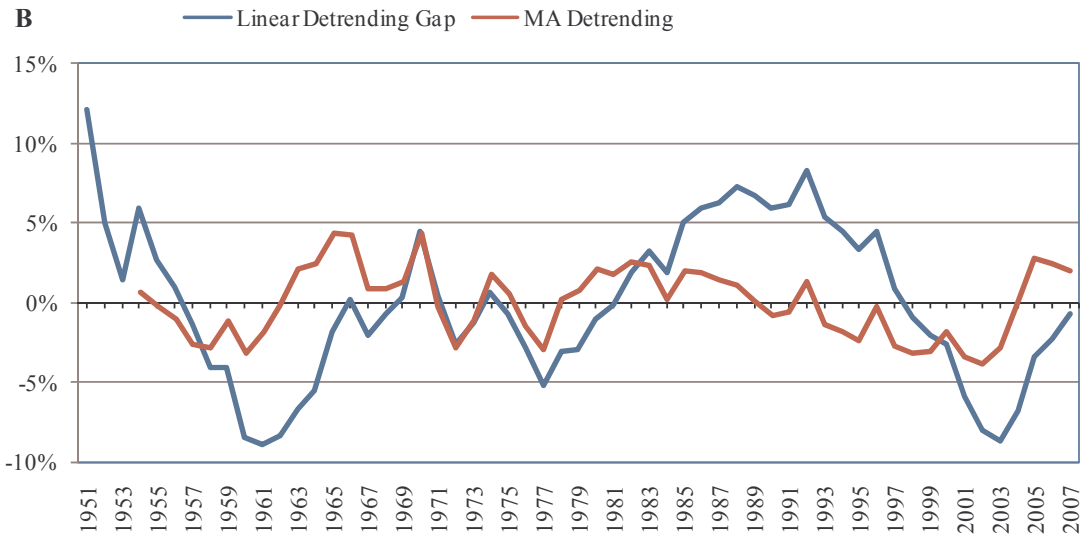
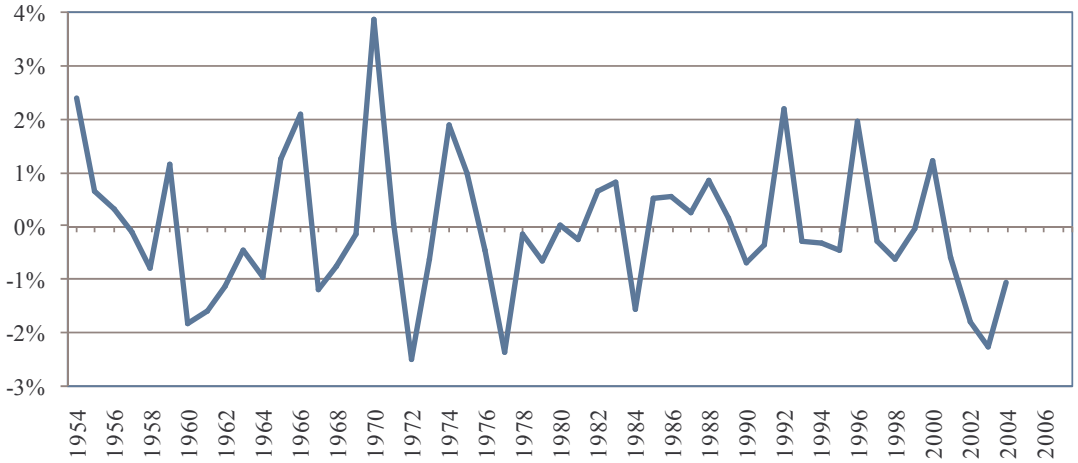
Appendix:

Figure 1: Output Gap





C: BP Filter



D: Moing average Gap

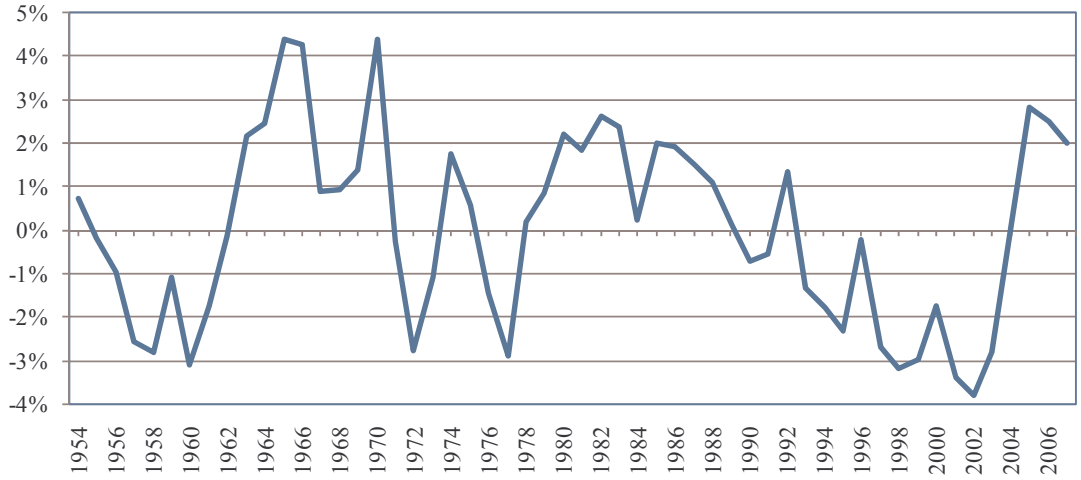


Figure 2: Comparative Interest Rates with ZERO Inflation Target

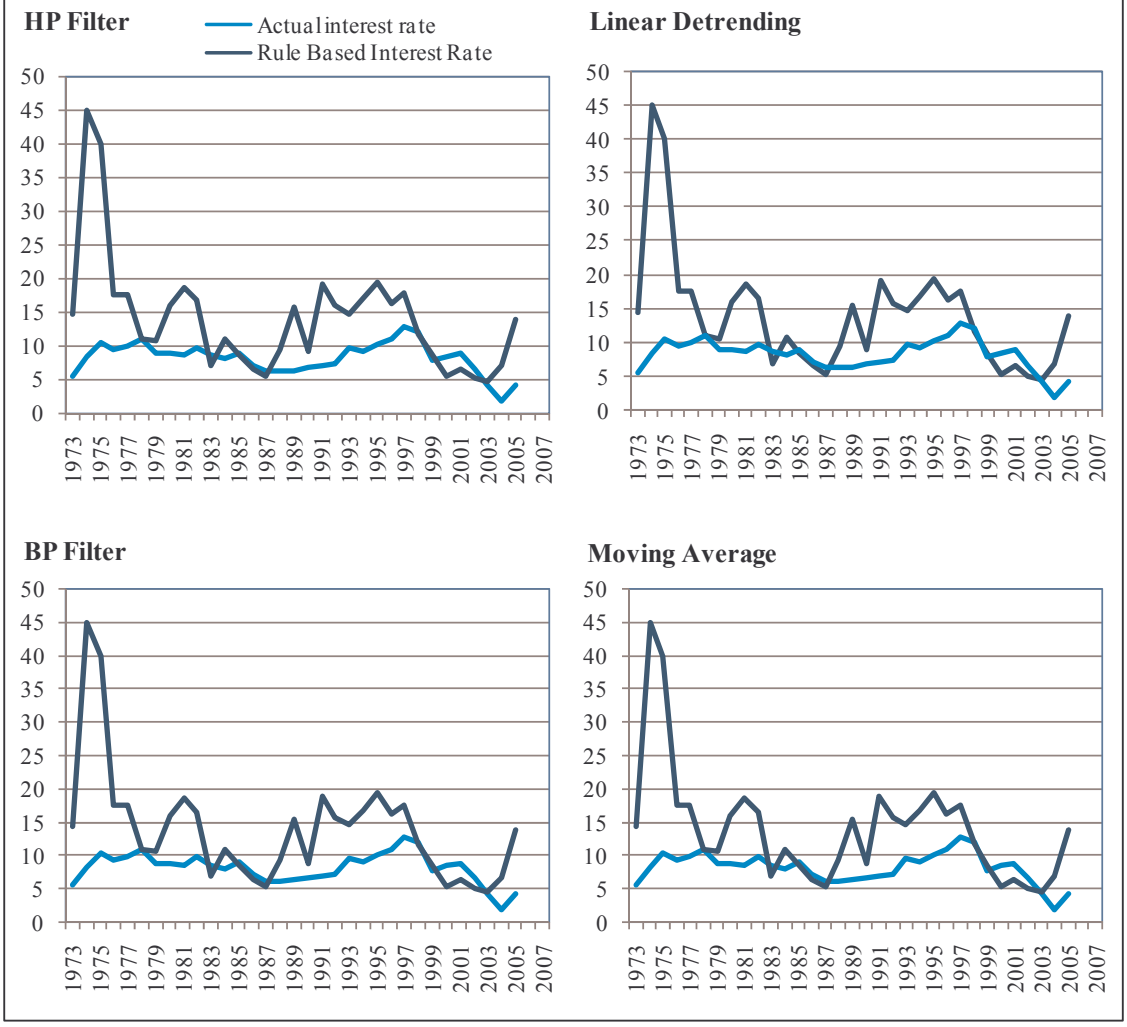


Figure 3: Comparative Interest Rates with Inflation Target = 7%

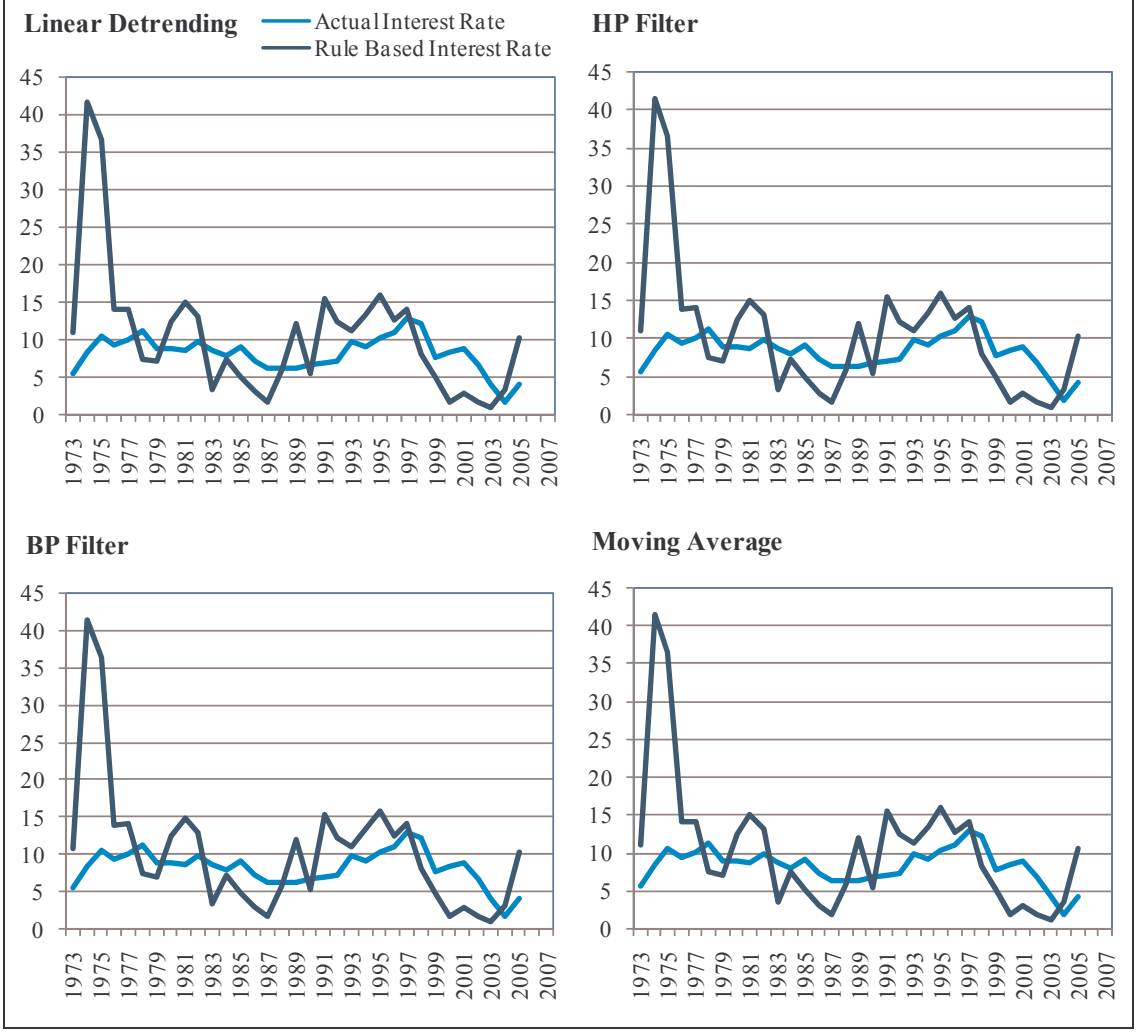


Figure 4: Comparative Interest Rates with Inflation Target = 8%

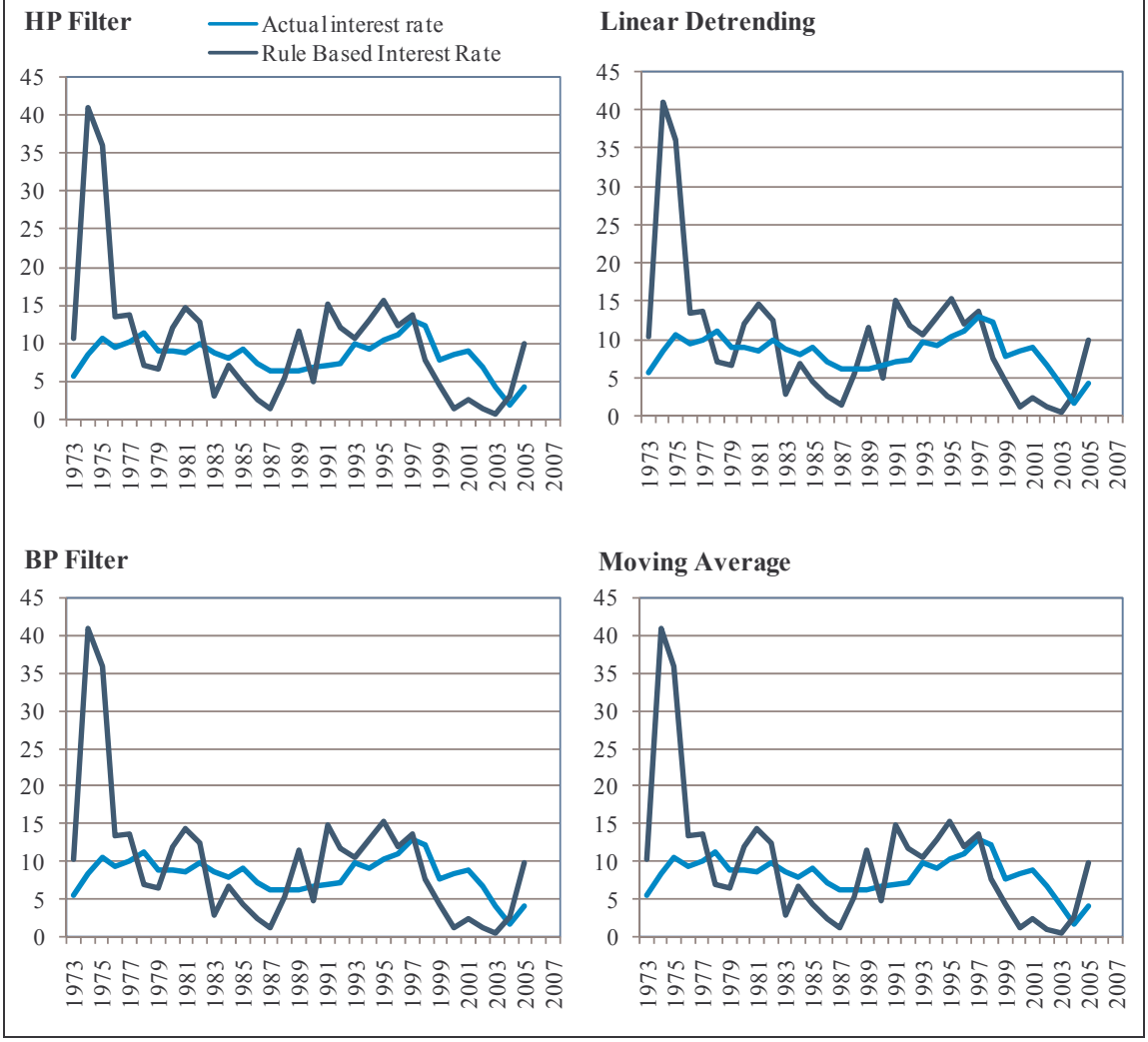


Figure 5: Comparative Interest Rates with Inflation Target = 9%

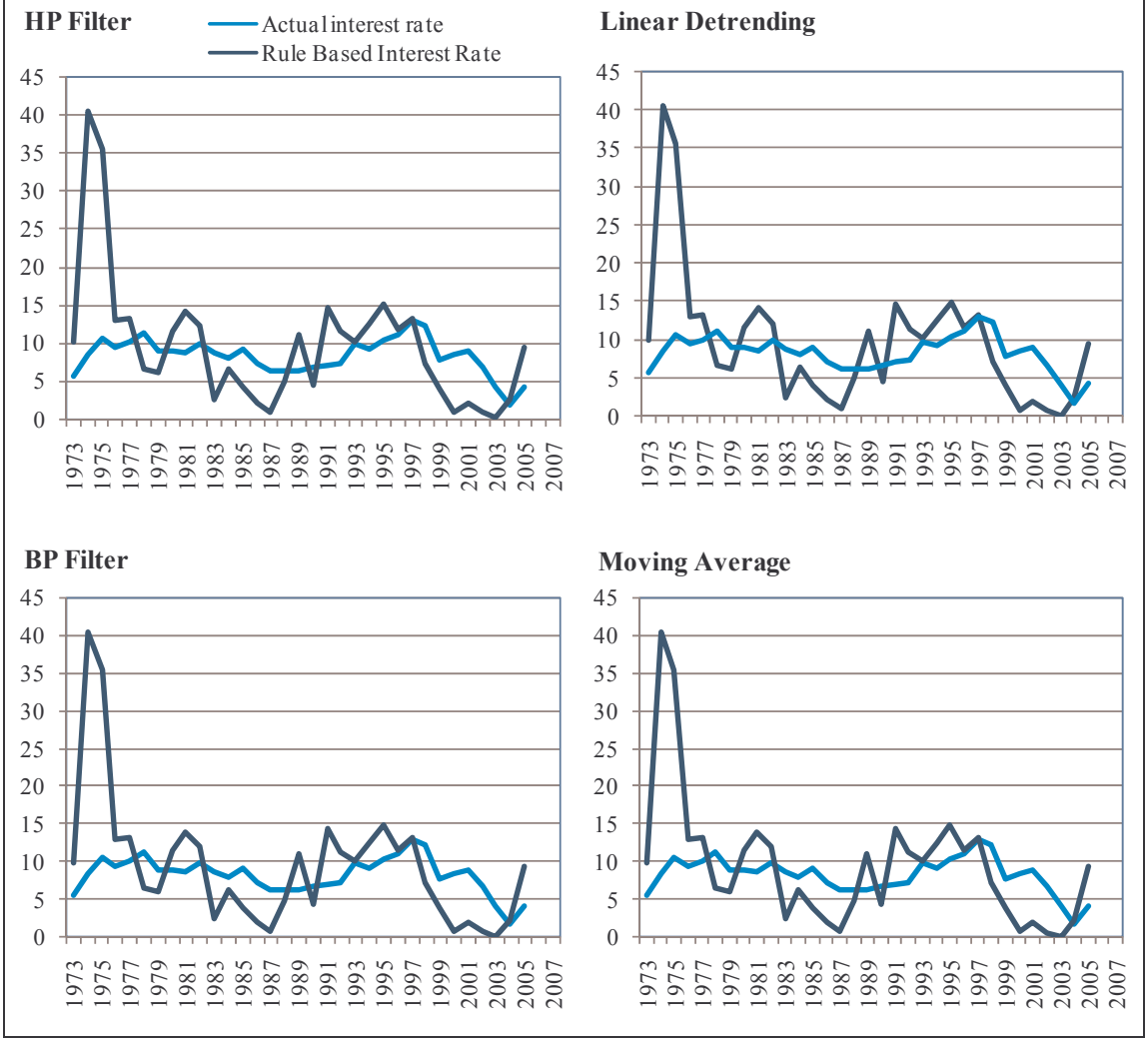


Figure 6: Comparative Interest Rates with Inflation Target = 10%

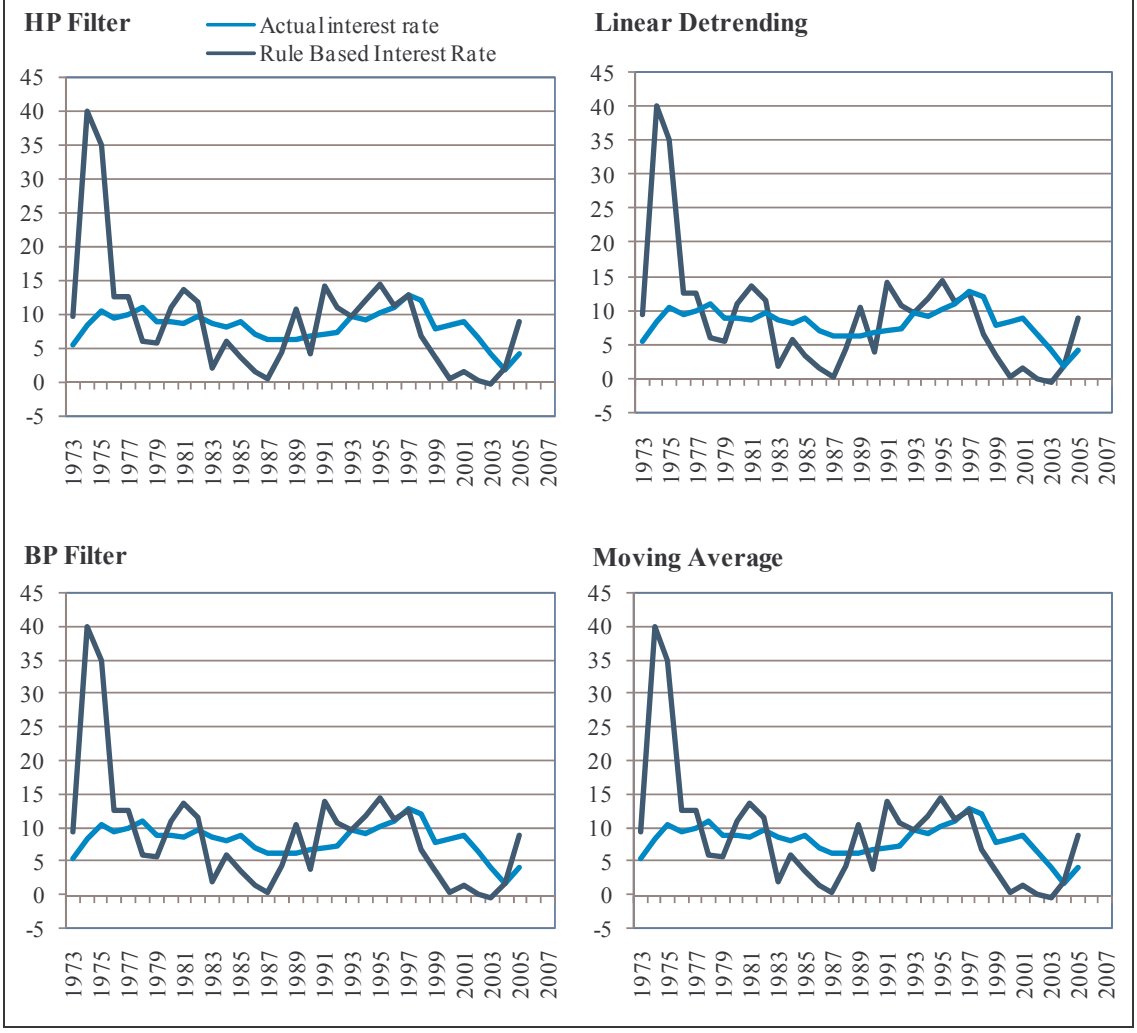
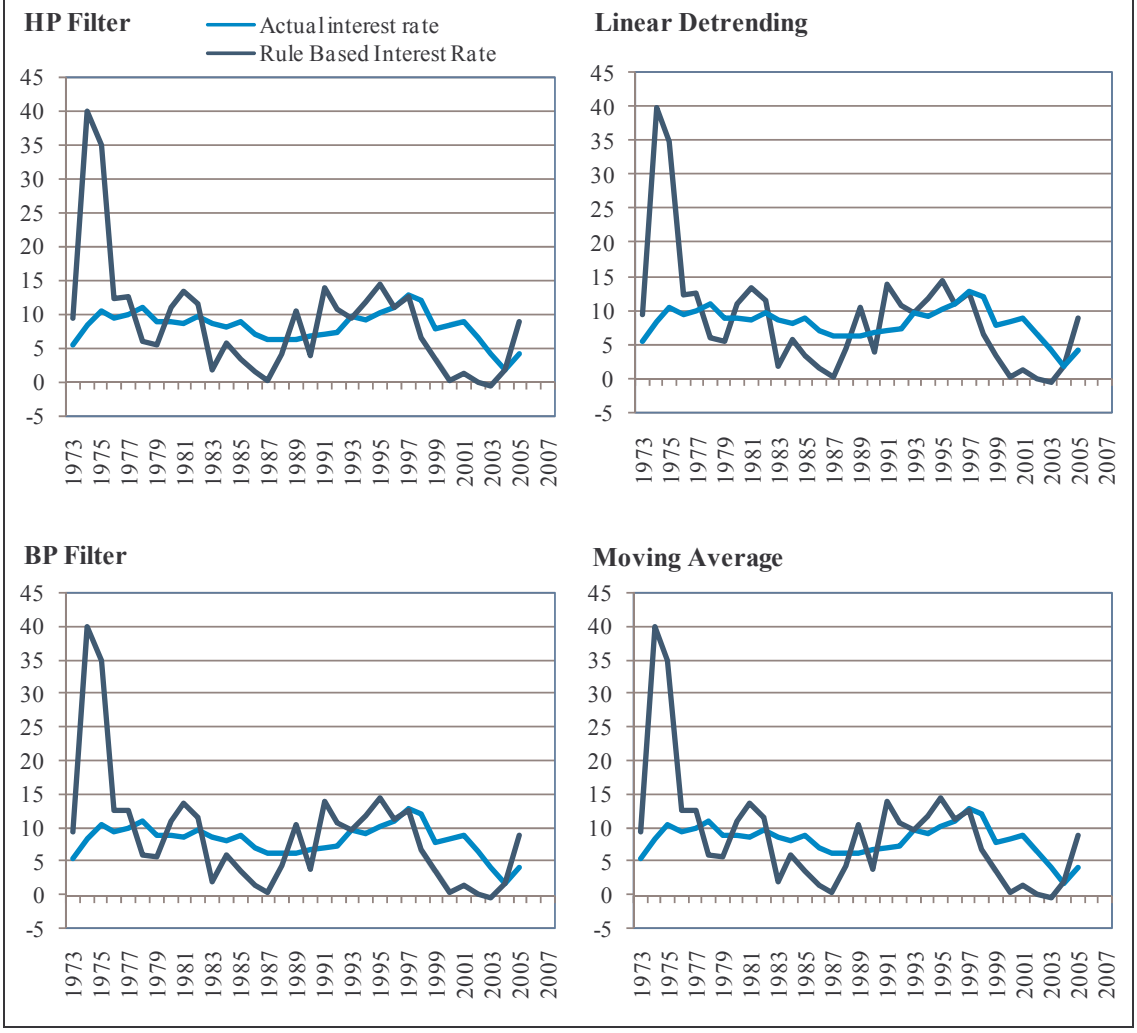


Figure 7: Comparative Interest Rates with Inflation Target = 11%



MODELLING INFLATION DYNAMICS. A PRACTICAL APPROACH

Laura **UNGUREANU,** Viorel **MATEI**
Spiru Haret University, **Romania**
ungureanu@lycos.com, viomdean@yahoo.com

Abstract*:*

Over the past decades, the ultimate goal of central bank monetary policy has systematically moved towards monetary stability and low-inflation credibility. To obtain this goal, various strategies have been implemented, such as the use of explicit intermediate targets or target ranges for some monetary aggregate, or the commitment to maintain a fixed exchange rate with a low-inflation country.

Therefore, in this study we present a dynamical model for monetary policy. The model emphasis the principal interdependence that is stabilized between the system variables (real stock of money, rate of inflation) and the variation of these in function of the parameters values. In this paper we address the issue whether a switch to inflation targeting can help build monetary policy credibility and can substitute for a track record of low inflation.

Keywords: mathematical modelling, inflation dynamics, monetary policy, forecast.

JEL Classification: C61, E47, E52.

1. Monetary Policy and Inflation

The monetary experiment made by J. Law on the territory of France - with treasury impoverished by his big spending Louis the XIV century - has amazed, but the knowledgeable and curious. Contradictory reactions were due to the record of monetary increased capacity to give impetus to the economy, but its ephemeral character, followed by triggering inflation.

Since then until today economists in general and monetarists, in particular, pay attention to the manoeuvres and what can be done with monetary aid, especially during periods in which the economy faces greater difficulty.

Many contradictions and disagreements between economists are legitimate, as M. Friedman (1959), the natural tendency of everyone to bring something new and to compete in others. Are major contradictions, which I divided the economists in opposing camps, derived from options to the basic ideas and different lifestyles, such as freedom, the one hand, opting for devotees classicism and neoclassicism, life safety and welfare, on the other, opting for devotees of directed economy.

Implementation of the neoclassical synthesis theory gave acceptable fray about a decade, then that should take place the mess in economy inflation.

A broad controversy took place in the 70's between the neokeynesists and the monetarists, about the following practices of fiscal and monetary policies applied by the developed and the instability and economic crisis and the consequences that occur in the real level of interest, fiscal policy and monetary policy.

Meanwhile economies have evolved, and along with development, have created tools and resources that put into service, routing the negative side effects of the economy. Using rational tools available savings, and among them monetary, may offer a way to resolve dilemmas: freedom or welfare security, recovery of the economy on short and medium term or long-term recovery.

Monetary policy determines the supply of money. Changes in money supply interest rate changes up and down and affect the costs for various items. Monetary policy has a significant effect on GDP.

An expression of the progress made in economic analysis and forecast of modern and contemporary is the use of economic models and mathematical modelling practice.

Inflation is a general increase, while the level of prices of goods and services. Inflation is measured, usually as a percentage increase of the consumer price index, but not the only way that can be measured, because it can use several indices of prices. Most of the economists believe that an increase in the rate of inflation is a consequence of monetary growth.

Regarding factors that may induce a moderate level of inflation, economists are divided opinions. Some specialists consider that the inflation rate is influenced by demand for real goods or services or a lack of certain products on the market, but demand and supply of money market.

In the mid-twentieth century, economists were divided in two camps effects: monetarists who say that money is determined to any other factor for inflation and fluctuations kinesics who argues that real demand is greater and important than money.

Milton Friedman said - "Inflation is always and everywhere a monetary phenomenon." Here thus a rapid increase in broad money will not only increase prices. Is it true that monetary aggregates are not a perfect indicator to describe the state economy, but long-term relationship between money and prices remains intact. Moreover, this relationship is analyzed in studies conducted by the European Central Bank shows that monetary dynamics contains information about inflation.

A second phrase - "Nothing is free in this world" - (There isn't no such thing as a free lunch) - say that any excess will be balanced in the future. Economic history is full of examples in which the mandated implementation of monetary and economic policies has ignored the signals given by the mass of money: the crisis of 1929-1933, 70 years of hyperinflation, financial collapse in Japan and the'80 Asian crisis of 1997. All these crises have been preceded by the rapid growth of broad money.

We can thus introduce the idea that money and inflation there is a direct relationship and I could give a definition of inflation. We can describe as a structural imbalance monetary-real, which express the existence in a mass movement of money exceeding the needs of the economy, which train depreciation inconvertibility money in gold and the inconvertibility in general, and sustainable growth and a generalized price. This surplus money can be determined by the monetary issue, create the scripts, insufficient control of the power of issuing currency, increasing the speed of money circulation, decreasing confidence in national currency. This type of inflation by specialists is the *inflation by the coin*.

2. Forecast by Dynamic Models

As new telescopes we broaden their horizons without necessarily invalidate the findings of the previous universe near and mathematics reveal her sight in November, while developing the existing knowledge. Perspectives may change, but not mysteries.

New theories rediscover the reality of change. Time is not eternal repetition of the same things, but the difference becomes bearer. This means that the system at a certain time is not contained in its previous state: state between the first and second there is a qualitative leap. Sudden transitions, "catastrophic" bifurcations do not occur in an uncertain manner. Rather, they result from a conjunction of the multitude of factors that push system in a certain direction and not in another.

A dynamic model is about highlighting temporal relationships. The model operates with events and conditions that express an attribute value that identifies the occurrence of events. With the data structures are built diagrams of the transition states indicate that all operations specific to each type of object and class appropriate.

Against this background of facilities exchanger research, econometric studies have shifted the analysis to period dynamic models that can be studied by means of new theories.

Model as an instrument of knowledge, is used in many theoretical and practical disciplines. The knowledge gained from working with models and attempt to apply concepts may find valuable in relation to a particular problem and the types of decisions that are needed. The mere recognition of areas of decision may be a major progress in many situations. In addition, if we are using models to recognize the variables that can be controlled to influence system performance, the relevant costs and their size and the correlation between costs and variables, include option costs.

But there are also a multitude of factors that may affect the chances of success in the modelling. Some of them are related to environmental conditions, others are related to actual driving process modelling, while others are related to the nature of the model to be developed.

In economic science, especially in organization and management disciplines, models are used in all types of diversity that exists. In recent decades, however, the shape of increasingly tend to use specifically in these disciplines, a type of mathematical models, in particular due to their ability to compress the meat thoroughly, and their opportunities to be programmed using techniques computational, together constituting a scientific investigation of an unknown until now, a prodigious "extension" of human intelligence.

An economic process modelling is a scientific means of detecting the factors involved in determining the phenomenon in question. To be established importance of these factors for the process

is considered necessary to introduce in the model built to the most important factors in such a manner as, or than it is possible to ensure their eventual quantification, which allows mathematical treatment.

Starting from the idea that any model based on real data and parameters necessary to obtain the reliable data this would allow a convenient representation of reality by the model. Thus, identifying, where appropriate, the issue of periodic or cyclical phenomenon studied by default time horizon covered.

From the classical econometric methods based on continuity, linearity and stability have proved inadequate to represent the economic phenomena and processes with a higher complexity. Researchers are obliged to follow these processes in a dynamic study of quantitative changes which occur between economic variables involved and the results achieved with their help. In addition to other features of mathematical models allow the introduction of an isomorphism between the real economic and ideally represented by the model. With their approach becomes possible unstable behaviour of different economic systems are highly nonlinear increasingly often that the linearity and stability are in fact cases of economic developments.

Dynamic modelling is based on the fact that operation of a system is the knowledge of interactions between the flows of information, orders, human resources and material resources etc.. A surprising dynamic behaviour of complex systems emphasizes how their trajectory determines the behaviour over time.

Application of dynamic models is essentially a simulation exercise. Whether someone is studying the cyclical policies alternative interpretation of history, the evaluation model error or whatever, numerical simulation is the appropriate tool for this. For small systems or for the linear, many of these questions are answerable directly to the analytic work, often in forms including mathematical expressions, but for general cases, especially in the case of large systems used in the day, numerical simulation the only possible method to use. However, all types of simulation model, is considered a "queen" - prognosis [Klein, and Welfe (2003)].

3. A Dynamic Model of Monetary Policy

As in [Tu, P.N.V (1990)] and [Popescu, and Ungureanu, (2003)] we find many models of monetary policy. In [Ungureanu, and Matei, (2008)] we presented another model about this. Here we decided to present a two-dimensional model, whose economic characteristics are: *P*- average price; $\pi = P^{/} / P$ - inflation; M - rated reserves money; $\mu = M^{/} / M$ growth rate of nominal money balance; *E*- excess stock; Y - real income; Y^{*} - employment in the real production, $m = M / P$ - money stock; *h*- balance real money; *z* - deposits of real "requests"; *I* - the reference rate of interest; *i* - interest rate deposits applications. Some of these functions are unknown and some data model. Economic assumptions are expressed by:

$$\begin{cases} E = Y - Y^{*} \\ \dot{\pi} = -bE; b > 0 \end{cases}$$

Last expresses proportionality relationship between inflation and excess amount, with a negative coefficient of proportionality. Relations

$$\begin{cases} m = h + z \\ h = \alpha_1 Y - \alpha_2 I, \alpha_1, \alpha_2 > 0 \\ z = \alpha_3 I - \alpha_4 (I - i), \alpha_3, \alpha_4 > 0 \end{cases}$$

shows that requests for h and z increase with income and decrease the opportunity cost for keeping each item. Decrease the real interest rate is given by

$$Y = \alpha_7 - \alpha_8 (I - \pi), \alpha_7, \alpha_8 > 0$$

and the balance of money market

$$\dot{m} = (\mu - \pi)m$$

Obtained by substituting

$$m = \alpha_5 Y - \alpha_6 I + \alpha_4 i$$

where $\alpha_5 = \alpha_1 + \alpha_3$, $\alpha_6 = \alpha_2 + \alpha_4$, and

$$I = \frac{1}{\alpha_6}\left[-m + \alpha_5 Y + \alpha_4 i\right]$$

This way we find that

$$Y = \phi_0 + \phi_1 \pi + \phi_2 m - \phi_3 i$$

where $\phi_0 = \frac{\alpha_6 \alpha_7}{\alpha_6 + \alpha_5 \alpha_8}$, $\phi_1 = \frac{\alpha_6 \alpha_8}{\alpha_6 + \alpha_5 \alpha_8}$, $\phi_2 = \frac{\alpha_8}{\alpha_6 + \alpha_5 \alpha_8}$, $\phi_3 = \frac{\alpha_4 \alpha_8}{\alpha_6 + \alpha_5 \alpha_8}$. Substituting in the expression of $\dot{\pi}$ and taking into account $\dot{m}$ we obtain the model:

$$\begin{cases} \dot{m} = (\mu - \pi)m \\ \dot{\pi} = b\left[-\phi_0 + Y^* - \phi_1 \pi - \phi_2 m + \phi_3 i\right] \end{cases}$$

Therefore, this model is the Cauchy problem $\pi(0) = \pi_0$, $m(0) = m_0$ for this non-linearity with the square.

The balance points of this system are the solutions $\bar{u} = (m, \pi)$ of the algebraic system:

$$\begin{cases} (\mu - \pi)m = 0 \\ b\left[-\phi_0 + Y^* - \phi_1 \pi - \phi_2 m + \phi_3 i\right] = 0 \end{cases}$$

Thus, we find that the system admits two equilibrium points, $u_1 = (0, \frac{\phi_3 i - \phi_0}{\phi_1})$ and $u_2 = (\frac{-\phi_0 + Y^* - \phi_1 \mu + \phi_3 i}{\phi_2}, \mu)$, and the matrix is attached $\begin{pmatrix} \mu - \pi & -m \\ -b\phi_2 & -b\phi_1 \end{pmatrix}$. Since economically speaking the u_1 point does not represent any importance because $m = 0$ we will turn our attention over the u_2 equilibrium.

The lining of the system surrounding this point is:

$$\begin{cases} \dot{m} = -\pi \dfrac{-\phi_0 + Y^* - \phi_1 \mu + \phi_3 i}{\phi_2} \\ \dot{\pi} = b\left[-\phi_2 m - \phi_1 \pi\right] \end{cases}$$

with the associated matrix $A = \begin{pmatrix} 0 & \dfrac{\phi_0 - Y^* + \phi_1 \mu - \phi_3 i}{\phi_2} \\ -b\phi_2 & -b\phi_1 \end{pmatrix}$.

There are three classes of topological equivalence of equilibrium in the hyperbolic plane: stable nodes or outbreaks (attractor), outbreaks or unstable nodes (repulsive) and set [Ungureanu, and Matei, (2008)]. We will determine the type of equilibrium studying their corresponding values. In these solutions: equation $\lambda^2 - trA\lambda + \det A = 0$. If $\mathrm{Re}\,\lambda_1 \neq 0$, $\mathrm{Re}\,\lambda_2 \neq 0$ equilibrium is hyperbolic and if $\mathrm{Re}\,\lambda_1 = 0$ or/ and $\mathrm{Re}\,\lambda_2 = 0$ say that balance is nonhyperbolic.

Phase Portrait of nonlinear dynamic systems around equilibrium nonhyperbolic points can not be deducted from the lining system and it can only be characterized by a nonlinear.

In our case, because $trA = -b\phi_1 < 0$ and $\det A = b(\phi_0 - Y^* + \phi_1\mu - \phi_3 i)$ we obtain, $\Delta > 0$ and $\lambda_1\lambda_2 < 0$. So the point is a saddle point, so an unstable equilibrium. In fig.1 we can track the invariant set and evolutionary pathways for the lining.

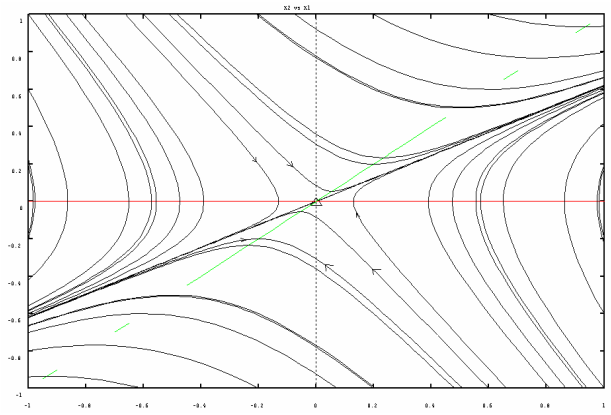


Figure 1. The saddle point equilibrium

To underline that we take account of the parameters as they were put into the model. We believe that major changes may occur in the system. These changes in development trajectories may occur in the following cases, which are not so far from reality:

- Speed of decrease depending on E is, that inflation is increasing, in which appear two lower cases:

a) if $b < -\dfrac{4m_e\phi_2}{\phi_1^2}$, $\Delta > 0$ and their values are real positive, the balance becoming a repulsive node, unstable (fig. 2)

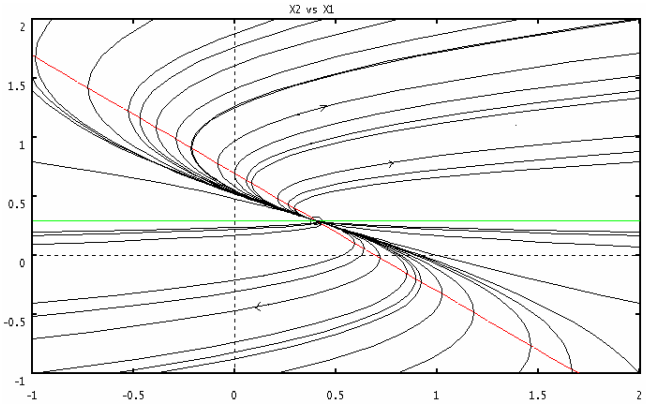


Figure 2. The repulsive node equilibrium

b) If $b > -\frac{4m_e\phi_2}{\phi_1^2}$, $\Delta < 0$ and their values are complex $\mathrm{Re}\,\lambda > 0$, the balance becoming a repulsive focus, pathways having an explosive increase (Figure 3)

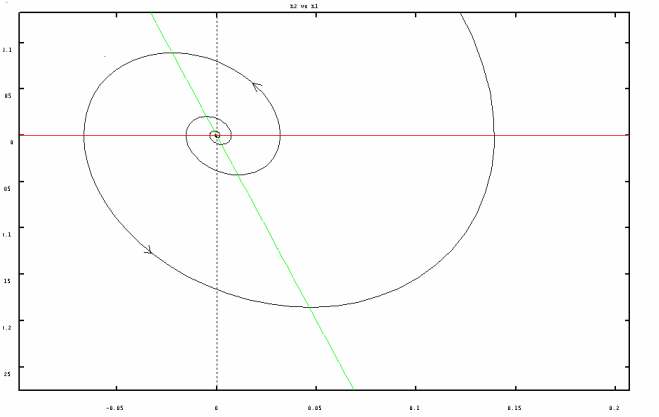


Figure 3. The repulsive focus equilibrium

- The speed of decrease of π depending on E is constant. In this case the inflation rate remains constant, and the money grows steadily.

The model can be applied to both short periods (weeks, months) and highest for periods (semesters, years) according to the purpose of analysis and data source. In Romania most data can be found on www.bnr.ro besides that proves particularly useful and is relatively easy to work with him.

4. A Study Case: Romania

For years, Romanian National Bank (BNR) has been repeatedly in a position to pursue multiple objectives, often contradictory. Thus, in the first part of 90 years were done on relatively large scale targeted credit, especially for agriculture and exports, the central bank of issue, with preferential interest. These loans, by the phenomenon of multiplication of the monetary base, generally an amount of excess money in the economy and - most important - distort resource allocation in the economy by fostering non-transparent areas to the detriment of all others. Agriculture remains an open question, although at one time implicit subsidy generated by the agriculture appropriations NBR reached 10 percent of GDP, not just incidentally in 1993, which was the highest rate of inflation. Lesson that detaches from these experiences is that the central bank may not, while controlling monetary expansion and massive support Government policy development sector.

Another objective which had the central bank was paying foreign debts. The existence of important structural imbalances made of over the past 14 years there are critical moments that simply avoiding a major external crises forced to focus full attention on this component of central bank policy, fighting inflation became secondary.

There are two examples in this regard. The first refers to the period in the winter of 1991-1992. Currency reserves of the central bank at that time were the order of several hundred million dollars, that level would not be satisfied even imports of strict necessity of the country. Year 1991 was a very poor agricultural year and attracted the urgent need for wheat imports. In the same terms we put the issue of seasonal energy imports. Political crisis triggered by miners' revolution in autumn 1991, completely blocked the financing (except for an instalment loan from the IMF) so that the country was close to the external termination payments. In such circumstances it was decided to unify exchange rates, while taking currency held by economic agents by the central bank. The measure was criticized gruelling, but it has resolved a situation of crisis, for which no alternative at that time, and attenuated than the gap between the official rate and the market.

The second critical moment was in 1999, the year that have accumulated significant maturities of previous loans, totalling payments for public debt and publicly guaranteed 2 160 million, the amount exceeded the reserve currency of the National Bank at the beginning of the year . Romania had to cope with external payments and termination payments to avoid, almost exclusively due to internal

resources. Subsequently, this performance has played an important role in improving the rating of the country and passed favourably on the conditions of access to external financial market, present and future. The price paid was a compression of domestic consumption, accelerating the depreciation rate and inflation inflamed again, who arrived in 1999 to 54.8 percent versus 40.6 percent in the previous year. Worth noted that the Romanian authorities for exchange rate flexibility and has proven its usefulness in this very critical time. Situations described above are, in the last analysis, the choice between immediate goals and interests longer term.

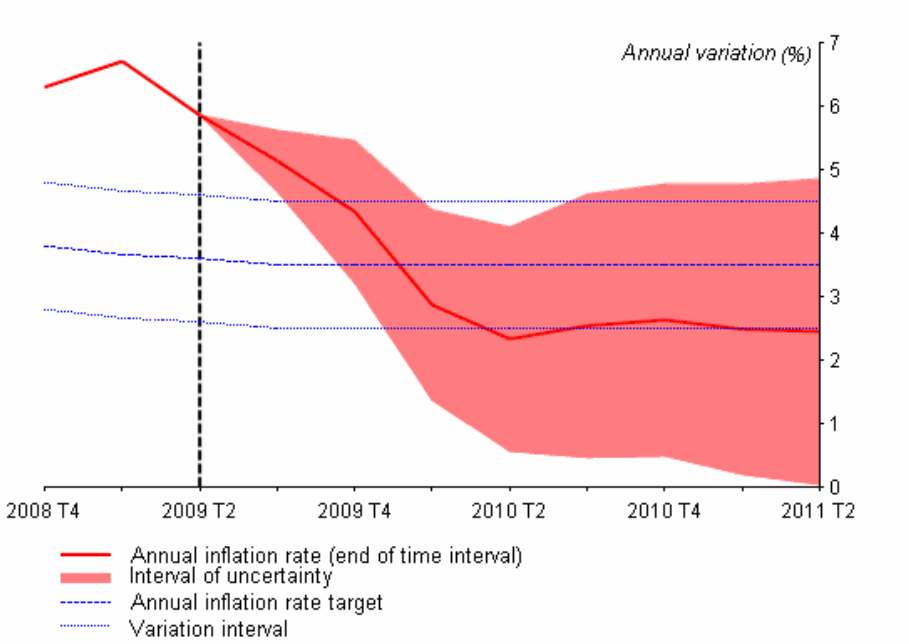


Figure 4. BNR prognosis from inflation evolution.

Source: www.bnro.ro

The analysis of the most recent statistic data exposes the consolidation of the uninflation process, the annual rate of the inflation lowering to the level of 4,96% in August this year, comparing to 5.06% in the month before, in conditions of an accelerated decrease of the aggregate request lowering and the moderate fluctuations of the Romanian currency exchange rate. The same data reveal the significant and persistent adjustment of the external deficit in the manifestation of the financial and economic crisis at a global level. At the monetary level, it is to see: the maintenance of the high annual dynamic of the credit accorded to the public sector, the recording of a positive monthly dynamic for the credit accorded to the private sector for the first time in the last six months and continuing the tendency of rising of the economy at the level of the national economy (Figure 4).

The conduct of the monetary politics has remained aware, BNR calibrating permanently the ensemble of monetary conditions largely in concerning the consolidation of the inflation rate convergence towards the settled objectives for medium term, as well as for assuring the conditions for sustainable revitalizing of the crediting process.

The banking debt rates have maintained in approaching the level of the debt rate of the monetary politics. At the same time, reducing the practical debt rates by the institutions crediting in relation with the clients has continued for bank deposits, as well as for credits, the descendent adjustment of the last being however relatively slow.

Percent per year **Table 1.**

Since	Monetary politics	Crediting facility	Deposit facility
30 sep.2009	8,00	12,00	4,00
5 aug.2009	8,50	12,50	4,50
1 jul.2009	9,00	13,00	5,00

Since	Monetary politics	Crediting facility	Deposit facility
7 may 2009	9,50	13,50	5,50
5 feb.2009	10,00	14,00	6,00
1 aug.2008	10,25	14,25	6,25
27 jun.2008	10,00	14,00	6,00
7 may 2008	9,75	13,75	5,75
26 mar.2008	9,50	12,00	2,00
4 feb.2008	9,00	12,00	2,00
8 jan.2008	8,00	12,00	2,00
1 nov.2007	7,50	12,00	2,00

Based on the currently available data (table 1) and the analysis of the recent evolutions we have managed to identify the data which interfere in the model and, by the Maple 8 software, to determinate the solution for the system and certain values of the inflation's evolution, values which we have obtained starting from the initial data m(0)= 198 682,8 mil. lei (august 2009), $\pi(0)$=5.06 (august 2009) we obtain:

```
> sys1:=[diff(m(t),t)=0.54*pi(t), diff(pi(t),t)=-0.25*pi(t)-
0.54*m(t)+0.846];sol1:=dsolve(sys1);
>
```

$$sys1 := \left[\frac{d}{dt}\mathrm{m}(t) = 0.54\ \pi(t), \frac{d}{dt}\pi(t) = -0.25\ \pi(t) - 0.54\ \mathrm{m}(t) + 0.846\right]$$

$$sol1 := \{\mathrm{m}(t) = \frac{47}{30} + \mathbf{e}^{\left(-\frac{t}{8}\right)}\left(\sin\left(\frac{\sqrt{11039}\ t}{200}\right)\_C2 + \cos\left(\frac{\sqrt{11039}\ t}{200}\right)\_C1\right), \pi(t) = -\frac{1}{108}$$
$$\mathbf{e}^{\left(-\frac{t}{8}\right)}\left(25\sin\left(\frac{\sqrt{11039}\ t}{200}\right)\_C2 - \cos\left(\frac{\sqrt{11039}\ t}{200}\right)\sqrt{11039}\ \_C2\right.$$
$$\left. + 25\cos\left(\frac{\sqrt{11039}\ t}{200}\right)\_C1 + \sin\left(\frac{\sqrt{11039}\ t}{200}\right)\sqrt{11039}\ \_C1\right)\}$$

```
> g := dsolve({diff(m(t),t)=0.24*pi(t), diff(pi(t),t)=0.25*pi(t)-
0.34*m(t)+0.846,m(0)= 198 682,8, pi(0)=5.06}, {m(t),pi(t)}, type=numeric,
method=classical, output=procedurelist);
```

$$g := \mathbf{proc}(x\_classical)\ \ldots\ \mathbf{end\ proc}$$

```
> g(1);
```

[t = 1., m(t) = 207219.577305958548, π (t) =4.45535207781];

```
> g(2);
```

[t = 2., m(t) = 219.92627957692094, π (t) =3.45535207781];

```
> g(3);
```

[t = 3., m(t) = 237889.020627460676, π (t) = 2.9361876360940];

```
> h(5);
```

[t = 5., m(t) = 312.35091653164, π (t) = 1.923426204478] ;

Therefore, utilizing this model we obtained the same values which are found also in the forecast values from BNR.

5. Conclusions

The modelling this phenomenon may lead to an equilibrium value of variables and give an approximation of their behaviour over time. Mathematical properties of the dynamics of the model

proposed can read features concrete evolution of the phenomenon can be modelled and highlight opportunities to influence this development, obliging it to follow the optimal requested needs.

The model presented is particularly complex, mainly due to the large number of variables that appear in its equations and non-linearity in the square field vectors associated.

We believe that the mathematical theories on the dynamics of linear and fork can lead to the identification, knowledge and understanding of a wide range of types of economic phenomena and processes, and alternative or variations of them, if certain parameters pass through critical values.

An important role of the dynamic modelling is the one of fixing the optimum intervals, between which it is good to move the main financial-economic indicators, so that the realization of the economic objectives will not raise problems.

We consider that it is best the adequate gesturing of the liquidity in the banking system concerning empowering the channels of transmission of the monetary politics and the correlation of the debt rates from the market with the debt rate of the monetary politics, as well as maintaining the actual levels of the rates for the minimum obligational reserves applicable to the passives in lei and respectively in currency of the crediting institutions.

The ferm and consequent implementation of the macroeconomic politics mixture – monetary, fiscal, of incomes, as well as the structural reforms approved in the multilateral arrangement for external financing finalized by The European Union, The International Monetary Fund and other international financial institutions is essential for the sustainable continuity of the uninflation process, maintaining the financial stability and the long-lasting relaunch of the economic activity.

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DAY OF THE WEEK EFFECTS ON THE MAURITIAN DEVELOPMENT ENTERPRISE MARKET (DEM)

Subadar Agathee **USHAD**
University of Mauritius, Reduit, **Mauritius**.
Faculty Law and Management,
Department of Finance and Accounting,
u.subadar@uom.ac.mu

Abstract

This paper attempts to examine the day of the week effects on the Development and Enterprise market (DEM) on the Stock Exchange of Mauritius. Using observations as from the year the DEM started its operation, i.e 2006 to 2009, the study reveals the presence of a Friday effect. The returns are jointly statistically different across the days of the weeks but not for the years. Given that the DEM is still in its infancy stage, the study is a first formal attempt to assess this calendar anomaly.

Keywords: day of the week effects; stock market anomalies; african emerging stock markets; efficient market hypothesis; DEMDEX.

JEL Classification: G15

1. Introduction

It has already been established through the cornerstone of the modern finance literature, being the efficient market hypothesis, that returns should follow a random walk whereby successive price changes are independent. However, there are anomalies which cannot be explained by market efficiency. Calendar anomalies have been the subject of many studies so far and being a characteristic inherent in financial markets, can be termed in a nutshell as the tendency of stocks to exhibit different returns, which appear to be peculiar to a particular time period. However, the focal point that many researchers have taken is the day of the week effect. The latter is a phenomenon whereby the distribution of stock returns is seen to vary according to specific days and many published research have dealt with this matter. We can note inter alia studies conducted by [French, (1980), Gibbons and Hess, (1984), Rogalski, (1984), Smirlock and Starks, (1986), Flannery and Protopapadakis, (1988), Kohers and Kohers, (1995)] who propounded the presence of Monday effect and Friday effect when analyzing US and Canadian daily stock market. In addition, according to other pioneers[1] in this field, daily returns in Pacific Ocean countries adopt downward trends on Tuesdays.

Though there is usually the presumption that these anomalies stem from the inefficiency of the market, this may not always stand true. In fact, in many cases there is an element of psychological belief that comes in and makes investors act as such over specific days of the week. Also, returns being abnormal on a particular day may simply mean that the trader is provided with the opportunity for making a return on a stock that is greater than a fair return for the riskiness associated with that stock. Nevertheless, according to some researchers[2], these market puzzles are viewed as a fact in all financial markets and that emerging markets would be positing these characteristics after being developed. As far as this field is concerned, to my knowledge, the day of the week effect has not been given due attention and tested for on the Development & Enterprise Market (DEM). Thus, the aim of this paper is to check for the existence of this stock anomaly in the Mauritian stock market.

The next section gives the empirical background of the day of the week effect, depicts the former empirical studies and the results. In section 3 we provide an overview of the Development & Enterprise Market (DEM) while section 4 presents the research methodology. Section 5 displays the analysis of the results and finally section 6 concludes the paper.

2. Prior Research

Time patterns in asset prices have been subject to many studies since its very existence providing a very flourished and extensive literature on this topic. Day of the week effect is just one out

[1] Jaffe and Westerfield (1985), Dubois and Louvet (1996), Brooks and Persand (2001)
[2] Ajayi and Mehdian (2004)

of the very number of calendar anomalies that exist and is often termed as the DOW effect. It can be summarized by describing Monday as a bad day because at the start of the week, the market is usually bearish while at the end of the week, Friday is considered as a good day and the market is buoyant. Indeed, Agrawal and Tandon (1994), Alexakis and Xanthakis (1995), and Balaban (1995) depicted for various countries that on some days of the week relatively low returns are experienced while on others relatively higher returns are found. The most prominent studies carried out used the US stock market and the researchers[3] have documented that on Monday across the different samples taken by each that lowest returns are observed but though Mehdian and Perry (2001) obtained the same results for small-cap companies, large-cap companies displayed the traditional reversal of the Monday effect propounded by Gibbons and Hess (1981), who additionally reported significantly higher returns on Wednesdays and Fridays. Jaffe and Westerfield (1985) decided on their part to broaden their research and examined the anomaly from an international perspective by analyzing four different stock markets namely U.K, Japan, Canada and Australia and discovered that for U.K and Canadian stock market evidence of Monday effect was observed but for the other equity market lower returns turned out on Tuesdays.

Reviewing studies carried out on emerging markets, Brooks and Persand (2001) found intriguing results with Asian stock markets with some showing no signs of calendar effect like South Korea while others Tuesday and Wednesday effects in Malaysia and Taiwan respectively. Kumari and Mahendra (2006) analyzed the Bombay Stock Exchange and the National Stock Exchange to find the presence of reversal of the traditional Monday effect and negative returns on Tuesdays. Basher and Sadorsky (2006) chose to investigate the anomaly in 21 emerging markets, only to discover that only three of them have displayed signs of calendar effects with a Friday effect for Taiwan among others. Gao and Kling (2005) documented for the Chinese stock market that Friday effect was present but that it would last only for a short period as the source of this anomaly was speculation both from individual and institutional investors.

However some researchers in their quest of search of this did not in fact see their existence like for instance Hussain (1999) and Nishat and Mustafa (2002) documented no calendar anomalies in the Pakistani equity market and Karachi Stock Exchange respectively. Besides, focusing on the Spanish stock market, some researchers[4] discovered trivial day of the week effects.

In truth, many attempts have been made by researchers to try to identify some of the causes resulting in these calendar anomalies and the reasons obtained varied from one to another. One of the foremost reasons advanced was that of inefficiency of the stock market as put forward by Elton and Gruber (1995) but conceded also that there may be patterns that come at random when studying the same data and not necessarily that anomalies are present. Keim and Stambaugh (1984) and Rogalski (1984) considered on their side that this may simply be due to a non-trading problem whereby mingling both small and large stocks give rise to these anomalies.

Moreover there is usually the issue concerning the settlement surrounding a particular transaction and Lakonishok and Levi (1982), alongside Keef and McGuinness (2001) confirmed that the payment procedures may be a cause for day of the week effect. Condoyanni & al. (1987) have considered the anomaly from a different perspective and suggested that the source of the problem was found in the time-zone theory whereby what happens in one particular market on one day will have a snowball effect on another market the next day. Hence, they considered that the so called Monday effect depicted on the US stock market was the simply the cause to Tuesday effect that other markets displayed.

Furthermore, it is good to bear in mind that the anomaly is the resultant of the individual investor himself. In fact the investor psychology is the key to this phenomenon as set forth by Rystrom and Benson (1989) Pettengill (2003) who documented that the investor pessimism on Mondays led to the Monday effect as they are reluctant to trade on that date based on the presumption that the seller may have obtained some adverse information on the stocks put for sale during the week end, thereby not taking up any risk of having to bear imminent potential losses. Alongside, it has been observed that the moody attitude of the investor creates optimism at the end of the week and therefore the market is bullish on Friday pushing up prices, hence leading to abnormally higher returns.

[3] Gibbons and Hess (1981) Lakonishok and Smidt (1988)

[4] Santemases (1986), Pena (1995) and Gardeazabal and Regulez (2002)

3. Development & Enterprise Market – An overview

The Stock Exchange of Mauritius (SEM) has been constantly booming since its existence and many developments have set off a chain reaction making it a platform of utmost importance for investment in the country. There are broadly two main equity markets in the Mauritius Stock Exchange namely, the Official Market and Development and Enterprise Market (DEM). The latter has recently been given birth to, more precisely on 4th August 2006 where it was launched to accommodate mostly the small to medium sized companies listed on the Over-The-Counter Market, lower market capitalization but which have high growth potential and in the look for additional resources, mainly foreign capital funds to propel their businesses and activities. This is so because the requirements for compliance are lower alongside the easier documentation for the listing company.

When the DEM was set up, 43 companies aggregating a market capitalization of approximately US$1 bn were reported quoted on this new market and trading took place thrice a week but eventually with the driving spirit and great zeal from the part of investors making it a real success, trading move to five days a week on 14th March 2007. To track the evolution of the DEM, the DEMEX measuring the price performance of the market and the DEMTRI, which is a total return index have been constructed. Actually the listed companies have increased to attain 52 by the end of 2008 with a market capitalization of US$ 1.185 bn[5]and are categorized into 7 sectors – namely Commerce, Industry, Investments, Leisure & Hotels, Sugar, Transport, Banks and Insurance. The rules governing the DEM have been established under the Financial Services Commission and trading is done through the Stock Exchange of Mauritius Automated Trading Systems (SEMATS) substituting the conventional and feudal open-outcry single auction method. Indeed the implementation of the Central Depository and Settlement Co. Ltd has accelerated and provided an easy way to clear and settle all transactions.

4. Research Methodology

For the purpose of examining the day of the week effect on the Stock Exchange of Mauritius, daily observations of the DEMEX are used. The DEMEX is an index constituting of ordinary shares of companies quoted on the Over-The-Counter Market (OTC) and each stock is weighted according to its share in the total market capitalization. The methodology used to compute the index is to use the current value of the DEMEX in regard to a base period, which is set at 4th August 2006 whereby only companies that would have traded on that day would be included in the calculation of the initial market capitalization using a simple summation. The daily index number employed for this analysis is from August 2006 to May 2009[6]. Unconditional logarithmic returns that amounting to 637 observations are calculated as follows:

$$Rt = \ln (I_t / I_{t-1}) \quad (1)$$

where *It* and *Rt* refers to DEMEX number and return on the DEMEX on day *t*, respectively. Returns for each day of the week are separately calculated for each year as well as for the whole period.

In order to test the existence of statistically significant difference among index returns on different days of the week the following regression is run for the period 2006 to 2009:

$$R_t = B_1 D_{1t} + B_2 D_{2t} + B_3 D_{3t} + B_4 D_{4t} + B_5 D_{5t} + B_6 R_{t-1} + ut \quad (2)$$

where $D_{1t} = 1$ if day *t* is a Monday and 0 otherwise; $D_{2t} = 1$ if *t* is a Tuesday and 0 otherwise; and so on. The OLS coefficients B_1 to B_5 are the mean returns for Monday to Friday, respectively while the lagged variable has been added to cater for the problem of autocorrelation. The stochastic disturbance term is indicated by *ut*.

The hypothesis to be tested for any presence of weekday effects is as follows:

$$B_1 = B_2 = B_3 = B_4 = B_5 \quad (3)$$

[5] Stock Exchange of Mauritius Factbook 2009

[6] Essentially, the DEM has been trading on a daily basis for the full year as from 2007.

5. Analysis of Data

The table 1 below provides summary statistics for daily DEMEX returns across the days of the week for different time periods.

Table 1

YEAR	2006	2007	2008	2009	2006-2009
MONDAY					
Observations	19	51	51	18	139
Average[9]	0.004273663	-7.2215E-05	-0.000970055	0.000992812	0.00033032
S.Deviation	0.012514094	0.007076806	0.005758478	0.003652345	0.007423784
P-Value[10]	0.1539	0.9422	0.2346	0.2648	0.6007
TUESDAY					
Observations	NIL	38	50	20	108
Average	NIL	-0.00083393	-0.000570693	-0.000270873	-0.00060779
S.Deviation	NIL	0.006263538	0.004617696	0.010044016	0.006425314
P-Value		0.4171	0.3864	0.9053	0.3278
WEDNESDAY					
Observations	21	52	49	20	142
Average	0.003858203	0.000916663	-0.000578044	0.001185386	0.000873749
S.Deviation	0.01254781	0.007819603	0.007690889	0.005216407	0.00838606
P-Value	0.1742	0.4019	0.6012	0.3223	0.2165
THURSDAY					
Observations	NIL	41	48	20	109
Average	NIL	-0.0010726	-0.001712075	-0.001195886	-0.001376823***
S.Deviation	NIL	0.006411416	0.007504679	0.011124618	0.007848407
P-Value		0.2905	0.1207	0.6362	0.0698
FRIDAY					
Observations	21	49	50	19	139
Average	0.00779386**	0.001942707**	-0.001594743**	-0.000379277	0.001236836***
S.Deviation	0.013447994	0.005166657	0.004868189	0.004215832	0.007497487
P-Value	0.0152	0.0114	0.0248	0.6996	0.0538

From Table 1, it is observed that there is a Tuesday and Thursday effect on the DEM market. In fact, across all years, the average returns have been negative on Tuesday and Thursday. Taking into account the whole period 2006-2009, this pattern is also observed where the highest negative average returns are observed on those two days. The highest positive average returns for the whole period seem to occur on Friday and Wednesday. However, for the whole period, all returns are statistically equal to zero with the exception of the average returns for Thursday and Friday. Also, on a yearly basis, average Friday returns from 2006 to 2008 are the only statistically significant returns. As such, the overall conclusion will be that average Friday returns are among the highest wile Thursday returns are statistically confirmed as being the lowest. With regards to the standard deviation, the results suggest that lowest standard deviation for the whole period 2006-2009 is associated with Tuesday returns. However, on a yearly analysis, it seems that Friday returns exhibit lowest standard deviation across all years, except in 2006.

In addition, the following hypothesis is tested based on the results of Table 1 and the results are summarised in Table 2.

Hypothesis: Testing of a day of the week effects

Ho: Mean returns are not significantly different across the five trading days

H1: Mean returns are significantly different across the five trading days

Table 2. Testing of the day of week effects

	2006	2007	2008	2009	2006-2009
F-statistics	0.587470	1.610446	0.379147	0.338138	2.424343*
P-value	0.5590	0.1725	0.8234	0.8516	0.0470

From table 2, it appears that the mean returns are not significantly different across the five trading days for all given years. However, taking into account the whole period from 2006 to 2009, there are evidences of day of the week effects. The above results may be consistent with earlier results where returns are statistically zero for most of the years, except for Thursday and Friday. On the other hand, the contrasting results for the yearly analysis against the whole period may reveal the sample size limitation which the yearly analysis suffers. However, given that the DEM market is still at its infancy stage, it may be suggested to wait for more data to be available to provide more solid evidence for the day of the week effect.

The results of regressions with dummy variables are presented below in Table 3.

Table 3. Regression Results[7]

$$R_t = B_1 D_{1t} + B_2 D_{2t} + B_3 D_{3t} + B_4 D_{4t} + B_5 D_{5t} + B_6 R_{t-1} + u_t$$

	B_1	B_2	B_3	B_4	B_5	B_6	F-Statistics
2006[8]	-0.000764	n/a	0.001765	n/a	0.005725**	0.53626*	7.939620
p-value	0.7859		0.4751		0.0233	0.0000	0.000168
2007	-0.00026	-0.00064	0.000991	-0.00105	0.001911**	0.091654	1.631010
p-value	0.7841	0.5583	0.289	0.3116	0.0457	0.1688	0.152773
2008	-0.00054	-0.00028	-0.00032	-0.00165	-0.00107	0.299345*	5.097047
p-value	0.503	0.6612	0.7692	0.0731	0.1771	0.0085	0.000184
2009	0.000863	-0.00037	0.001238	-0.00136	0.000149	0.192756**	0.953211
p-value	0.6399	0.8255	0.4657	0.4242	0.9325	0.0718	0.450905
2006-2009	0.000295	-0.00054	0.000752	-0.00119	0.00103***	0.144221*	4.613938
p-value	0.6412	0.3851	0.2792	0.1167	0.0907	0.0043	0.000383

From the above table, all the regression results have been test for autocorrelation and heteroscedasticity. It is observed that the Durbin Watson statistics for all regression results are close to

[7] Note 1: ***,**,* denotes statistical significance at 1%,5% and 10% level with p-values reported below each coefficient

[8] For the year 2006, the DEM was trading only three days a week.

2 and as such, free from autocorrelation. In the same spirit, the White test has been used to test for heteroscedasticity and corrections have been made where appropriate to ensure constant variance of the residuals. Based on the results for the whole period, a Friday effect is observed while the coefficients for all the other days remain statistically insignificant. The finding is consistent with earlier results from table 1. Similarly, on a yearly analysis, there seems to be a Friday effect for the year 2006 and 2007. However, for all the other days across all years, the coefficients were insignificant.

With the exception of 2007 and 2009, the coefficients for the five trading days were jointly statistically not equal to zero, showing some support for the day of the week effects. Similarly, for the whole period 2006 to 2009, the F-statistics were significant.

6. Conclusion

This paper attempts to assess whether or not day of the week effects does exist on the DEM market of the stock exchange of Mauritius. The results initially show average returns seem to be lowest on Thursday and highest on Friday. With regards to the regression analysis, it seems that a Friday effect is confirmed for the whole period 2006 to 2009. The returns for all the other days are insignificant. However, as stressed out earlier, the DEM market is still in its infancy stage such that data limitation may be a problem. Undoubtedly, this anomaly needs to be revisited again in the nearby future where more data will be available.

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ARE STOCK EXCHANGES INTEGRATED IN THE WORLD? – A CRITICAL ANALYSIS

Vijay Kumar **VARADI,** Nagarjuna **BOPPANA**
Department of Economics,
University of Hyderabad, Hyderabad, **India**
varadivk@gmail.com, bnss@uohyd.ernet.in

Abstract:

In the recent times rapid reforms made the world into a global village in nature and in terms of efficiency, transparency. The information flow in one market may affect the other markets in the world, because of its integration. In this regard, this paper explores the objective whether there is any integration of markets taken place or not. For reaching the objective, we have used rigorous time series techniques for the equal period of data (1st January, 2001 to 30th April, 2009) of 17 stock exchanges in the world, which includes Asia, Europe, north America, Latin America etc.,. Our findings are markets within the region are well integrated both in terms of short run and long run equilibrium, because of its less cross-country restrictions. Many of the markets are showing granger causal relations between each other.

Key Words: stock markets, co-integration, economic reforms

JEL Classification: C12, C22, E44, G00, G15

Introduction:

Economic reforms in the process of globalization positively changes in its nature of world stock exchanges. Many research scholars would pose a question, is stock exchanges are become integrated in the reform period. In the recent years, the world economies are moving its own dimension, is experiencing a new kind of financial crisis with its integrity and efficiency. Recent years are evident to stock exchanges, stock prices are falling drastically and majority of investment in stock market and its allied services is evaporating and no idea how it makes people miserable.

The integration of stock exchanges produces a number of significant efficiency gains, some of which are passed on by the exchanges to their users (intermediaries, investors and issuers) in the form of lower fees, and some of which accrue directly to users. The integration of exchanges eliminates the duplication of costly infrastructure, thus reducing the average cost of processing a trade. The competitive constraints imposed by other trading mechanisms and the bargaining power of users induce the integrated exchange to pass on those cost savings to its members by reducing trading fees. Final investors can then benefit from this reduction in the explicit costs of trading in the form of lower brokerage fees.

Many researchers are found that co-integration among national stock markets may be implied by one or more of the following factors: less cross-country restrictions on stock investment and foreign ownership. A question then arises here: what kind of co-integration, linear or nonlinear, are these factors supposed to result in? So far, all of the studies on international stock market integration that adopt co-integration analysis have taken the former for granted if co-integration is indeed present, while completely ignoring the latter. Therefore, it is of importance to detect the possible existence of linear and nonlinear co-integration among national stock markets.

However, the former studies specifies and estimates a nonlinear regression model without paying attention to the possible non-stationarity of the regressand and the regressors that are the transformations of the original time series. Thus the study is unable to cut loose from the problem of spurious regression which co-integration techniques have been developed to overcome. In the latter study, the authors use the original series and their cross-products and squares in the co-integration regression model after unit root tests are applied to ensure that all the complex elements in the vector are integrated of the same order (order one). Furthermore, the normality condition for employing the Johansen method is violated. Even though the authors argue that no autocorrelation in the residuals is more important than the normality condition, this does not mean that the latter is unimportant as finite sample critical values are computed using normally distributed data.

In the theoretical literature, financial market integration derives from various postulates such as the law of one price (Cournot (1927). Despite distinguishing features, these postulates share a common perspective: if risks command the same price, then the correlation of financial asset prices and the linkage among markets comes from the movement in the price of risks due to investors' risk aversion. Based on these theoretical postulates, financial integration at the empirical level is studied using several factors. Among several others in the applied finance literature, have used the co-integration hypothesis to assess the international integration of financial markets. Taylor and Tonks (1989) found that the co-integration technique is useful from the perspective of the international capital asset price model. Kasa (1992) suggested that the short-term return correlation between stock markets is not appropriate from the perspective of long-horizon investors driven by common stochastic trends.

The co-integration model is useful since it not only distinguishes between the nature of long-run and of short-run linkages among financial markets, but captures the interaction between them as well. What is striking about the empirical literature is that studies on the subject have brought to the fore various useful perspectives relating to price equalization, market equilibrium, market efficiency and portfolio diversification (Chowdhry *et al* (2007)).

Harvey (1995) suggested that the improvement in market efficiency is consistent with increasing integration with world markets. If markets are predictable and foreign investors are sophisticated, then investors are likely to profit from the predictability of returns. Hassan and Naka (1996) suggest that in co-integrated markets, price movements in one market immediately influence other markets, consistent with efficient information sharing and free access to markets by domestic and foreign investors. Another viewpoint is that national stock markets are different since they operate in the economic and social environments of different countries. Accordingly, a country's financial market is efficient when prices reflect the fundamentals and risks of that country, rather than the fundamentals and risks of other countries. Several studies have, however, argued that financial integration could occur due to real economic interdependence or linkages among economic fundamentals across nations. For instance, the profit and loss account and the balance sheet of a domestic company relying on a large volume of exports and imports can be affected by the macroeconomic fundamentals of other countries.

Based on these considerations, the current paper attempts to detect non-linearity in the long-run equilibrium relationship between several national stock markets. It is organized as follows.

Motivation of the study:

When we plot (Figure 1) the closing prices of different stock markets, we found the falling trend in all markets at same point. It makes to go in deep, study about the reflection and affect of stock prices on other markets relatively.

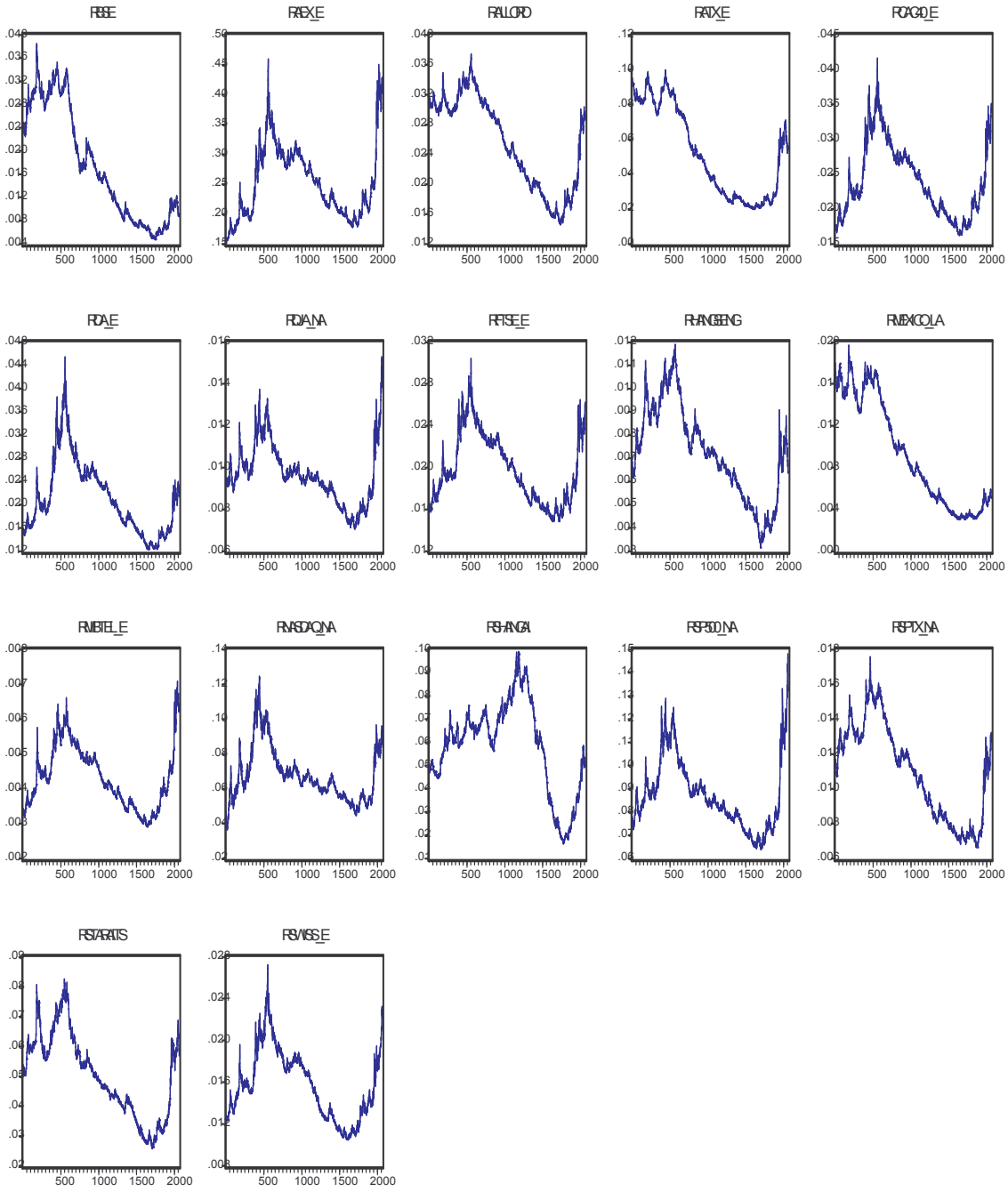

Figure 1. Return values of different stock indices

Objectives and Hypothesis:

This paper major objective is to understand the co-integration relationship between intra and inter stock exchanges in the world and how they are integrated towards reaching the efficiency.

H_0: Stock Markets are well co-integrated and leads to major fall or leads to financial crisis

H_1: Otherwise

Data Sources:

World stock exchanges price series is collected and taken support from various data sources; such as world stock exchanges, yahoo finance, BSE and its own stock exchanges for daily data of closing price series for almost 17 major stock exchanges in the world. The data which includes ie., **in Asia and Pacific Markets** we have Bombay Stock Exchange (BSE), All Ordinaries, Shangai, Hang Seng, Jakarta Composite, KLSE, Nikkei 225, Staraits Times; **in European Markets** we have ATX (Vienna), CAC-40 (Paris), DAX, AEX –General (Amesterdom), MIBTEL (Milan), Swiss Market, FTSE 100; **in Latin American Markets** we have MERVAL, Bovespa and IPC (Mexico) **and in North American Markets** we have S&P TSX Composite, Dow Jones Index, S&P 500 index and Nasdaq-100.

Data:

The data we have considered in this paper is daily data for the period 1st January, 2001 to 30th April, 2009. The data includes closing prices of the every stock market indices.

Methodology:

To study the above said objectives, I have followed the following methodology. First I have changed the raw data into the return form for normalize the data. Then I have concentrated on descriptive statistics i.e., Mean, standard deviation, minimum, maximum, skewness, kurtosis and J-B Statistic to know the behavior of the data. After that, I just regress RBSE (return series of Bombay Stock Exchange) as a dependent variable, other variables are independent variables to check whether there is any relationship taken place, but D-W statistics shows autocorrelation exists. I checked the correlation matrix for at what stages all these variables correlated each other.

Although regression analysis deals with the dependence of the variable on other variables, it does not necessarily imply causation. To find lag length of the variable, whether they have any unit root or stationary, I have used ADF statistics with level form and ADF statistics with first difference, I found in level form there is a unit root.

A Vector Error Correction Model:

The finding that many time series may contain a unit root has spurred the development of the theory of non-stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary, linear combination exists, then the non-stationary time series are said to be co-integrated. The stationary linear combination is called the co-integrating equation and may be interpreted as a long-run equilibrium relationship between the variables. Although the two series may be non stationary they may move closely together in the long run so that the difference between them is stationary. The series RBSE and RAEX_E are said to be integrated of the order one, denoted by I(1), if they become stationary after first difference. If there are two such series which are I(1) integrated and their linear combination is stationary, then these two series are said to be co-integrated. This relationship is the long run equilibrium relationship between RBSE and RAEX_E.

A principal feature of co-integrated variables is that their time paths are influenced by the extent of any deviation from long-run equilibrium. If the system is to return to its long run equilibrium, the movement of at least one variable must respond to the magnitude of the disequilibrium. If co-integration exists between St and Ft, then Engle and Granger representation theorem suggests that there is a corresponding Error Correction Model (ECM). In an ECM, the short term dynamics of the variables in the system are influenced by the deviations from the equilibrium.

The present research, seeks to determine whether there exists an equilibrium relationship between the different indices. Engle and Granger suggest a four step procedure to determine if the two variables are co-integrated. The first step in the analysis is to pre-test each variable to determine its order of integration, as co-integration necessitates that the two variables be integrated of the same order. Augmented Dickey- Fuller (ADF) test has been used to determine the order of integration. If the results in step one show that both the series are I(1) integrated then the next step is to establish the long run equilibrium relationship in the form

$$RBSE_t = \beta_0 + \beta_1 RAEX\_E_t + e_t \qquad \text{Eq (1)}$$

Where RBSE is the log of Bombay stock exchange index; RAEX_E is the log of aex_E index prices at time t and e_t is the residual term. In order to determine if the variables are co-integrated we need to estimate the residual series from the above equation. The estimated residuals are denoted as (ê). Thus the ê series are the estimated values of the deviations from the long run relationship. If these deviations are found to be stationary, then the RBSE and RAEX_E series are co-integrated of the order (1,1). To test if the estimated residual series is stationary Engle- Granger test for co-integration was performed.

The third step is to determine the ECM from the saved residuals in the previous step.

$$\Delta RBSE_{\mathrm{t}} = \alpha_1 + \alpha_{RBSE}\hat{e}_{t-1} + lagged\left(\Delta RBSE_t, \Delta RAEX\_E_t\right) + \varepsilon_{RBSE,,t} \quad \text{Eq (2)}$$

$$\Delta \mathrm{A}EX\_E_{\mathrm{t}} = \alpha_1 + \alpha_{RAEX\_E}\hat{e}_{t-1} + lagged\left(\Delta RBSE_t, \Delta RAEX\_E_t\right) + \varepsilon_{RAEX\_E,t} \quad \text{Eq (2.1)}$$

In the above equations, $\Delta RBSE_t$ and $\Delta RAEX\_E_t$ denote, respectively, the first differences in the log of spot and futures prices for one time period. $\hat{e}_{t-1}$ is the lagged error correction term from the co-integrating equation and $\varepsilon_{RBSE,t}$ and $\varepsilon_{RAEX\_E,t}$ are the white noise disturbance terms.

The above equations describe the short-run as well as long-run dynamics of the equilibrium relationship between spot index and futures index. They provide information about the feedback interaction between the two variables.

In the equation $\Delta RBSE_t$ has the interpretation that, change in $RBSE_t$ is due to both, short-run effects. From lagged futures and lagged spot variables and to the last period equilibrium error $\hat{e}_{t-1}$, which represents adjustment to the long-run equilibrium. The coefficient attached to the error correction term measures the single period response of changes in spot prices to departures from equilibrium. If this coefficient is small then spot prices have little tendency to adjust to correct a disequilibrium situation. Then most of the correction will happen in the other index prices.

The last step involves testing the adequacy of the models by performing diagnostic checks to determine whether the residuals of the error correction equations approximate white noise. The reverse representation of Engle and Granger's Co-integration analysis along with the empirical findings has been given in the appendix. A pair wise Granger Causality test was done to establish the cause and effect relationship between the different series.

For causality, we have used Granger causality test which assumes that the information relevant to the prediction of the respective variables. The test involves estimating the following regressions:

$$RBSE_t = \sum_{i=1}^{n}\alpha_i AEX\_E_{t-i} + \sum_{j=1}^{n} RBSE_{t-j} + u_{1t} \quad \text{Eq (3)}$$

$$AEX\_E_t = \sum_{i=1}^{m}\lambda_i AEX\_E_{t-i} + \sum_{j=1}^{m}\delta_j RBSE_{t-j} + u_{2t}$$

Where it is assumed that the disturbances u_{1t} and u_{2t} are uncorrelated.

Results Discussion:

As we discussed earlier, the simple/ descriptive statistics reveals (Table 1) that all series of indices behavior in terms of Mean, Standard Deviation, skewness, kurtosis and J-B statistic. The mean is a measure of the center of the distribution of the series. Whereas, standard deviation is the measure of degree of desperation of the data from the mean value, it indicates form the table spread exists in all indices. Skewness is a measure of symmetry. In the given table, except rallord, rshagai (negative skewness having left tail) all are having positive skewness, but rnasdaq_na is having positive skewness i.e., (1.013) which indicates a long right tail exists. Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution i.e, k=3. But in the given indices there is no such series are to be seen. But, all the indices are negative excess kurtosis with having heavy peaked in its nature..

Table 1. Simple Statistics

Variable	Mean	Std Dev	Min	Max	Skewness	Kurtosis	J-B
Rbse	0.01744	0.00968	0.00479	0.03847	0.372299	-1.35197	204.576
raex_e	0.25175	0.05987	0.15581	0.45884	0.702415	-0.068381	169.879
Rallord	0.02544	0.00614	0.01459	0.03741	-0.184831	-1.367147	172.243
ratx_e	0.05207	0.02590	0.02007	0.09968	0.255174	-1.520951	220.020
rcac40_e	0.02397	0.00528	0.01621	0.04162	0.578205	-0.599483	145.701
rdax_e	0.02113	0.00634	0.01234	0.04540	0.861994	0.337652	265.022
rdja_na	0.00966	0.00142	0.00706	0.01528	0.579020	0.340848	125.139
rftse_e	0.01985	0.00332	0.01485	0.03043	0.471153	-0.804038	131.767
Rhangseng	0.00721	0.00203	0.00316	0.01189	0.070610	-0.755893	50.779
rmexico_la	0.00924	0.00511	0.00305	0.01968	0.334909	-1.434489	215.238
rmibtel_e	0.00433	0.0008974	0.00291	0.00708	0.499589	-0.524792	109.384
rnasdaq_na	0.06769	0.01539	0.03664	0.12436	1.013820	-0.775439	404.697
Rshangai	0.05816	0.01983	0.01642	0.09891	-0.426033	-0.551224	88.439
rsp500_na	0.08729	0.01513	0.06391	0.14792	0.879686	0.405621	279.945
rsptx_na	0.01096	0.00274	0.00663	0.01756	0.066348	-1.196638	124.480
Rstaraits	0.05026	0.01403	0.02580	0.08242	0.118407	-0.902155	74.708
rswiss_e	0.01570	0.00331	0.01049	0.02721	0.434573	-0.449368	82.212

The correlation matrix (Table 2) reveals that, there is a positive correlation between Bombay stock exchange indexes with other indices. Bombay stock index is having positive i.e., nearer to one relationship is having allord, atx_e, sptx_na, stratits. And positive with greater than 0.5 indices are cac40_e, dax_e. dja_na, ftse_e, mibtel, nasdaq, sp500_na and swiss_e. But there is least correlation between Bombay stock exchange index with aex_e and shangai.

Table 2: Cross correlations: For all Markets

	RBSE	RAEX E	RALLORD	RATX E	RCAC40 E	RDA E	RDJA NA	RFTSE E	RHANG	RMEX	RMIB	RNASDAQ	RSHANGAI	RSP500 NA	RSPTX NA	RSTARAITS	RSWISS E
RBSE	1	0.216	0.914	0.936	0.536	0.648	0.673	0.593	0.904	0.980	0.559	0.631	0.295	0.608	0.926	0.898	0.641
RAEX E	0.216	1	0.496	0.257	0.914	0.795	0.718	0.861	0.527	0.168	0.864	0.681	0.367	0.769	0.508	0.537	0.837
RALLORD	0.914	0.496	1	0.913	0.734	0.787	0.810	0.778	0.926	0.917	0.759	0.694	0.412	0.760	0.968	0.953	0.805
RATX E	0.936	0.257	0.913	1	0.541	0.577	0.735	0.610	0.855	0.943	0.622	0.614	0.139	0.688	0.904	0.908	0.642
RCAC40 E	0.536	0.914	0.734	0.541	1	0.940	0.831	0.963	0.768	0.492	0.942	0.831	0.403	0.865	0.758	0.761	0.957
RDA E	0.648	0.795	0.787	0.577	0.940	1	0.778	0.923	0.832	0.617	0.843	0.807	0.522	0.778	0.815	0.798	0.930
RDJA NA	0.673	0.718	0.810	0.735	0.831	0.778	1	0.870	0.841	0.646	0.871	0.885	0.382	0.980	0.827	0.889	0.872
RFTSE E	0.593	0.861	0.778	0.610	0.963	0.923	0.870	1	0.808	0.554	0.928	0.858	0.379	0.901	0.801	0.815	0.970
RHANG	0.904	0.527	0.926	0.855	0.768	0.832	0.841	0.808	1	0.864	0.774	0.807	0.485	0.797	0.946	0.952	0.827
RMEX	0.980	0.168	0.917	0.943	0.492	0.617	0.646	0.554	0.864	1	0.513	0.567	0.295	0.569	0.911	0.881	0.605
RMIB	0.559	0.864	0.759	0.622	0.942	0.843	0.871	0.928	0.774	0.513	1	0.802	0.318	0.902	0.779	0.799	0.928
RNASDAQ	0.631	0.681	0.694	0.614	0.831	0.807	0.885	0.858	0.807	0.567	0.802	1	0.342	0.915	0.760	0.784	0.829
RSHANGAI	0.295	0.367	0.412	0.139	0.403	0.522	0.382	0.379	0.485	0.295	0.318	0.342	1	0.286	0.410	0.374	0.382
RSP500 NA	0.608	0.769	0.760	0.688	0.865	0.778	0.980	0.901	0.797	0.569	0.902	0.915	0.286	1	0.788	0.844	0.887
RSPTX NA	0.926	0.508	0.968	0.904	0.758	0.815	0.827	0.801	0.946	0.911	0.779	0.760	0.410	0.788	1	0.962	0.828
RSTARAITS	0.898	0.537	0.953	0.908	0.761	0.798	0.889	0.815	0.952	0.881	0.799	0.784	0.374	0.844	0.962	1	0.838
RSWISS E	0.641	0.837	0.805	0.642	0.957	0.930	0.872	0.970	0.827	0.605	0.928	0.829	0.382	0.887	0.828	0.838	1

Table 3. Regression results

Dependent Variable: RBSE **Method: Least Squares** **Sample: 1 2061** **Included observations: 2061**				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.001877	0.000511	-3.676565	0.0002
RAEX_E	-0.009936	0.002503	-3.969651	0.0001
RALLORD	0.182827	0.027857	6.562946	0.0000
RATX_E	-0.004735	0.007179	-0.659570	0.5096
RCAC40_E	0.083059	0.041364	2.007985	0.0448
RDA_E	-0.143537	0.023610	-6.079523	0.0000
RDJA_NA	0.668038	0.187994	3.553507	0.0004
RFTSE_E	-0.554943	0.044480	-12.47632	0.0000
RHANGSENG	1.773305	0.060411	29.35384	0.0000
RMEXICO_LA	0.770191	0.051565	14.93622	0.0000
RMIBTEL_E	-0.398041	0.135576	-2.935923	0.0034
RNASDAQ_NA	0.132507	0.007591	17.45558	0.0000
RSHANGAI	-0.052620	0.002936	-17.92480	0.0000
RSP500_NA	-0.235353	0.022091	-10.65362	0.0000
RSPTX_NA	0.911251	0.058433	15.59482	0.0000
RSTARAITS	0.045955	0.011213	4.098336	0.0000
RSWISS_E	0.456324	0.043808	10.41651	0.0000
R-squared	0.986175	Mean dependent var		0.017438
Adjusted R-squared	0.986067	S.D. dependent var		0.009678
S.E. of regression	0.001142	Akaike info criterion		-10.70320
Sum squared resid	0.002667	Schwarz criterion		-10.65676
Log likelihood	11046.65	F-statistic		9113.088
Durbin-Watson stat	0.166991	Prob(F-statistic)		0.000000

The regression results (table 3) reveal that, majority of the variables are significant at 1% level, even though there is high t-statistic evidence this and also r-square, adjusted r-square is also evidence the same picture about the results. But when we look at the D-W stat with 0.166991 indicates, the regression is having a spurious regression i.e., having high t-values, high r-square and adjusted r-square and F-statistic. It indicates that there is a non-stationary occurs among the series. However, that the long-term information contained in levels time series will be lost after the differencing. To avoid loss of long-term information, the majority of economists insisted on working with levels instead of differences.

Table 4. Augmented Dickey Fuller Test Statistic

Variable	**In level form (with intercept and trend) ADF Statistic**	**First Difference (With intercept) ADF Statistic**
Rbse	-1.9567	-32.65831
raex_e	-1.009637	-23.00168
Rallord	0.101336	-47.44972
ratx_e	0.286237	-42.83707
rcac40_e	-0.954035	-22.27270
rdax_e	-2.136046	-47.39743
rdja_na	-0.615159	-26.25541
rftse_e	-1.125754	-21.69613
Rhangseng	-2.434619	-46.78170
rmexico_la	-1.378196	-40.86398
rmibtel_e	-0.544494	-15.95365
rnasdaq_na	-2.360269	-35.94068
Rshangai	-1.462871	-45.11517

rsp500_na	-0.459460	-26.70852
rsptx_na	-0.673454	-48.53236
Rstaraits	-1.067458	-44.83061
rswiss_e	-0.574758	-21.71180

Critical values in level form -3.9625 at 1%, -3.4119 at 5%, and -3.1279 at 10%
Critical values in first difference -3.433 at 1%, -2.862 at 5%, and -2.567 at 10%

An augmented Dickey Fuller (ADF) test with 4 lags of the dependent variable in a regression equation on the return data series with a intercept and trend, results indicate that the test statistic less than the crucial values in the level form at least at 10% level. But, if I repeat the same process in the first difference with intercept not with trend, all series are exceeds the test statistic critical values. So the null hypothesis of a unit root in the all the series cannot be rejected. The test statistic is more negative than the critical value and hence the null hypothesis of a unit root in the returns is convincingly rejected. Since the dependent variable in this regression is non-stationary, it is not appropriate to examine the coefficient standard errors or their ratios. Unit roots can be obtained by estimating the shift dates running a properly augmented Dickey–Fuller (ADF) regression (Table 4); the critical values depend on the shift dates and the power of the tests declines as the maximum number of allowed shifts (which is assumed to be known) increases.

Table 5. Pair-wise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Probability
RAEX_E does not Granger Cause RBSE	2059	3.93588	0.01968
RBSE does not Granger Cause RAEX_E		2.12430	0.11978
RALLORD does not Granger Cause RBSE	2059	2.02515	0.13224
RBSE does not Granger Cause RALLORD		2.00149	0.13540
RATX_E does not Granger Cause RBSE	2059	5.13742	0.00595
RBSE does not Granger Cause RATX_E		0.20330	0.81605
RCAC40_E does not Granger Cause RBSE	2059	3.30472	0.03690
RBSE does not Granger Cause RCAC40_E		3.33658	0.03575
RDA_E does not Granger Cause RBSE	2059	2.40348	0.09066
RBSE does not Granger Cause RDA_E		5.67874	0.00347
RDJA_NA does not Granger Cause RBSE	2059	0.31500	0.72982
RBSE does not Granger Cause RDJA_NA		0.62320	0.53633
RFTSE_E does not Granger Cause RBSE	2059	0.77553	0.46059
RBSE does not Granger Cause RFTSE_E		1.48933	0.22577
RHANGSENG does not Granger Cause RBSE	2059	10.3530	3.4E-05
RBSE does not Granger Cause RHANGSENG		4.98209	0.00694
RMEXICO_LA does not Granger Cause RBSE	2059	11.6726	9.1E-06
RBSE does not Granger Cause RMEXICO_LA		9.18103	0.00011
RMIBTEL_E does not Granger Cause RBSE	2059	2.13096	0.11899
RBSE does not Granger Cause RMIBTEL_E		3.49238	0.03061
RNASDAQ_NA does not Granger Cause RBSE	2059	1.88499	0.15209
RBSE does not Granger Cause RNASDAQ_NA		2.24799	0.10587
RSHANGAI does not Granger Cause RBSE	2059	2.07382	0.12597
RBSE does not Granger Cause RSHANGAI		2.68248	0.06863
RSP500_NA does not Granger Cause RBSE	2059	0.46386	0.62892
RBSE does not Granger Cause RSP500_NA		0.10915	0.89661
RSPTX_NA does not Granger Cause RBSE	2059	1.77191	0.17027
RBSE does not Granger Cause RSPTX_NA		9.27591	9.8E-05
RSTARAITS does not Granger Cause RBSE	2059	0.49231	0.61129
RBSE does not Granger Cause RSTARAITS		8.81523	0.00015
RSWISS_E does not Granger Cause RBSE	2059	1.34510	0.26074
RBSE does not Granger Cause RSWISS_E		1.75901	0.17247

Causality between any pair of variables there is a possibility of unidirectional causality or bidirectional causality or none. The primary-condition for applying Granger Causality test is to

ascertain the stationarity of the variables in the pair. The second requirement for the Granger Causality test is to find out the appropriate lag length for each pair of variables.

For this purpose, we used the vector auto regression (VAR) lag order selection. Finally, the result of Granger causality test is reported in Table 5. There is a unidirectional causal influence between Indian stock indices and AEX, ATX_E, Hangseng, Mexico_LA, Mibtel, Shangai, Staraits. There is no causal relationship between Indian stock indices and Allord, DJA_NA, FTSE_E, SP500_NA. But there is bi-directional causal relationship between CAC40_E, DAX_E, NASDAQ_NA, SPTX_NA and SWISS_E. The present study found that direction of causality is from at 1 and 5% level of significance.

Co-integration test results:

The valuable contribution of the concepts of unit root, co-integration, etc., is to force us to find out if the regression residuals are stationary. In the language of co-integration theory, a regression known as co-integration regression and the parameter is known as the co-integrating parameter. As the unit root tests try to examine the presence of stochastic trend of time series, co integration tests search for the presence of a common stochastic trend among the variables from the unit root test results, the required condition for co integration test that given series are not I (O) is satisfied. At levels all the variables are non-stationary, where as first differenced stationary. Majority of the cases, if two variables that are I(1) are linearly combined, then the combination will also be I(1). In general, if variables with difference orders of integration are combined, the combination will have an order of integration equal to the largest.

A set of variables is defined as co-integrated if a linear combination of them is stationary. Many time series are non-stationary but 'move together' over time – that is, there exist some influences on the series, which imply that the series are bound by some relationship in the long run. A co-integration relationship may also be seen as a long-term or equilibrium phenomenon, since it is possible that co-integrating variables may deviate from their relationship in the short run, but their association would return in the long run (Chris Brooks, 1995).

To analyze long run relationship between Indian stock Market and other stock markets, Johansen co-integration model has adopted. For testing co-integration, there are two test statistics to use. First, trace statistics and other is Maximum Eigen value statistics. The results are shown in table 5. An empirical result of trace statistic indicates that the rejection of null hypothesis at 0.05 critical values i.e. there are no co-integration vector. In other words, Indian stock market has long relationship with other markets. Trace test also indicates that four co-integration equations at 1% level and one co-integration equation at 5 % level of significance, tells about long run equilibrium between Bombay stock exchange and other markets.

Table 6. Multivariate co-integration Unrestricted Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.113150	1371.519	NA	NA
At most 1	0.104365	1124.635	NA	NA
At most 2	0.083718	898.0177	NA	NA
At most 3	0.067779	718.2603	NA	NA
At most 4	0.053064	573.9602	NA	NA
At most 5 *	0.046007	461.8589	334.9837	0.0000
At most 6 *	0.041605	365.0233	285.1425	0.0000
At most 7 *	0.030684	277.6538	239.2354	0.0003
At most 8 *	0.026532	213.5790	197.3709	0.0060
At most 9	0.019171	158.2935	159.5297	0.0583
At most 10	0.017531	118.4960	125.6154	0.1251
At most 11	0.013125	82.13194	95.75366	0.2969
At most 12	0.012402	54.96791	69.81889	0.4204
At most 13	0.006529	29.30985	47.85613	0.7534
At most 14	0.004036	15.84192	29.79707	0.7234
At most 15	0.003645	7.526611	15.49471	0.5173
At most 16	9.04E-06	0.018596	3.841466	0.8914

**MacKinnon-Haug-Michelis (1999) p-values

Similarly, the empirical results of Maximum Eigen value are shown in the table 6. The empirical result indicates that the rejection of null hypothesis at 0.05 critical value i.e. no-co integration vector. It also tells that Bombay stock exchange have long run equilibrium with other markets. Maximum Eigen value indicates those two co-integration equations at 1% and one co-integration at 5 % level of significance.

Table 7. Multivariate Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.113150	246.8843	NA	NA
At most 1	0.104365	226.6174	NA	NA
At most 2	0.083718	179.7574	NA	NA
At most 3	0.067779	144.3001	NA	NA
At most 4	0.053064	112.1012	NA	NA
At most 5 *	0.046007	96.83559	76.57843	0.0003
At most 6 *	0.041605	87.36951	70.53513	0.0007
At most 7	0.030684	64.07480	64.50472	0.0549
At most 8	0.026532	55.28551	58.43354	0.0991
At most 9	0.019171	39.79754	52.36261	0.5079
At most 10	0.017531	36.36404	46.23142	0.3765
At most 11	0.013125	27.16403	40.07757	0.6214
At most 12	0.012402	25.65806	33.87687	0.3420
At most 13	0.006529	13.46793	27.58434	0.8575
At most 14	0.004036	8.315304	21.13162	0.8834
At most 15	0.003645	7.508015	14.26460	0.4309
At most 16	9.04E-06	0.018596	3.841466	0.8914

Empirical analysis Error Correction Mechanism:

From the above analysis, it has explained that, Indian capital market has long run relationship with other developing markets. But that does not mean they have short run equilibrium. There may exist short run dynamics among capital markets. For taking care of short run equilibrium Error Correction Mechanism (ECM) has been adopted. ECM empirical results have shown in the table (6). Indian capital market and Australian capital market has taken into consideration. Empirical result shows that coefficient of difference closing price ATX-100 is non-zero that means difference closing price Sensex is out of equilibrium. Since co-efficient of lagged residual is negative, the term θut-1is negative. Therefore, the dependent variable ΔX is also negative to restore equilibrium. That means dependent variable ΔX is above its equilibrium value, it starts falling in the next period to correct the equilibrium error. Empirical result also finds that Indian capital market adjusts to change in Australian capital market have a positive impact on short-run changes. Similarly, in case of UK, Japan and France, short run changes in the capital market has positive impact on short-run changes in Indian capital market except USA capital market which has shown negative impact on short run changes in Indian capital market.

Vector Error Correction estimates

Cointegrating Eq:	CointEq1
RBSE(-1)	1.000000
RAEX_E(-1)	0.055373
	(0.02067)
	[2.67931]
RALLORD(-1)	-1.091942
	(0.21132)
	[-5.16732]
RATX_E(-1)	-0.035879

Cointegrating Eq:	CointEq1
	(0.05483)
	[-0.65437]
RCAC40_E(-1)	1.890385
	(0.38265)
	[4.94027]
RDA_E(-1)	0.121756
	(0.19005)
	[0.64063]
RDJA_NA(-1)	1.606171
	(1.40853)
	[1.14032]
RFTSE_E(-1)	0.842189
	(0.35916)
	[2.34490]
RHANGSENG(-1)	-2.511124
	(0.46817)
	[-5.36375]
RMEXICO_LA(-1)	0.008306
	(0.40725)
	[0.02039]
RMIBTEL_E(-1)	2.219601
	(1.07268)
	[2.06921]
RNASDAQ_NA(-1)	-0.297622
	(0.05803)
	[-5.12900]
RSHANGAI(-1)	0.044028
	(0.02170)
	[2.02881]
RSP500_NA(-1)	-0.192976
	(0.16733)
	[-1.15324]
RSPTX_NA(-1)	1.558806
	(0.45090)
	[3.45713]
RSTARAITS(-1)	-0.010596
	(0.08544)
	[-0.12402]
RSWISS_E(-1)	-4.050963
	(0.35075)
	[-11.5495]
C	0.008051

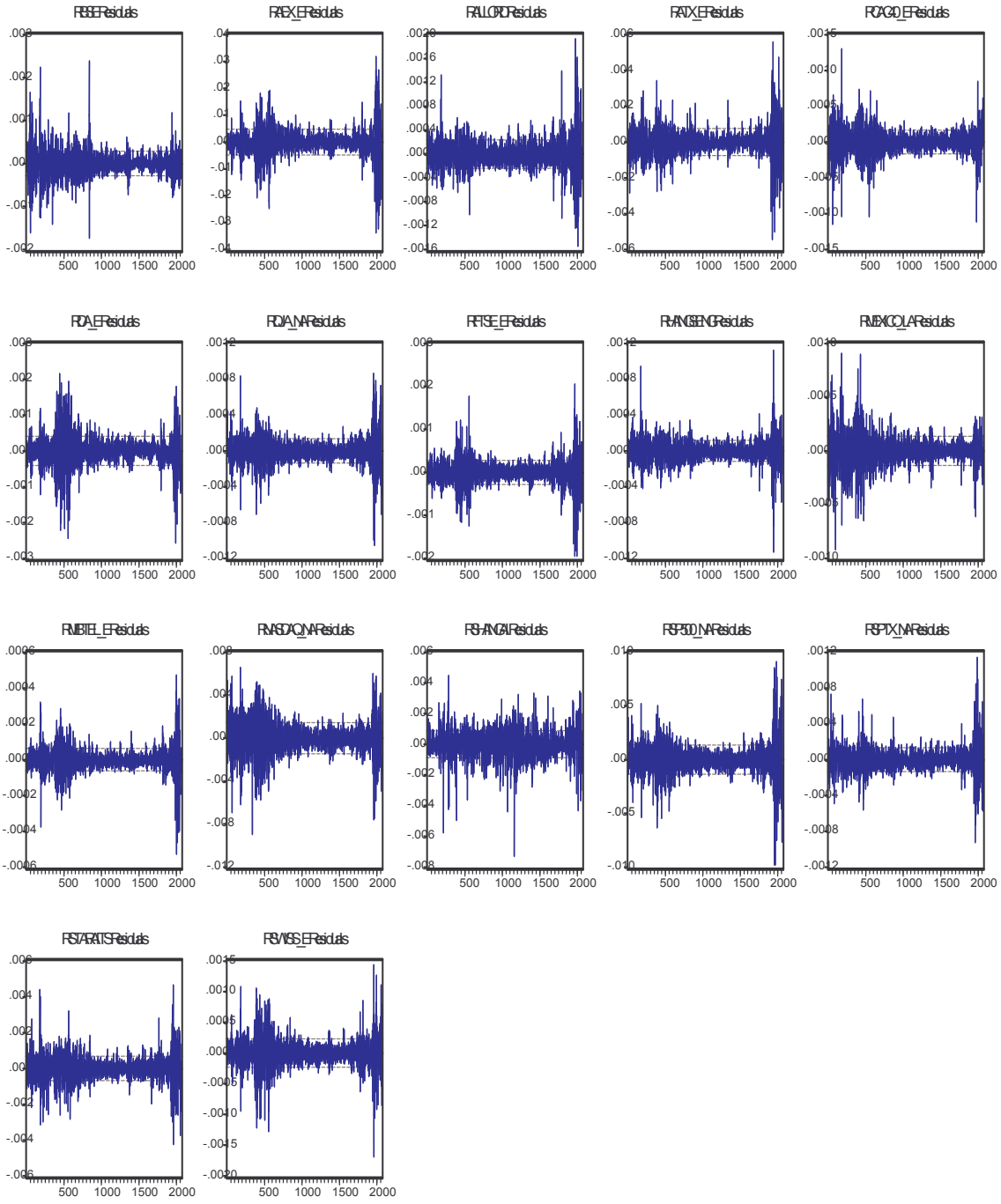

Figure 2. Residual series of stock indices

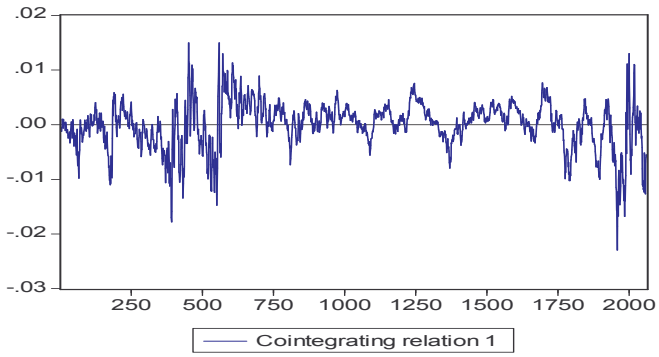

Figure 3. Co-integration analysis for the above said equation

Concluding Remarks:

This paper empirically investigates the long run equilibrium relationship between the Indian stock market and the stock market indices of five developed countries as a using the multivariate co integration. The multivariate co integration technique is used to investigate the long run relationship. To assess the short run influence of one market on the other and to assess how many days each market takes to factor out the influence Indian market, we have used the granger causality test with two days.

The study concludes, that India and other countries markets highly co integrating during the period of the study. Financial integration is the key to delivering competitiveness, efficiency and growth. But Is integration brings financial stability? Not necessarily. As it indicates that, the integration of markets may also have positive impact of financial crisis which happened all over the world.

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