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Brazda lui Novac Street, no 4 Craiova, Dolj, Romania
Phone: +40 251 598265 Fax : + 40 251 598265
Email: jarf_secretary@yahoo.com
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AN EMPIRICAL STUDY OF DIVIDEND POLICY MODELS IN INDIAN CONTEXT WITH SPECIAL REFERENCE TO ENGINEERING INDUSTRY

Deepika AGGARWAL
Rattan Group of Institutions
Mohali-Punjab, **India**

Jasmeet Singh PASRICHA
Punjabi University, Department of Commerce,
Patiala-Punjab, **India**
jspasricha1@rediffmail.com

Abstract

Hindsight of literature, last decadal studies and de facto corporate trends as studied in our empirical research conducted in hand revealed the fact that dividend payouts by the companies and their relative firms' value are based on the two theories i.e.

Keywords: dividend policy models, engineering industry, Multiple Regression Analysis, Dividend Payout Modeling.

JEL Classification: C50, C52, G32, G35

1. Introduction

Theory of Relevance and **Theory of Irrelevance** and various dividend models was given by the various academicians and professionals. Conceptually, '***dividends are payments by a corporation to shareholders and represent a return on the capital directly or indirectly contributed by the shareholders'***. *Efficient dividend decision making is of paramount importance for any company as it influences its share prices in the market, maximizes its shareholders' welfare and enhances its reputation in the market*. Hence, it is quite imperative that the companies have to be very cautious in dividend decision making. In simple words, dividend decision refers to the amount/quantum of profits to be distributed as dividend among the shareholders. There is a reciprocal relationship between retained earnings and cash dividends i.e. larger retentions mean lesser dividends whereas smaller retentions imply larger dividends as the retained earnings help the firm to concentrate on the growth, expansion and modernization of the firm. Thus, the alternative uses of net earnings – dividends and retained earnings have always been an issue of contention, competitiveness and conflicting among the various domains of knowledge.

2. Significance of dividends

The study of corporate dividend decision is important from the point of view of shareholders since it affects their current earnings as well as savings and the market value of their investments. Thus, plays an important role in creating a healthy investment climate for rapid economic growth of a country. Dividend policy influences, to a large extent, the saving pattern in an economy and corporate savings, an important source of corporate liquidity and investment potential is inversely related to the changes in dividend policies. Distribution of dividends has an impact on the savings of the household sector as well. The pattern of savings generated is thus of great importance to the planners entrusted with the task of planning for economic growth which in the long run depends upon flow of savings as viewed by Khurana (1985).

3. Objectives of the study

- *To test the applicability and validity of dividend models especially in the context of Engineering Industry in India*.

4. Hypothesis of the study

H_1: *Empirically evident that Lintners's model applicable in majority of the Indian companies.*

H_2: *Majority of Indian companies payout dividend from the current earnings after tax*.

5. Research Methodology

Descriptive research design is adopted for the study as the study encompasses review of descriptive data of various 10/40 (40 companies under doctorate degree research, however, only 10 companies considered for the research paper in hand) companies that are further spelt out 10 each from the 4 type of industries under study. For the conduct of this research paper period from 2001 – 2010 was considered and data for the study retrieved from prowess database of the Centre for Monitoring Indian Economy (CMIE), India and the selection of the firms has been made from S&P CNX 500 Index. Multiple Regression analysis tools have used to draw inferences by calculating R^2 values and F-values. Statistical tools have been used to establish facts, content validity and generalization of findings of our research study.

6. Review of Literature

Dobrovolsky (1951) analyzed the factors influencing retained earnings by using regression analysis and viewed that corporations depended, to a large extent, on current profitability, continuity of dividend policies and rate of operating asset expansion. Linter (1956) tested the dividend pattern of 28 companies for the period from1947 – 1953. He found that current year's earnings and lagged dividend were associated with current year's dividend. It was also ascertained that the financial decisions of the firms were predominantly dividend oriented.

Paul G. Darling (1957) concluded that the dividends tended to vary directly with current profit, lagged profits, the rate of amortization recoveries and shift in anticipation of future earnings; and inversely with persistent changes in level of sales. Miller and Modigliani (1961) studied the relation between dividend smoothing and information asymmetry. If the firms had more asymmetry information, they tended to smoothened dividend as it was beneficial for the firm. Brittain (1964) used the cash flow version of Lintner's model. He concluded that the funds are allocated to dividends on the basis of income with modification for tax factors, investments, liquidity positions, depreciation and sales changes. Further he suggested cash flow (net current earnings after tax plus depreciation) as a more influential determinant of dividend.

Krishnamurty and Sastry (1974) also scanned the dividend behavior through a cross section study of 40 companies belonging to the chemical industry. They perused the Lintner model's cash flow variable (gross profit net of tax) after having introduced investment expenditure and external finance established that the dividend payout bears an inverse relationship with the investment activity, while the external borrowings do not normally affect dividend distribution. Bhatia and Singh (1978) witnessed a similarity in the dividend behavior of these companies on the basis of cross section analysis. They were also of the opinion that regularity of dividend payment and the uniformity of its rate are the two basic guides for the distribution of dividends.

Ojha (1978) studied the impact of earnings, retained earnings and dividend on shares prices which has been captured through explanatory variables like liquidity, investment expenditure. The study reveals that, dividend had the most powerful impact on share prices. Dividend impact is almost two times higher than that of retained earnings. Khurana (1985) in his study analyzed dividend policy and practices in respect of selected Indian industries. His study based upon regression analysis, revealed that lagged profits offered a significant explanation of the current level of dividends. The result based on survey observed that 49 out of 65 companies considered previous year's profits for taking dividend decision for the current year. Sharma (1986) analyzed the dividend behavior of 71 companies covering six industries for the period of 1967-68 to 1980 – 81. The study found support to Lintner's model on both short term and long term basis in respect of 50% of the firms studied. Jayadev (1992) based on a sample of 18 companies selected from manmade fiber industry for the period 1978 – 79 to 1987 – 88. According to the study, the Lintner's hypothesis in the determination of dividends is found to be relevant in the sample companies while the Earnings are found to be the determinants of dividends, lagged dividend is found to be insignificant.

Akhigbe, Borde *et al.*. (1993) used an event study methodology to measure the share price response of insurers to dividend increases and matched samples of banks and industrial firms. The favorable signal of increased dividends appeared to be tempered by a perceived reduction in the contribution to capital. Consequently the level of favorable asymmetric information was less for life insurers, so the signal resulting from their dividend changes was smaller as well. Mahapatra and Sahu (1993) analyzed the dividend behavior of 90 companies covering all the major industries. The study based its analysis mainly on well-known dividend models and concluded that neither the Lintner model nor the Darling model could hold good in Indian industries in explaining the dividend behavior, however, the Brittain's cash flow model did explain the movements in dividend. Mahapatra and Sahu (1994) suggested that corporate saving decision in India was basically influenced by profit after tax during the period of study.

Jain and Kumar (1997) included a sample of 96 public limited companies that were listed on the Bombay Stock Exchange and covered a period of 12 years (1984 – 95). The study concluded that majority of Indian firms follow stable dividend policy. They seem to follow an approach similar to Lintner's model. Saxena (1999) concluded that a firm's dividend policy would depend upon its past growth rate, future growth rate, systematic risk, the percentage of common stocks held by insiders and the number of common stockholders. Reddy (2002) stated that analysis of characteristics of payers and non-payers showed that dividend-paying companies were more profitable and large in size. Anand (2004) analyzed the results of survey of 81 CFOs drawn from bt-500 companies and public sector firms (PSUs) in India to find out the determinants of the dividend policy decisions of the corporate India. The findings on dividend policy are in agreement with Lintner's study on dividend policy. He concluded that the dividend policy is used as a signaling mechanism to convey information on the present and future prospects of the firm and thus affects its market value.

Naeem and Nasr (2007) found that investment opportunity, liquidity and leverage were negatively related to dividend payout. Kanwal and Kapoor (2008) studied to identify the various factors that influence the dividend payout policy decisions of Information Technology firms in India. They suggested that dividend payout ratio was positively related to profits, cash flows but it had inverse relationship with corporate taxes, sales growth and market to book value ratio. Chauhan and Bhayani (2009) studied the impact of profitability, liquidity and size of business on dividend payout. It indicated that dividend policies of Indian companies were highly influenced by profitability and liquidity of the firm. Chigozie (2010) showed that three factors-earnings, current ratio and last year's dividends impacted significantly the dividend payout and dividend yield in Nigeria. Earnings exerted a negative impact on the payout ratio indicating that they were apportioned more earnings to retention for the ploughing back and for the growth of the firm when it experiences surplus earnings.

7. Dividend Payout Modeling Framework and Applications

Testing of Various Models

This research paper with the theoretical framework and empirical analysis of the validity of different models as propounded by Dobrovolsky (1951), Linter (1956), Darling (1957) and Brittain (1966) in explaining the dividend behavior of the selected companies.

Regression results

The validity of the model has been tested in Engineering Industry with the help of regression analysis.

Lintner Model

Lintner has assumed dividend to be an active variable and retained earnings as a residual one when appropriation of earnings is made. He opined that the dividend payments move very gradually over time, while profits and retention exhibit volatile movements and oscillate from year to year even within the same industry. In his model, dividends depend upon current year's earnings after interest and tax and last year's dividend. Hence, his hypothesis implies that the dividend payout ratio is a function of net current earnings and dividend paid in the previous year.

The Lintner's dividend model can be defined as:

$$D_t = a + b_1 P_t + b_2 D_{t-1} + U_t$$

Where,

D_t – current year equity dividend,
D_{t-1} – previous year equity dividend,
P_t – net current earnings after tax,
U_t – error term.

Regression Results of Lintner Model

The analysis of regression results of Lintner Model has been presented in Table 1. The data in the table reveals that R^2 is statistically significant in all the companies. The values of R^2 range between 0.74 and 0.99. The maximum value of R^2 i.e. 0.95 implies that 95% of the variations in the dividend payment are explained by current year's profits and last year's dividend. The F-values also hold the value of R^2 to be significant at 1% level.

The coefficient of both the independent variables i.e. net current earnings after tax and lagged dividend have shown positive significance in 60% of the companies in the context of first independent variable whereas in case of second independent variable, there is a 40% positive significance. It is evident from the above table that both the independent variables i.e. profit after tax (P_t) and last year dividend (D_{t-1}) are positively correlated with dependent variable i.e. dividend (D_t) in majority of companies under study. It is also deductive that the variable P_t is having highly positively correlation with D_t in comparison with D_{t-1}. Thus, it is inferred from the above analysis that Lintner Model offers satisfactory explanation of dividend behavior in the case of majority of companies in engineering industry.

Table 1. Regression results of Lintner's Model

Company name	a	b_1	b_2	R^2	F
Alfa Laval (India) Ltd.	14.347	0.007	.681*	0.783	12.664**
BEML Ltd.	3.098	.199**	-0.015	0.958	80.520**
Bharat Forge Ltd.	0.375	.312**	-0.063	0.934	49.375**
Cummins India Ltd.	-6.884	.250*	.675*	0.897	30.456**
Electrosteel Castings Ltd.	1.197	-0.044	1.285**	0.95	67.178**
Engineers India Ltd.	-184.774	0.048	6.132	0.794	13.505**
Graphite India Ltd.	0.078	.181**	.395**	0.993	487.768**
Greaves Cotton Ltd.	7.596	0.184	0.133	0.745	7.285*
HEG Ltd.	-0.494	.280**	-0.045	0.975	134.572**
Larsen and Toubro Ltd.	145.118	.139**	0.028	0.971	116.736**

* Significant at 5% level
** Significant at 1% level

Darling's Model

Darling (1957) holds the view that lagged dividend used in Lintner's Model may be very useful for short-term prediction purposes, instead lagged profit would offer better explanation of current level of dividends i.e. a firm moves toward the new target (rP_t) by letting current dividend reflect the target ratio, r, applied to recent past levels of earnings (rP_{t-1}) plus a smaller fraction, c, of the current change in earnings; that is, plus $c(P_t - P_{t-1})$ (Darling, 1957, p. 212). This alternative hypothesis implies the following function:

$$D_t = a + b_1 P_t + b_2 P_{t-1} + U_t \tag{1}$$

Darling further adds some more variables like depreciation and amortization recoveries, which are a source of funds and also changes in sales over the previous years which reflect working capital requirements (Darling 1957, 209 – 24).

Thus, according to Darling, for the universe of large industrial corporations, aggregate dividends will tend to vary directly with current profits, past profits, depreciation and amortization recoveries and will tend to vary inversely with persistent changes in the level of sales. This comprehensive dividend function can be expressed as follows:

$$D_t = a + b_1 P_t + b_2 P_{t-1} + b_3 A_t + b_4 \Delta S_{-2} + U_t \tag{2}$$

Where,

D_t – total equity dividend in the current year,
P_t – net profit after tax of the current year,
P_{t-1} – net profit after tax of last year,
A_t – amount of depreciation and amortization recoveries in period ‘t’,
ΔS_{-2} – change in sales in current year (period ‘t’) over the preceding two years,
U_t – error terms.

Regression results of Darling Model

The analysis of regression results of Darling Model (Table 2) over the period of 10 years reveals that coefficient of determination (R^2) is found to be statistically significant in 90% of the companies. The value of R^2 ranges between 0.83 and 0.98. The maximum value of R^2 i.e. 0.98 implies 98% of the variations in the dividend payment are explained by current year profit, lagged dividend and operating asset expansion. The regression coefficients among independent variables i.e. b_1, b_2, b_3 and b_4, only b_1 i.e. current profit after tax seems to be averagely relevant with some of the companies and other variables do not seem to have any significant impact on dependent variable. Thus, it is evident from the analysis that only profit after tax is considerably significant whereas the other variables considered by Darling do not have significant impact on dividend payout. However, according to Darling’s Model, the values of R^2, adjusted R^2 and F-values seem to be highly significant and have more dependency on first independent variable i.e. current profit after tax.

Table 2. Regression Results of Darling Model

Company name	a	b_1	b_2	b_3	b_4	R^2	F
Alfa Laval (India) Ltd.	35.026	0.264	0.336	-3.508	-0.042	0.837	6.407*
BEML Ltd.	2.72	.199**	-0.02	-0.144	0.016	0.983	73.783**
Bharat Forge Ltd.	11.675	.433**	0.141	-0.447	-0.035	0.992	157.281**
Cummins India Ltd.	-77.827	0.795	-0.282	3.477	-0.105	0.943	20.675**
Electrosteel Castings Ltd.	2.381	-0.075	-0.022	1.138**	-0.013	0.975	49.099**

Company name	a	b_1	b_2	b_3	b_4	R^2	F
Engineers India Ltd.	-431.851	-0.215	1.299	41.362	0.027	0.822	5.778*
Graphite India Ltd.	-0.817	.200**	.092**	-0.053	0.006	0.997	377.473**
Greaves Cotton Ltd.	42.294	0.106	0.107	-1.665	-0.013	0.877	5.362
HEG Ltd.	-0.655	.264**	-0.013	0.017	0.007	0.981	63.137**
Larsen and Toubro Ltd.	194.362	0.207	-0.057	-0.234	-0.005	0.984	79.329**

* Significant at 5% level.
** Significant at 1% level.

Brittain Model

Brittain has suggested an alternative hypothesis. According to him, cash flow is a better variable as compared to earnings after interest and tax in shaping the magnitude of dividends. He has strongly advocated that dividend payment being a charge on the revenue prior to depreciation necessitates earnings after interest and tax to be replaced by cash flow. His model can be expressed as follows:

Dt = a + b1 Ct + b2 Dt-1+ Ut (Cash Flow Model) (3)

Where,

Dt – total equity dividend for the current year,
Dt-1 – last years' dividend,
Ct – cash flow of current year,
Ut – error term.

However, Brittain has suggested one more model where he has replaced cash flow with net profit and depreciation. To put the same in mathematical notion, the model is detailed below:

Dt = a + b1 Pt + b2 Dt-1 + b3 At + Ut (Explicit Depreciation Model) (4)

Where,

Dt – current year equity dividend,
Dt-1 – last years' equity dividend,
Pt – current year net profit after tax,
At – current year depreciation,
Ut – error term.

Table 3. Regression Results of Brittain Cash Flow Model

Company name	a	b_1	b_2	R^2	F
Alfa Laval (India) Ltd.	14.357	0.002	0.690*	0.783	12.652**
BEML Ltd.	-0.452	.188**	0.024	0.94	55.085**
Bharat Forge Ltd.	0.412	0.166	0.088	0.652	6.552*

Company name	a	b_1	b_2	R^2	F
Cummins India Ltd.	-12.669	0.241*	0.675	0.898	30.770**
Electrosteel Castings Ltd.	1.163	-0.04	1.326**	0.948	63.816**
Engineers India Ltd.	-185.002	0.05	6.12	0.794	13.507**
Graphite India Ltd.	-2.17	0.169*	0.361**	0.993	487.408**
Greaves Cotton Ltd.	5.086	0.173	0.142	0.713	6.203*
HEG Ltd.	-4.592	0.238**	-0.098	0.973	126.786**
Larsen and Toubro Ltd.	91.646	0.106*	0.288	0.955	74.089**

* Significant at 5% level.
** Significant at 1% level.

Regression Results of Brittain Cash Flow Model (Table 3)

The analysis of regression results of Brittain Cash Flow Model over the period of 10 years reveals that coefficient of determination (R2) is found to be statistically significant in all the companies. The values of R2 cluster around 0.90 for majority of the companies. The maximum value of R2 i.e. 0.99 implies 99% of the variations in the dividend payment are explained by cash flow and lagged dividend. The regression coefficients b1 and b2 also suggest a mixed behavior of the variables. The cash flow indicates that 50% of the companies under study have a positive relation with dividend. It is amply clear from the table that cash flow is explanatory independent variable and is significant in relation to dividend. In the context of lagged dividend only 30% of the companies have shown some significant relationship. It is amply clear from the above table that both independent variables, i.e. cash flow (Ct) and last year dividend (Dt-1) are positively correlated with dividend (Dt). The cash flow (Ct) is more positively correlated as compared to lagged dividend (Dt-1).Therefore; the Brittain's Cash Flow Model explains moderate level of significance to dividend payouts among the companies under study.

Regression Results of Brittain Explicit Depreciation Model (Table 4)

The analysis of regression results of Brittain Explicit Depreciation Model reveals that R2 is statistically significant in all the companies. The values of R2 range between 0.79 and 0.99. The maximum value of R2 i.e. 0.99 implies 99% of the variations in the dividend payment are explained by profit after tax, lagged dividend and depreciation. The regression coefficients b1, b2 and b3 also suggest a mixed behavior of the variables. The profit after tax indicates that 50% of the companies under study have a positive relation with dividend. It is amply clear from the table that profit after tax is explanatory variable and is significant in relation to dividend. In the context of lagged dividend, only 10% of the companies have shown some significant relationship whereas 90% of the companies shown negative association with dependent variable i.e. dividend. However, depreciation shows only 20% significance association which, in other words, shows considerably highly negative relationship with dividend. Thus, the table shows that independent variable, i.e. profit after tax (b1) is considerably significant whereas last year dividend (Dt-1) and depreciation are negatively correlated with dividend (Dt).

Table 4. Regression Results of Brittain Explicit Depreciation Model

Company name	a	b_1	b_2	b_3	R^2	F
Alfa Laval (India) Ltd.	22.557	0.181	0.509	-1.791	0.816	8.841*
BEML Ltd.	14.312	.200**	0.003	-.559*	0.981	101.025**
Bharat Forge Ltd.	6.451	.310**	0.129	-.160**	0.989	183.430**
Cummins India Ltd.	-24.031	0.221	0.681	0.719	0.899	17.727**
Electrosteel Castings Ltd.	0.755	-0.036	0.502	0.543	0.966	56.335**
Engineers India Ltd.	-326.296	-0.056	5.389	20.623	0.798	7.908*
Graphite India Ltd.	-1.049	.175**	.377**	0.084	0.993	287.830**
Greaves Cotton Ltd.	27.602	0.16	0.378	-1.37	0.858	8.043*
HEG Ltd.	-2.432	.263**	-0.076	0.109	0.978	89.475**
Larsen and Toubro Ltd.	208.279	.163**	-0.121	-0.234	0.984	122.036**

* Significant at 5% level.
** Significant at 1% level.

Dobrovolsky Model

Dobrovolsky, in his model, advocated that the amount of the income which a corporate entity desires to retain shall also affect the dividend decision. According to him, the amount of retained income, to a large extent, influences the dividend though negatively and bit indirectly. With a given level of income, an increase (decrease) in dividend income means decrease (increase) in retained income. The level of retained income is a function of asset expansion requirement, apart from other factors, such as current year's profit and last year's dividend. His model can be expressed as:

$$D'_t = a+b_1 Y'_t + b_2 D'_{t-1} + b_3 E'_t + U_t \quad (5)$$

Where,

- D'_t – total amount of equity dividend in period't' as percentage of average net worth in period't',
- Y'_t – net current earnings after tax in period 't' as percentage of average net worth in period 't',
- D'_{t-1} – total amount of equity dividend in period't-1' as percentage of average net worth in period't-1',
- E'_t – operating assets expansion in period't' as percentage of operating assets in the beginning of the year,
- U_t – error terms.

Regression Results of Dobrovolsky's Model

The regression results of Dobrovolsky's Model in case of Engineering Industry have been presented in Table 5.

Table 5. Regression Results of Dobrovolsky Model

Company name	a	b_1	b_2	b_3	R^2	F
Alfa Laval (India) Ltd	14.865	-0.16	0.454	0.104	0.472	1.785
BEML Ltd.	0.344	.200**	-0.012	0.004	0.963	52.302**
Bharat Forge Ltd.	0.677	.266*	0.111	-0.01	0.905	19.118**
Cummins India Ltd.	2.524	0.112	0.593	-0.011	0.469	1.768
Electrosteel Castings Ltd.	2.008	0.058	0.189	0.003	0.633	3.451
Engineers India Ltd.	-15.164	0.96	1.808	-0.047	0.67	4.058
Graphite India Ltd.	-0.353	.199**	.328**	-0.001	0.97	64.564**
Greaves Cotton Ltd.	5.461	0.118	0.063	0.113	0.526	1.478
HEG Ltd.	-1.652	.327**	0.01	0.025	0.955	42.296**
Larsen and Toubro Ltd.	2.369	0.164	0.135	-0.029	0.404	1.356

* Significant at 5% level.
** Significant at 1% level.

The table describes that R2 is statistically significant only in 40% of the companies which indicates a slightly below average positive relationship between first two variables i.e. current earnings after tax and lagged dividend and negative relationship between operating asset expansion and dividend. However, only one independent variable i.e. current year profit shows significant relationship with the dividend payout whereas other two variables do not show so good relationship. Conclusively, it is evident from the analysis that only current year profit after tax is considerably significant whereas the other variables considered by Dobrovolsky do not have significant impact on dividend payout. However, the values of R2 and F-values seem to be significant and have dependency on first independent variable i.e. current year profit after tax.

8. Conclusion

It can be concluded from the data analysis carried out in this paper that dividends refer to the amount and timing of any cash payments made to the company's stockholders/ stakeholders. Dividend decision is an important element for every firm that influences its capital structure and stock price. The objective of the present study was to test the applicability of dividend models in the Indian context with special reference to Engineering Industry. It have been found that out of four models under study, the models developed by Dobrovolsky, Darling, Brittain do not offer appropriate explanation of dividend behavior in majority of the companies under study. However, the **Lintner's model** provided a good fit and considering current earnings after tax as a measure explanatory independent variable that effects the dividend payout and coefficient of determination (R2) is statistically significant at 1% for majority of the companies in the Engineering Industry.

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EQUITY HOME BIAS PUZZLE BETWEEN MACRO-FINANCE INTERFACE AND RISK-FACTORS INTERFERENCE

Mongi ARFAOUI
Mahdia University of Monastir, Faculty of Economics and Management Sciences, **Tunisia**
Arfaoui.mongi@gmail.com

Ezzeddine ABAOUB
Nabeul University of Carthage, Faculty of Economics and Management Sciences, **Tunisia**
abaoub.ezzeddine@planet.tn

Abstract

Through this article we shed light on equity home bias puzzle in the current global finance area. We aim to see where the problem lies and to highlight, theoretically and practically, its determining factors. In that framework, a sample of developed and developing markets is studied using annual frequency data over the period 2001 to 2007. By means of dynamic panel data approach, we find that equity home bias is closely associated with both local and global risk factors (risk-factors interference) and it's a matter of the macro-finance interface. Indeed, it rises with domestic economic growth, industry value added, local PER and momentum effects on domestic markets. However, it falls with the rising local inflation, trade openness, national systematic risk and cross-border capital flows. As for the value added of the paper, we confirm the rise of global risk factors and, then, the interference between idiosyncratic and common factors. Moreover, specification tests enable as to verify the suitability of the selected variables and corroborate the mild-segmentation hypothesis. We state that our findings provide a potential usefulness for portfolio managers and domestic governors who plan on improving their attractiveness indices.

Keywords: home bias, behavior finance, beta, momentum, investor perception, optimism, macro-finance.

JEL Classification: D23, E44, F21, F33, G11, G15, G18

1. Introduction

Standard Portfolio theory establishes a straight link between diversification across domestic and foreign markets to maximize portfolio efficiency (Levy and Sarnat 1970) and enhance benefits from international diversification (Solnik 1974). However, a persistent gap between domestic portfolio allocation and value-weighted portfolio allocation has been observed on international equity markets (French and Poterba 1991). It's the puzzling equity home bias (Obstfeld and Rogoff 2000) in international finance but also it becomes a likely feature of international macroeconomics.

In fact, International portfolio allocations are associated with economic and financial development in host countries, national governors' strategies and with the behavior of international investors. Accordingly, numerous explanations consist of economic factors, financial factors and behavioral factors that belong to macro-finance interface. Furthermore, given the sustainable international financial integration (Vo and Daly 2007), Arfaoui and Abaoub (2010c), interconnection between local risk-factors and global risk-factors has rather been raised. It's the risk-factor interference.

In this paper, we attempt to contribute to empirical literature by investigating the dynamics of individuals' portfolio holdings. Indeed, we plan to clarify local factors and specify them separately and consider the context of increasing financial integration to assess the eventually contribution of global risk factors having a common feature.

2. Theoretical motivation and background

The financial theory of capital markets provides various immediate explanations to the equity home bias puzzle. However, empirical literature supports few of these explanations supposed *a priori* relevant. In fact, Black (1974), Stulz (1981), Adler and Dumas (1983), Solnik (1974, 1983), Sercu (1980), recommends the effect of observable barriers, such as restrictions on capital flows, taxes, risk of stochastic inflation and transactions costs. For instance, Errunza and Losq (1985, 1989), were interested in institutional barriers and restrictions on foreign positions. Nevertheless, Cooper and Kaplanis (1994), Coën (2000), rejected the assumption of hedge against local inflation risk and human capital. Tesar and Werner (1995), Warnock (2002, 2004), checked the weakness of the effect of transaction costs. Coeurdacier (2009) said that trade costs are not enough to explain the both puzzle of equity home bias and consumption home bias. Recently, Mondria and Wu (2010), show that equity home bias increases with informational advantage on domestic markets and decreases with financial openness. The authors suppose that, on the long term, equity home bias remains high because of interaction between information and portfolio choice process. Likewise, Wincoop and Warnock (2010), say that trade costs are far from of providing a plausible explanation to the home bias and doubt models of general equilibrium which recommend that hedging against exchange rate risk gives rise to the relevance of trade costs as explanation to equity home bias.

Several studies consider that international diversification benefits are very often over-estimated and, then, don't justify the current holdings of foreign assets. Other studies show that differences in accounting standards could discourage the holding of foreign assets (we cite, Uppal 1992, Rowland 1999). For instance, Beneish and Yohn (2008) examined the relationship between the adoption of IFRS standards and the behavior of under-diversification. In other words, they tried to test the assumption that IFRS standards reduce information costs and decrease uncertainty on the quality of annual reports and on the distribution of firms' future cash-flows. The authors noticed that the reduction of this uncertainty does not form a perfect explanation to equity home bias and underlined the effect of bias associated with geographical proximity, familiarity and hedging strategies.

Furthermore, we notice that last carried explanations emanate from economic psychology and highlight attitude and investor's perception. Thus, although he overcomes the effects of barriers, investor supposes additional non-monetary costs related on non-knowledge and non-familiarity with some financial assets and some foreign equity markets (for example, Heath and Tversky 1991). According to Solnik (1996), the unknown is perceived like risky because of the lack of familiarity to foreign assets. In this direction, Veldkamp and Van Nieuwerburgh (2008), focused on differences in volume and quality of information between domestic assets and foreign assets.

Obviously, alternative explanations here do not manage to confirm an entirely robust interpretation with the preference of national assets. Baele *et al.*. (2007), suppose that a proper explanation of this puzzle of international finance requires a better specification of benchmark weights. That is, those necessary to be confronted with current holdings of foreign assets. Arfaoui and Abaoub (2010a), suggest that the coexistence of increasing international financial integration with the persistent equity home bias raises the puzzle and makes this interrogation always renewable. Question which was been lately raised by Coeurdacier and Guibaud (2011). Nevertheless, Baele *et al.*. (2007), suppose the absence of connection between home bias and idiosyncratic factors. In this framework, we seek to contribute to empirical literature by a central motivation and two aims. From the first, we highlight rejection of the null hypothesis of relevance of idiosyncratic factors. From the seconds (i) we plan to clarify these idiosyncratic factors and specify them separately and (ii) consider the context of increasing financial integration to declare the alternative hypothesis of the contribution of global risk factors having a common feature. We justify our objectives by reflections of recent empirical investigations which confirm the rise of common factors. We cite, *inter alia* Carrieri *et al.*. (2006), Abugri (2008), Arfaoui and Abaoub (2010a,c).

3. Data and hypothesis' statement

3.1. The equity home bias measure

Basically, measurement of the equity home bias is based on the relative gap between weights of assets resulting from the pattern of a current portfolio through observed statistics and weights of assets resulting from the structure of an optimal portfolio according to lessons of the standard portfolio theory. If we note by (ACT_i), the actual structure of a portfolio of country i, and by (OPT_i), the optimal structure of a portfolio of the country i, then the degree of home bias associated with the country i (HB_i), will be calculated as follows:

$$HB_i = 1 - \frac{ACT_i}{OPT_i} \qquad (1)$$

The optimal proportions (OPT_i), can be estimated in accordance with lessons of ICAPM by which holdings of foreign assets of country i, should be proportional to the relative share of market capitalization of the reference country i, in the world market capitalization. On the other hand, real proportions are calculated via a meticulous diagnostic of various characteristics of cross-border holdings observed on international equity markets. Indeed, the share of foreign assets in the total portfolio of country i, is calculated by the ratio of holdings of foreign assets in the portfolio of country i, (FA_i), reported to the total holdings in the same portfolio. The detention of domestic assets is computed by the difference between total market capitalization of country i (MC_i) and domestic assets held by foreign investors (FL_i).

$$ACT_i = \frac{FA_i}{FA_i + MC_i - FL_i} \tag{2}$$

Obviously, the measurement of home bias (HB_i), varies between 1 (the portfolio consists of 100%, of domestic assets) and zero (equality between optimal allocation and current allocation). For instance, if a country should hold for an optimal level of its portfolio, 80%, of foreign assets by presenting a current allocation equal to 20%. Its degree of home bias will be 75%. However, other cases can be characterized by a current allocation which exceeds an optimal one. For example, a negative or a very small proportion is allocated with the index of world market. In that case, the portfolio of country i, is not biased in domestic market but, on the contrary, it overweight foreign assets. Assessment of the home bias is then erroneous. Baele *et al..* (2007), provide a new formulation of the basic equation to take into account that case of over weighted foreign assets. It is a new measurement which enables us to adjust the initial formulation in the following way:

$$HB_i = \frac{\min(|OPT_i|, ACT_i)}{\mathrm{Sign}\,(OPT_i)\max(|OPT_i|, ACT_i)} - 1 \tag{3}$$

This new definition makes it possible to provide a more fitting estimate of the degree of *home bias*, when the optimal allocation is lower than the current allocation. Data relating to this estimate are described in the table of descriptive statistics.

3.2. Construction of variables and declaration of hypothesis

Exhaustive identification of explanatory factors must account for the current dynamics of international equity markets; in particular the increasing trend of international financial integration, but also must be developed in a reasoning which takes as starting point lessons of the capital-markets financial theory. However, the choice of explanatory variables remains based on an intuitive reflection and checks an ad hoc extension of the empirical literature.

By highlighting the whole of these postulates, it seems relevant to update the explanatory factors. Indeed, we aim at clarifying idiosyncratic factors and contributing to the empirical literature by an apprsaisal of the marginal contribution of common factors.

- *Growth of national product*

Empirical literature establishes a straight link between economic growth and financial development (for example, Edison *et al..* 2002, Agenor 2003, Vo 2005). Given the capital mobility, international investors that are interested in profitability, controls firms listed on equity markets belonging to countries which carry out a sustainable economic growth. In the same way, the success of attractiveness' strategies is far from being synonymous with a high economic growth. In this direction, the economic growth in host countries is likely to modify the destination of indirect investment flows, or to make them biased in domestic markets. Indeed, if investors observe that growth rates of their domestic economies are higher than those carried out by host countries, then they will prefer to target national assets that insure a relatively higher profitability. For that, we anticipate to observe a positive relation between the preference of national assets and local economic growth. Consequently, we declare the null hypothesis as follows:

H0 : there is a positive relation between local economic growth and equity home bias.

We approximate the economic growth by evolution of annual GDP at constant price. In fact, we use a GDP at constant price to neutralize the effect of local inflation on economic growth. Economic growth presents an average value equal to 3.3481, a median value equal to 3.0000, and a standard deviation equal to 2.9359.

▪ *Local inflation*

Although it is rejected by empirical tests (for instance, Cooper and Kaplanis 1994, Coen 2000) local inflation remains a first-order factor which leads macroeconomic fundamentals and financial indicators. For example, Chen *et al*.. (1986), Fama (1990), and Prat (2001, 2003) highlight an interaction between inflation and industrial production, on the one hand, and the equity risk premium on the other hand. Moreover, inflation sets up a strategic variable insofar as the international economic and monetary unions use it as a *de jure* indicator for the membership candidacy. We support the relevance of this variable and let us admit it in our vector of explanatory variables.

Economic common sense lets to us think so that the preference of national assets is led by the intention of a hedging against local inflation; notably, in inflationary economies. However, the empirical literature contradicts this assertion. Conversely, we'll suppose that the increase in local inflation penalizes real profitability of national portfolios. In this case, the overweight of foreign assets makes it possible to overcome this deficiency under the condition which local inflation exceeds average inflation on international markets. Consequently, if we support the second reasoning, then we will expect to observe a negative relation between local inflation and equity home bias. In that case, we state the null hypothesis as follows:

H_1 : there is a negative relation between local inflation and equity home bias.

We approximate the variable inflation by the annual growth of GDP deflator. The variable inflation presents an average value equal to 3.9375, a median value equal to 3.0336, and a standard deviation equal to 4.5071.

▪ *Economic openness*

A high economic openness translates a high level of economic integration associated with low costs on exports and imports; that is to say, trade costs. With reference to Coeurdacier (2005), if we suppose that exports of the country *j* to country *i*, are prone to a given cost of exogenous transaction τ, such as the price supported by a consumer in the country *i*, on goods and services of country $j,\ i \neq j$.

$$p_j^i = (1+\tau)\,p_j \tag{4}$$

This relation translates the presence of various frictions on international markets of goods and services such as costs of transportation, barriers to the mobility of goods and services, taxes, protectionist behaviours, patriotism, ...

For example, Obstfeld and Roggof (2001), show that the trade costs on international markets can be used like a potential explanation of *the equity home bias*. Engel and Matsumoto (2004), show that the preference of national assets is, inter alia, function of the elasticity of substitution between domestic goods and foreign goods, of the persistence of technological shocks and nominal prices.

Insofar as there is a positive relation between financial integration and economic integration and that there exists, also, a positive relation between e*quity home bias* and *consumption home bias*, we expect to find a negative sign associated with the variable 'Trade'. Consequently, we state the following null hypothesis:

H2 : a negative relationship between economic openness and equity home bias.

We use the openness rate as a proxy to economic openness. This one shows an average value equal to 56.6255, a median value equal to 45.7567, and a standard deviation equal to 40.8985.

▪ *Added value of domestic industrial sector*

The added value is a measurement of the wealth truly created by production sectors. With reference to corporate financial theory, the added value tells about firms' profitability and forms an indicator of value creation. Being the listed firms on international equity markets, the added value informs about profitability and marginal efficiency of investment and, so, about potential growth opportunities (Bekaert *et al*.. 2007). The profitability and the marginal efficiency of investment let know, also, about the dynamics of local investment, attributions of taxation advantages, adequacy of business environment, managerial style and modern governance (Goergen *et al.*. 2005, Martynova and Renneboog 2010).

In fact, a country which presents domestic indicators that converges to international standards will be more attractive to national investors, especially those who associate a great uncertainty with investment in foreign assets. In this direction, we expect to observe a clear positive relation between added value of local industrial sector and the equity home bias. Thus, we declare the null hypothesis in the following manner:

H3: a positive relationship between added value of domestic industrial sector and home bias.

The variable 'indust.va', exhibits an average value equal to 31.9687, a median value equal to 30.1270, and a standard deviation equal to 7.7536.

▪ *Reward-to-Risk*

Very conscious of behavior-finance contribution, we're thinking of taking emotional characters of last returns into account. Indeed, if the investors' decision-making process is based, even partially, on the last behavior of equity prices, then they will be brought to under-weight stock markets having been less powerful in the past; it is *the strategy of impulse-continuation.* The opposed case, investors often tends to make a decision reverses even on a short horizon: it is *the strategy of contradiction (of short term).* Being the international portfolio holdings, we suppose that this type of strategy is likely to contribute to the explanation of equity home bias. Moreover, Baccmann and Dubois (1999), confirmed the robustness of contradiction strategies and momentum strategies on international equity markets. In parallel, by studying the benefit on 34 markets, Griffen *et al.*. (2006), show that the momentum is potentially advantageous for international investors who can take solely long positions. They observed, also, that momentum-price profits and momentum-benefit are often significantly positive on the world market. Indeed, short term rises of benefits and last prices contribute to the formation of excess return. These results, also, were checked on several other international equity markets over periods of study which cover the Eighties, 90, up to 2006. We cite the Swiss market (Rey and Schmid 2004), the Canadian market (Assoé and Sy 2004), the Indian market, notably Bombey SE, (Sehgal 2006), the Irish market (O'Donnell and Baur 2007), the NYSE, AMEX and NASDAQ (Akbas *et al.*. 2008), and (Haan and Kakes 2011) for Dutch institutional investors.

We approximate the momentum effect by the ratio *reward-to-risk* such as it was been built by Ahearne *et al.*. (2004). That is, the average returns over its standard deviation. As for the specification in the model, we move back the variable by one period to reflect the effect of last information. Insofar as we attend a coexistence of two contrary strategies, momentum versus inversion, on international markets we cannot expect a given sign. However, we state the null hypothesis as follows:

H_4 : there is a close connection between equity home bias and reward-to-risk.

The variable *rewrisk* displays an average value equal to -0.0088, a median value equal to 0.0757, and a standard deviation equal to 1.0506.

▪ *Systematic risk*

According to financial theory of capital markets, beta informs about systematic risk on target equity markets (inter alia, Patro *et al.*. 2002), Coeurdacier (2005) and it forms *a proxy* for international financial integration (for instance, Solnik 1974b, Stehle 1977, Baele *et al.*. 2007). Within the framework of initial aims of this study, we suppose that investors who limit their strategies to domestic markets deal with not only the systematic risk but also the idiosyncratic risk specific to host country i. Baele *et al.*. (2007), shows that beta is a main factor for the explanation of equity home bias puzzle but rejects the relevance of idiosyncratic risk factors.

If we develop our reflection within the framework of portfolio standard theory, we can say that financial integration involves that investors can freely negotiate without restrictions and transaction costs on international equity markets. In the same order of idea, in the presence of homogeneous expectation, investors hold the same optimal portfolio. The equilibrium situation in the international framework is achieved when all investors hold world market portfolio in which the weight of each country is associated with its share in world market capitalization. In this case, the higher national beta the more investors are overweighted are domestic financial assets. In view of that, we're expecting a negative relation between beta and the equity home bias puzzle. Consequently, we declare the null hypothesis as follows:

H5 : there is a negative relationship between beta and equity home bias.

The beta is time-varying and it's estimated via the standard ICAPM. Thus, we used weekly data to minimize non-synchronization risk of the data, market anomalies and the effect of transaction costs. Beta exhibits an average value equal to 0.7968, a median value equal to 0.8546, and a standard deviation equal to 0.3015.

▪ *Local growth opportunities*

Local growth opportunities translate the degree of attractiveness of domestic stock markets. They reflect, also, the profitability and the marginal efficiency of local investment. Bekaert *et al.*. (2007), approximated the growth opportunities by *Price Earnings Ratio*. In fact, the authors used the PER to examine the relationship between growth opportunities and international financial integration. They support the relevance of this variable while some empirical studies shows that earning per share follows a random walk from time to time. As the PER is the price over earnings per share, a high value of the PER involves that investors will have a raised expectation for the future growth of benefits and will be likely to stake on assets having a high PER. In that case, the higher local PER, the over-weighted are national assets. Accordingly, we expect to observe a positive relationship between local growth opportunities and home bias. Thus, we formulate the null hypothesis as follows:

H6: there is a positive relation between local growth opportunities and home bias.

The variable 'PER' displays an average value equal to 20.6939, a median value equal to 16.8000, and a standard deviation equal to 14.8531.

▪ *Capital control: Asset-Liabilities*

Capital control includes all direct effects such as institutional barriers which influence capital mobility (*inflows* and *outflows*). Chaieb and Errunza (2007), show that the barriers on capital flows limit benefits from international diversification in the presence of an incomplete risk sharing on international markets. In fact, the capital mobility is basically associated with institutional quality, legal systems, taxation systems of host countries, etc. Consequently, the whole factors seem to form a vector of *de jure* indicators of cross-border holdings of international financial assets. Thus, observing nonresident investors on a given international stock mark*et al.*lows to underweight national assets in national portfolios. Reciprocally, observation of nonresident holders on a national stock market informs about the beginning of the end of equity home bias. In view of that, we're expecting a negative relationship between capital flows and equity home bias. From where, we state the following null hypothesis:

H7: there is a negative relationship between capital flows and equity home bias

We approximate capital control by aggregate flows of portfolio investment ('assets and liabilities'), which was been divided by GDP to minimize heterogeneity associated with the differences in size (market capitalization) of domestic markets. The variable 'A+L/GDP' shows an average value equal to 1.6869, a median value equal to 0.0016, and a standard deviation equal to 14.1218.

Given the increasing international financial integration, we suppose to preferably connect the home bias phenomenon to the dynamics of whole international market. Moreover, we appreciate the weakness of explanatory power of idiosyncratic risks (for example, Baele *et al.*. 2007). We aim at assessing the contribution of common factors. Indeed, we construct a vector of three variables; world interest rate, growth of world industrial production and global growth opportunities. For instance, Ferson and Harvey (1999), employed world dividend yields, Eurodollar deposit rates, spread of interest rate of G7, and short term interest rate of G7, as global factors. We use the US interest rate, to approximate world interest rate, world industrial production to reflect world economic situation and business environment, and the world PER as a *proxy* for global growth opportunities as done by Bekaert *et al.*. (2007).

As far as the holding of international financial assets, we state that if performance of global economic and financial sectors overrides domestic economic and financial sectors, then international investors will be waiting for abnormal returns associated with international markets and, then, will be brought to overweight foreign financial assets in their investment portfolios. In view of that, we're expecting a negative relationship with common risk factors. Consequently, we declare the following null hypothesis:

H8 : there is a negative relationship between common factors and equity home bias.

We approximate the common factors by US data considering the share of US stock market capitalization in the world market capitalization. Thus, the world interest rate exhibits an average value equal to 3.0343, a median value equal to 3.2200, and a standard deviation equal to 1.5549. The industrial production presents an average value equal to 105.4417, a median value equal to 104.2439, and a standard deviation equal to 5.0068. world PER, it presents an average value equal to 18.5369, a median value equal to 18.1167, and a standard deviation equal to 1.7577.

We associate hypothesis H2, H3, and H7 with the direct determinants, hypothesis H0, H1, and H5, with the indirect determinants and H6 and H4 with the contribution of behavioral Finance and, finally, the hypothesis H8 with the contribution of global risk factors. Accordingly, we suppose to connected theoretical background to a pragmatic though and we present, in the following paragraph, statistical properties of the sample and sources of the used data.

3.3. Descriptive statistics

We use a sample of 15 developed and emerging markets. Indeed, the sample consists of two groups; stock markets of G7 countries (Germany, Canada, France, Italy, Japan, United Kingdom and United States) and the eight major emerging markets (Argentina, Brazil, Chile, India, South Korea, Malaysia, Mexico and Thailand). We use annual data over the period 2001-2007. We justify this rather short period by the availability of data on foreign holdings. In fact, during the selection of these international equity markets, we tried to bear both local and common features in mind. Indeed, we make use of a geographical diversification criterion and, also, we aimed at favoring the markets which display a sustainable dynamics, mainly, in size and growth.

The data were collected from various sources. Indeed, data on international positions of domestic and foreign holders *(Foreign Assets and Foreign Liabilities)* have been extracted from *'Coordinated Portfolio Investment Survey'* (CPIS). The data on market capitalization of domestic markets have been obtained from *'World Federation of Exchanges'* (WFE). Macroeconomic data such as gross domestic product, inflation, economic openness and the added value of domestic industrial sector have been obtained from *World Development Indicators* (WDI) of the World Bank. As for financial data, Assets and Liabilities have been obtained from Datastream. For the construction of the 'reward-to-risk', we used annual data of the WFE. While for the estimate of Beta, we employed weekly series obtained from Datastream. To approximate local growth opportunities (LGO), we used the PER from WFE members. World interest rate and world industrial production have been extracted from the Federal Reserve Board (FRB), similarly to Carrieri *et al.*. (2006a,b). Lastly, global PER has been obtained from Datastream. Table 2, recapitulates the descriptive statistics of the whole data.

Table 2. Descriptive statistics of data

The table summarizes descriptive statistics of the data. Home Bias represents current positions and is calculated according to the approach of Baele *et al.*.(2007). 'GDP', is the annual growth of GDP. 'Inflation' is the deflator of GDP. 'Trade', is the rate of openness. 'indust.va', is the added value of domestic industrial sector. 'Asset-Liabilities', is the sum of domestic and foreign holdings over GDP. 'reward-to-risk', is the return of year t, divided by its standard deviation. Beta is the systematic risk of domestic market estimated by the ICAPM. LGO is the domestic PER. 'wrate', is the world interest rate obtained from FRB. 'indust.prod.', is the index of American industrial production to approximate world economic state. 'WGO ', is the world PER to approximate global growth opportunities.

Variable	Mean	Std. Dev.	Median	Min.	Max.
Home Bias	-0.4745	0.5919	-0.6956	-0.9976	0.9985
GDP	3.3481	2.9359	3.0000	-10.8945	9.6693
Inflation	3.9375	4.5071	3.0336	-4.0000	30.5553
Trade	56.6255	40.8985	45.7567	17.4409	186.5814
Indust. VA	31.9687	7.7536	30.1270	20.5697	49.7136
Assets-Liabilities	1.6869	14.1218	0.0016	-48.6914	81.4199
Reward-to-risk	-0.0088	1.0506	0.0757	-2.7867	2.0715

Variable	Mean	Std. Dev.	Median	Min.	Max.
Beta	0.7968	0.3015	0.8546	0.0300	1.3745
LGO	20.6939	14.8531	16.8000	4.9200	122.1300
W. interest rate	3.0343	1.5549	3.2200	1.1300	5.0200
Indust. prod.	105.4417	5.0068	104.2439	100.0000	112.9453
WGO	18.5369	1.7577	18.1167	16.8583	21.6500

Analysis of the descriptive statistics enables us to point out that international markets check heterogeneous degree of home bias. Thus, the home bias exhibits an intertemporal and intermarket dynamics. Indeed, the standard deviation is equal to 0.5919, with a minimal value equal to -0.9976 and a maximal value equal to 0.9985.

Interpretation of the explanatory factors allows observing a substantial variation that proves an economic and financial dynamics in domestic countries. The greatest variation is associated with the variable *'trade'* by a standard deviation equal to 40.8985, a minimal value equal to 17.4409 (Argentina, year 2001) and a maximal value equal to 186.5814 (Malaysia, year 2006). This result supports the hypothesis of mobility in goods and capital and differences in levels of international financial integration. We observe, also, heterogeneity in fundamental indicators of the domestic economies. Indeed, local inflation and domestic industrial production show, respectively, a standard deviation equal to 4.5071 and 7.7536.

The observation of financial factors makes it possible to raise dispersion in the variable *'asset-liabilities'* and domestic PER. Indeed, the former presents a standard deviation equal to 14.1218, a minimal value equal to -48.6914, (Canada, year 2007), and a maximal value equal to 81.4199, (Italy, year 2005). The later displays a standard deviation equal to 14.8531, a minimal value equal to 4.9200 (Thailand, year 2001) and a maximal value of 122.1300 (Japan, year 2003). On the other hand, we appreciate a stability in systematic risk, approximated by *Beta* which presents a standard deviation equal to 0.3015, a minimal value equal to 0.0300 (South Korea, year 2003) and a maximal value equal to 1.3745 (India, year 2006).

We interpret this obviousness by the economic revival which marked Japan and South Korea such as a quite economic growth in 2003, and a rectification of their stock markets, their investment strategies and exporting sectors. In fact, local features converge towards the global one. This obviousness lets us know the convergence towards international standards.

Table 3. Matrix of correlation coefficients

	HB	GDP	Inf.	Trade	Indust. va	Asset-Liab.	Rew-risk	Beta	LGO	w. rate	Indust. prod.	WGO
H. Bias	**1.00**											
GDP	0.21*	**1.00**										
Inflation	-0.13	0.005	**1.00**									
Trade	-0.27*	0.22*	-0.08	**1.00**								
Indust. VA	-0.25*	0.37*	0.12	0.79*	**1.00**							
Asset-Liab.	0.26*	-0.06	-0.12	-0.14	-0.05	**1.00**						
Rew-risk	0.02	-0.07	0.11	-0.02	0.02	-0.12	**1.00**					
Beta	0.25*	0.03	0.10	-0.46*	-0.32*	0.16	0.04	**1.00**				
LGO	0.34*	-0.14	-0.29*	-0.06	-0.01	0.24	0.15	0.07	**1.00**			
Wrate	-0.04	0.08	-0.11	0.05	0.06	-0.03	-0.31*	0.04	-0.07	**1.00**		
Indust-prd.	0.02	0.31	-0.03	0.07	0.10	0.02	-0.54*	0.05	-0.13	0.73*	**1.00**	
WGO	-0.06	0.37*	-0.03	-0.06	-0.09	-0.05	0.49*	-0.03	0.08	-0.30	-0.84*	**1.00**

The analysis of correlations' matrix makes it possible to confirm the weak connection between variables. Indeed, the average correlation is equal to -5.6123%, which proves the absence of redundancy among the selected variables.

4. Model and empirical specification

4.1. The model

We express the basic econometric model as follows:

$$HB_{it} = \alpha + \sum_{k=1}^{K} \beta_{kit} X_{kit} + \eta_{it} \tag{5}$$

Where, the endogenous variable is the equity home bias of country i, in year t. α is a constant and X_{kit}, the k[th] exogenous variable associated with country i, in year t. $i = 1, \ldots, N$ and $t = 1, \ldots, T$. β_k are parameters to be estimated. η_{it} is an error term which includes individual characteristics, temporal characteristics and idiosyncratic errors.

$$\eta_{it} = \upsilon_i + \theta_t + \varepsilon_{it} \tag{6}$$

Thus, υ_i, θ_t et ε_{it} are the individual component, the temporal component and the idiosyncratic error term, respectively. With, $\forall i$, $E(\varepsilon_{it}) = 0$, $E(\varepsilon_{it}^2) = \sigma_\varepsilon^2$ (homoskedasticity). $\forall i \neq j$, $E(\varepsilon_{it}\varepsilon_{jt}) = 0$ (inter-individual contemporaneous correlation). $\forall t \neq s$, $E(\varepsilon_{it}\varepsilon_{is}) = 0$ (absence of autocorrelation) and $\forall_i$, $E(x_{it}\varepsilon_{it}) = 0$ (orthogonality).

However, panel data estimation enables us to improve empirical results and the robustness of tests; initially, by taking the unobserved heterogeneity into account (Balestra and Nerlove (1995)), Then, by the decomposition of total variability *(within vs. between)* and, of course, via widening of the size of sample which increases number of degrees of freedom and reduces colinearity between explanatory variables. However, dynamic panel data models with GMM allows for non-normality and conditional heteroskedasticity, both likely features of the country data.

4.2. Empirical specification

We estimate our model using panel data and we introduce the lagged variable, HB_{it-1}, among the exogenous variables, for each country i. In fact, incorporation of this dynamics in the model produces a significant shift in interpretation of the equation. Indeed, without the lagged variable, dependent variables represent the whole of information producing HBi,t observed. However, with the lagged one, we have entire history of the explained variable. Thus, any measurable impact must be conditioned by this history.

In parallel, we bear the unobservable specific effects, υ_i, in mind, while controlling for the risk of heteroskedasticity and the endogeneity of explanatory variables. We point out that the lagged variable is likely to be correlated with the error term because the same term υ_i, enters the equation for all observations in group i. That does not prevent estimation of the model but requires additional techniques. The general approach developed by Balestra and Nerlove (1966), Arellano (1989), was been based on the estimators of instrumental variables. Accordingly, the GMM method allows us to meet our aims.

In view of that, empirical specification of the model is presented in the following manner:

$$HB_{it} = \alpha + \beta_1 HB_{i,t-1} + \sum_{k=2}^{K} \beta_{kit} X_{kit} + \varepsilon_{it} \tag{7}$$

Where, the dependent variable is the yearly measure of equity home bias of the reference country i. X_{kit} is a matrix of size ($NT \times K$) which consists in economic, financial, institutional, and behavioral explanatory factors that are endogenous and exogenous to country i, in year t. α is constant and ε_{it} is an error term. α and ε Have the size ($NT \times 1$). Yet, this method rely on two specification tests; the Sargan test to control restrictions for over-identifying of instrumental variables; in other words, the validity of instruments and the test of Arellano-Bond for second order serial correlation in residuals.

4.3. Specification of the instrumental variables

The overall risk factors include both local and global variables. We follow Ferson and Harvey (1993, 1999), and consider two local lagged variables. The two variables are used as instruments to represent the conditioning information closely related to domestic market of the reference country i. Consequently, the local instrumental variables are asset-liabilities and reward-to-risk.

As for global risk factors, contrary to Ferson and Harvey (1999), we use merely instrumental instantaneous variables given the current persistent international financial integration. Indeed, we are bearing in mind that the sustained international financial integration allows running the worldwide information diffuseness.

5. Interpretation and discussion of results

The interpretation of our results makes it possible to raise a set of instantaneous inferences. Indeed, the equity home bias depends mainly on its autoregression expression of order one (AR(1)). The relation is significantly positive at the 1% level proving, *ceteris paribus*, persistence of the phenomenon from year to year. This result is basically supported by recent empirical investigations. We cite, *inter alia*, Baele *et al.*. (2007), Karlsson and Nordén (2007). It's the *'home sweet home'* as in Karlsson and Nordén (2007). Likewise, several interesting interpretations can be raised. First, we test the explanatory power of fundamental characteristics of the country i; particularly, domestic economic growth, local inflation, economic openness and the added value of domestic industrial sector. Among these determinants, we find that equity home bias depends significantly on domestic economic growth, economic openness and the added value of domestic industrial sector. Indeed, the local economic growth exerts a positive effect. Moreover, Coval and Moskowitz (1999), say that portfolio managers prefer to target firms with headquarters located in the national territory. It's the *'home bias at home'* which supposes *familiarity* with domestic sectors (patriotism (Morse and Shive 2011), ethnocentrism (Shankarmahesh (2006). in the same way, investors overweight national firms which list their stocks on domestic market belonging to growing national economies. We state that present results corroborate empirical literature which supports a positive relationship between economic growth and financial development. We quote, *inter alia*, Edison *et al.*. (2002), Agenor (2003). By analogy, investors tend to overweight national assets while observing a value added among their national industrial sectors.

However, we observe that the coefficient associated with the variable inflation is not significant. Instantaneous interpretation supposes that this result is far from being surprising considering its conformity with former empirical tests which reject stochastic inflation as an explanatory factor to equity home bias. However, we argue this result by the absence of a direct link between local inflation and holding of foreign financial assets. Given the assertion that investors reasoning often in nominal term and not in real term, we support our second thought such as it is developed while stating our hypothesis, H1, by which domestic investors' overweight foreign assets while observing a rising local inflation compared with international standards. As far as economic openness, the positive relationship between economic integration and financial integration allows to accept the null hypothesis (H2) stating that home bias has a negative function of national exports and imports. Thus, coefficient associated with the variable 'Trade' is significant at the 5% level. Our results corroborate those obtained by the empirical literature such as work of Lane and Milesi-Feretti (2004), Aizenman (2004), Aizenman and Noy (2004), Heathcote and Perri (2004).

Second, the analysis of factors which establish a direct link with equity market makes it possible to support our expectations on the relation between home bias and each discussed factor (in particular, asset-liabilities, rew-risk, Beta and LGO). In fact, we approximated capital mobility by the aggregate sum of assets and liabilities, to reflect effects of institutional barriers, information asymmetry and constraints to capital flows. The coefficient associated with this variable displays a significantly negative relation at the 1% level, on whole specifications of the basic model. This obviousness supposes that the management of constraints to capital flows is likely to solve all home biased portfolio allocation liable to shift the benefits from international diversification (for example, Stulz 1981, 2005).

Table 4. Estimation of equity home bias determinants

Variable	Model 1		Model 2		Model 3		Model 4	
	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.
LD.EHB	0.379***	0.1113	0.402***	0.1141	0.432***	0.1150	0.379***	0.1174
Constant	0.298	0.2298	0.407*	0.2117	0.030	0.0504	0.105	0.2259
GDP	0.065**	0.0299	0.054*	0.0302	0.057*	0.0304	0.024	0.0261
Inflation	-0.011	0.0115	-0.016	0.0111	-0.0115	0.0116	-0.022*	0.0113
Trade	-0.014**	0.0061	-0.0143**	0.0060	-0.014**	0.0061	-0.017***	0.0061
Indust.va	0.037*	0.0198	0.040**	0.0197	0.032*	0.0192	0.036*	0.0208
LD.AL	-0.007***	0.0020	-0.006***	0.0020	-0.007***	0.0020	-0.006***	0.0021
LD.Rew-risk	0.077*	0.0460	0.098**	0.0397	0.029	0.0253	0.068	0.0482
Beta	-0.035	0.0961	-0.026	0.0965	-0.033	0.0966	-0.049	0.1010
LGO	0.007***	0.0020	0.007***	0.0019	0.007***	0.0021	0.007***	0.0021
Wrate	-0.046	0.0527	--	--	-0.079*	0.0456	-0.005	0.0524
Indust. prod.	-0.100	0.0831	-0.145**	0.0719	--	--	-0.019	0.0798
WGO	-0.226**	0.0937	-0.203**	0.0889	-0.176**	0.0864	--	--
	value	p-value	value	p-value	value	p-value	value	p-value
Wald Chi2(k)	104.08	0.0000	103.46	0.0000	101.95	0.0000	88.53	0.0000
Sargan test	18.59	0.1364	17.56	0.1759	19.34	0.1130	22.02	0.1550
ABond test	0.89	0.3748	0.76	0.4494	1.32	0.1874	1.18	0.2364

Note: ***, ** and *, denote significance at the 1%, 5%, and 10% levels, respectively.

This result allows pointing out that the home bias mirrors the reality of international equity markets. We check, also, the relevance of systematic risk. Indeed, even if the negative sign associated with beta is non-significant, it enables us to affirm that domestic investors' position is exposed not only to idiosyncratic risk but also to the systematic risk. International diversification, which is opposed to home bias, offers the advantage of diversifying this systematic risk. In view of that, we note that the equity home bias is a negative function of national systematic risk. In other words, in presence of exposure to systematic risk, investors tend to overweight foreign assets to achieve a better diversification. Third, we appreciate the presence of a momentum on international equity markets. Indeed, home bias is positively associated with the behavior of last returns. This result corroborates those obtained by former work. We cite, *inter alia*, Jagadeesh and Titman (1993, 2001), Rey and Schmid (2004), Assoé and Sy (2004), Sehgal (2006), Akbas *et al.*. (2008). In parallel, we observe that investor's perception leads the destination of investment flows. That's to say, portfolio selection process prefers national assets while observing a higher PER on domestic stock market. In reverse order, world PER is higher than the local one, investors prefer to hold foreign assets (result confirmed by variable WGO, in accordance with the thesis of Bekaert *et al.*. (2007)). We can interpret this result as the obviousness of a *relative optimism* of Norman and Xu (2003), according to which relative optimism towards domestic assets will take place when investors are more optimistic on their domestic markets better than foreign investors. Consequently, we think so that the assumption, H6, forms part well in the future prospects of works of Norman and Xu (2003), having recommended the relevance of relative optimism as explanatory factor to equity home bias.

Fourth, we control for the contribution of global risk factors by supposing an advanced level of international financial integration. Indeed, under the assumption of perfect integration, common factors provide a better marginal contribution to define global risk premium and then global asset pricing (for instance, De Santis and Gerard (1998), Carrieri *et al.*. (2006a,b)). Insofar as financial integration is opposed to home bias, we can state that our results are plausible. Indeed, signs associated with global variables are significantly negative in all specifications of the basic model. Accordingly, we point out that not only domestic economic and financial characteristics matter but also global characteristics affect whole international equity markets.

Specification test

Table 5. Specification test

The table summarizes joint tests of the null hypothesis of absence of explanatory-factors effects. *df* is the degree of freedom equal to k. k is the number of restrictions. Rejection of the null hypothesis is associated with a p-value lower than the threshold.

Null Hypothesis	*df*	Chi.2	p-value
1. Zero effects of macroeconomic fundamentals H_0 : GDP = Inflation = Trade = Indust.va = 0	4	14.36	0.0062
2. Zero effects of domestic financial-factors H_0 : AL = Rewrisk = Beta = LGO = 0	4	38.56	0.0000
3. Zero effects of global risk-factors H_0 : wrate = Indust.prod. = WGO = 0	3	6.17	0.1035
4. Zero effects of world interest rate H_0 : wrate = 0	1	2.25	0.1332
5. Zero effects of worldwide economic situation H_0 : indust.prod. = 0	1	0.01	0.7543
6. Zero effects of global growth opportunities H_0 : WGO = 0	1	4.01	0.0452

Finally, robustness tests allow confirming the relevance of selected variables, the validity of our predictions and the exhaustiveness of results. Table 5, summarizes the entire of these assumption tests. The first test is questioned on the null effect of fundamental macroeconomic factors. We found a result which supports this effect at the 1% level. By analogy, the second test is interested in financial factors referring directly to domestic equity market. The related assumption is rejected at the 1% level. The third test is focused on the join effect of global risk factors. We found that this assumption cannot be rejected. In view of that, we chose to clarify global factors and to dedicate an assumptions test to each global risk factor. As result, we observed that H0 is rejected for global growth opportunities (WGO) at the 5% level. Subsequently, we note that the world PER is relatively more affecting than world industrial production and world interest rate.

The results confirm well our expectations and corroborate those obtained by recent empirical literature. However, we state that our tests allow confirming the relevance of our theoretical thought as for the assessment of marginal contribution of common factors. Consequently, we accept our initially declared assumptions and support the increasing trend of international financial integration that coexists with equity home bias. That supposes that portfolio selection process in an international framework is in close connection with the control of global financial and economic sectors without being independent of idiosyncratic properties of domestic markets.

6. Conclusion

The study of equity home bias requires a pragmatic approach and, also, a reflection developed within a real framework. In fact, the literature supposes that this phenomenon translates an irrational behavior which believes little in benefits from international diversification. However, in the presence of markets friction, we say that this behavior can be solely rational. Consequently, we based our research on three main motivations. Initially, we were particularly interested in recent empirical literature and we're thinking of inserting our assumptions in the present framework of persistent international financial integration (e.g. Lane 2003, Vo and Daly 2007, Arfaoui and Abaoub 2010c). In fact, to our knowledge, the relevance of global risk factors in the process of holding of international assets was not been enough documented (e.g. Ferson and Harvey (1998). In this direction, our second motivation was an attempt to provide a valid empirical contribution while testing for the job of global risk factors in the explanation of equity home bias. Consequently, we joined an additional assumption (H8) by which common factors affect the home bias phenomena.

Our findings support the initially formulated predictions. Indeed, home bias increases with local economic growth, added value of domestic industrial sectors, local growth opportunities and in the presence of momentum on behalf of domestic investors. These results corroborate those obtained by recent empirical tests. We cite, *inter alia*, Agenor (2003), Bekaert *et al*.. (2007), Sehgal (2006), Burger and Warnock (2006), Stulz (2006), Rojas (2007), Buchannan and English II (2007), Graff (2008), and Akbas *et al*.. (2008). On the other hand, this bias decreases with a rising local inflation, economic openness, systematic risk on domestic markets, and with the capital mobility. Furthermore, we point out that results confirm the economic theory (keynesienne and post-keynesienne theory) and lessons of the portfolio fundamental theory.

We declare, also, that global risk factors affect negatively equity home bias. Indeed, the home bias decreases with world economic situation, a rising international interest rates and high world PER. These results fit within the framework of a persistent financial integration and reflect the logic of initially developed reflection and corroborate the recent empirical literature which recommends the gone up of common factors. We quote, *inter alia*, De Santis and Gerard (1998), Carrieri *et al*.. (2006a, b), Abugri (2008), Arfaoui and Abaoub (a,c). More generally, we point out that idiosyncratic factors form an engine of equity home bias while common factors support the holdings of foreign assets.

We consider that our results are plausible and economically interpretable. In parallel, they have a potential utility for portfolio managers and, also, for domestic governors aiming at promoting their attractiveness' indices.

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DYNAMIC RELATIONSHIP BETWEEN EXCHANGE RATES AND STOCK PRICES: EMPIRICAL EVIDENCE FROM INDIA

Krishna Reddy CHITTEDI
Centre for Development Studies-JNU, Trivandrum, Kerala, **India**
krishnareddy5111@gmail.com

Abstract

This study empirically determines the causal relation between the stock price and exchange rate in India. We used daily data since the use of monthly data may not be adequate to capture the effects of short term capital movements. Having established the stationarity condition of each series using ADF, PP and KPSS unit root tests, the causal linkages were examined using the Granger non-causality test prescribed by Toda and Yamamoto (1995). The study found that, there exists unidirectional causality from exchange rate to stock price in the India over the period 2004 to 2011. Johansen and Juselius (JJ) cointegration result shows that there is long run relationship between stock prices and exchange rates. The study suggests that the relationship between equity returns and exchange rate movements may be used to hedge their portfolios against currency movements. Additionally, risk management must take into consideration that these markets are correlated.

Keywords: stock prices, exchange rates, cointegration, vector error correction, TandY causality.

JEL Classification: C32, G15

1. Introduction

The last decade has witnessed significant changes in the international financial system such as the emergence of new capital markets, advent of floating exchange rates, opening up of current account, liberalization of capital account, reduction of customs duties, the development of 24-hour screen based global trading, and innovations in internationally traded financial products in emerging countries. All the mentioned features have broadened the variety of investment opportunities but, on the other hand, they have also increased the volatility of exchange rates and added a substantial portion of risk to the overall investment decision and portfolio diversification process. The weakness of the local currency against the greenback is beginning to hurt foreign investors. For example, the Indian rupees weakness has a cascading effect on equity returns of investor who buy stocks with dollar. In the absence of full convertibility, FIIs have to convert their dollars into rupees to buy stocks here and do the reverse while selling. Due to falling in Indian rupees, investors get fewer dollars for their rupee. That shaves off more from their already deflated equity portfolios. Foreign Institutional Investors have seen their investment lose more than the benchmark due to currency vagaries.

Studying the interaction between foreign exchange and stock markets has therefore become more complex and has received more research interest than before. The relations between exchange rate movements and stock prices are based on the rise in the domestic interest rate that leads to capital inflows and makes the exchange rate appreciate. This suggests that, for export dominant industries, currency appreciation has a negative effect on stock prices. In such industries because of reduction in exports while currency appreciation boosts the stock market (positive effect on stock prices) for import dominant industries due to increase in imports.

1.1. Theoretical framework

In retrospect of the literature, a number of hypotheses also support the existence of a causal relation between stock prices and exchange rates. Several studies have been conducted to examine the effect of changing exchange rates on the stock prices. There are two theories about the dynamic relationship between exchange rates and stock prices – the traditional and portfolio approaches – which have been discussed for a long time, yet have not resulted in any consensus. The traditional approach claims that a depreciation of the domestic currency makes local firms more competitive, leading to an increase in their exports and consequently higher stock prices. This implies a positive correlation between exchange rates and stock prices. The inference from the above traditional approach suggests that exchange rates lead stock prices. This relationship is attributed to Solnick (1987). He argued that a real currency appreciation is a bad news for domestic firms, because it will reduce its competitive ability to export, while a real depreciation enhances its ability to export in the short run. The portfolio approach, on the contrary, argues that an increase in stock prices induces investors to demand more domestic assets and thereby causes an appreciation in the domestic currency, implying that stock prices lead exchange rates and they are negatively related. We have to highlight that both approaches assume that the currency market is under flexible exchange rate regime. If the currency market is under some form of regulation, the relationship between exchange rate and stock price would be different. In case of fixed exchange rate regime investors there is no movement in the currency rate and by this way the stock market is fully independent from exchange rate movements.

There is theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship. Considering 'flow-oriented' models and 'stock-oriented' models as two basic approaches to the exchange rate determination, a cardinal disagreement can be found. Flow models assume that the exchange rate is determined largely by a country's current account or trade balance performance. These models posit that changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output (Dornbusch – Fisher 1980).

As theoretical economics as well as empirical researchers are far from any consensus related to the interactions between stock markets and foreign exchange markets it is advisable to carry out further tests and analysis of this kind of issue. However, this paper is mainly motivated by some other aspects. However, this paper is mainly motivated by some other aspects. The vast majority of empirical research already performed has been focused on developed countries. A wave of currency and financial crises in 1990s, Global financial crisis 2008 and recent US debt crisis redirected an interest to the emerging economies which also suffered from the consequences of the crises. This study would like contribute to the debate on stock prices and exchange rates in India by using Today and Yamamoto (TandY) (1995) causality test and Johansen and Juselius Cointegration model. TandY causality procedure improves the reliability of the F-statistic on which causality test is based.

This paper is organized as follows. Section 2 discuss review of the literature Section 3 describes the Nature of the data and brief review of methodology Section 4 presents and discusses the empirical results Section 5 offer concluding remarks.

2. Review of Literature

Several studies attempted to investigate the interaction between stock prices and exchange rates in the developed countries and emerging capital markets. However, the results of some of these studies are inconclusive.

Franck and Young (1972) was the first study that examined the relationship between stock prices and exchange rates. They use six different exchange rates and found no relationship between these two financial variables. Solnik (1987) analyzed influence of several economic variables including exchange rates on stock prices in nine industrialized countries. Changes in exchange rates proved to be a non-significant factor in explaining the development of stock prices. Bahmani-Oskooee and Sohrabian (1992) were among the first to use cointegration and Granger causality to explain the direction of mutual relationships between the two variables. They employed monthly data on the S&P 500 index and US dollar effective exchange rate for the period 1973–88 and showed bidirectional causalities, at least in the short run. Since then many other papers investigating these aspects in various countries have applied these econometric procedures and have reported very mixed and diverse results.

Philaktis and Ravazzolo (2000) investigated the long-run and short-run dynamics between stock prices and exchange rates in Hong Kong, Indonesia, Malaysia, Singapore, Thailand and the Philippines and the channels through which exogenous shocks impact on these markets through the use of cointegration methodology and multivariate Granger causality tests. The study found that no long-run relationship between the real exchange rate and the local stock market in each Pacific Basin country. The US stock market was found to be an important causal variable, which acts as a conduit through which the foreign exchange and the local markets are linked. The results from the trivariate systems suggest that for all the countries the real exchange rate and US stock prices are positively related to domestic stock prices.

Pan *et al*.. (2000) noted that exchange rates had significant effects on stock prices in seven Asian countries during 1988–98. They reported much stronger interaction during and after the financial crisis in 1997, which corresponds with the conclusions of Granger *et al*.. (2000).

Bhattacharya and Mukherjee (2003) investigated Indian market using the data on stock prices and macroeconomic aggregates in the foreign sector including exchange rate concluded that there is no significant relationship between stock prices and exchange rates. Ma and Kao (1990) found that currency appreciation negatively affected the domestic stock market for an export-dominant country and positively affected domestic stock market for an import-dominant country, which seems to be consistent with the goods-market theory.

Kurihara (2006) chooses the period March 2001-September 2005 to investigate the relationship between macroeconomic variables and daily stock prices in Japan. He takes Japanese stock prices, US stock prices, exchange rate (yen/US dollar), the Japanese interest rate etc. The empirical results show that domestic interest rate does not influence Japanese stock prices. However, the exchange rate and US stock prices affect Japanese stock prices. Consequently, the quantitative easing policy implemented in 2001 has influenced Japanese stock prices.

Morales (2009) show that there is no evidence of stock prices and exchange rates moving together either in the long-run or in the short-run, with the exception of Slovakia. But causality analysis results shows that a unidirectional causal relationship form the exchange rates to the stock prices in the case of Hungary, Poland and Czech Republic. There is also evidence of causality from the Hungarian exchange rate to the United Kingdom stock prices, from the Polish exchange rates to the United Kingdom stock prices, from the Czech Republic exchange rate to the United Kingdom stock prices and from the Slovakian exchange rates to the United Kingdom stock prices. Finally study also found evidence of causality from the stock prices to the stock prices in the case of Hungary to United Kingdom, United Kingdom to Poland, and the United States to Poland.

Rahman and Uddin (2009) investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia (Bangladesh, India and Pakistan). The evidence shows that there is no cointegrating relationship between stock prices and exchange rates. The study applied Granger causality test to find out any causal relationship between stock prices and exchange rates. They found that there is no causal relationship between stock prices and exchange rates in the countries.

In general, empirical literature suggests that there are no long run equilibrium relationships between exchange rates and stock prices in most countries. However, many studies have found that these variables have predictive ability for each other, although the direction of causality seems to depend on specific characteristics of country analyzed.

3. Nature of the Data and Methodology

3.1. Nature of Data

The study investigates the relationship between stock prices and exchange rates using daily data for India. The exchange rates are expressed as number of local currencies per US dollar. The Indian stock market represented by Bombay Stock Exchange – Sensex index. The data is collected from Reserve Bank of India (RBI). The daily data are used for the period April, 2004 to August, 2011.

3.2. Methodology

To examine the long run relationship between stock prices and exchange rates we employ the standard technique of cointegration. In particular, Johansen (1988, 1991) and Johansen and Juselius (1990) bivariate cointegration tests are applied. To implement the Johansen test we first examine the Unit roots tests.

3.2.1. Unit Roots Test

The preliminary step in the analysis is to establish the degree of integration of each variable. This study tests for the existence of a unit root in the level and first difference. We use Augmented Dickey Fuller (ADF), Phillips – Perron (PP) test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests to find out the order of integration of both the series. If the series are found to be of the same order of integration then we can apply the cointegration tests.

In Dickey Fuller (DF) test and PP tests, the null hypothesis is that a unit root exists in the autoregressive representation of the time series. The DF type test attempts to account for temporally dependent and heterogeneously distributed errors by including lagged sequences of first differences of the variable in its set of regressors. The Augmented Dickey-Fuller (ADF) (Said and Dickey, 1984) test is an extension of the DF test by allowing a higher order of autoregressive process. The semi-parametric PP type tests try to account for dependent and IID processes through adopting a non-parametric adjustment, hence eliminating any nuisance parameters.

However, Schwert (1987) and DeJong *et al.*. (1992) have shown that these tests tend to accept the null of unit root too frequently against a stationary alternative due to lack of power. Therefore the failure to reject a unit root may be simply due to low power of the standard unit root test (Masih and Masih, 1999). In addition, Stock (1995) points out those nuisance parameters such as the largest autoregressive root are quite typical of financial time series. Due to the growing controversy surrounding the specific test to employ, we complement the ADF and PP tests with mean stationary test proposed by Kwiatkowski *et al.*. (1992) (KPSS). The KPSS test is based on the following statistic

$$\eta(u) = (1/T^2)\sum_{t=1}^{T} S_t^2 / \sigma_k^2, \text{ where } S_t = \sum_{i=1}^{t} v_t,\ t=1,\ldots..T. \tag{1}$$

Where v_t is the residual term from a regression of y_t on an intercept, and σ_t^2 is a consistent long-run estimate of y_t, and T represents the sample size. If the computed value of $\eta(u)$ is larger than the critical value, then the null hypothesis of stationarity is rejected. We consider a variable to contain a unit root or be unit-root non-stationary if the null hypothesis of unit root is not rejected by the ADF and PP tests but the null hypothesis that the variable is mean stationary is rejected by the KPSS test.

3.2.2. Johansen and Juselius Cointegration[1].

The Johansen method applies maximum likelihood procedure to determine the presence of cointegrating vectors in non-stationary time series as a vector autoregressive (VAR):

$$\Delta Yt = C + \sum_{i=}^{K} \Gamma_{t-1} + \Pi Y_{t-1} + \eta_t \tag{2}$$

Where *Yt* is a vector of non-stationary variables and *C* is the constant term. The information on the coefficient matrix between the levels of the Π is decomposed as $\Pi = \alpha\beta$ where the relevant elements the α matrix are adjustment coefficient and the β matrix contains cointegrating vectors. Johansen and Juselius (1990) specify two likelihood ratio test statistics to test for the number of cointegrating vectors. The first likelihood ratio statistics for the null hypothesis of exactly *r* cointegrating vectors against the alternative *r+1* vector is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most *r* cointegrating vectors against the alternative is the *trace statistic*. Critical values for both test statistics are tabulated in Johansen and Juselius (1990). This is very useful when it is wished to test and incorporate both the economic theory relating to the long-run relationship between variables, and short-run disequilibrium behaviors. In the following ECM for example,

$$\Delta y_t = a_1 + \sum_{i=0}^{n} \beta_i \Delta y_{t-i} + \sum_{j=0}^{m} \gamma_i \Delta x_{t-i} + \theta(y_t - \lambda x_t)_{t-1} + e_t \tag{3}$$

The short-run relationship is captured by the lagged terms of the Δx variable the current impact of Δx to Δy is captured by the β_0 coefficient, while the long-run disequilibrium deviations are captured by the one period lagged error-term of the co integrating equation, with θ being the adjustment factor

[1] Please see Chittedi (2010), Chittedi (2011) and Raj, and Dal (2008) for more detail discussion on cointegration.

to equilibrium. θ Of course takes values between zero to one, while it is obvious that the closest to one the largest is the adjustment to equilibrium and vice versa.

3.2.3. Toda and Yamamoto (1995) Test

It is well known that in the context of integrated series, the conventional application of the F-test (i.e. in a standard VAR model) is invalid. Moreover, the F-test is not valid unless the variables are cointegrated in levels. Recently an alternative approach which utilizes the Modified WALD (MWALD) test for testing linear restriction on the parameters was proposed by Toda and Yamamoto (1995). This test has an asymptotic χ^2 distribution when a VAR (k + dmax) is estimated where dmax is the maximum degree of integration suspected to occur in the system. Therefore, the Toda-Yamamoto causality procedure is viewed as a long-run causality test. Toda and Yamamoto (1995) point out that, for *d*=1, the lag selection procedure is always valid since *k* 1=*d*. If *d*=2, then the procedure is valid unless *k*=1. Moreover, the MWALD statistic is valid regardless whether a series is I(0), I(1) or I(2), non-cointegrated or cointegrated of an arbitrary order.

Toda and Yamamoto (1995) Granger non-causality test, these variables can be causally linked in a system of two-variable, with 3-order VAR as follows[2]:

$$\begin{bmatrix} SN_t \\ EX_t \end{bmatrix} = \alpha_0 + \alpha_1 \begin{bmatrix} SN_{t-1} \\ EX_{t-1} \end{bmatrix} + \alpha_2 \begin{bmatrix} SN_{t-2} \\ EX_{t-2} \end{bmatrix} + \alpha_3 \begin{bmatrix} SN_{t-3} \\ EX_{t-3} \end{bmatrix} + \alpha_4 \begin{bmatrix} e_{SN} \\ e_{EX} \end{bmatrix} \tag{4}$$

Where α_0 is an identity matrix and $E(\varepsilon_t) = [\varepsilon_{SN_t} \varepsilon_{EX_t}]' = 0$ and $E(\varepsilon_t \varepsilon_t') = \Sigma$. For example, if k=2 and d_{max}=1, a causality from EX to SN can be established through rejecting the null of EX_{t-1} and EX_{t-2} are jointly equal to zero in the first equation of the above system. A similar procedure can be used to test the causality from SN to EX by establishing a significance of the MWALD statistic for a group of lagged SN variables in the second equation of the system.

4. Empirical analysis

To examine the stationarity property of all the variables, we have carried out the ADF, PP and KPSS unit roots. All the tests have been conducted both with intercept and with intercept and trend, without intercept.

Table 1 to 1.1 carry the required statistics of ADF, PP and KPSS tests for the variables on both levels and first differences. Sensex and Exchange rate, when measured in levels are not stationary as the value of the test statistics i.e. ADF, PP and KPSS are not significant. However, results for first-difference clearly show that the hypothesis of unit root can be rejected for both sub-samples. This indicates that the first-difference of each series is stationary. Thus, like most financial time series, both stock price and exchange rates require differencing to achieve stationarity or they are I(1).

Table 1. Results of Unit Roots Tests at levels

Variables	Augmented Dickey-Fuller Test			Phillips-Perron Test			KPSS Test	
	With Intercept	With Intercept and Trend	Without Intercept and Trend	With Intercept	With Intercept and Trend	Without Intercept and Trend	With Intercept	With Intercept and Trend
Sensex	-1.41	-2.32	0.61	-1.37	-2.14	0.67	3.86	0.44
Exchange Rate	-1.55	-1.62	0.37	-1.62	-1.70	0.35	0.69	0.38

[2] SN – stock prices; EX – exchange rates.

Table 1.1. Results of Unit Roots Tests First difference

Variables	Augmented Dickey-Fuller Test			Phillips-Perron Test			KPSS Test	
	With Intercept	With Intercept and Trend	Without Intercept and Trend	With Intercept	With Intercept and Trend	Without Intercept and Trend	With Intercept	With Intercept and Trend
Sensex	-39.50	-39.49	-39.48	-39.46	-39.45	-39.44	0.07	0.06
Exchange Rate	-42.39	-42.38	-42.40	-42.42	-42.41	-42.42	0.08	0.07

4.1. Johansen and Juselius Cointegration analysis

Co-integration tests are helpful while dealing with non-stationary in the data and also examine the long run relationship. 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, whereas first differenced stationary.

Table 2. Results of J- J Cointegration between Sensex and Exchange rate

Variables	Null Hypothesis H_0	Trace test		Max test	
		Alternative	Statistics[Prob]**	Alternative	Statistics[Prob]**
Sensex	r=0	r=1	**21.80 [0.016]***	r>=1	**19.44 [0.022]***
Exchange rate		r=2	2.36[0.1244]	r>=2	2.36[0.124]

Table 2 Results shows that both trace test and maximum eigenvalue test reject the null hypothesis of no cointegration in all the cases. Thus there is a long-term co-movement between stock prices and exchange rates and the variables can be predictable on the basis of past values of other variable.

4.3. Results of Vector Error Correction

Table 3. Results of Vector Error Correction Method (VECM)

Error Correction:	D(SENSEX)	D(ER)
CointEq1	-0.000562	-7.49E-07
	(0.00065)	(5.8E-07)
	[-0.86958]	[-1.28240]
D(SENSEX(-1))	0.071764	9.46E-06
	(0.02374)	(2.1E-05)
	[3.02319]	[0.44098]
D(ER(-1))	-47.97891	-0.001494
	(26.3070)	(0.02378)
	[-1.82381]	[-0.06282]
C	6.745009	0.002762
	(5.43924)	(0.00492)
	[1.24006]	[0.56189]
R-square	0.007517	0.001046
Adj. R-squared	0.005833	-0.000649
F-statistic	4.463462	0.616895
Standard errors in ( ) and t-statistics in [ ]		

From the above analysis, it's explained that, Sensex and exchange rates have long run relationship. But that does not mean they have short run equilibrium. There may exist short run dynamics among Sensex and exchange rate also. For taking care of short run equilibrium Error Correction Mechanism (ECM) has been adopted. Three types of inference, concerning the dynamics of the two variables, can be drawn from the Error Correction Mechanism results Table 4.3. It is evident from the co-integration coefficients found to be weekly exogenous or endogenous, that is shocks exchange rate do destabilize the equilibrium Sensex.

4.2. TandY causality analysis

Having identified that all series exhibit I (1) behavior or the maximum degree of integration in the system is unity, we examine the nature of causal linkages between the stock price and exchange rate by performing the Granger non-causality test. Applying the methodology proposed by Toda and Yamamoto (1995) outlined in section III, we analyze the nature of causal linkages between stock price and exchange rates. The bivariate model was estimated and the results for are tabulated in Table 2.

Table 4. Results of TandY causality: Sensex and Exchange rate

Cause	Effect	MWald- Test values	P-Value	Causality Inference
Exchange Rate	Sensex	10.438	0.033	Exchange rate does causes Sensex
Sensex	Exchange Rate	5.796	0.214	Exchange Rate does not causes Nifty

The result of bivariate model suggests that there exist unidirectional causal relation between stock price and exchange rate for both sub-sample periods. It means changes in exchange rate may effects the stock prices but changes in stock prices does not have any impact on exchange rate.

5. Conclusions

In this paper we have explored the association between two important component of an economy named as stock prices and exchange rates. First of all, we applied unit root test to find the stationarity of data series. The results show that all the data series of the variables are non-stationary and integrated of order one. Then we applied Johansen procedure to test for the possibility of a cointegrating relationship. Result shows that there is cointegrating relationship between stock prices and exchange rates. In India, stock market investment does not constitute a very significant portion of total household savings compared to other form of financial assets, due to this it may have a significant impact on exchange rate movement as FII investment has playing a dominant role in Indian stock market. This study confirms belief of investors that there is an association between exchange rates and stock prices and they are predictable on the basis of the values of other variables. One of the practical applications of portfolio management is that the relationship between equity returns and exchange rate movements may be used to hedge their portfolios against currency movements. Additionally, risk management must take into consideration that these markets are correlated.

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AN APPROACH OF COMBINING EMPIRICAL MODE DECOMPOSITION AND NEURAL NETWORK LEARNING FOR CURRENCY CRISIS FORECASTING

Mustapha DJENNAS
University of Tlemcen, Faculty of Economics, **Algeria**
djennasm@yahoo.fr

Mohamed BENBOUZIANE
University of Tlemcen, Faculty of Economics, **Algeria**
mbenbouziane@yahoo.fr

Meriem DJENNAS
University of Amiens, Faculty of Economics, **France**
meriem.djennas@gmail.com

Abstract

This paper presents a hybrid model for predicting the occurrence of currency crises by using the artificial intelligence tools. The model combines the learning ability of the artificial neural network (ANN) with the inference mechanism of the empirical mode decomposition (EMD) technique. Thus, for a better detection of currency crises emergence, an EMD-ANN model based on the event analysis approach is proposed. In this method, the time series to be analyzed is first decomposed into several intrinsic mode components with different time scales. The different intrinsic mode components are then exploited by a neural network model in order to predict a future crisis. For illustration purposes, the proposed EMD-ANN learning approach is applied to exchange rate data of Turkish Lira to evaluate the probability of a currency crisis. We find evidence that the proposed EMD-ANN model leads to a good prediction of this type of crisis. Significantly, the model can thus lead to a somewhat more prescriptive modeling approach based on the determination of causal mechanisms towards finding ways to prevent currency crises.

Keywords: emerging markets, currency crisis, artificial neural network, early warning system, empirical mode decomposition, intrinsic mode components.

JEL Classification: G01, G17, C45, F31

1. Introduction

Many crises of financial origin took place during the 1990ties and currency systems have often played the major role within the observed dynamics. Thus, the sudden currencies' depreciation experienced by the European Monetary System (EMS), Latin America or Asia has prompted many studies seeking to model situations of vulnerability and exchange rate depreciation. The different generations of currency crises models have therefore enabled the development of several tests regarding the optimal monetary policy to implement in such situations.

Many emerging economies have benefited from substantial inflows in direct and portfolio investment. However, especially when short-term flows are concerned, changes in investors' attitude - often motivated by concerns related to the accumulation of public debt or financial imbalances – have often determined sudden capital outflows. Since 1994, these reversals have generated important financial turmoil in most Latin American countries, a part of Southeast Asia, and some countries in transition. These crises have often been aggravated by financial contagion, during which liquidity suddenly dried up in some countries, not because of changing of fundamentals of their economy, but because of common characteristics with other economies that lost market confidence. Experiences show that the risk of contagion increases when news on the financial health of a country are limited.

The increasing integration of economies is reflected by a rise in the systemic risk and by a multiplication of crises over the recent years in some developing countries. These successive crises were often followed by bailouts insured by international institutions (especially IMF) in order to restore confidence and limit the slowdown in global economic growth. These successive crises are usually triggered by a brutal depreciation of exchange rate of domestic currency.

In this context, the literature on currency crises has experienced a rapid growth. Its aim is to build a successful model for crisis forecasting, which can detect the emergence of problems in the foreign exchange markets in order to help countries to avoid crises.

Due to the high fluctuations of financial time series, it is difficult to use a single technique to capture its non-linearities and accurately describe its moving trend. Hence, a novel hybrid intelligent forecasting model, based on empirical mode decomposition (EMD) and neural network (ANN), is proposed in this paper. EMD can adaptively decompose the dataset into a number of independent intrinsic mode components (IMC) and a residue. These IMC could represent factors that affect exchange rate movements. These IMC which have different scales will represent the input layer for the proposed neural network learning system. The probability of crisis will then be the output layer of the neural network. Successful forecasting application on the Turkish exchange rate will demonstrate the feasibility and validity of the presented model.

In the proposed EMD-ANN approach, the exchange rate - a typical financial indicator reflecting changes in economic conditions - is chosen. Then, the EMD algorithm is applied on the exchange rate data and the IMC of the exchange rate series with different scales are obtained. Consequently, the relation between these different IMC and the probability of crisis is explored by a back-propagation neural network algorithm.

The distinct feature of the proposed model is that it uses only one indicator (the exchange rate). However, most previous studies (i.e. several statistical-based models, structural analysis models and some artificial intelligence methodologies), use different financial indicators related to crisis situations. However, these indicators are usually hard to obtain, mainly because disastrous financial crises occur rarely, or over a very short period of time. Another important characteristic of this study is that the exchange rate data is used to judge whether the economic condition is approaching a crisis state or not.

The paper is articulated as follows: Section 2 gives a literature review on currency crises. Some empirical evidence is developed in Section 3. Section 4 describes some previous forecasting models of currency crises. The construction of the EMD-ANN system and its benchmarks is discussed in Section 5. The empirical results are presented and interpreted in Section 6. Finally, in Section 7, we provide some conclusions and considerations for further researches.

2. Currency Crises Literature Review

Models of currency crises deal with situations in which a speculative attack is triggered in the foreign exchange market and causes important sudden depreciation of the exchange rate.

The first studies attempting to explain the occurrence of crises have been developed by Krugman in 1979. According to Krugman (1979), economic programs implemented by public authorities that are incompatible with a fixed exchange rate regime are the main cause of the outbreak of a crisis.

The first models have shown that the origin of currency crises comes from the weakness of fundamental economic variables typically related to expansionary monetary and fiscal policies. Krugman's model shows that under a fixed exchange rate, an expansion of domestic credit higher than the money demand leads to a gradual, but inexorable, decline in international reserves and ultimately to a speculative attack on the currency. This attack brutally depletes reserves and forces the authorities to abandon the parity. The attack is justified by the fact that agents understand that the fixed exchange rate regime will collapse, followed by capital losses on their holdings in domestic currency. In terms of indicators, this model suggests that the months preceding a currency crisis are characterized by a progressive decline in reserves, and a rapid rise in domestic credit compared with money demand.

A number of extensions have been added to this basic model. They showed that a speculative attack is usually preceded by an appreciation of the real exchange rate and a deterioration of trade balances. These results derive from models where fiscal policy and expansionary credit lead to greater demand in both tradable goods (which causes deterioration in the trade balance) and non-tradable goods (which causes an increase in the relative price of these goods, and therefore an appreciation of the currency in real terms).

The different currency crises in the nineties have strained the predictive qualities of these models. Indeed, these models fail in taking into account financial globalization and the reversibility risk of capital flows. However, the speculative crisis that hit the EMS in the early nineties has contested the idea that the crisis would be preceded by deterioration in fundamentals, particularly a loss in foreign reserves.

Thus, a more recent stand of literature, the so-called second generation models, has been developed following the EMS crisis in 1992 – 1993 (Eichengreen and Wyplosz 1993).

The second-generation models rely on the idea that abandoning fixed parity by the government is no longer exclusively linked to the inexorable loss in foreign reserves, but rather the result of an arbitrage between the advantages of the parity and the costs of abandonment. Typically, maintaining the parity may require economic policies (such as increasing interest rates) which may have adverse effects on other key variables (such as the unemployment rate).

Obstfeld (1994) explains the currency crisis as a result of the conflict between the fixed exchange rate regime and the government's willingness to pursue an expansionary monetary policy. When investors begin to form expectations concerning the abandonment of fixed exchange rates, further pressures on interest rates are likely to push the government to abandon this exchange rate regime. This is more than a significant deterioration, *ex ante*, of macroeconomic fundamentals.

Therefore, this new generation of models is characterized by the existence of multiple equilibriums where governments are represented as 'optimizing' agents. In these circumstances, crises can be unpredictable and the probability of survival of an exchange rate regime depends upon the willingness of public authorities to pay conservationist costs. Hence, crises can occur even when initial macroeconomic conditions are sound.

The Asian crisis seems differ from the description provided by these standard models for two main reasons (Krugman 1998): first, the monetary and fiscal fundamentals were not significantly degraded; second, the authorities' ability to trespass a speculative attack was strong, due to the economic overheating observed in many countries from this zone.

The collapse of the Asian system has trigged a large debate on the existence of a third generation crisis (Radelet and Sachs 1998, Corsetti, Pesenti and Roubini 1998) having its roots in the banking and financial fragility of the economy. The crisis is thus reduced to a problem of banking panic.

The crisis may also result from a contagion effect related to the concept of 'spillover effects', when the crisis in one market affects the economic and financial systems of the neighboring countries and make them vulnerable. Situations of 'pure contagion' (Masson 1998), which cannot be explained by fundamentals, are also possible.

3. Empirical Evidence

Sachs, Tornell and Velasco (1996) tested the hypothesis on countries affected by the Mexican crisis. They found that the ratio of short-term debt to total capital flows was higher than in the other countries not affected by crisis. The authors used a simple model based on three factors that determine whether a country is more vulnerable or not to a financial crisis: a high appreciation of real exchange rate, a recent explosion in loans and a low level of foreign reserves.

In an attempt to diagnose the crisis in Southeast Asia, Radelet and Sachs (1998) found that the ratio of short-term debt to foreign exchange reserves helps predicting large reversals of capital flows. Rodrik and Velasco (1999) obtain results in the same line, revealing that greater short-term exposure is associated with more severe crises in the case of capital outflow.

Frankel and Rose (1996) examined the composition and level of debt and a variety of macroeconomic factors. They found that currency crises occur when output growth is low, the growth of domestic credit is high, the level of foreign interest rates is high and the ratio of FDI/debt is low.

In a study on countries with low and medium income, Milesi-Ferretti and Razin (1998) found that domestic factors (such as low foreign exchange reserves) as well as external factors (such as deteriorated terms of exchange) can trigger currency crises. The authors found no effect of liquidity on these crises. However, when the sample is broadened to include the recent crisis, the liquidity variables become significant (Berg and Patillo 1999, Bussiere and Mulder 1999). In addition to this result, in a study identifying variables responsible of the crises in 1994 (Mexico), 1997 (Asia) and 1998 (Russia), Bussiere and Mulder (1999) concluded that these variables are consistent with those used by IMF in implementing 'early warning signals' and that the presence of an IMF program significantly reduces the importance of the crisis.

Detragiache and Spilimbergo (2001) showed that for a given level of external debt, the probability of a crisis increases with the proportion of short-term debt and decreases with foreign exchange reserves.

Eichengreen, Rose and Wyplosz (1994) presented an empirical analysis of speculative attacks on the fixed exchange rate and concluded to the impossibility of rejecting the null hypothesis of the presence of significant differences in the behavior of macroeconomic variables in periods of crisis and during 'quiet' periods in the countries composing the European Monetary System.

Kaminsky and Reinhart (1999) analyzed the potential links between banking crises and currency crises. They found that problems disrupting the banking sector typically precede a currency crisis; the latter even worsens the banking crisis by creating a vicious circle. Furthermore, it is clear that financial liberalization often precedes banking crises.

Kaminsky, Reinhart and Lizondo (1998) tried to empirically explain currency crises in order to provide an early warning system that is able to detect the evolution of indicators that tend to show unusual behavior during the periods preceding a crisis. Indeed, when the value of an indicator exceeds a certain 'threshold', on can interpret it as an alarming signal indicating that a currency crisis will occur in the next 24 months. The indicators which have been chosen by the authors are the amount of exports, the deviation of the exchange rate from its average, the ratio M2/foreign exchange reserves, the output and the stock prices.

It is clear from this empirical work that crises are assumed to be the same, since researchers used the same battery of indicators for all crisis episodes independently of the category to which they belong (1^{st}, 2^{nd} or 3^{rd} generation)

Hence, Kaminsky (2006) used a new method in order to classify 96 currency crises in 20 countries between 1970 and 2001. This empirical classification clearly reflected the variety of crises presented in the theoretical literature proving that the attacks were not the same.

4. Currency Crises Forecasting Models

As a result of the recent crises in emerging markets and the evolution of financial markets, financial research is increasingly focusing on the study of forces that contribute to the emergence of a financial crisis.

Recent literature has been directed towards the identification of indicators that could explain the burst of a currency crisis. The objective is to determine if the causes of currency crises can be anticipated in advance, in order to allow governments to adopt preventive measures.

The empirical analyses use two different methods to identify leading indicators of the crisis.

The first one is the warning signals approach which consists in following the evolution of a number of economic indicators that tend to behave systematically differently before the crisis compared to 'normal' periods. Notable examples include Alvarez- Plata and Schrooten (2004), Kaminsky *et al.*. (1998), Kaminsky (1999), Kaminsky and Reinhart (1999), Goldstein *et al.*. (2000), and Peng and Bajona (2008). In their models, individual variables such as the real effective exchange rate, the stock prices or the reserves level are considered as 'signals' indicating that a country is potentially in a state of crisis whenever they exceed a specified threshold. While intuitively appealing, signal models are essentially univariant by nature. Kaminsky (1999) suggested a way of combining individual signals to form a composite index for prediction purposes, but this method does not solve all problems. For example, assuming that some of signal variables are closely correlated, means that each of them may have a very high noise-to-signals ratio, even though one of them does not significantly contribute to the analysis. The problem here is that the noise-to-signal weights are themselves based on a univariate analysis.

The second approach identifies variables that help to statistically anticipating the crisis and directly estimates the probability of occurrence of a crisis on the basis of an explicit model, knowing that the indicators are measured simultaneously. We can cite the work of Frankel and Rose (1996), Klein and Marion (1997), Goldfajn and Valdés (1998). These authors use *logit* or *probit* models to assess the probability of a crisis at time $t + i$, based on a set of explanatory variables observed in t. This type of financial crisis models focus on panel data analysis employing discrete choice techniques in which macroeconomic and financial data are used to explain discrete crisis events that could occur in different countries. Eichengreen *et al.*. (1996) adopted a *probit* model to analyze and predict crises in industrial countries using quarterly data on the period between 1959 and 1993. Likewise, Berg and

Pattillo (1999) also used a *probit* model to predict currency crisis. Kumar *et al*.. (2003), Beckmann *et al*.. (2006), Kalotychou and Staikouras (2006) and Bussiere and Fratzscher (2006) used *logit* and multinomial *logit* models to predict currency crashes in emerging markets and financial crises and obtained good performance. In addition, Cipollini and Kapetanios (2008) and Mouratidis (2008) applied the dynamic analysis model and the Bayesian Markov switching approach to identify signals of financial crises. However, these models are parametric statistical models, and include several statistical assumptions leading to weak robustness. Since a currency crisis is a rare event with nonlinear characteristics, it is difficult for these statistical models to capture all the possible crises at all times. Furthermore, a large number of data on different variables needs to be collected to construct these models.

Hence, financial studies generally seek to identify a set of macroeconomic, financial and real indicators likely to be responsible for triggering the currency crisis that could serve as leading indicators or predictive factors of the vulnerability of a country to a currency crisis. These indicators should enable governments to determine the context in which the country would be more vulnerable to attacks in order to anticipate the crisis and intervene to prevent its outbreak. The results of the empirical tests are different, sometimes in conflict and highlight many fundamental variables.

Therefore, a new approach to predict financial crises has been developed over the recent years; it is based on some emerging computational techniques such as artificial intelligence methods, based upon some technical or volatility indicators. For example, Niemira and Satty (2004) proposed an analytic network process (ANP) model for financial crisis forecasting. Kim and Moon (2001) adopted a computable general equilibrium (CGE) model to analyze the relationship between the currency crisis and the Korean industrial structure. Kim *et al*.. (2004) applied a back-propagation neural network (BPNN) model to predict economic crisis in South Korea using the Korean stock market index. Yu *et al*.. (2006) employed a general regression neural network (GRNN) to predict the currency crisis in Southeast Asian economies using some currency volatility indicators. Celik and Karapete (2007) used a feed forward neural network (FFNN) model for forecasting banking crisis and obtained successful solutions. In addition, Son *et al*.. (2008) and Lin *et al*.. (2008) adopted some machine learning approaches such as fuzzy experts system to construct early-warning systems for financial crisis prediction.

However, it is worth noting that these methods depend on the selection of the different indicators. Usually, the randomness in the selection of indicators often leads to some unexpected results. Differently said, different selections will lead to different prediction results.

The main objective of this paper is to develop a preventive model that would be able to signal in advance any problem or tension on the foreign exchange market. We propose an empirical mode decomposition system which is a new learning paradigm combined with neural networks for currency crisis forecasting. The neural network algorithm used in this study is the back-propagation one, a popular tool for pattern recognition.

5. Methodology Formulation

5.1. An Overview of Artificial Neural Networks

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by biological nervous systems, such as the brain process information. The key element of this paradigm is the structure of the information processing system. It is composed by a large number of highly interconnected processing elements (neurons) working together to solve specific problems. Figure 1 illustrates a neural network structure as defined by various previous works:

The ANNs learn through examples. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process.

One of the most commonly used supervised ANN models is the back-propagation neural network (BBNN). Back-propagation algorithm is one of the well-known algorithms in neural networks. This algorithm is essentially a network of simple processing elements working together to produce a complex output. These elements or nodes are arranged into different layers: input, hidden and output layers.

The learning process of a neural network tries to find the best outputs by minimizing the error function. The algorithm can first be trained by using an in-sample dataset and then be applied on an out-of-sample dataset for prediction. This ability to learn through examples and the ability to be generalized to new situations is the most attractive feature of the neural network paradigm. Basically, the BPNN-based forecasting model can be summarized as follows:

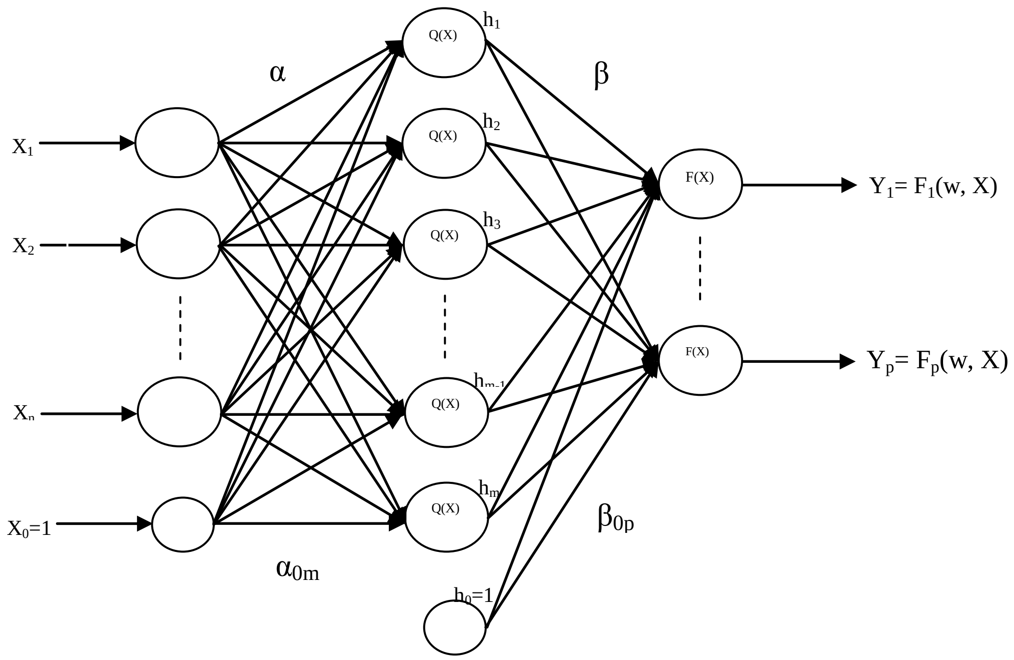

Figure 1. General Architecture of a Neural Network

Source: Zhang and Hu, 1998.

The network receives the information in the input layer as a set of explanatory variables which are then processed using one or more hidden layers containing one or more neurons. In this phase, variables are weighted by connection weights α and transformed by the activation function Q. We obtain a new set of variables h_1, h_2…..h_n, so that:

$$h_j = Q\left(\alpha_{0j} + \sum_{i=1}^{n} \alpha_{ij} X_i\right) \quad (1)$$

In turn, variables h_j are weighted by the connection weights β and processed by the transfer function F (see figure 1). Each output is interpreted by the following formula:

$$Y_k = F\left[\beta_{0k} + \sum_{j=1}^{m} \beta_{jk}\left(h_j\right)\right] \quad (2)$$

Where:

$X_1, X_2, \ldots X_n$	– are the explanatory (exogenous) variables in the input layer,
$w(\alpha, \beta)$	– is a set of model parameters (connection weights),
$h_1, h_2, \ldots h_m$	– is the number of neurons in the hidden layer,
$Q(X)$	– is the activation function of neurons,
$F(X)$	– is the transfer function,
$Y_1, Y_2, \ldots Y_p$	– are the explained (endogenous) variables.

The main reason for selecting BPNN as a predictor is that a BPNN is often viewed as a ‘universal approximate’. Hornik *et al.*. (1989) found that a three-layer BPNN with an identified transfer function in the output unit and a logistic functions in the middle-layer units can well approximate arbitrarily any continuous function, given a sufficient amount of middle-layer units. Neural networks have the ability to provide flexible mapping between inputs and outputs. In this study, we utilize the three-layer BPNN method for modeling and forecasting.

The general principle of the back-propagation algorithm is giving to the network a large number of examples for which the inputs and their associated outputs are known and weights are adjusted to correct the error of the network (i.e. the difference between targets and obtained responses). Thus, learning is seen as an optimization problem to find the network coefficients which minimize a cost function. The most used cost function is the mean square error (MSE) where error represents the difference between the network outputs and the real values.

One of the major BPNN advantages is that their learning algorithms are applicable to all types of networks. One is free in choosing the best architecture adapted to the problem, and whatever the network structure, one can always use the same set of learning algorithms. This flexibility allows implementation including networks whose architecture depends strongly on the structure of problems which are expressed by equations.

The most frequent problem that appears during the learning is the over-fitting. If the ANN learns insufficiently or inappropriately, it will give incorrect results when it receives some slightly different data. To avoid over-fitting, the performance of the trained network should then be compared to another set called validation set. This strategy should provide a better generalization of the model. It consists in monitoring the evolution of the cost function on a validation dataset and stopping the iterations as soon as the calculated cost on this dataset starts increasing. Once the network is executed, one should always apply tests to verify if it responds correctly. In the test phase, a part of the sample is simply removed and conserved for out-of-sample tests. For example, we can use 60% of the sample for learning, 20% for validation and 20% for testing.

5.2. An Overview of the Empirical Mode Decomposition System

Huang *et al*.. (1998, 1999) developed the Hilbert-Huang transformation[3] (HHT) to decompose a time-dependent data series into its individual characteristic oscillations with the so-called empirical mode decomposition (EMD). This adaptive technique is derived from the simple assumption that any signal consists of different intrinsic mode components (IMC), each of them representing an embedded characteristic oscillation on a separate time-scale. An IMC is defined by two criteria: *i)* the number of extreme and the number of zero crossings must either equal or differ at most by one, and, *ii)* at any instant in time, the mean value of the envelope defined by the local maxima and the envelope of the local minima is equal to zero. The first criterion is almost similar to the narrow band requirement of a Gaussian process, while the latter condition transforms a global requirement into a local one, to ensure the instantaneous frequency if necessary. In other words, the EMD is based on the direct extraction of the energy associated with various intrinsic time scales.

A sifting process is designed to extract IMCs level by level. First, the IMC with the highest frequency riding on the lower frequency part of the data is extracted, and then the IMC with the next highest frequency is extracted from the differences between the data and the extracted IMC. The iterations continue until no IMC is contained in the residual.

The starting point of the empirical mode decomposition is to consider oscillations in signals at a very local level. In fact, if we look at the evolution of a signal$x(t)$ between two consecutive extrema (two minima occurring at times $t^-$and t^+), we can heuristically define a (local) high-frequency part $d(t), t^- \leq t \leq t^+$ or local detail, which corresponds to the oscillation that ends at the two minima and that passes through the maximum which necessarily exists between them. For the picture to be complete, one still has to identify the corresponding (local) low-frequency part $m(t)$, or local trend, so that $x(t) = m(t) + d(t)$for $t^- \leq t \leq t^+$. Assuming that this is done in some proper way for all the oscillations composing the global signal, the procedure can then be applied to the residual consisting of all local trends, and the constitutive components of a signal can therefore be iteratively extracted.

Given a signal $x(t)$, the effective algorithm of EMD can be summarized as follows:

1. Identify all extrema of $x(t)$,
2. Interpolate between minima (respectively, maxima), ending up with some envelope $e_{min}(t)$ (respectively,$e_{max}(t)$),
3. Compute the mean $m(t) = \left(e_{min}(t) + e_{max}(t)\right)/2$,
4. Extract the detail $d(t) = x(t) - m(t)$,
5. Check the properties of $d(t)$:

[3]Huang *et al.*, 'The empirical mode decomposition and the Hilbert spectrum for nonlinear and non-stationary time series analysis', Proc. R. Soc. Lond. A (1998) 454, 903–995.
http://keck.ucsf.edu/~schenk/Huang_etal98.pdf

a. If it is an IMC, denote $d(t)$ as the i^{th} IMC and replace $x(t)$with the residual $r(t) = x(t) - d(t)$. The i^{th} IMC is often denoted as $c_i(t)$ and i is its index,

b. If not, replace $x(t)$with $d(t)$;

6. Repeat steps 1 to 5 until the residual satisfies some stopping criterion.

One stopping criterion proposed by Huang *et al.*. (2003) for extracting an IMC is iterating a predefined number of times after the residual satisfies the restriction that the number of zero-crossings and extrema do not differ by more than one and the whole sifting process can be stopped by any of the following predetermined criteria: either when the component $c_i(t)$ or the residual $r(t)$becomes so small that it is less than the predetermined value of a substantial consequence, or when the residual $r(t)$ becomes a monotonic function from which no more IMC can be extracted. The original time series can thus be expressed as the sum of IMCs and the residual:

$$x(t) = \sum_{i=1}^{N} c_i(t) + r(t) \tag{3}$$

Where N is the number of IMCs, and $r(t)$ means the final residual.

The advantages of an EMD can be briefly summarized as follows: first, it can reduce any type of data, from non-stationary and nonlinear processes into simple independent intrinsic mode functions; second, since the decomposition is based on the local characteristic time scale of the data and only extrema are used in the sifting process, it is local, self-adaptive, concretely implicational and highly efficient.

6. Empirical Study

6.1. Data

In order to illustrate and verify the proposed EMD-ANN model, we conduct an analysis on the Republic of Turkey, a country in MENA region.

The dataset is the daily exchange rate of the Turkish Lira against the US Dollar obtained from the Pacific Exchange Rate Service.[4] The main reason for choosing this currency is its representativeness of the MENA region which suffered from the 1994 currency crisis and 2000-2001 financial and currency crisis. The sample data covers the period from January 1991 to December 2009, with a total of 4958 observations (19 years). For purposes of training and testing, the dataset is divided into two parts, in-sample and out-of-sample. The in-sample (60% of data) part goes from 01/01/1991 to 05/27/2002 (2975 observations). It is used for the neural network model building. The out-of-sample part (40% of data) goes from 05/28/2002 to 12/31/2009 (1983 observations), and is used for validation and test. Figure 2 shows the data series of USD/TRY.

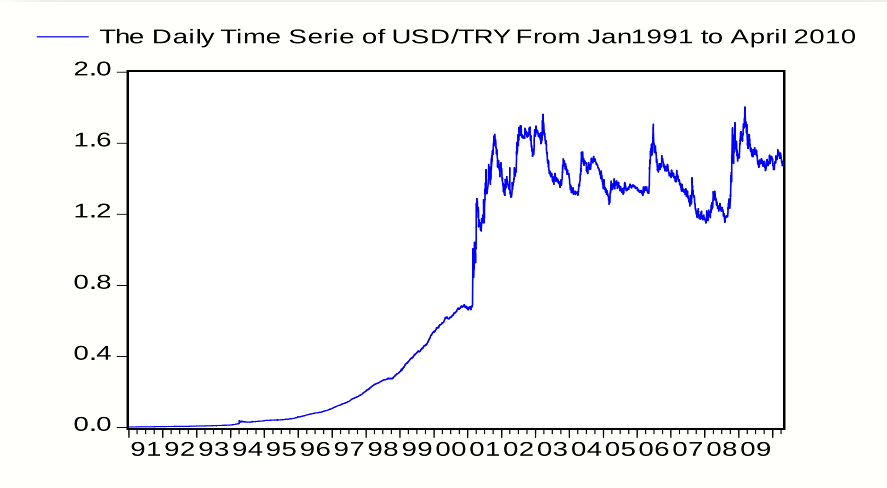

Figure 2. The Daily Spot USD/TRY from January 1991 to December 2009

[4] http://fx.sauder.ubc.ca/

The Turkish economy has been hit by two crises in the two last decades. The first one occurred at the beginning of 1994. At that time, the exchange rate was under a managed float regime. In the aftermath of the crisis, the Turkish economy contracted by 6%, the highest level of annual output loss in its history. In the first quarter of 1994, the Turkish Lira was devalued by more than 50% against the US Dollar, the Central Bank lost half of its reserves, interest rates skyrocketed, and the inflation rate reached three digit levels.

The second crisis erupted in the second half of November 2000, in the midst of an exchange rate based stabilization program. In response to the turmoil, a new letter of intent was presented by the government to the International Monetary Fund (IMF) and calmed market pressure. However, by the end of December, the interest rates were almost four times higher than the levels at the beginning of November and five times higher than the pre-announced (at the outset of 2000-2002 program) level. This unsustainable situation ended on February 19, 2001 when the Prime Minister announced that the country experienced a severe political crisis, which had ignited an equally serious economic crisis on the highly sensitive markets. As a consequence, overnight rates jumped to unprecedented levels of 6,200 percent. Three days later, the exchange rate system collapsed, and Turkey declared that it was going to implement a floating exchange rate system.

6.2. Crisis Model

According to Eichengreen *et al.*. (1995, 1996), currency crisis can be measured using the EMP (Exchange Market Pressure) index, which is calculated as follows:

$$EMP_{i,t} = \alpha\Delta e_{i,t} + \beta\Delta\left(i_{i,t} - i_{USD,t}\right) - \gamma\Delta r_{i,t} \tag{4}$$

Where:

$\Delta e_{i,t}$	– is the deflation rate of the nominal exchange rate of currency i at time t;
$\Delta\left(i_{i,t} - i_{USD,t}\right)$	– is the change of the interest rate differential between currency i and US Dollar;
$\Delta r_{i,t}$	– is the change rate of the foreign exchange reserves;
α, β, γ	– are the weights insuring that the variances are equal among these three parts.

Kaminsky *et al.*. (1998), Kaminsky (1998), Kaminsky and Reinhart (1999) and Goldstein *et al.*. (2000) built on Eichengreen *et al.*. (1995, 1996), but they excluded interest rate differential from their index. Hence, Kaminsky and Reinhart (1999) formula becomes:

$$EMP = (\Delta e/e) - (\sigma_e/\sigma_R)(\Delta R/R) \tag{5}$$

Where:

$\Delta e/e$	– is the rate of change of the exchange rate;
$\Delta R/R$	– is the rate of change of the foreign exchange reserves;
σ_e	– is the standard deviation of $\Delta e/e$, and $\sigma_R$is the standard deviation of $\Delta R/R$.

The reason for removing the interest rate change part is that some countries adopt interest rate control which forces this variable to have no significant explanatory role for the currency crisis. The function of σ_e/σ_R is similar to the function of α, β, γ, i.e. insure variances equality.

However, a major drawback of this approach is that the threshold value used to identify the speculative attack is somewhat arbitrary. Kaminsky *et al.*. (1998), for example, define crises as periods during which the exchange market pressure index is at least three standard deviations above the mean, while in Edison (2000), a crisis is detected as soon as the index is above its mean by more than 2.5 standard deviations. We adopt the Kaminsky and Reinhart (1999) classification. The currency crises are defined as the situation when the observed EMP is greater than its mean by more than 3 standard deviations; otherwise no currency crisis is going to happen, e.g.:

$$crisis_{i,t} = \begin{cases} 1 \; if EMP_{i,t} > \mu_{EMP_i} + 3\sigma_{EMP_i} \\ 0 \; otherwise \end{cases} \tag{6}$$

Where $\mu_{EMP_i}$and $\sigma_{EMP_i}$are calculated based on the in-sample data and used to define the crisis for both in-sample and out-of-sample data.

7.3. EMD-ANN Analysis

In the EMD analysis, the first step is to identify the specific event of interest and define the indicator (i.e. time series) to be analyzed. In our study, a currency in the MENA region is analyzed by fully EMD-ANN procedure. The dataset of Turkish Lira is decomposed into some IMCs via the Hilbert-Huang transformation technique.

Figure 3 presents the results of decomposition. It is easy to notice that the USD/TRY data consists of 10 IMCs and one residue. These IMCs represent the basis of the proposed EMD-ANN learning system.

We include the IMCs and residue in the neural model as input variables for the final multi-scale learning. The output variable represents the probability for a currency crisis to occur (Equation 6). If the probability is greater than a threshold value, it is interpreted as a warning signal that a currency crisis will happen. Otherwise, there is no expected currency crisis.

The IMCs derived by applying EMD to the dataset are shown in Figure 3. The sifting processes produce 11 IMCs for daily data. All the IMCs are listed following the exact order in which they are extracted, that is, from the highest frequency to the lowest frequency, the last one being the residue.

All the IMCs present changing frequencies and amplitudes, which are different depending on each IMC. With the frequency changing from high to low, the amplitudes of the IMCs are becoming larger: for example, all the amplitudes of IMC1 are smaller than 0.1, but the amplitudes of IMC10 attain 2. The residue is a slowly varying mode around the long-term average.

From this decomposition, a neural network model analyzes the components for final multi-scale learning. The network has eleven neurons in the input layer (corresponding to the 11 IMCs), and one neuron in the output layer (corresponding to the presence or absence of crisis). The number of neurons in the hidden layer is fixed at 10. Note that the number of hidden nodes is determined by trial-and-error. This simple structure is able to guarantee a good generalization on new data.

The next step is to use the IMCs (input data) to train the neural network model. In this step, the first task is to determine the training targets using equation 6. Based on the IMCs and the training targets, the neural network training process is easy to implement. The final step is to test the trained neural network for verification purposes.

The simulation is conducted under MATLAB r2008b. The configuration of our ANN is characterized by the following steps:[5]

- Dividing the dataset into two sets, the training series (60% of data), and validation and test set (40% of data).
- Normalization of data (all data values are included in the interval [-1, 1]).
- Creation of an ANN with one hidden layer including 10 neurons. We chose a sigmoid hyperbolic tangent activation function (tansig).
- The learning function is Gradient Descent with momentum term (traingdm).
- The number of iterations is 10.000 epochs, the learning rate is 0.3, and the convergence rate is 0.6.

The neural network minimizes the mean square error (MSE). The learning stops when the MSE no longer decreases after 10.000 iterations.

The neural network provides a continuous output with values between zero and one. We have already defined a threshold and when the output reaches this threshold, a warning signal about a possible currency crisis is released.

[5] We determined the neural network parameters after a large number of tests since there is no general rule that can easily define these parameters.

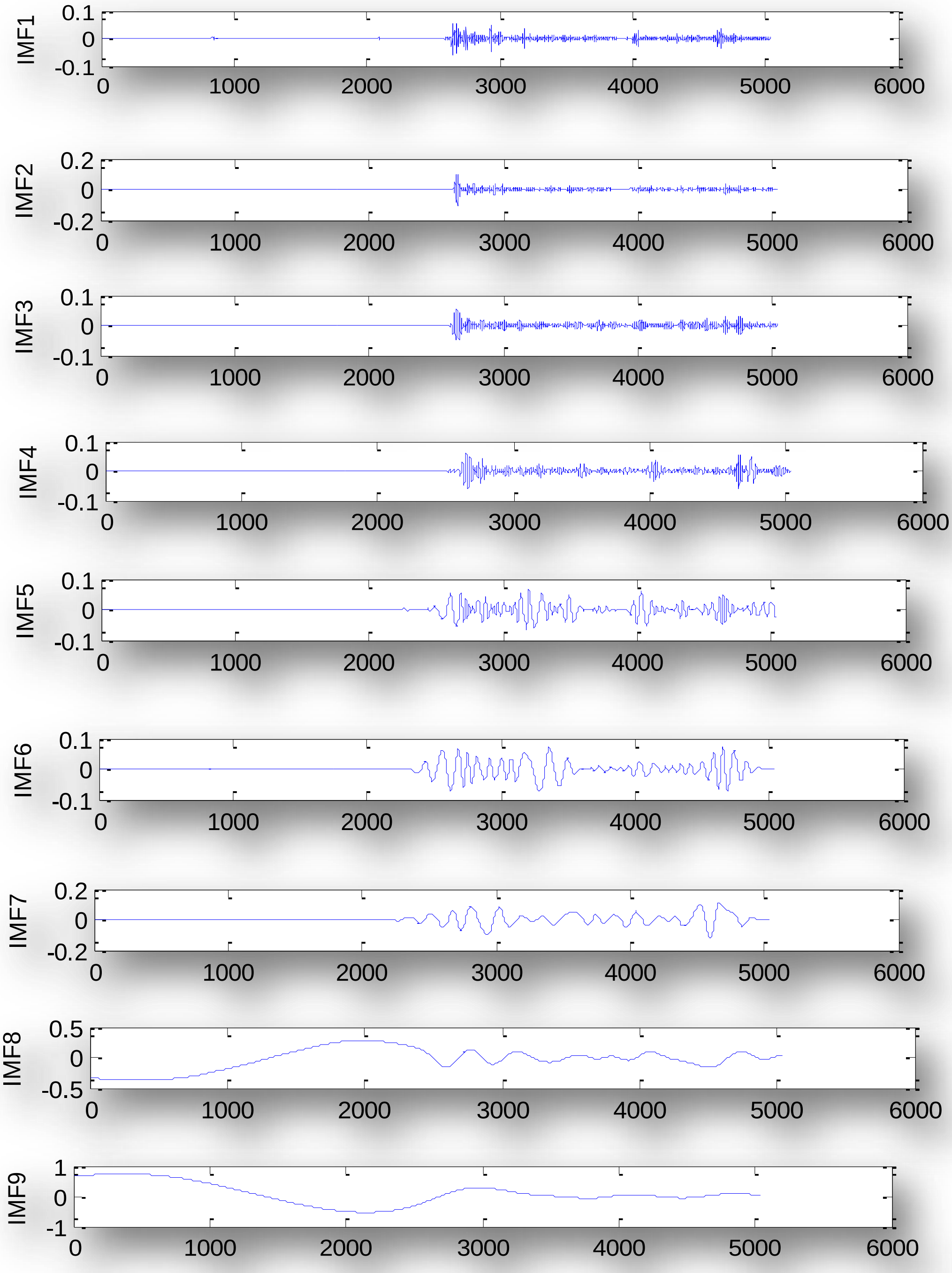

Figure 3. Empirical Mode Decomposition of USD/TRY Exchange Rate

6.4. Results

The performance assessment of a warning tool is traditionally based on two measures which can be defined from the following matrix:

Table 1. Contingency Table

	Crisis	No Crisis
Signal	A	B
No Signal	C	D

Let A represents the number of true signals released when a crisis is indeed taking place and B is the number of false or noise signals when no crisis is on stake. C is the number of false silences (no-signal) and D is the number of true silences. The table indicates if a signal (or a no-signal) occurs during one year (12 months).

We begin by assessing the quality of our system; we thus calculate conditional probabilities based upon the cell counts in the contingency table. We calculate the percentage of time over which the indicator released a signal when there was a crisis. In this case we are looking only at the 'crisis' column of the contingency table to compute the probability that a signal was released. This probability is given by $A/(A+C)$. A high probability is associated with a good quality of the model. We also need to know how noisy the signal is. In particular, if no crisis occurs over the forecast horizon, we have to determine how often the indicator released a signal. Looking at the 'no crisis' column of the contingency table, we compute the ratio $B/(B+D)$. A lower probability is a signal of a good model.

Let the noise-to-signal ratio represent a measure of the background noise relative to the signal strength. The ratio is usually measured by the following equation:

$$NSR = \frac{B/(B+D)}{A/(A+C)} \tag{7}$$

The smaller the NSR is, the better the indicator is for signaling a currency crisis. Table 2 presents the performance results of our indicator (currency exchange rate):

Table 2. Classification Results for the USD/TRY Exchange Rate

	Crisis	Non Crisis	Total
Signal	3	1	4
Non signal	0	15	15
Total	3	16	19
A/A+C	100%	---	
B/B+D	---	6%	
NSR	0.06		

The performance obtained using neural networks is good for our forecasting horizon since the NSR approaches zero. This very small NSR is associated with significant coverage, i.e. 100% of crises. This implies that the proposed EMD-ANN learning approach is a very promising alternative for currency crisis forecasting.

This implies that all the currency crises (1994 and November 2000 – February 2001) are successfully captured and supports our claim that crisis-related data are usually easily classified. However, the model also released one false signal while there was no crisis.

All in all, the proposed EMD-ANN tool performs well. The main reason is that the EMD produces some IMCs with different scales, which simplifies the problem. Furthermore, different IMCs with different scales include different news and, therefore, the neural network is able to extract more knowledge, thereby increasing the generalization ability of the neural network.

7. Conclusions

There is a wide agreement among financial economists and policy makers that in order to avoid the devastating damages of a currency crisis, we need to have an effective early warning system. We thus propose in this paper, to build up such system by using the EMD-ANN technique.

Two techniques, neural networks and empirical mode decomposition, have shown their ability to adapt to the complex field of currency crises. Neural networks are particularly characterized by an outstanding performance. Empirical mode decomposition techniques allowed us to decompose the currency crisis indicator in several independent components. The empirical results show that EMD-ANN model could provide accuracy rates that are as high as 100% for the dataset.

Moreover, if we suppose that a database of different currency crisis indicators is available, we will be able to build a database providing more detailed causal relationship among variables, hence suggesting potential policy decisions for increasing the chances to avoid crises. These relationships can also be the basis for theoretical modifications in the modeling approach to be implemented by further researches.

To sum up, this work provides the following main contribution: we proposed an estimate for the probabilities of occurrence of currency crisis, as well as an alternative to deal with the inherent nonlinearities of this problem. The main drawback of our work is the inability of this modeling to offer an economic explanation of the crisis and to detect potential economic indicators that are responsible for crisis. This limit comes from the fact that we have used only one explanatory financial indicator in our empirical study (the exchange rate).

Finally, a general approach to identify the relationships among the different variables can be the basis for further hypothesis testing on other important explanatory indicators of currency crises. Another significant area for future applications could be banking crises and stock market crashes.

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INTERNATIONAL DIVERSIFICATION AND STOCK MARKETS VOLATILITIES

Achraf GHORBEL
University of Sfax, Faculty of Business and Economics, **Tunisia**
ghorbelachraf@yahoo.fr

Younes BOUJELBENE
University of Sfax, Faculty of Business and Economics, **Tunisia**
boujelbeneyounes@yahoo.fr

Abstract

The current paper examines the volatility parameters of thirteen stock markets returns (mature and emerging) by GARCH models in order to see its effects on the potential gains of international diversification. Then, we identify the effects of the volatilities on the correlation between international stock markets.

The empirical results show that an ARCH effect exists for all stock markets returns and that volatility is persistent and asymmetrical according to the shock nature. Moreover, the volatility spillover, which is important between the mature stock markets, is checked between the majorities of stock markets. Indeed, we observe the contagion effect which negatively affects the potential gains of international diversification. The assumption stipulating the increase of a coefficient correlation in period of high volatility, which reduces the benefit of international diversification, is confirmed for the majority of markets.

Keywords: international diversification, volatility, GARCH model, asymmetric effect and volatility spillover.

JEL Classification: G15, G19

1. Introduction

Characterized by its integration and a reduction into the international financial investment barriers during the last decades, the international financial market situation encouraged the investors to distribute their wealth between several stock exchange markets. At this level, we can say that such an investment aims at a better widening of the financial markets. This release was characterized by the progressive lifting of various barriers to the foreign investment and by the suppression of capital movement restrictions, where the intervention of international diversification serves to improve the profitability of various financial assets rather than the domestic diversification. For that, international investment has been regarded for a long time as a means to reduce and distribute the total risk of the financial portfolios by encouraging investment in companies belonging to different industrial branches. The reduction of the risks will be actually stronger mainly when the national economic situations are more and more different and disconnected. Hence, a fall in a stock exchange market is met by a rise in another stock exchange market.

On this basis, international diversification is one of the fundamental principles of a careful management with regards to investment in stock markets. The profits of international diversification strategy were discussed in the pioneering works of Grubel (1968), Grubel and Fadner (1971), Levy and Sarnat (1970), Lessart (1973), and Solnik (1974). The principal advantage of international diversification lies in the possibility of increasing its long-term returns by reducing to the minimum the risk as well as the effects of the market's volatility on a portfolio. A geographically diversified portfolio can help to reduce the risk, i.e. the geographically diversified placements is largely recommended and forms an integral part of a strategic placement seeking to design the optimal portfolio which reaches a better balance between the risk and the return.

The variety of reforms, already introduced, led to major changes in the financial environment and announced thereafter the process of financial integration which would have increased the correlations between various international financial markets reducing the benefits of international diversification. Therefore, the discounted profits of international diversification are functions of returns and volatilities of the selected market. However, when it comes to a strictly segmented market, the local factors play a pivotal role. So, when the integration of a domestic market in the world market increases, its financial assets become increasingly sensitive to the international factors. This sensitivity is basically originated from three sources: value share variations, operator's behaviors and contagious effects.

Despite these risks, the international diversification profits remain always higher than those of the domestic diversification because of the existence of several specific national factors for each country creating thereafter weak correlations between international stock markets. However, the studies which were interested in the exploration of the correlations' variability between international stock exchange markets showed that integration as well as capital movements and the strong volatility of these markets increase along the period of crises.

Moreover, the financial crises of the last decades seem to differ from those having preceded them with regard to the fragile banking system which appeared to be one of the first symptoms, but never a result as it was in previous works such as those of Kaminsky and Reinhart 1996. This banking fragility of the emergent countries probably increased the aversion of risk degree for the international investors, inducing a volatility increase of international capital movements and increasing contagion crises. We can say that the financial markets volatility is a measurement of the risk which constitutes the basis of the financial theory. Besides, with the development of the statistical tools, it is assumed that volatility varies in time and is influenced by several factors. Fundamental work of Engel (1982), generalized by Bolleverse (1986), initiated a panoply of heteroscedastic models – ARCH and GARCH. These models make it possible to study the dynamics of the volatility of the stock exchange markets. Since then, a set of representations was proposed to check the characteristics of conditional volatility, asymmetry, persistence, and the international volatility spillover.

The objective of this paper is to study – in weekly frequency – the various aspects of stock returns volatility of four developed markets and nine emergent ones over the period of July 1997 until 2009. Basing on GARCH model, this work tries to compare the markets and to highlight the upheavals induced by the financial crises. The objective is therefore to check whether the observed empirical works on the developed markets are also checked on the emergent markets.

2. Literature review

Several studies indicate that the impact on the market volatility shocks is asymmetrical: volatility is more sensitive to the negative shocks than with the positive ones. This asymmetrical effect was explained by two arguments, namely: the leverage effect (Black 1976, and Christie 1982) and the feedback effect of volatility (Pindyck 1984, and French, Kenneth, Schwert, and Stambaugh 1987).

Volatility is also characterized by its persistence (Poterba and Summers 1986, Lamoureux and Lastrapes 1990) which indicates that the important variations of assets prices do not stop directly after the arrival of new information, but tend to persist. Poterba and Summers (1986) explain this phenomenon by the fact that a high volatility for certain titles can affect future anticipations.

Indeed, with the increase in the interdependence of the financial markets, the innovations in market volatility are quickly transmitted to the others, especially in very strong volatility period (financial crises, financial crash stock market …). Consequently, the assets' prices behave in the same way, which explains the increase in the stock market return correlation rates. Several empirical studies are interested in explaining the interdependence of the international stock markets during the historical tragic events (crash stock exchange 1986, Asian crisis 1997, Mexican crisis 1998, and subprime crisis 2007…). They showed the increase in returns correlation rates of the stock exchange indexes during strong volatility periods.

The literature on financial contagion is rich. The 1987 stock market crash in the US and the 1992 ERM crisis gave rise to numerous empirical analyses of the transmission of shocks across mature financial markets. Research on financial contagion in emerging markets was boosted by the emerging market crises of the 1990s, in particular the Asian crisis. Given the rapid widespread and large economic impact of these crises, contagion became virtually synonymous with turbulence in emerging markets and studies of the role of different contagion channels during these crises multiplied. Karolyi (2003) and Pericoli and Sbracia (2003) provide comprehensive surveys. Masson (1998), Claessens, Dornbusch, and Park (2001), Kaminsky and Reinhart (2000), Kaminsky, Reinhart, and Vegh (2003) discuss real and financial transmission channels and review different approaches to the analysis of contagion. Pericoli and Sbracia (2003) and Pritsker (2001) examine channels of financial contagion. While views on the precise definition of contagion differ, there is a fairly broad consensus in the empirical literature on financial contagion that contagion refers to an unanticipated transmission of shocks. Contagion should thus be distinguished from 'normal' interdependencies and spillovers across asset markets.

An important strand of the empirical research on contagion uses conditional correlation analysis to test shifts in linkages across financial markets during crisis periods. Following the seminal paper by King and Wadhwani (1990), subsequent studies refined this approach by addressing key features of the data generating process that affect the validity of these tests such as heteroscedasticity, endogeneity, and the influence of common factors. (King, Sentana, and Wadhwani 1994, Forbes and Rigobon 2002, Corsetti, Pericoli, and Sbracia 2005, and Caporale, Cipollini, and Spagnolo 2005). In a related vein, Dungey, Fry, Gonzalez-Hermosillo, and Martin (2002 and 2003) estimated dynamic latent factor models to test for contagion in bond and stock markets during crisis episodes. Based on a factor model that allows for time-varying integration with global markets, Bekaert, Harvey, and Ng (2005) identified contagion as 'excess correlation,' that is, cross-country correlations of the model residuals during crisis episodes.

Prompted by the widespread repercussions of past financial crises in emerging markets, empirical analyses of contagion involving emerging financial markets have understandably focused on the transmission of shocks originating in these markets, rather than shocks emanating from mature markets. One exception is Serwa and Bohl (2005), who include the US stock market crashes following 9/11 and the 2002 accounting scandals in their sample of crisis events and test for contagion in three emerging and seven mature stock markets in Europe after these events. Using variants of the adjusted correlation coefficients proposed by Forbes and Rigobon (2002) and Corsetti, Pericoli, and Sbracia (2005), they find little evidence of contagion. Studies of linkages between mature and emerging financial markets have focused primarily on the implications of market liberalization and integration for return correlations and volatility spillovers, and have generally ignored the possibility of 'shift contagion' during episodes of heightened volatility in mature markets. 5 Several episodes of turbulence in mature financial markets in the past decade, in particular the events of 2007–08, suggest that this may be an important gap in the empirical contagion literature.

3. Variable and data description

The present study is undertaken on four developed stock markets, namely USA, UK, France and Japan markets, and nine emergent stock markets (Taiwanese, Indonesian, Mexican, Argentinean, Brazilian, Malaysian, Thailand, Hong Kong and Singapore markets). The empirical study is during the period of July first, 1997 until June, 2009. These markets belong to four different blocks where international diversification is beneficial. This choice is used as a basis for the comparison of the results of the current work where the effect of the financial crises of the last decades on the international diversification portfolio is illustrated.

For these various markets, we collected stock prices indices expressed in local currencies and exchange rates of the local currencies compared to the American dollar. The stock price indices were obtained from 'the econstats' and data base 'Yahoo Finance', whereas exchange rates were obtained from the data base 'Oanda'. The stock prices indices are converted into American dollar according to the following formula:

$$P_t = T_t * C_t \tag{1}$$

Where:

P_t – The price index expressed in American dollar for the week t,

T_t – The exchange rate of the local currency compared to the American dollar for the week t,

C_t –The price index expressed in local currency for the week t.

The prices stocks indices expressed in dollar are thus used to generate the series of the weekly returns for the thirteen markets according to the following formula:

$$R_t = \ln(P_t / P_{t-1}) \tag{2}$$

R_t – Indices returns for the week t,

P_t – Price index for the week t,

P_{t-1} – Price index for week t-1.

From the series of index returns, we generated the series of conditional volatilities of the various stocks indices as well as the series of the conditional correlations between returns of the American index and the returns indices of the other countries.

Table 1 shows key descriptive statistics for stock markets returns, which point calculating the means Skewness, Kurtosis, Jarque-Bera and the standard deviation of each returns series and Table 2 illustrate the correlations matrix between the stock returns. Table 1 shows that the average returns are generally weak for the various indices. The maximum average returns of the French market are 0.392% but the minimal ones of the British markets are 0.0314%.

All countries have kurtosis values higher than three. We also observe that the distribution of excess returns is negatively skewed for the majority of the countries; only two present positive skewness. Therefore, the assumption of Gaussian returns is rejected by the Jarque-Bera test for almost all countries.

It is noted that the South-East Asian block and the Latin American ones seem to have not only the lowest returns, which are also negative, but also the most important volatility cases as those in Taiwan, Thailand, Argentina and Malaysia. Indeed, these two blocks underwent the most remarkable movements during the last decade and precisely during the 1997's Asian crisis, the 1999 Brazilian one, the 2002 Argentinean one, and the current international financial crisis (subprime crisis).

When comparing the emerging and the mature markets, the emerging markets are characterized by a couple return/risk higher than that of the mature markets (as the case of the Brazilian, Indonesian, Mexican and Hong Kong markets). This finding is fine-tuned with several studies. For instance, Harvey (1995) found out 21 mature markets and 20 emerging markets over the period of January 1976- June 1992.

Table 1. Descriptive statistics of stock markets returns

Stock markets	US	UK	France	Japan	Hong Kong	Indonesia	Malaysia
Mean (%)	0.35	0.0314	0.392	0.0952	-0.0165	0.1603	-0.0827
Skewness	-0.79	-0.7	-0.76	-0.85	-2.15	-0.52	-0.704
Kurtosis	4.02	5.2	4.3	4.793	12.59	4.059	4.528
J.B	24.3	47	28.3	43.09	774.4	15.53	29.337
S. D (%)	2.629	2.876	8.7245	3.5676	3.8006	9.5089	4.3857
Stock markets	**Thailand**	**Singapore**	**Taiwan**	**Mexico**	**Argentina**	**Brazil**	
Mean (%)	-0.0039	-0.0207	-0.1758	0.1854	-0.137	0.1245	
Skewness	-0.5712	-0.039	-0.4849	-1.126	-0.6950	0.1215	
Kurtosis	4.9641	4.47	4.777	6.417	5.3426	5.239	
J.B	36.143	15.28	27.857	117.2	51.941	35.507	
S. D (%)	5.51	3.92	3.947	3.9385	5.5042	5.5138	

Notes: S.D is the Standard Deviation,
( ): t of Student *: significance at the 5% level

Figures 1 shows stock market returns for the mature and emerging markets. We show that the indexes of all markets lost about a third of their value after mid-2007. Such pronounced drops in stock market indexes prices are the typical result expected during this crisis. We clearly show that most of stock market indexes have a significantly sharp decrease between mid-2007 and 2009. Over this period, indexes prices in all countries studied, have followed the same downward trend as the US index.

Figure 2 plots the volatility of indexes during our period of study. We notice that the current financial crisis dramatically influenced the market volatility which has been high during 2007–2009, particularly during the 2008 period. Moreover, volatility presents a peak during the recent crisis.

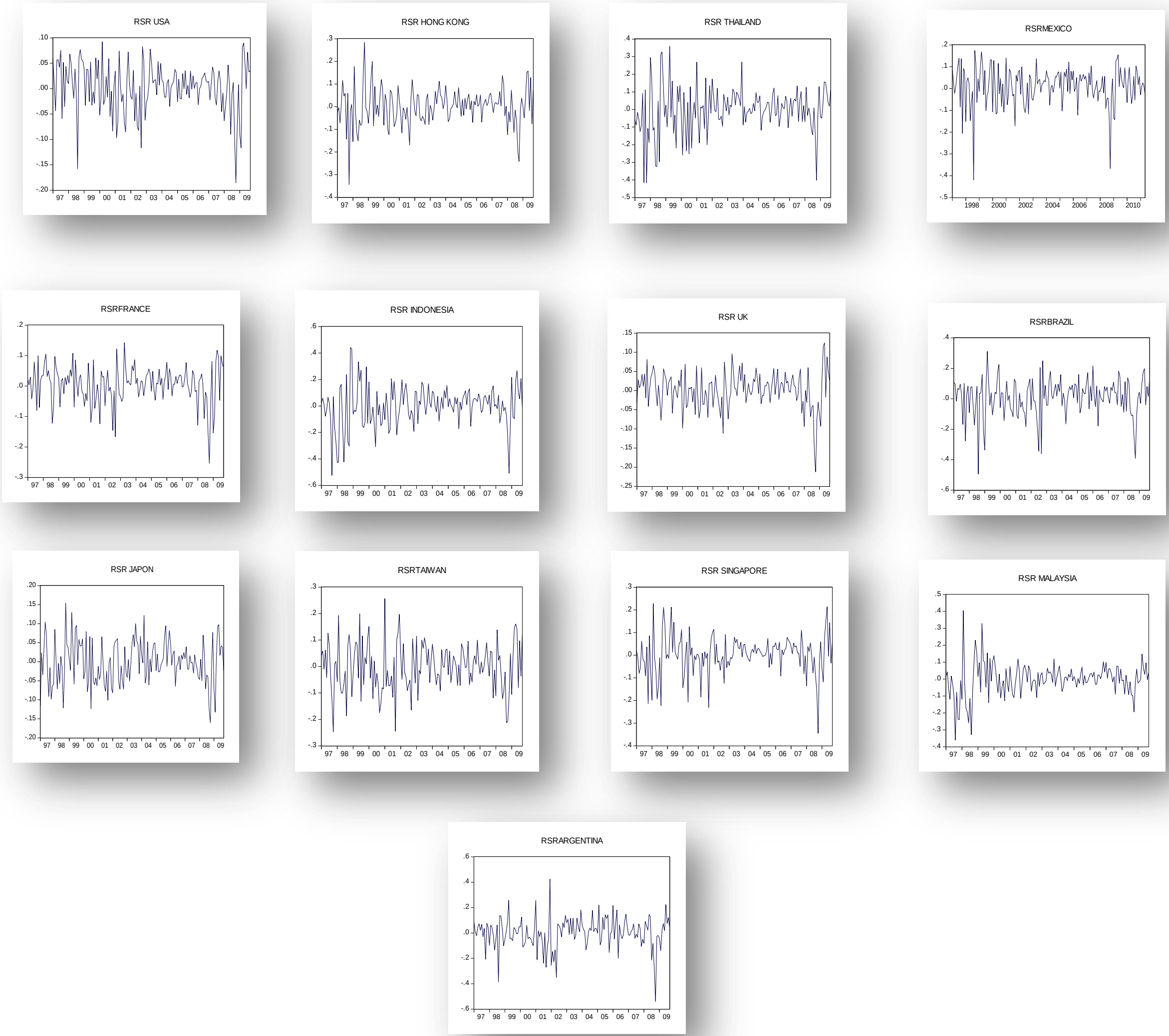

Figure 1. Stock markets returns

Also, Figure 2 presents the stock markets volatilities of mature and emergent countries during past financial crises. Stock markets of Hong Kong, Japan, Malaysia, Thailand, Taiwan, Indonesia and Singapore present high level of volatility in 1999 which reflects persistent of 1997 East Asian crisis.

The current financial crisis dramatically influences the stock market volatility which has been high during 2007–2009, particularly during the 2008 period.

The high volatility show the peak of volatility for Brazil, Mexico, Argentina, France US and UK stocks markets during this period appears to be the result of the currency (the 1998 Mexican crisis, the 1999 Brazilian one, the 2002 Argentinean one …).

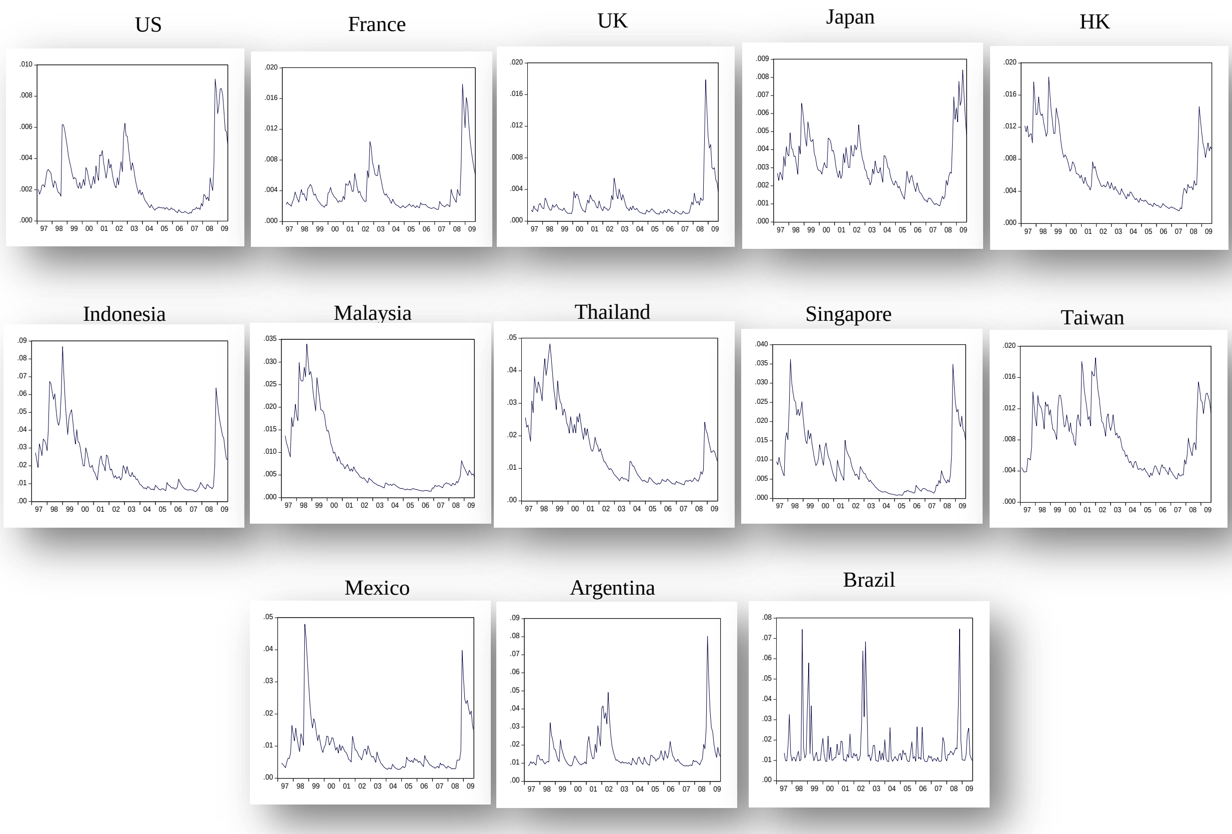

Figure 2. Volatility stock market returns: Mature and Emerging Markets

Table 2. The correlations between the international stock markets returns in (%)

	US	France	UK	Japan	Taiwan	Sing	Mexico	Malaysia	Ind	HK	Brazil	Arg	Thai
US	100												
France	2.99	100											
UK	29.88	-01.19	100										
Japan	0.39	-02.18	7.04	100									
Taiwan	12.07	1.64	5.15	6.46	100								
Singapore	01.71	2.55	-4.46	4.91	10.55	100							
Mexico	00.12	19.52	6.38	0.27	4.85	0.090	100						
Malaysia	-3.04	3.51	-0.88	-5.61	11.76	54.91	13.12	100					
Indonesia	0.79	4.47	0.80	-0.99	-1.18	5.15	1.37	3.68	100				
HK	9.75	0.84	3.37	3.46	8.57	67.81	0.81	38.02	9.36	100			
Brazil	39.08	01.09	37.45	5.37	5.38	6.16	3.47	1.78	-5.85	10.38	100		
Argentina	4.58	-0.31	6.98	3.54	8.65	11.25	5.94	7.89	-5.00	9.35	12.50	100	
Thailand	1.22	0.07	-11.71	7.01	12.51	49.58	4.44	39.32	4.51	37.65	-5.87	4.02	100

Notes: US is United States of America, UK is United Kingdom, Arg is Argentina, Ind is Indonesia, Thai is Thailand, Sing is Singapore and HK is Hong Kong,

Table 2 illustrates the correlations between the stock returns of all mature and emerging countries. The correlation coefficients of mature countries vary between 6.54% for the French and Japanese markets and 46.95% for the American and British markets. These high correlations and low stock markets returns of mature countries can explain the low returns of the portfolio.

The coefficients of correlation between the stock returns of the emerging markets are low and always negative. These coefficients vary between -5.87% for the Brazilian and Thailand markets and

72.016% for Hong Kong and Singapore. Negative correlations are found in several emerging markets mainly for those geographically located far from each other. This result confirms well the independence of these markets on each other.

The coefficients of correlation between the emerging stock returns and the mature stock returns vary between -11.71% (the UK, Thailand) and 39.08% (Brazil, US). Thus, compared to the mature stock returns which present a strong correlation between them, which implies their strong integration, the emerging markets present a weak relation of dependence between them and with the mature markets as well. This independence between the mature and emerging markets implies a segmentation of these markets between them and with the mature markets. This segmentation makes it possible to carry out profits of international diversification on these emerging markets.

The weak correlation of the emerging stock returns with the mature stock returns and the strong correlation between the mature stock returns make a priori the international diversification of the portfolio more attractive. On the basis of this reasoning, internationalized diversification makes it possible to reduce the risk of portfolio considerably.

The rates of correlation between these mature markets are thus more important than those between the emerging markets. Equally, they are also more important than those between the mature and the emergent markets. This can be explained by the vital circulation of capital flows and the financial and economic integration of the mature markets compared to the emerging ones.

It is also noticed that the emerging stock markets provide the best opportunities for international portfolio diversification owing to the fact that the returns on these stock markets present weak correlations with the American and the European stock markets returns.

Indeed, an American investor can benefit from investment on the Asian stock markets since they represent the weakest rates of correlation with the American stock market: Thailand (1.22%), Malaysia (2.67%), and Indonesia (2.57%). However, the Brazilian market, as an emerging market of the Latin America, does not offer a significant advantage. In fact, we notice a strong correlation between the United States and Brazil stock returns which can be justified by the synchronization of the business cycles between the two countries.

4. Methodology

4.1. Test of the presence of ARCH effect

Following the work of Engel (1982), it is worth noting that the variance of a process ARCH (Autoregressif Conditionnal Heteroscedasticity) is an indicator of conditional volatility which is applied to allow the variance of financial series depending on a set of information and in particular on time. This type of model has the aim of mitigating the insufficiencies of the ARMA traditional representations which are not adapted to the characteristics of the financial series. Indeed, these models are characterized by a volatility variable and by the phenomena of asymmetry which cannot be taken into account by ARMA model.

To test the presence of an effect ARCH, it should be seen whether the square residues resulting from the estimation of the preceding model are correlated, i.e. if they follow an auto-regression process of order q: AR (q).Indeed, to test the null assumption H_0 (absence of an ARCH effect of order q), it is enough to carry out the following regression:

The test of the presence of an effect ARCH is made by the Lagrange multiplier test.

4.2. Test of volatility persistence on the stock markets: Test of GARCH model

The GARCH (Generalized Autoregressive Conditional Hetroskedasticity) Model suggested by Bollerslev (1986) is a generalization of the ARCH model which makes the conditional volatility dependent on the last values of the innovations as well as the last volatility.

The degree of volatility persistence can be measured in GARCH model by the sum of the coefficients of the variance equation. If this sum is very close to the unit, it indicates the volatility persistence.

The GARCH model of order (p, q) is presented by the following equation:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad (3)$$

σ_t^2 - The conditional volatility with information available to date (t-1), $I_{t-1} = (\{\varepsilon_{t-1}, \varepsilon_{t-2}..........\})$ of the innovation ε_t.

Concerning the choice of p and q, it is recommended to use GARCH(1,1):

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \qquad (4)$$

4.3. Test of the asymmetric volatility: estimate of EGARCH model

GARCH(1,1) model is a symmetric representation of conditional volatility, i.e. the positive and the negative returns are treated in an identical way in determining the volatility.

We use EGARCH model (Exponential Generelized Autoregressive Conditional Heteroskedasticity) which was proposed by Nelson (1991) to deal with the insufficiencies of GARCH model in the detection of the asymmetry volatility.

EGARCH model represents several advantages compared to the GARCH model. Indeed, it does not present any restriction of non-negativity on α and β and takes into account the volatility asymmetry explained primarily by the feedback and leverage effects that GARCH model does not take into consideration, but takes into account the positive and the negative returns treated as being equal to volatility.

The estimated EGARCH Model is presented as follow:

$$Log\sigma_t^2 = \omega + \beta Log\sigma_{t-1}^2 + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \alpha \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}}, \ \gamma \neq 0 \qquad (5)$$

Where ω, α, β and γ are the estimated parameters.

β represents the auto-regression term, α the effect of a shock on the returns and γ the effect of asymmetry corresponding to the complementary or specific impact of a negative shock. It is supposed that the good news (when $z_t = \frac{\varepsilon_t}{\sigma_t} \succ 0$) and the bad news (when $z_t = \frac{\varepsilon_t}{\sigma_t} \prec 0$) have different effects on the conditional variance. Consequently, the impact of the news on volatility is asymmetrical if $\gamma \neq 0$.

The effect of a positive shock is measured by ($\alpha + \gamma$) and that of a negative shock by ($-\alpha + \gamma$). γ must be thus negative so that the effect of a negative shock is stronger than a positive one. In this respect, we are dealing with the leverage effect: the presence of the leverage effect can be checked while testing if γ < 0 (Avouyi- Dovi S. and Jondeau E (1999)).

To compare relative asymmetries of the various stock markets indices, it's enough to compare the degree of asymmetry of each index measured by $\frac{|\alpha - \gamma|}{\alpha + \gamma}$.

This indicator makes it possible to compare asymmetries relating to the various stock markets.

4.4. The volatility spillover between the international stock markets

The subprime crisis, characterized by increased volatility in stock markets has been considered as the worst crisis in recent times. Our emphasis is strictly examining the transmission of the US subprime crisis across global financial markets, both developed and emerging. Since it is important to understand the manner in which shocks are propagated across markets and determine the channels of transmission. For this end, we estimate the univariate augmented GARCH model (Equation 6)

To analyze the volatility transmission mechanisms between the stock markets, we estimate for each series the GARCH model augmented by the square residue of all the other series. The estimated model is as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \theta X_t \tag{6}$$

Where:

X_t – the square residues derived from GARCH model applied to the foreign market.

The estimated parameter θ measures the spillover effect between the markets.

4.5. Interaction between correlation and volatility of the stock markets

The objective is to check the relation between the variation of rolling correlation and the volatilities of two stock markets. To this end, we use the approach suggested by Solnik, Boucrelle and Fur (1996) which consists in regressing the series of the correlations on the series of volatilities for each couple of stock markets.

For each couple of markets i and j, we calculate the variations of the rolling correlation between couple of markets $\Delta\rho_{i,j}$ and the variations of their volatilities $\Delta\sigma_i$ and $\Delta\sigma_j$.

Then, we consider the following regression model:

$$\Delta\rho_{ij,t} = \alpha + \beta_1 \Delta\sigma_{i,t} + \beta_2 \Delta\sigma_{j,t} + u_{ij,t} \tag{7}$$

It is noted that the American stock market is regarded as a reference. The model implies twelve equations to be estimated.

5. Results

5.1. ARCH effect

The results of ARCH test on the residues for the series of stock returns are represented in the Table 3.

Table 3. Test of the presence an ARCH effect

	US	Argentina	Brazil	UK	France	Thaïland	Malaysia
Fisher	38.38	22.68	8.853	6.01	22.68	5.870	10.101
N R^2	36.186	21.923	8.753	9.105	21.92	6.306	9.966
	Japan	**Indonesia**	**Mexico**	**HK**	**Taiwan**	**Singapore**	
Fisher	7.59	10.013	28.229	4.827	4.367	9.843	
N R^2	7.52	9.88	27.045	6.804	5.35	9.715	

The statistics of score (N R^2) are definitely higher than 5.99, in more the statistics of Fisher records a positive values, which proves the existence of an ARCH effect for all markets. The presence of a strong heteroscedasticity concludes that the statistical properties of the emerging stock returns are similar to that for the mature stock returns. Thus an ARCH model can be retained to describe the evolution of the volatility.

5.2. The volatility persistence

The results of the estimate of the GARCH(1,1) model on the stocks returns are represented in the Table 4.

Table 4. Estimate of the GARCH(1,1) model on the stocks markets returns

	US	Japan	Brazil	UK	France	Thaïland	Argentina
α_1	0.212 (8.83)*	0.335 (9.16)*	0.091 (4.0006)*	0.148 (4.569)*	0.1142 (3.539)*	0.0886 (2.903)*	0.151 (5.915)*
β_1	0.745 (24.01)*	0.578 (4.66)*	0.877 (29.211)*	0.85 (22.69)*	0.858 (19.758)*	0.9044 (13.622)*	0.791 (32.66)*
MV	1413.6	1196	934.78	1332.4	589.15	803.08	960.7
D-W	1.968	2.196	2.144	1.929	2.014	2.0084	2.006
$\alpha_1+\beta_1$	0957	0.913	0.968	0.998	0.972	0.993	0.942
	Indonesia	**Mexico**	**HK**	**Malaysia**	**Taiwan**	**Singapore**	
α_1	0.084 (6.659)*	0.094 (5.522)*	0.0835 (5.076)*	0.071 (5.288)*	0.153 (5.357)*	0.11 (6.446)*	
β_1	0.867 (86.93)*	0.881 (36.53)*	0.91 (54.65)*	0.924 (80.29)*	0.844 (33.6)*	0.888 (49.064)*	
MV	943.08	1148.79	1180	1262.9	1131	1190.56	
D-W	1.895	1.905	1.87	2.206	2.071	2.031	
$\alpha_1+\beta_1$	0.951	0.975	0.9935	0.995	0.997	0.998	

Note: ( ): t of Student *: significance at the 5% level

Therefore, the sign of the square coefficient of the last observed innovation measured by α_1 (ARCH effect) is always significantly different from zero; it's included between 0.071 and 0.335 for Malaysia and Japan respectively.

The autoregressive coefficient of volatility measured by β_1 (GARCH effect) is between 0.578 and 0.924 for Japan and Malaysia respectively. This coefficient is thus very significant for all the markets. The significance of the two coefficients α_1 and β_1 shows the volatility of the stock markets. The sum of the estimated coefficients $\alpha_1+\beta_1$ gives an indication about the degree of volatility persistence. Table 4 shows that this sum is between 0.913 and 0.998 for the Japanese and the British markets respectively. So, the phenomenon of the volatility persistence is available in all the stocks markets.

It is worth noting that in the literature of finance, the volatility persistence is associated to the data of high frequencies (Poon and Taylor 1992) and to the process of information flow introduced in the market (Lamoureux and Lastrapes 1990).

5.3. The asymmetric volatility: estimation of the EGARCH model

Table 5 presents the estimated results of EGARCH model relating to the test of the null assumption of asymmetry. Let us recall that in the EGARCH model specification, the good news (when $z_t=\dfrac{\varepsilon_t}{\sigma_t}\succ 0$) and the bad news (when $z_t=\dfrac{\varepsilon_t}{\sigma_t}\prec 0$) have different effects on the conditional variance. Consequently, the impact of the news on volatility is asymmetrical if $\gamma\neq 0$. The presence of the leverage effect can be checked while testing if $\gamma<0$ (Avouyi-Dovi and Jonondeau 1999).

Table 5. stimation of EGARCH(1,1) model

	US	UK	France	Argentina	Japan	Thaïland	Indonesia
ω	-0.868 (-5.76)*	-0.281 (-3.989)*	-0.373 (-5.28)*	-0.709 (-10.59)*	-1.074 (-4.199)*	-0.1887 (-2.425)*	-0.201 (-10.87)*
α	0.2137 (5.387)*	0.0132 (0.554)	0.0317 (0.724)	0.246 (6.75)*	0.186 (3.709)*	0.0427 (2.0139)*	0.0693 (3.963)*
γ	-0.2136 (-8.996)*	-0.148 (-8.965)*	-0.123 (-8.134)*	-0.134 (-6.31)*	-0.167 (-5.975)*	-0.0706 (-3.3629)*	-0.072 (-5.021)*
β	0.9072 (52.114)*	0.963 (102.92)*	0.948 (100.03)*	0.913 (101.35)*	0.863 (24.48)*	0.973 (84.972)*	0.976 410.2
Asymmetry Degree	4273	1.195	1.69	3.392	18.578	4.0658	52.33
M-V	1432.6	1360.8	1240	964.08	1205.2	853.95	955.3
	Mexico	**HK**	**Brazil**	**Malaysia**	**Taiwan**	**Singapore**	
ω	-0.356 (-3.93)*	-0.28 (-4.087)*	-0.368 (-4.312)*	-0.181 (-4.83)*	-0.489 (-5.486)*	-0.399 (-5.379)*	
α	0.122 (3.867)*	0.174 (4.701)*	0.121 (3.713)*	0.182 (6.493)*	0.255 (5.692)*	0.1751 (5.44)*	
γ	-0.119 (-5.354)*	-0.093 (-4.075)*	-0.118 (-4.937)*	-0.0002 (-0.013)	-0.067 (-2.728)*	-0.132 (-6.9048)*	
β	0.96 (85.74)*	0.978 (120.97)*	0.953 (79.26)*	0.993 (273.4)*	0.955 (84.44)*	0.9604 (111.64)*	
Asymmetry Degree	80.33	3.296	79.66	1.012	1.712	7.125	
M-V	1157.1	1186.3	946.65	1265.3	1137.2	1207.8	

Note: ( ): t of Student
*: significance at the 5% level

The estimated coefficients α and β are mostly statistically significant cases indicating the GARCH (heteroscedasticity) effect. The estimated coefficient α is between 0.0132 and 0.255 for the British and the Taiwan markets respectively. The significance of α indicates that conditional volatility responds substantially to the innovations' shocks.

The estimated coefficient β is between 0.863 and 0.993 for the Japanese and the Malaysian markets respectively. The significance of β indicates that volatility presents a long recall memory. The β coefficients are considerably higher than the α ones, which indicate that the shocks induced relatively weak revisions of future volatility.

Concerning the γ coefficient representing the leverage effect, the results indicate that this coefficient is significantly different from zero for all the markets, except for Malaysia. Moreover, γ is always negative, which implies the asymmetry of volatility on the one hand and the presence of a leverage effect on the other hand. The impact of a negative shock (such as the publication of indicators relatively badly oriented, social disturbance, and so on) is more important than the impact of a positive shock (such as the publication of well oriented indicators rather than the anticipated ones, and so on) on conditional volatility.

There are several theoretical and empirical explanations to justify the asymmetrical effect of good and bad news on the conditional volatility of the stock markets indices. Indeed, this asymmetry is justified by the financial leverage effect (Black 1976) and by the feedback effect of volatility (Christie 1982, Pindyck 1984, and French, Kenneth, Schwert, and Stambaugh 1987). The degree of asymmetry, measured by $\frac{|\alpha-\gamma|}{\alpha+\gamma}$ is always higher than 1. It's between 1.012 and 4273 for Malaysia and the

United States markets respectively. The degree of asymmetry makes it possible to compare the sensitivity of the stock markets to bad news. Consequently, the United States market is the most sensitive market; on the other hand, the Malaysian market is the least sensitive one to bad news.

5.4. International volatility spillover

By measuring the relationship between stock markets volatility, the GARCH augmented model seeks to check the existence of the contagion volatility or a 'spillover' effect between the stock markets. The assumption that volatility is transmitted from country *i* to country *j* is accepted when θ is significantly different from zero.

Table 6 gives the released θ coefficients of the estimated GARCH augmented model.

5.4.1. Volatility spillover between the mature markets

The majority of studies confirm well the transmission system of volatility between the mature markets explained by strong economic and financial integration taking into account the effects of globalization on these markets. The developed markets concerned in this study are the American, the Japanese, the British and the French markets.

The impact of the American market volatility surprise is statistically significant for all markets, except for the Taiwanese market. Indeed, the θ parameter is of 14.5% for the French market, 33.8% for the British market and 11.1% for the Japanese market.

While examining the relationship between the British market and the mature ones, it is worth pointing out that there exists a mutual influence and reciprocal volatility spillover between the British as well as those mature markets.

In the same way, the impact of the surprised volatility of the French market is statistically significant for the British (θ = 19.9%), the Japanese (θ = 2.83%) and the American (θ = 5.84%) markets. Besides, it's influenced by these mature markets, i.e. the American market (θ = 14.5%), the British market (θ = 11.26%) and the Japanese market (θ = 9.3%).

The Japanese market is influenced by the American (θ = 11.1%), the French (θ = 2.83%) and the British (θ = 6.8%) markets. On the other hand, it influences all these mature markets.

5.4.2. Volatility spillover between the emerging stock markets

Contrary to the mature markets, the emerging markets are slightly integrated in spite of the effect of the financial globalization. The volatility spillover between the emerging stock markets seems to be less noticeable. Nine emerging stock markets are included in our study, which are the stock markets of Taiwan, Malaysia, Argentina, Indonesia, Brazil, Mexico, Hong Kong, Thailand and Singapore.

According to table (6), we can note that the volatility surprise of the Singapore stock market has a significant impact on all the emerging stock markets, especially the stock markets of the South-East Asia, Hong Kong (θ = 66.04%), Indonesia (θ = 42.8%), Malaysia (θ = 16.6%), Thailand (θ = 1.1%), and Taiwan (θ = 1.08%).

In the same way, the Taiwanese market influences the markets of Singapore (θ = 6.3%), Malaysia (θ = 10.9%), Thailand (θ = 15.3%), Hong Kong (θ = 5.94%) and Indonesia (θ = 17.3%).It also influences the Latin American markets; the Brazilian (θ = 10.3%), the Mexican (θ = 7%) and the Argentinean markets (θ = 10.76%).

Table 6. International volatility spillover: estimated of GARCH augmented model

	US	Japan	Brazil	UK	France	Malaysia	Taiwan	Singapore	Argentina	Indonesia	HK	Thaïland	Mexico
US		0.0274 (3.283)*	0.07 (6.41)*	0.209 (5.29)*	0.0584 (5.61)*	0.0001 (0.056)	0.043 (3.804)*	0.006 (1.08)	0.0086 (2.323)*	0.0071 (0.384)	0.031 (3.3)*	0.004 (0.06)	0.0717 (6.033)*
Japan	0.111 (5.278)*		0.022 (7.73)*	0.068 (5.76)*	0.0283 (3.219)*	0.109 (5.014)*	0.056 (7.724)*	0.1585 (5.58)*	0.0435 (8.06)*	0.0003 (0.092)	0.155 (5.9)*	0.002 (3.412)*	0.131 (5.293)*
Brazil	0.863 (5.029)*	0.083 (2.484)*		0.415 (5.14)*	0.0003 (2.16)*	0.006 (0.729)	0.103 (4.006)*	0.0537 (2.743)*	0.0199 (2.85)*	0.004 (1.438)	0.1017 (3.1)*	-0.007 (-0.068)	0.184 (4.642)*
UK	0.338 (4.66)*	0.063 (5.967)*	0.0701 (8.352)*		0.199 (4.68)*	0.001 (0.619)	0.108 (9.05)*	0.104 (8.453)*	0.0705 (8.99)*	0.0276 (6.75)*	0.071 (9.5)*	0.0004 (1.08)	0.084 (0.084)*
France	0.145 (2.036)*	0.093 (2.301)*	-0.219 (7.88)*	0.1126 7.26)*		0.121 (2.344)*	0.516 (15.7)*	0.198 (15.25)*	0.129 (6.93)*	0.0047 (0.108)	0.355 (6.6)*	0.05 (18.7)*	0.3114 (5.91)*
Malaysia	0.013 (1.993)*	0.0004 (0.198)*	0.0002 (0.196)	0.011 (2.83)*	0.0003 (3.219)*		0.109 (4.71)*	0.166 (6.59)*	0.0297 (13.7)*	0.0074 (3.085)*	0.1305 (6.0)*	0.0002 (2.67)*	0.0084 (2.006)*
Taiwan	0.077 (1.708)	0.008 (0.53)	0.0232 (2.972)*	0.195 (3.62)*	0.0002 (0.65)	0.0033 (3.56)*		0.0108 (3.73)*	0.0027 (0.005)	0.0005 (4.96)*	0.0575 (2.5)*	0.0163 (2.239)*	0.0378 (2.89)*
Singapore	0.139 (3.558)*	0.028 (3.016)*	0.0264 (4.583)*	0.127 (4.40)*	0.0002 (1.43)	0.489 (6.256)*	0.063 (4.947)*		0.0176 (4.435)*	0.0568 (5.234)*	0.637 (7.8)*	0.203 (7.38)*	0.0698 (5.167)*
Argentina	0.204 (3.23)*	0.177 (3.99)*	0.052 (5.058)*	0.143 (3.49)*	0.0003 (2.89)*	0.0473 (4.23)*	0.1076 (5.77)*	0.101 (4.056)*		0.0002 (0.6978)	0.1167 (5.2)*	0.0242 (3.55)*	0.128 (5.933)*
Indonesia	0.402 (5.163)*	0.278 (5.613)*	-0.003 (-8.55)*	0.303 (4.59)*	0.0015 (4.746)*	0.464 (5.97)*	0.173 (5.89)*	0.428 (6.048)*	0.1526 (6.704)*		0.394 (6.8)*	0.215 (5.46)*	0.1501 (6.369)*
HK	0.091 (2.7)*	0.0087 (1.993)*	0.0132 (2.908)*	0.0895 (2.84)*	0.0004 (3.632)*	0.193 (4.027)*	0.0594 (7.449)*	0.6604 (5.805)*	0.0037 (2.895)*	0.0025 (2.647)*		0.137 (5.17)*	0.06 (3.89)*
Thaïland	0.197 (2.44)*	0.109 (3.57)*	0.02 (0.34)	0.2032 (2.02)*	0.0014 (25.4)*	0.011 (0.513)	0.153 (11.13)*	0.011 (2.39)*	0.075 (23.36)*	0.4922 (2.11)*	0.077 (2.81)*		0.15 (14.55)*
Mexico	0.115 (3.104)*	0.05 (3.339)*	0.0137 (2.68)*	0.05 (2.84)*	0.0002 (1.68)	0.0553 (3.072)*	0.07 (3.26)*	0.0532 (3.503)*	0.0012 (0.407)*	0.0046 (2.751)*	0.078 (3.4)*	0.0029 (7.26)*	

Note: ( ): t of Student
*: significance at the 5% level

The volatility surprise of the Hong Kong stock market has a significant impact on the volatility of all the stock markets – emerging as well as mature. Similarly, the volatility surprise of the Indonesian stock market has a significant impact on the volatility of all the emerging stock markets except for the Brazilian market. In the same way for the Malaysian stock market, the volatility surprise has a significant impact on the volatility of all the emerging stock markets except for the Brazilian and Thailand stock markets.

The volatility surprise of the Mexican stock market has a significant impact on the volatility of all the emerging stock markets. As for the Brazilian stock market, the volatility surprise has a significant impact on the volatility of all the emerging stock markets except for the Malaysian and Thailand stock markets. Finally, the volatility surprise of the Argentinean stock market has a significant impact on the volatility of all the emerging stock markets except for Taiwan.

5.4.3. Volatility spillover from mature to emerging markets

The parameters of volatility spillover from mature to emerging markets showed that there is a mutual influence between the American market and the Latin America markets (Brazil, Argentina, and Mexico), and also between the American and Hong Kong market. This result can be explained by the geographical membership of Brazil, Argentina, Mexico and the United States and by the importance of the economic and financial exchanges between the United States and Hong Kong.

Indeed, the American stock market volatility has a significant influence on the volatility of all the emerging stock markets except for the Taiwanese market. And the volatility surprise of the Malaysian, Indonesian, Thailand and Singapore stock markets do not have a significant impact on the American stock market volatility.

In the same way, the British stock market volatility has a significant impact on the volatility of all the emerging stock markets. On the other hand, it's influenced by the volatility of all emerging stock markets except for Malaysia.

The volatility surprise of the French stock market has a significant influence on the volatility of the Brazilian (θ= 0.03%), Hong Kong (θ= 0.04%), Thailand (θ= 0.14%), Malaysian (θ= 0.032%), Indonesian (θ= 0.15%) and Argentinean stock markets (θ = 0.03%) and does not have an influence on the volatility of the Taiwanese, Mexican and Singapore stock markets. However, it is influenced by all the emerging markets except for the Indonesian market.

By examining the inter-influence between the Japanese market and the emergent markets, it is also noticed that the existence of a mutual volatility spillover between this market and all emerging markets except for the Taiwanese and Indonesian markets.

Thus, the American stock market is the most influential market, owing to the fact that it influences all these stock markets – mature and emerging. This significant influence of the American stock market is due to the potential importance of the recent financial crisis of 2008. This finding corroborates the results released by Eum and Shim (1989) who studied the international transmission mechanisms of the movements of nine stock markets (Australia, Canada, France, Germany, Hong Kong, Japan, Switzerland, the United Kingdom and the United States), by using the daily stock markets returns over the period 1980 – 1985.

The volatility spillover is more significant between the mature stock markets since they represent an important degree of economic and financial integration. Several empirical studies tried to explain the volatility spillover between the stock markets focusing on variables such as the size of the markets or/and the distance between the markets (Anderson 1979, Bregstrand 1985).

5.5. Interaction between correlation and volatility of the stock markets

The results of the estimation of model (7) linking the variation of the rolling correlations with the variation of the volatilities of the American market and the other markets are presented in Table 7.

Table 7. Interaction between correlation and volatility

	Δ Volatility of the Americain market	T de Student	Δ Volatility of the partnership market	T de Student	R^2
Japan	20.36	8.578*	0.957	0.493	0.647
Brazil	47.57	7.35*	2.047	2.34*	0.793
UK	37.58	7.36*	23.56	1.99*	0.539
France	49.72	8.37*	-1.35	-1.78	0.473
Malaysia	26.73	9.53*	2.65	7.43*	0.694
Taiwan	22.46	7.234*	1.29	1.235	0.563
Thaïland	12.60	7.177*	0.753	0.625	0.788
Singapore	18.34	6.23*	0.987	0.239	0.837
Mexico	38.53	7.15*	15.76	3.56*	0.971
Hong Kong	25.56	7.48*	9.51	3.98*	0.855
Indonesia	27.19	8.46*	0.064	1.27	0.783
Argentina	14.48	9.74*	5.39	5.76*	0.695

Note: ( ): t of Student
*: significance at the 5% level

Table 7 indicates that the coefficient of the American market variation volatility is in all cases positive and significant, which implies the role of the variation of the American market volatility in the explanation of the variation of rolling correlations.

However, the coefficient relating to the other stock markets volatility is positive for all markets except for the French one. Moreover, this coefficient is significant for Malaysia, Mexico, Hong Kong, Argentina and Brazil, which implies that the effect of the foreign markets volatility is less than that of the American market.

In all the cases, the variation of the American market volatility is more important than the variation of the emergent market volatility in the explanation of the variation correlations. These results are confirmed with those found in Solnik, Bourcelle and Fur's (1996) studies. The national stock markets are affected by not only those common international factors, but also by the specific national factors. In light of Harvey's (1995) findings, it is observed that when the national factors dominate, the coefficients of correlation are low. However, when the international factors dominate, all the markets are affected increasing their correlations.

Sabri (2002) studied the evolution of the moving correlation between 16 international stock markets indices (emerging and developed markets). He calculated the moving correlation between the monthly returns for each pair of index. He concluded that the increase in the interdependence of the stock markets and their integration in the world market increase the correlation between the stock markets indices.

Indeed, the international factors play a pivotal role in the determination of the returns market whereas the local factors have a very weak impact. In short, the world's economic globalisation and the importance of the worldwide factors seem to explain the interaction between international correlation and volatility of the stock markets.

6. The implication on international diversification

International diversification was adopted by investors for a long time as being an effective tool to improve the returns of their portfolios. It makes it possible on the one hand to carry out important profits by assigning part of the portfolio to foreign credits and on the other hand to reduce the total risk. These benefits are the outcome of the weak correlations between the various national markets. Indeed, the profits of international diversification are a function of the interdependence between the national markets. When the latter have raised correlations between them, the profits will be weak or even non-existent. On the other hand, when the correlations between the national markets are weak, the profits are important.

However, there is a relationship between correlation and volatility of the stock markets. The interaction between correlation and volatility is bad information for the investors: it is precisely noticed that when the local market is turbulent, and when the investor wishes to reduce his portfolio risk by an international diversification, the correlations between the stock markets increase and consequently international diversification proves non beneficial.

Solnik and Longin (1998) insist on the fact that in period of crisis, and thus of strong negative returns, the advantages of international diversification are low. In case of the emerging countries, Groslambert (1998) shows that the stock market of these countries is correlated with the stock market of the mature countries either when these markets are falling or when they have a great volatility. Campbell (1991) also underlines the instability of the coefficients' correlation.

This assertion can explain two phenomena characterizing the international investment. The first characteristic concerns the orientation towards the emerging markets whereas the second concerns investing in the domestic market.

Indeed, a policy of management based on international diversification aims at finding alternate placements. Their weak correlation with the starting portfolio allows, at the time of the strong volatilities periods, to reduce a level of portfolio risk. The logic of diversification on the emerging markets, due to their high segmentation between them as well as with the mature markets and potential growth, always attract the investors' passion. Besides, in spite of their integration in the world market, they always represent weak rates of correlation between them and with the mature markets.

With reference to the framework of an international management of portfolio, the interest offered by the emerging markets was the subject of several theoretical as well as empirical works.

Indeed, with regard to their level of development and to their particular business cycles, these markets should generate potential diversification compared to the mature markets. These potentials of diversification could be more important than the mature economies, which tend to be correlated more and more with one another due to their increasing integration.

However, the emergent markets are proven not to always offer a prominent possibility of diversification since they are influenced by the mature markets, mainly in strong volatility period.

The interaction between correlation and volatility can also explain the fact that the investors tend to invest less internationally than the theory anticipates it. This recommendation was suggested by Ramchand and Susmel (1998) and Ang and Bakaert (1999).

These two authors considered the univariate form of the SWARCH (switching ARCH) model regarding two phases: the 'volatile' phase and the 'tranquil' one. They show that the variance is associated with these two phases: the 'volatile' phase which is concerned with the strong volatility is characterized by a high rate of correlation. The 'tranquil' phase which center on the weak volatility is characterized by weak rates of correlation.

To put the implication of their results on diversification strategies into light, it is remarked that they built an optimal portfolio which reflects the fact that the structure of covariance varies in time and according to the phase. They claimed that, during the 'volatile' phase, the optimal portfolio is entirely invested either in the domestic or foreign market. However, during the 'tranquil' phase, the optimal portfolio is more diversified.

7. Conclusions

Along this article, we studied the phenomenon of integration-segmentation of the mature as well as the emerging financial markets with regard to its implications on the potential profits of the portfolio's international diversification strategies. The increase in financial integration supports the increase in the correlations between the national markets that would reduce the profits of the international diversification strategies. In the current study, the analyzed data prove that the mature markets are integrated between them whereas the emerging markets are segmented as well between them as with the mature markets. This finding supports the international diversification. However, it's necessary to take into account the shocks' transmissions of many crises which affect the financial stock markets these last years (the South-East Asian crisis of 1997, the events of September 11, 2001 on the American market and subprime crisis of 2007 …).

ARCH and GARCH Models were applied to check the empirical works relating to the volatility of the stock markets indices. The analyzed data proved the existence of ARCH effect for all the returns stock markets indices. The study of the volatility persistence of the various stock markets by the estimated GARCH (1,1) model is checked in all the cases.

The asymmetry of volatility was carried out by the estimated EGARCH (1,1) model for all the markets. It was found that the reaction of volatility to the shocks is asymmetrical according to the nature of the shocks. The reaction is important when the shock is negative. Taking into account the degree of asymmetry, the mature markets represent very high degrees of asymmetry compared to the emerging markets. In addition, the United States market is the most sensitive market to the bad news.

The volatility spillover is checked for the majority of stock markets indices. Indeed, the volatility spillover is more remarkable between the developed stock markets since the latter ones represent an important degree of economic and financial integration. Moreover, the contagion is stronger between American and the European block than between the American and that Asian block or between the European and the Asian block. Lastly, the American market is found out to be the most influential one.

The last conclusion to be drawn from this research is that there exists a positive relation between the moving correlation of each couple of stock markets and their volatilities, with regard to the American market as the domestic one. The results showed that, on the one hand, the variation of the stock markets volatilities can explain the variation of correlations between American and other markets. On the other hand, the variation of the American market volatility is more important than the variation of the foreign market volatility. This relation can be analyzed within the framework of international diversification. As the correlations between international stock markets grow in period of high volatility, the profits carried out by the international diversification of the portfolios are reduced, which explains the orientation of the investors either towards the emerging markets, or towards the domestic markets in period of strong volatility.

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OIL PRICE SHOCKS AND FINANCIAL STOCK MARKETS

Achraf **GHORBEL**
University of Sfax, Faculty of Business and Economics, **Tunisia**
ghorbelachraf@yahoo.fr

Mouna **BOUJELBENE ABBES**
University of Sfax, Faculty of Business and Economics, **Tunisia**
abbes.mouna@gmail.com

Younes **BOUJELBENE**
University of Sfax, Faculty of Business and Economics, **Tunisia**
boujelbeneyounes@yahoo.fr

Abstract

This article explores the relation between oil market and the financial stocks market. Particularly, this article examines the impact of oil price shocks on stock markets returns and volatilities for large set of oil importing and exporting countries over 1997:1–2009:08 period. Using VAR approach, we estimate the dynamic relations between oil price shocks, stock markets and other variables, including short-term interest rates, exchange rates, and industrial production. Orthogonalized impulse response function shows that oil exporting countries (Russia, Norway, Canada, Malaysia, Venezuela and Argentina) have a significant positive response of stock market returns to oil price shocks. Although, oil importing countries (UK, France, Italy, Portugal, Sweden, Switzerland and Japan) have a statistically significant negative response of stock returns to an oil price increase. Empirical results from the impact of oil price volatility on stock markets volatilities show that oil price volatility has a significant positive impact for all oil exporting and importing countries expect for Brazil and Korea.

Keywords: stock returns, oil price shock, volatility, vector autoregression (VAR) model.

JEL Classification: G15, G19

1. Introduction

Several studies document that the variation in crude oil price has significant impacts on a variety of economic activities and certain macroeconomic variables, such as, real GDP growth rates, inflation, employment and exchange rates (Hamilton 1983, Mork 1989, Lee and Ni 1995, Hooker 1999, Davies, and Haltiwanger 2001, Hooker 2002, Hamilton 2003, Kilian 2008).

However, there has been relatively little work done on the relationship between oil price shocks and financial stock markets. Generally, although shocks in the price of crude oil are often considered as a significant factor for understanding variations in stock prices, there is no consensus about the relationship between stock prices and the oil price among economists.

Huang *et al*.. (1996) examine the link between daily oil future returns and daily United States returns. They find that oil returns do lead some individual oil company stock returns, but oil future returns do not have much impact on general market indices. Faff and Brailsford (2000) report that oil-price risk proved equally important to market risk, in the Australian stock market.

El-Sharif *et al*.. (2005), through a sector-based analysis, investigate the relationship between oil prices and stock returns, listed on the London Stock Exchange. Their empirical findings display that a significant positive association between oil prices and oil-related stock returns is present.

Using daily data of Vietnam's stock market for the period 2000–2008, Narayan *et al*.. (2010) find that stock prices, oil prices and nominal exchange rates are cointegrated, and oil prices have a positive and statistically significant impact on stock prices.

By contrast, a negative association between oil price shocks and stock market returns has been reported in several recent papers. Jones and Kaul (1996), Sadorsky (1999) and Ciner (2001) show a significant negative connection.

Also, Hong *et al*.. (2002) suggest a negative relation between oil-price returns and stock-market returns. Park and Ratti (2008) show that oil price shocks have a statistically significant negative effect on stock prices for an extended sample of 13 developed markets.

Papapetrou (2001) shows that an oil price shock has a negative impact on stock prices, since they negatively affect output, i.e. industrial production, as well as employment growth.

Pollet (2002) and Driesprong *et al.*. (2003) find that oil-price changes predict stock market returns on a global basis. Nandha and Faff (2008) find oil prices rises have a detrimental effect on stock returns in all sectors except mining and oil and gas industries, O'Neill *et al.*. (2008) find that oil price increases lead to reduced stock returns in the United States, the United Kingdom and France. Park and Ratti (2008) report that oil price shocks have a statistically significant negative impact on real stock returns in the US and 12 European oil importing countries. Bjornland (2008) shows that oil prices may affect indirectly stock prices, especially via monetary policy shocks.

Kilian (2008) examines the relation between energy prices and economic performance. The results suggest that is critical to account for the endogeneity of energy prices and to differentiate between the effects of demand and supply shocks in energy markets.

Using a structural VAR model, Kilian and Park (2009) relate US stock returns to measures of demand and supply shocks in the global crude oil market. They find that 22% of the long-run variation in US real stock returns is caused by the demand and supply shocks driving the global crude oil market.

The contribution of this paper is to explore the effects of oil price shocks both on the stock market returns and volatilities after controlling the macroeconomic fundamentals. The study considers 27 oil-importing and oil-exporting countries over the 1997:1–2009:8 period.

The methodology followed in this study considers various empirical frameworks. First, a multivariate Vector Autoregression is employed to study the impulse responses of stock returns to oil price shocks and to provide variance decomposition. Second, a GARH (Generalised Autoregressive Conditional Heteroscedasticity) model is used to estimate oil price and market indexes volatilities. Then, the VAR model is considered to estimate the impact of oil price volatilities on stocks markets volatilities.

The rest of the paper is organized as follows. In Section 2, we present the empirical methodology. Section 3 describes empirical data and variables. Section 4 presents the empirical results. Section 5 concludes the paper.

2. Methodology

Our empirical analysis involves the following steps: First, we use a vector autoregressive model (VAR) to capture the complexities between oil price shocks and stock prices in this paper is an unrestricted vector autoregression (VAR) model. A VAR model consists of a system of equations that expresses each variable in the system as a linear function of its own lagged value and lagged values of all the other variables in the system.

For example, a VAR of order p, where the order p represents the number of lags, that includes k variables, can be expressed as:

$$y_t = A_0 + \sum_{i=1}^{p} A_i y_{t-i} + u_t \tag{1}$$

where $y_t = [y_{1t}...y_{kt}]'$ is a column vector of observation on the current values of all variables in the model, A_i is $k \times k$ matrix of unknown coefficients, A_0 is a column vector of deterministic constant terms, u_t is a column vector of errors with the properties of $E(u_t) = 0$ for all t, $E(u_s u_t') = \Omega$ if $s = t$ and $E(u_s u_t') = 0$ if $s \neq t$, where Ω is the variance–covariance matrix. Thus, $\boldsymbol{u}_t$'s are assumed to be serially uncorrelated but may be contemporaneously correlated and Ω is assumed to have non-zero off-diagonal elements. All the variables, $y_t = [y_{1t}... y_{kt}]'$, in the model must have the same order of integration.

Using this VAR model, we estimate the dynamic relations between oil price shocks and stock prices and other variables, including short-term interest rates, exchange rates, and industrial production, that may influence the connections between oil price shocks on stock market returns. At least since the formulation of Fama's (1981) hypothesis, measures of inflation and real activity have played a role in analysis of the behavior of real stock returns. In literature focused on oil price shocks, Sadorsky (1999) considers the effect of oil price shocks on real stock returns in the US within a framework similar to that in this paper, and Jones and Kaul (1996) include industrial production as a proxy variable for cash flow in their analysis of oil and the stock market.

Our basic VAR model will have the five variables, first log of industrial production (*ip*), oil price returns (*opr*), short-term interest rate on level (*r*), exchange rate returns (*rex*) and stock market returns (*rsr*). Lag length in Equation (1), *p*, will be taken to be 6 for VAR model.

The optimal lag length of the VAR model was examined by the information criterion of Akaike (*AIC*), Schwartz (*SIC*), Likelihood Ratio (*LR*) and Hannan-Quinn (*HQ*) which is equal to six.

Based on the estimation results of this model, we study the orthogonalized impulse response function of stock market returns to oil price shocks and the variance decomposition of indexes returns.

The orthogonal innovations, denoted by ε_t, are obtained by transforming the errors terms in Equation (1) by:

$$\varepsilon_t = qu_t \qquad q\Omega q' = I \tag{2}$$

Where q is any lower triangular matrix, I is an identity matrix, and Ω is the covariance matrix of the residual u_t. The orthogonal innovations can be represented as follow

$$u_t = q\varepsilon_t \qquad E(u_t u_t') = I \tag{3}$$

The variables in the VAR model are placed in the following order: first log difference of industrial production (*ip*); oil price returns (*opr*); short-term interest rate on level (*r*); exchange rate returns (*rex*) and stock market returns (*rsr*). The order of variables in this VAR model is indicated by the notation. With this order of variables, shocks to the interest rate, oil prices, exchange rate and industrial production have possible contemporary effect on stock market returns, but not the other way around.

Second, we use the GARH model to measuring the volatilities of crude oil price (Brent) and stocks market indices. Lee *et al.*. (1995) proposed the following GARCH (1,1) representation of oil prices:

$$\begin{aligned} op_t &= \alpha + \sum_{i=0}^{p} \alpha_i . op_{t-i} + \sum_{i=0}^{q} \beta_i . z_{t-i} + \varepsilon_t \\ \varepsilon_t / I_{t-1} &\approx N(0, h_t), h_t = \gamma_0 + \gamma_2 \varepsilon_{t-1}^2 + \gamma_2 h_{t-1} \end{aligned} \tag{4}$$

Where op is the oil price and h_t is the oil volatility.

Third, we study the impact oil price volatilities on market index volatilities using the VAR model of Equation1. In this model oil price volatility (*Vol.op*) and volatility stock market (*Vol.rsr*) replace respectively oil price shock and stock returns. So, The variables order in the VAR model system become: log difference of industrial production (*ip*); oil price volatility (*Vol.op*); short-term interest rate on level (*r*); exchange rate returns (*rex*) and volatility stock market (*Vol.rsr*).The orthogonalized impulse response function of stock market volatilities to oil price volatility and the variance decomposition of indexes volatilities are then presented.

Since most time series variables have a unit root, we cannot use those data without considering their unit root property. So, before running a VAR, we check the stationarity of each variable with Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) unit-root tests. Since some variables such as the short- term interest rate on level and industrial production in log level contain a unit root, we conduct cointegration test (Johansen and Juselius, 1990) for common stochastic trend.

3. Variable and data description

This study examines the impact of oil price shocks on stock returns of 27 countries (Russia, Canada, Norway, Malaysia, Argentina, Venezuela, UK, France, Italy, Spain, Germany, Netherlands, Denmark, Belgium, Greece, Sweden, Portugal, Switzerland, Japan, Korea, Hong Kong, China, Indonesia, Singapore, Thailand and Brazil) over 1997:1–2009:08.

This empirical study uses the monthly data of stock prices, short-term interest rates, exchange rates, and industrial production for 27 countries.

Using Energy Administration Information (EAI) classification, this study categorizes these countries into importing and exporting countries. Oil exporting countries are Russia, Canada, Norway, Malaysia, Venezuela and Argentina. Oil importing countries are United States (US), United Kingdom (UK), France, Italy, Denmark, Belgium, Portugal, Spain, Greece, Sweden, Germany, Switzerland, Netherlands, Japan, Korea, Hong Kong (HK), China, Indonesia, Singapore, Thailand and Brazil.

Industrial production data are drawn from OECD for the European countries and from FRED for the US and from IFS, IMF, for Asian and Latin American countries. Short-term interest rates (usually Treasury-bill rates) are from IFS, IMF and OECD. For the US the three month Treasury-bill rate is from FRED. Stock price indices in US dollar price for all countries are from MSCI. Oil price is taken as an index in US dollar price of UK Brent crude oil from IMF of UK. Exchange rates from FRED for all countries. Data and sources are described in detail in an Appendix A.

For each country, stock market returns are defined as the continuously compounded return on stock price index. The stock market returns are computed as follows:

$$r_t = \ln(p_t / p_{t-1}) \tag{5}$$

Where p_t is the stock price on month *t*.

Also, oil price return is calculated as the continuously compounded returns on oil price (Brent) and exchange rate returns are calculated as the continuously compounded returns on units of currency country *i* per US dollar.

Figure 1 plots returns of oil price (Brent) during 1997.01–2009.08 periods. We clearly show that oil price have a significantly sharp decrease after July – 2008.

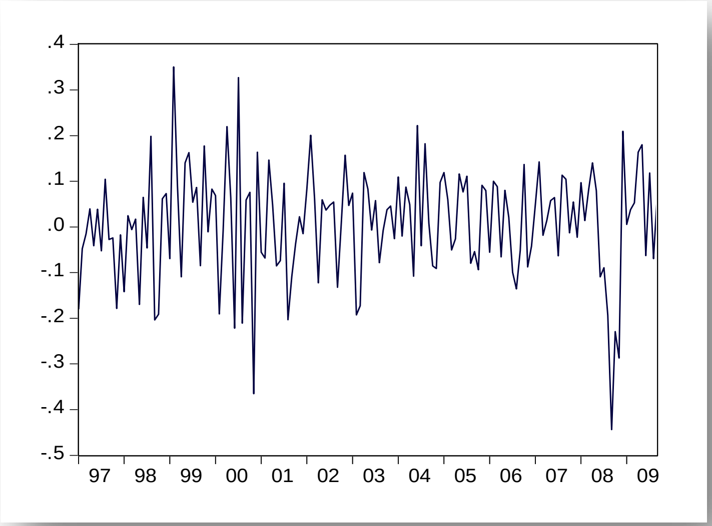


Figure 1. Oil price returns

Source: (own)

Figure 2 plots the volatility of oil price returns (Brent). We show an increasing of volatility on 2003 year due to the second golf wars. Also, oil prices displayed sharp volatility throughout much of 2008, setting record highs on a consistent basis during the early part of the year and jumping to a high of over $147 per barrel in July. Consequently, a peak of volatility during mid-2008 and 2009 can be noted.

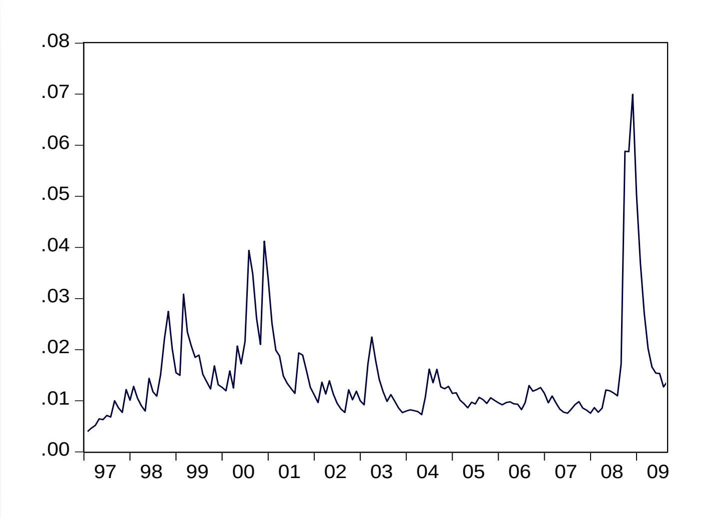


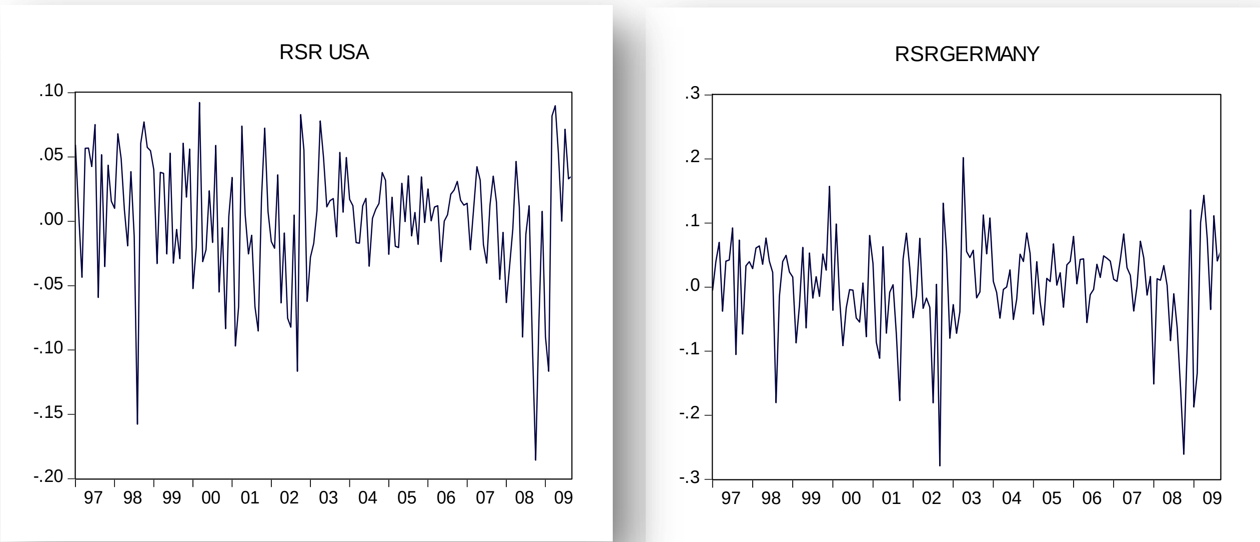
Figure 2. Oil price volatility

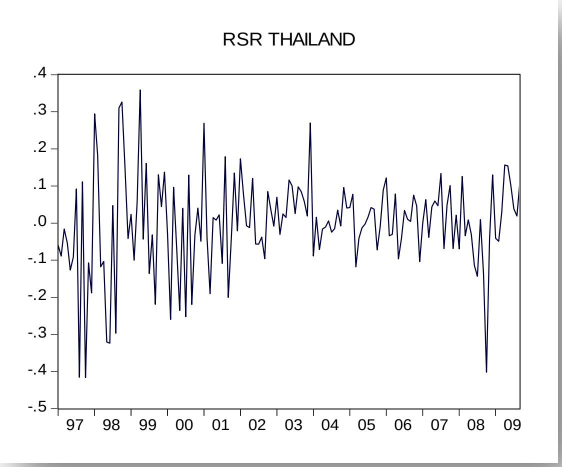
Source: (own)

Figure 3 plots returns of indexes prices during 1997.1–2009.08 for all countries. We clearly show that most of stock market indexes have a significantly sharp decrease between mid-2007 and 2009. Over this period, indexes prices in all countries studied, have followed the same downward trend as the US index. The behaviour of index return can be caused by the subprime crisis started in the US market on 2007 and transformed after that on global financial crisis.

Figure 4 plots the volatility of indexes for all countries during 1997.1–2009.08. We notice that the current financial crisis dramatically influenced the market volatility which has been high during 2007-2009, particularly during the 2008 period. Moreover, volatility presents a peak during the current crisis. Also, figure 4 presents the behaviour of volatility during past financial crises. Stock markets of Korea, China, Hong Kong, Japan, Malaysia, Thailand, Indonesia and Singapore present high level of volatility in 1999 which reflects persistent of 1997 East Asian crisis. The peak of volatility for Brazil, Argentina, Russia, Germany, France, Sweden, Switzerland, Netherlands stocks markets during this period appears to be the result of the currency crisis.

Figure 3. Stock markets returns




RSR THAILAND
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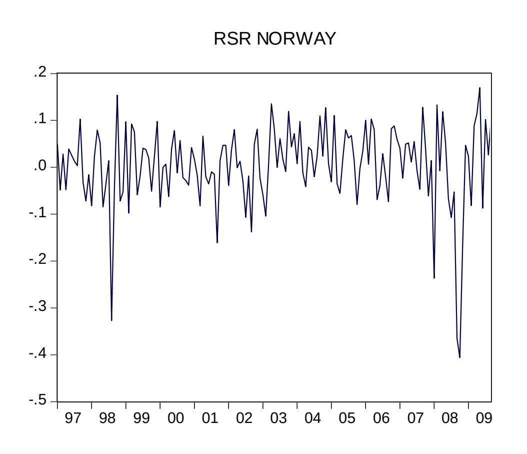
RSR NORWAY
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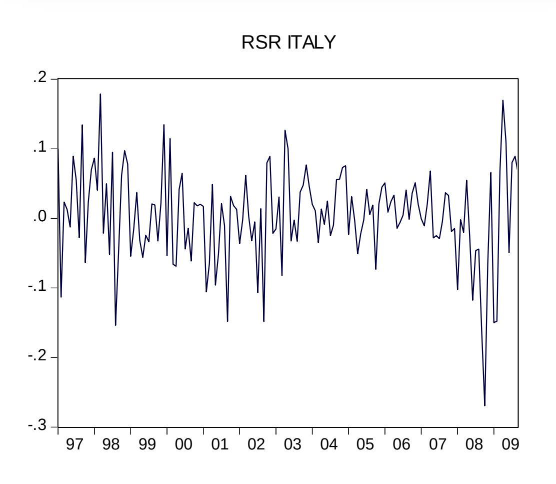
RSR ITALY
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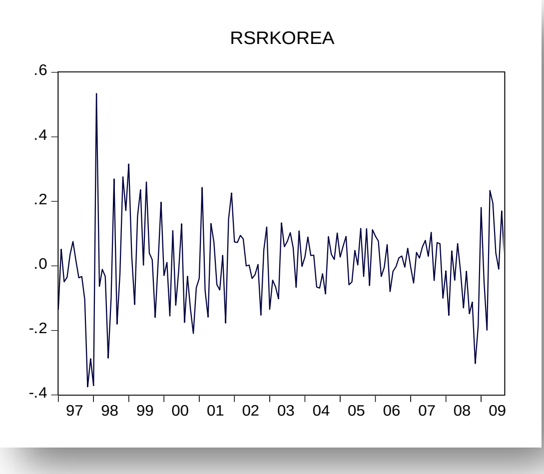
RSRKOREA
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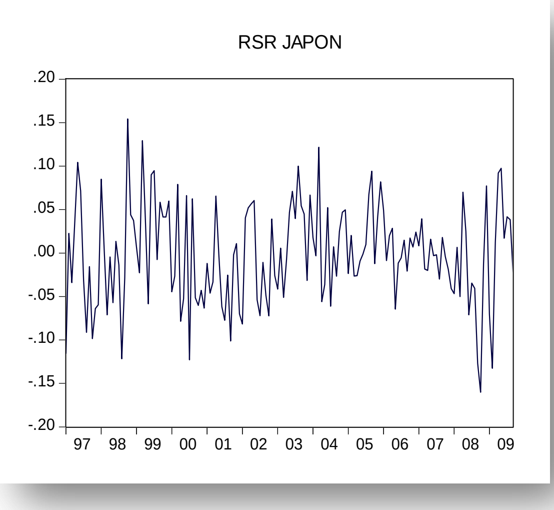
RSR JAPON
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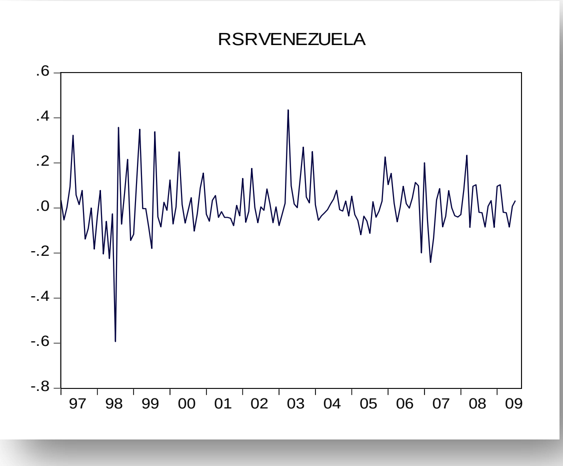
RSRVENEZUELA
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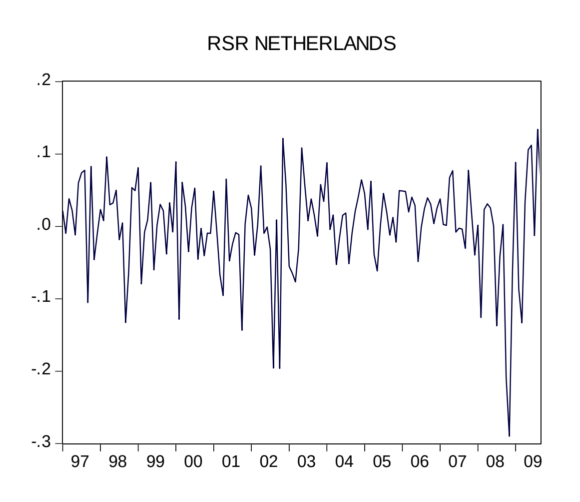
RSR NETHERLANDS
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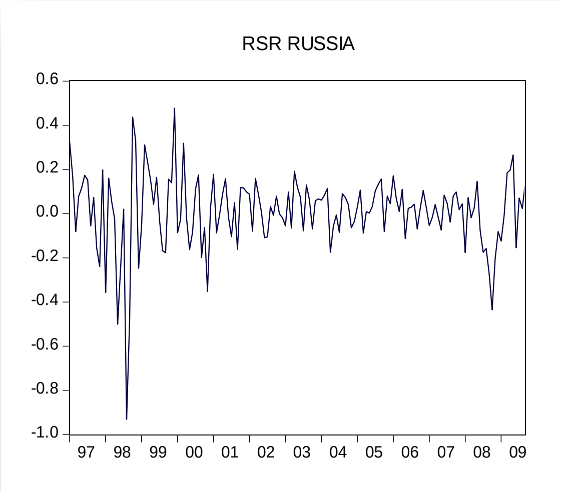
RSR RUSSIA
0.6
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-0.2
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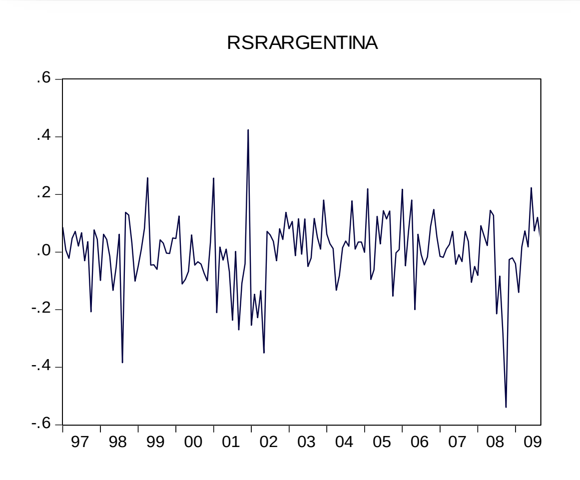
-0.6
-0.8
-1.0
97 98 99 00 01 02 03 04 05 06 07 08 09


RSRARGENTINA
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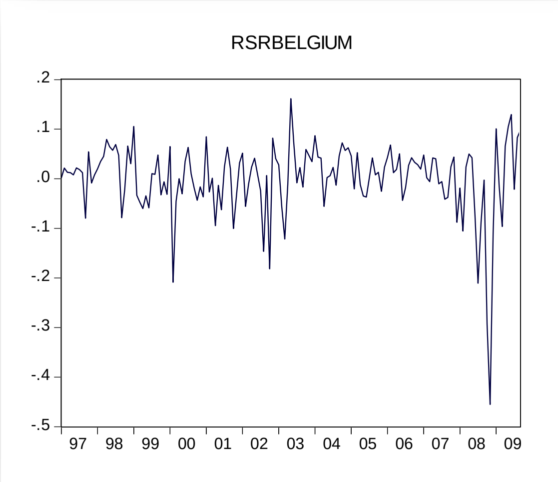
RSRBELGIUM
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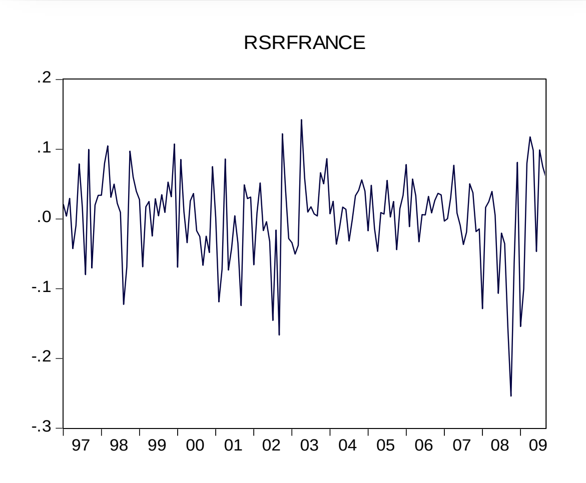
RSRFRANCE
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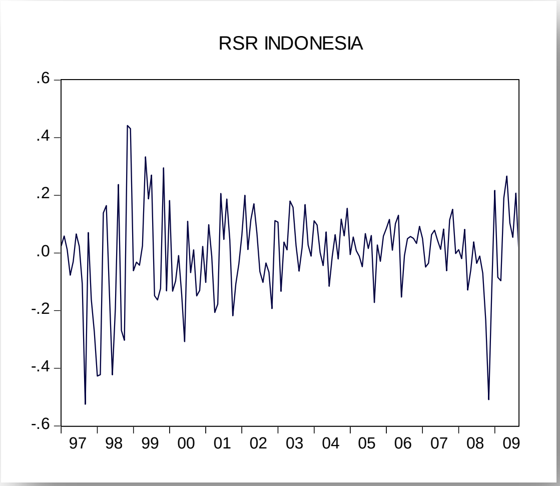
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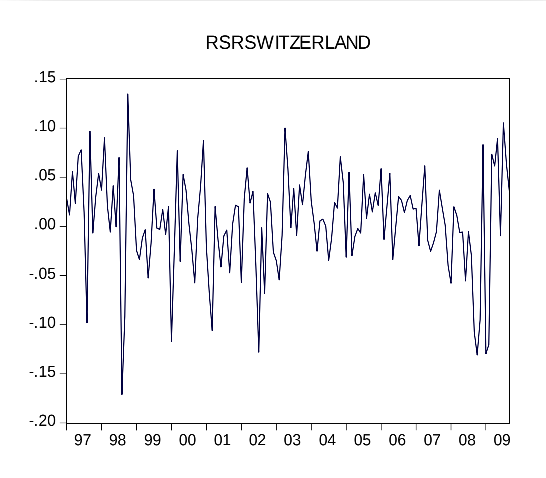
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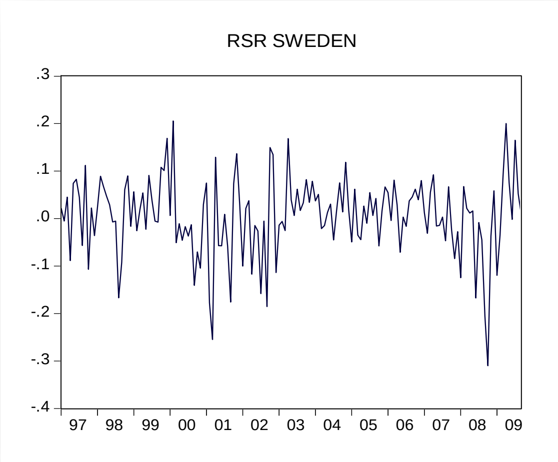
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-.3
-.4
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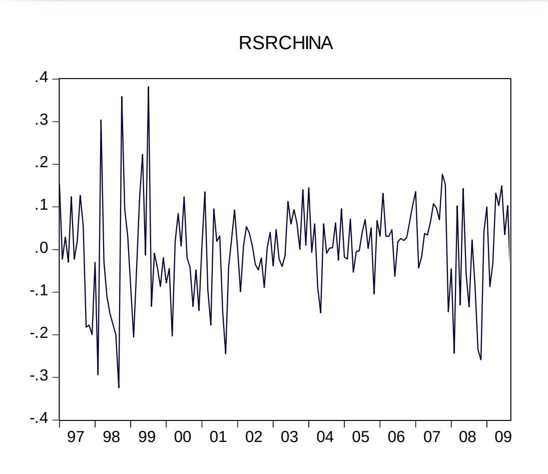
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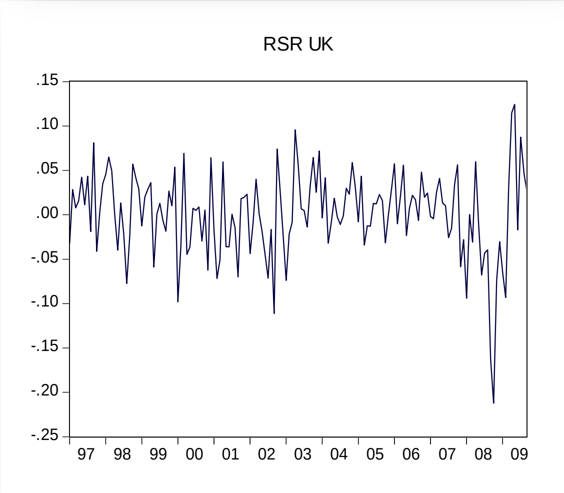
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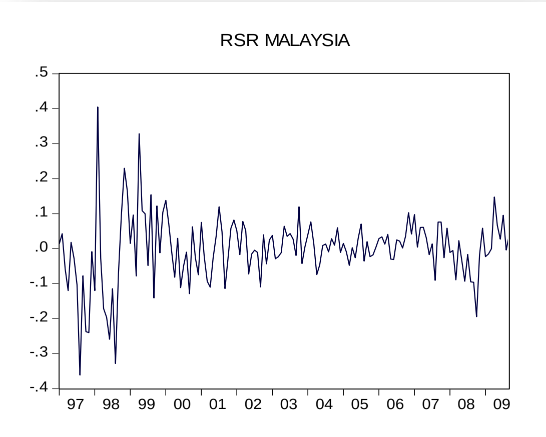
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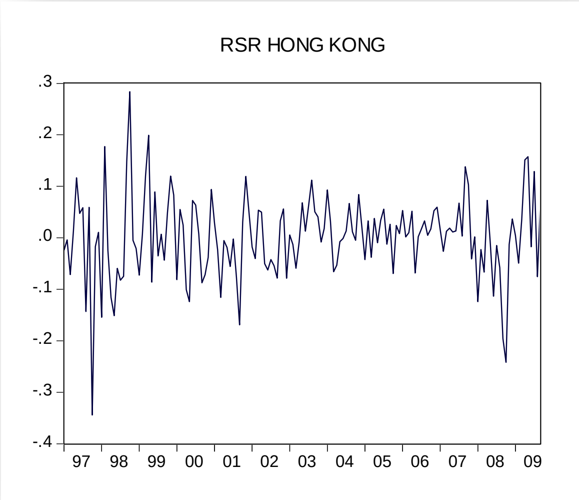
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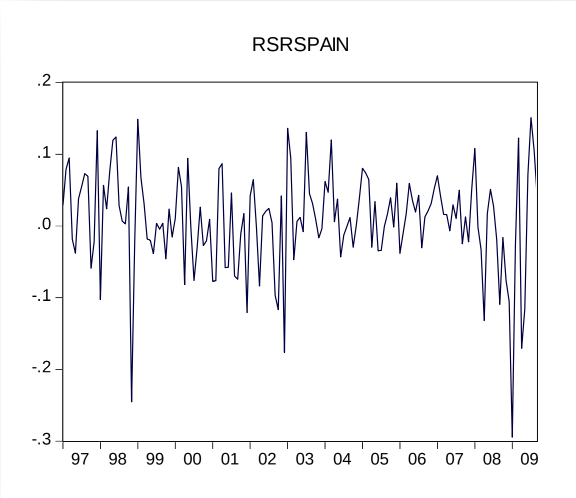
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.1
.0
-.1
-.2
-.3
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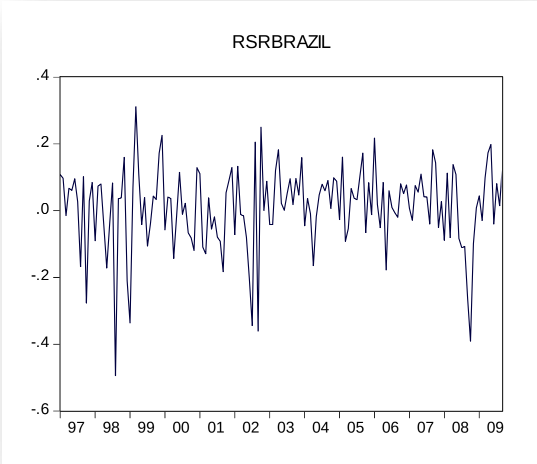
RSRBRAZIL
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.2
.0
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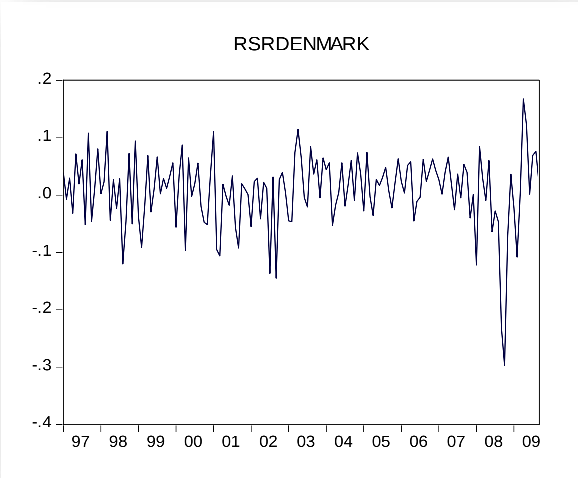
RSRDENMARK
.2
.1
.0
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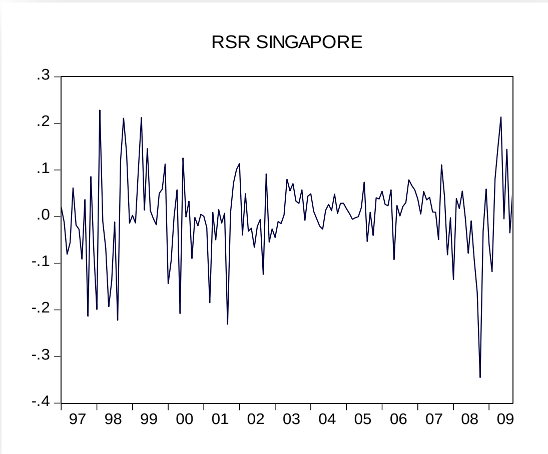
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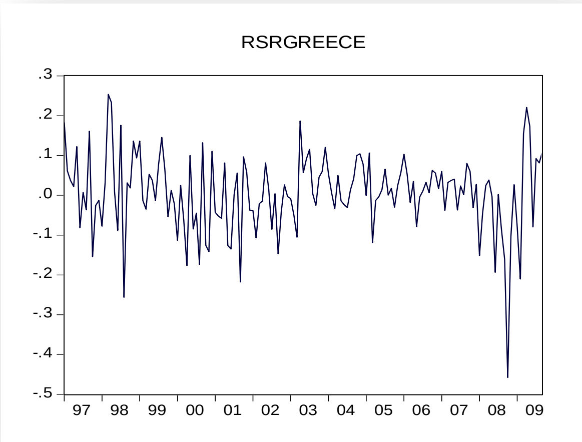
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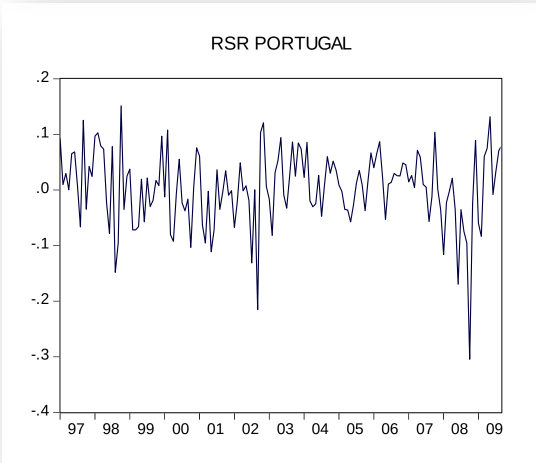
RSR PORTUGAL
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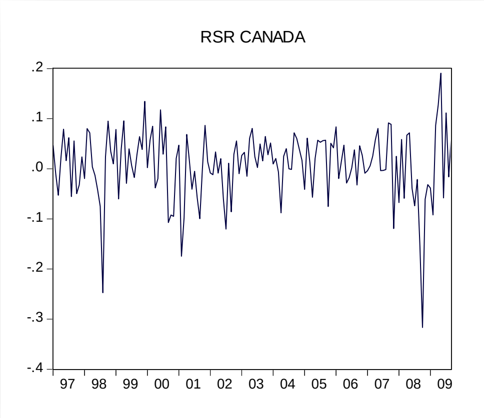
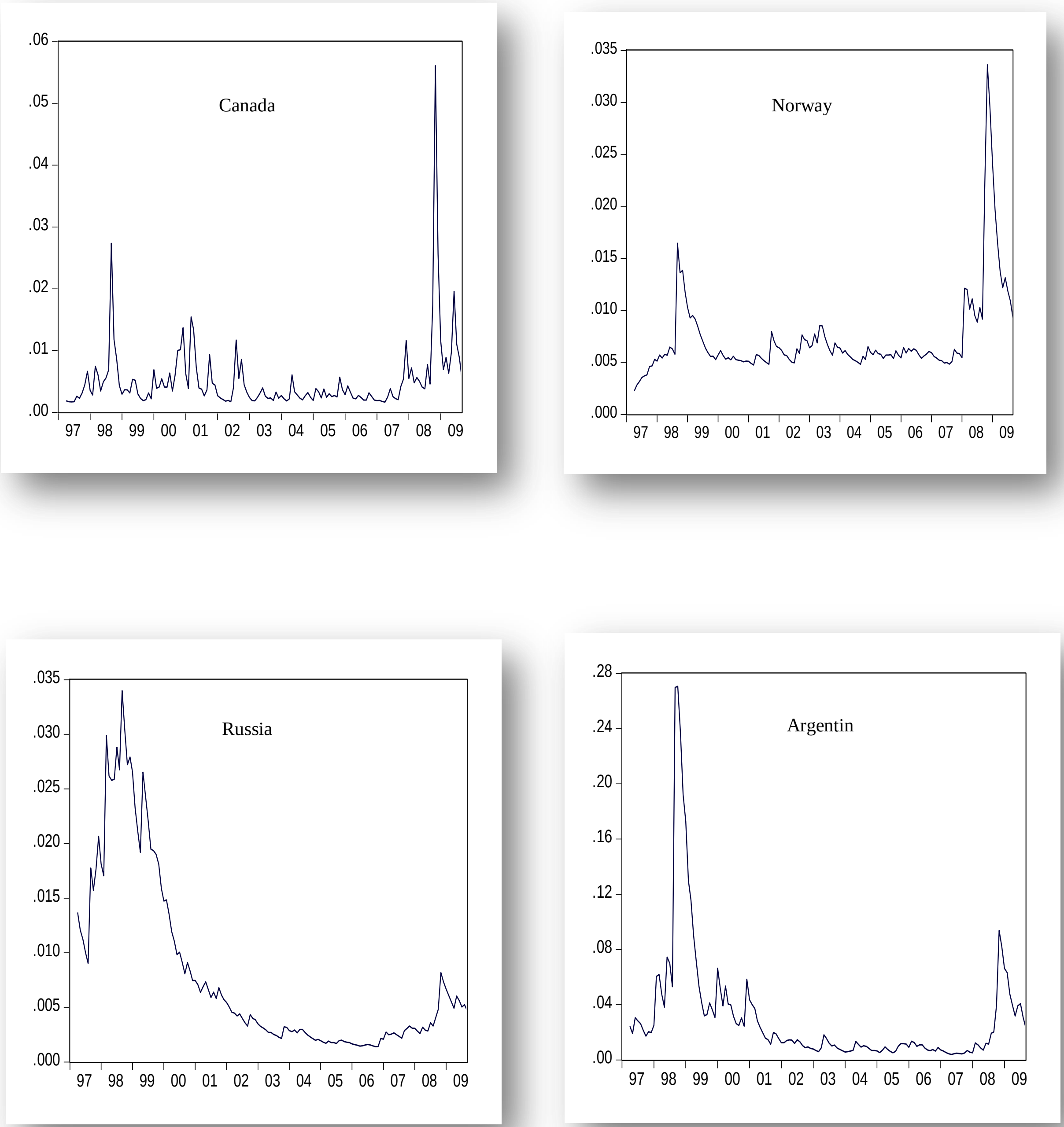
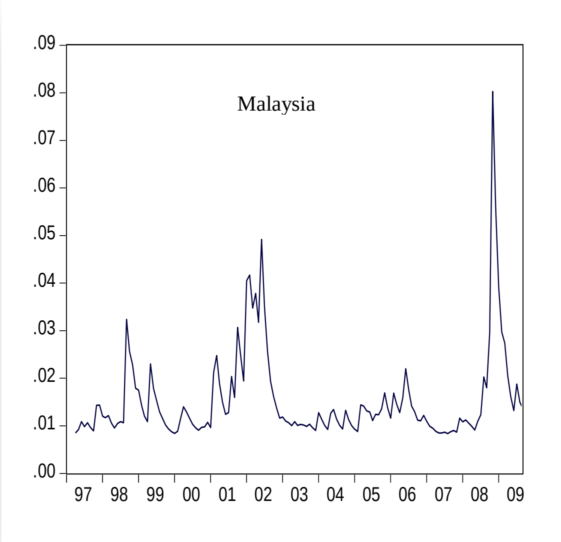


Source: (own)

Figure 4. Volatility stock market returns: exporting and importing countries




Malaysia
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.08
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.06
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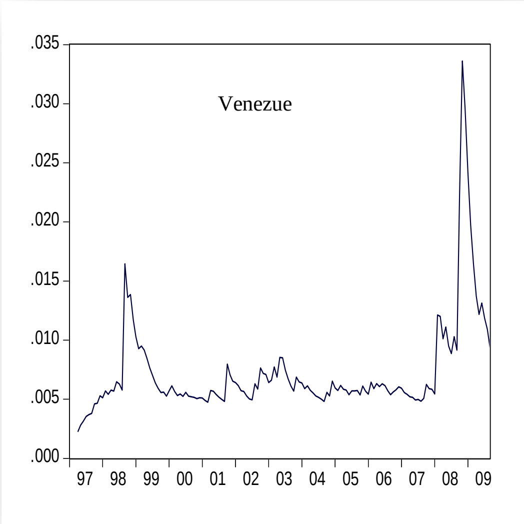
.04
.03
.02
.01
.00
97 98 99 00 01 02 03 04 05 06 07 08 09


Venezue
.035
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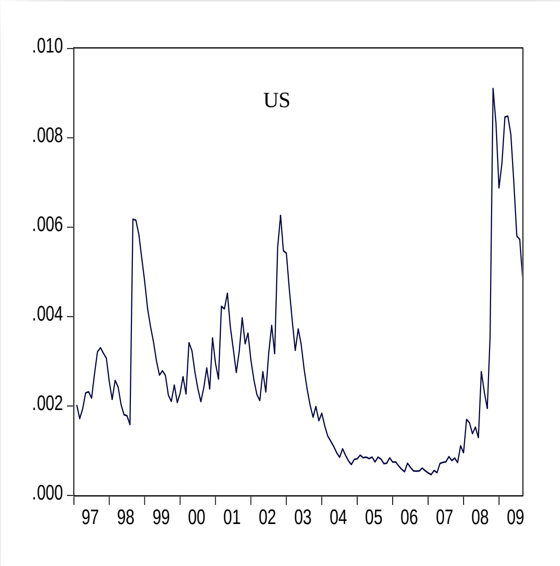
.025
.020
.015
.010
.005
.000
97 98 99 00 01 02 03 04 05 06 07 08 09


US
.010
.008
.006
.004
.002
.000
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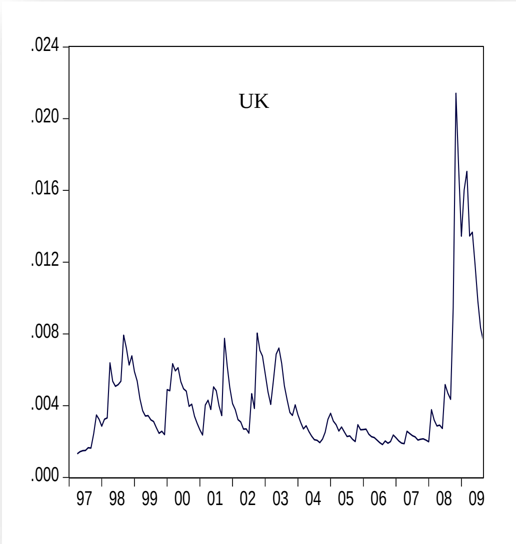
UK
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.020
.016
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.008
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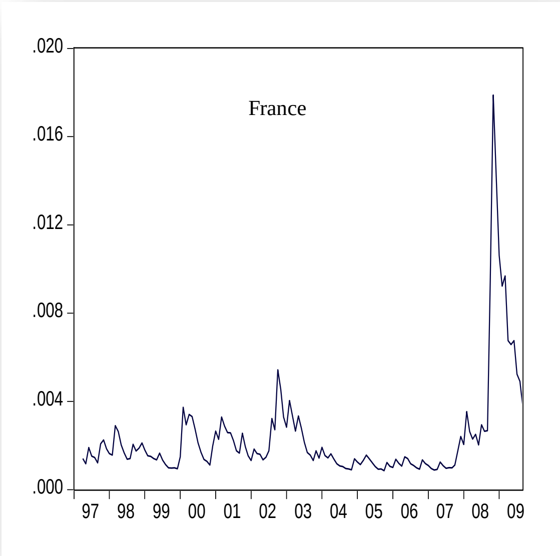
France
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.016
.012
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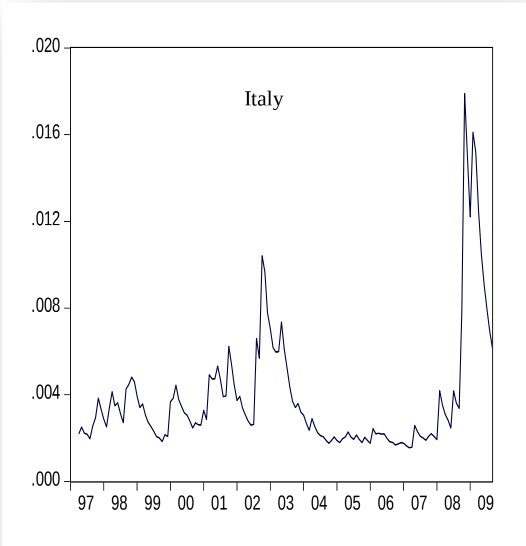
.004
.000
97 98 99 00 01 02 03 04 05 06 07 08 09


Italy
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.012
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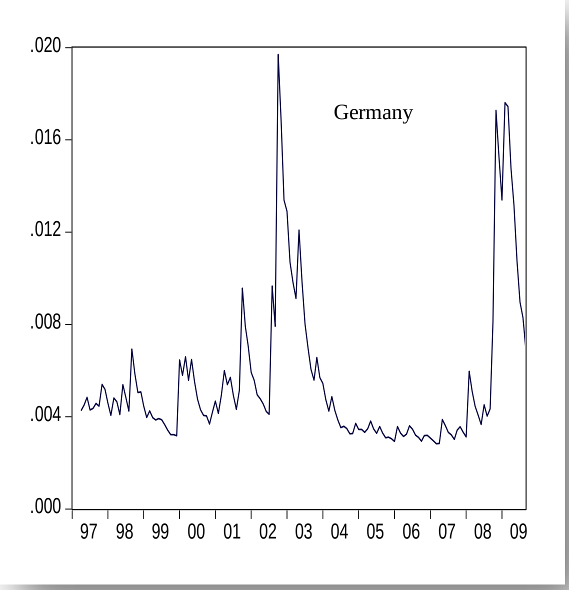
97 98 99 00 01 02 03 04 05 06 07 08 09


Germany
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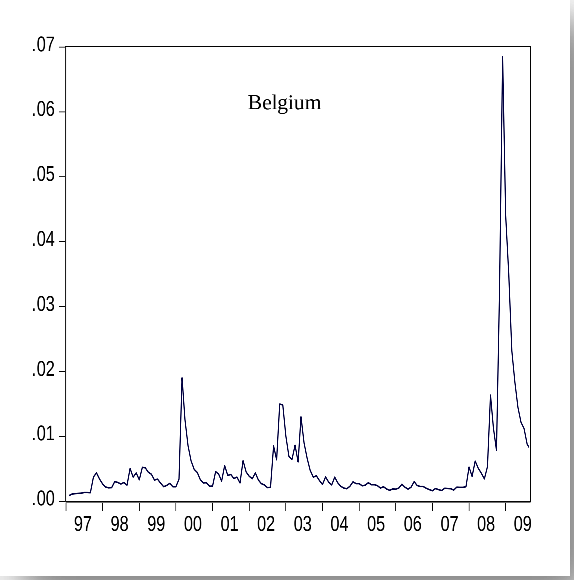
Belgium
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.05
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.03
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.01
.00
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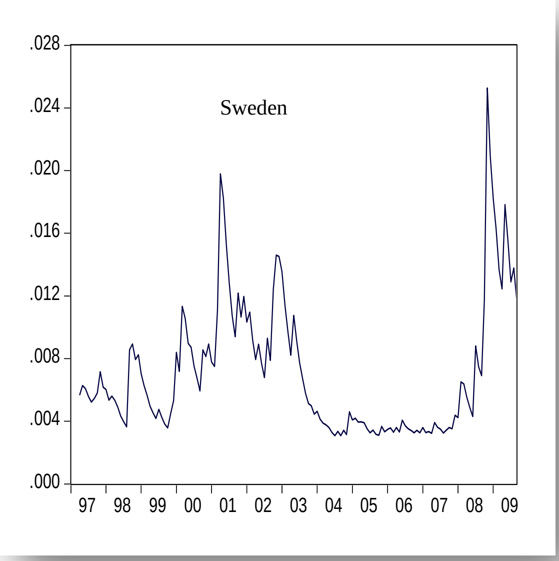
Sweden
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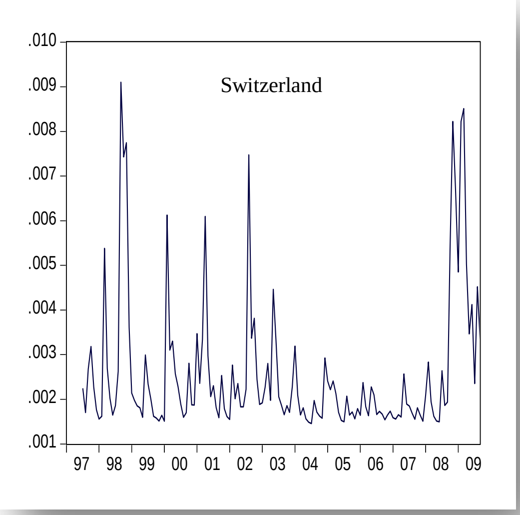
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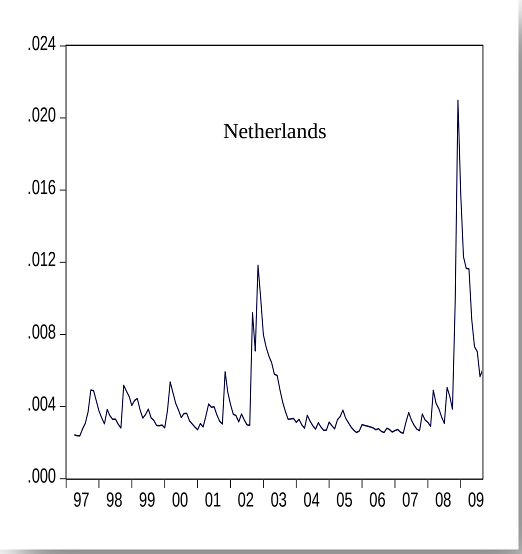
97 98 99 00 01 02 03 04 05 06 07 08 09


Netherlands
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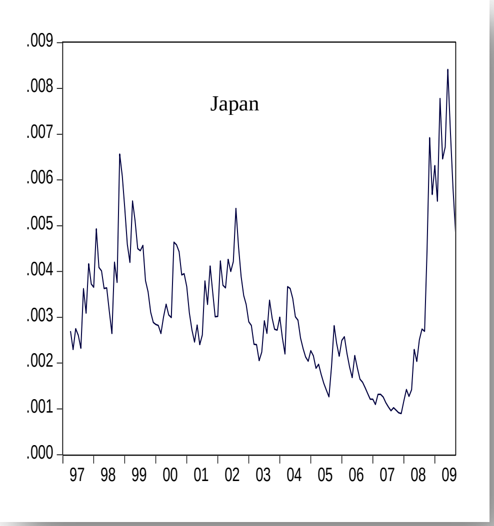
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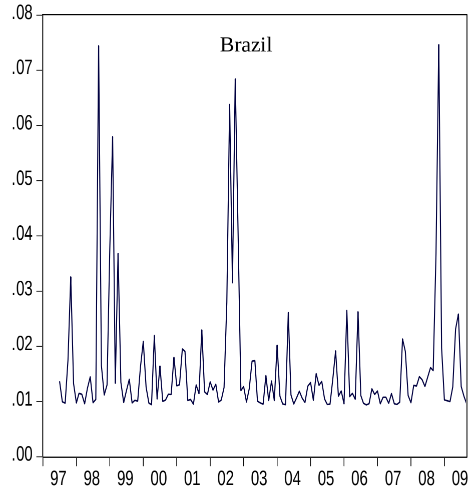
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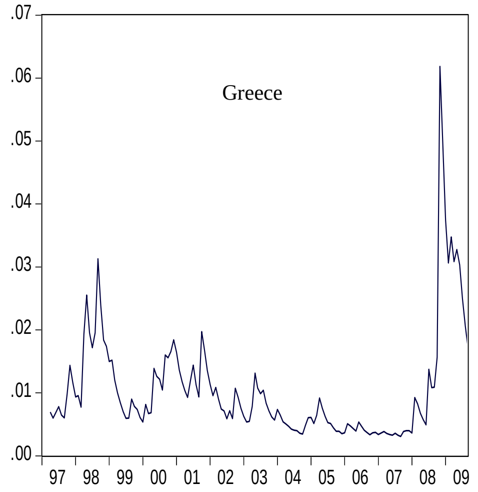
Greece
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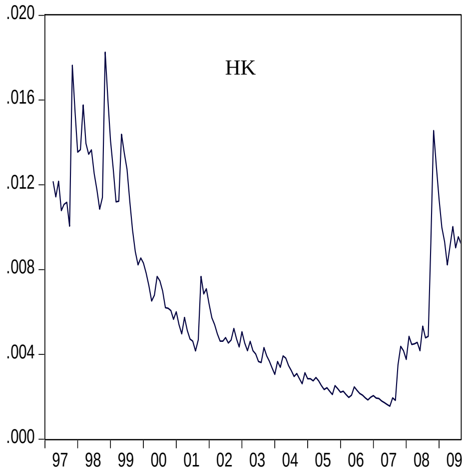
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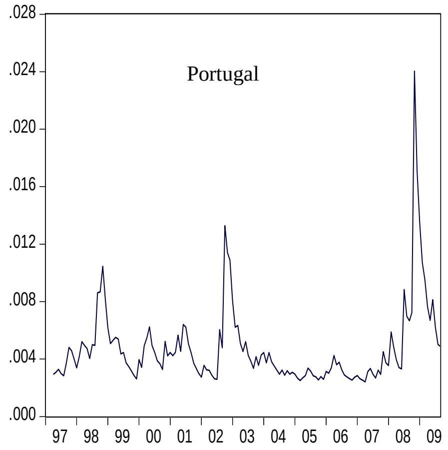
Portugal
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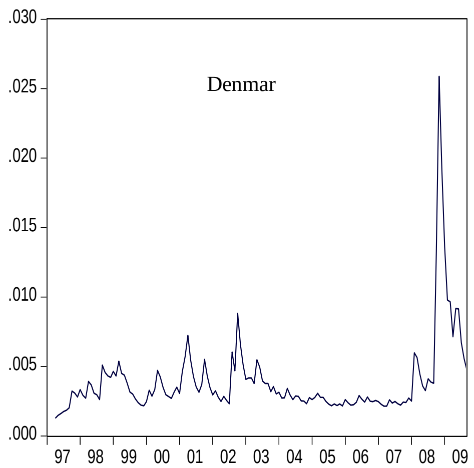
Denmar
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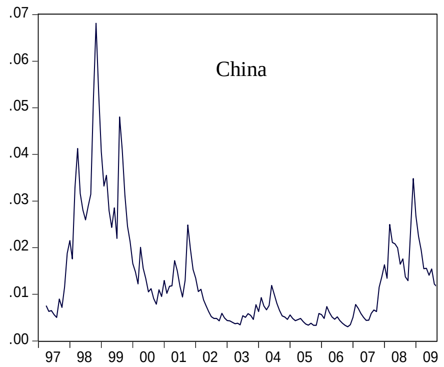
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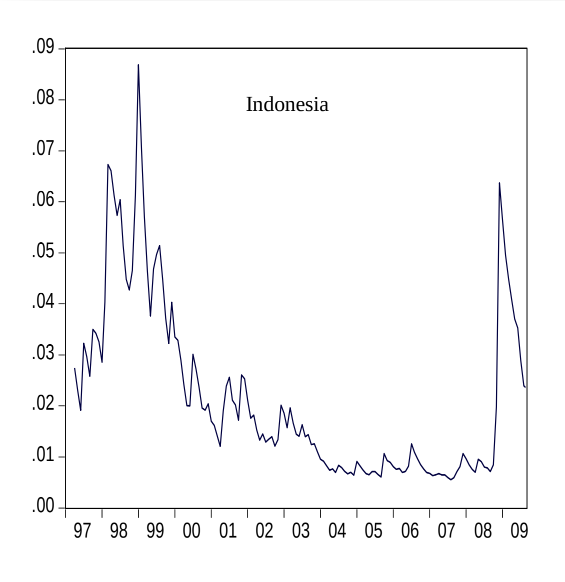
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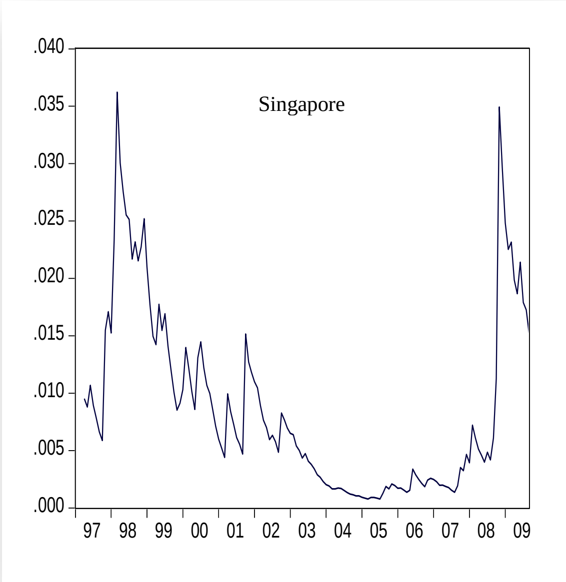
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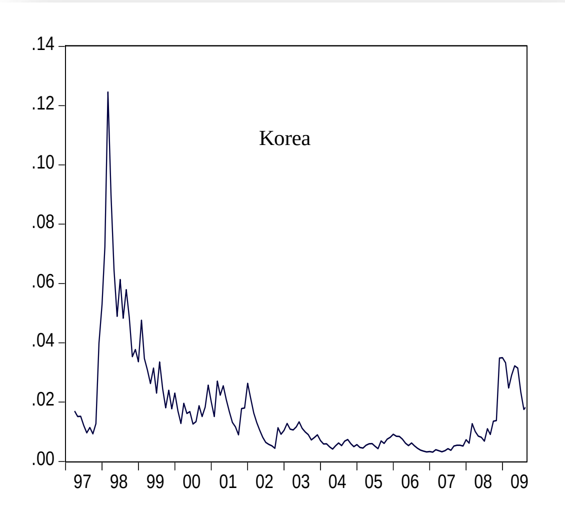
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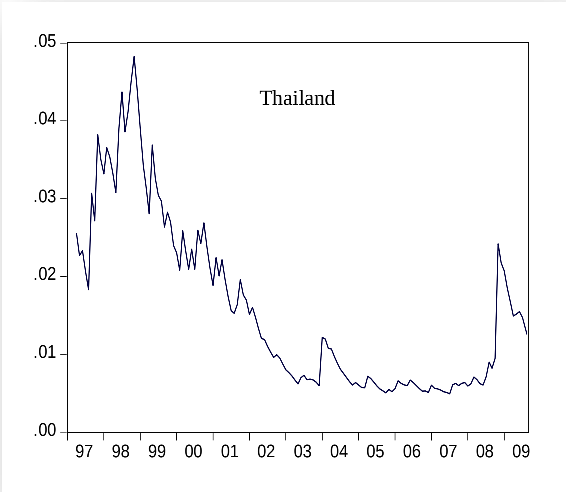
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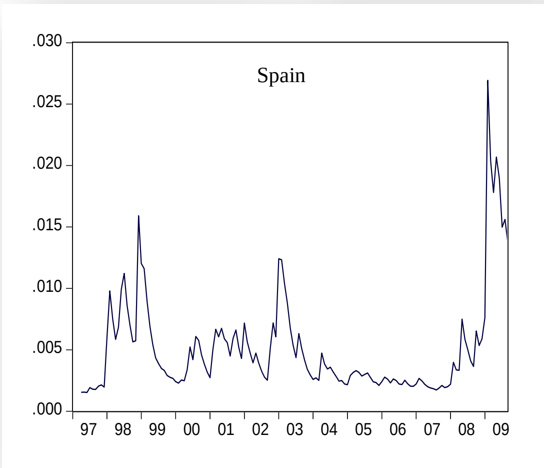
Spain
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.005
.000
97 98 99 00 01 02 03 04 05 06 07 08 09

Source:(own)

4. Results

4.1. Tests of unit Root and cointegration:

We test for unit roots in the natural logarithms of our variables for each country. We test the null hypothesis of non-stationary variables versus the alternative hypothesis of stationary variables using the Augmented Dickey–Fuller (ADF) statistics (Dickey and Fuller, 1981). We employ the Akaike information criteria (AIC) to select the lag length from the ADF test.

Table 1 reports the results with and without a trend for the ADF test. We reject the null hypothesis that all variables contain a unit root at the 5-percent significant level except for stock returns (*rsr*), oil price returns (*opr*) and exchange rate returns (*rex*). For the exception, we cannot reject the null hypothesis of a unit root for short term interest rate on level (*r*) and first log difference of industrial production (*ip*).

We employ cointegration tests, based on the methodology of Johansen and Juselius (1990), for the oil price, exchange market, short-term interest rate and stocks markets variables. Table 2 reports the tests for cointegration. In all cases, we choose VAR models with six lags length. The trace test statistics find that a long-run relationship exist among the five jointly determined variables in either case.

Thus, we proceed to estimate VAR models for these variables on level for all countries.

Table 1. ADF unit root test results

	Stocks markets and oil price returns		Exchange rate returns (country i / US)		Industrial production in log level		Industrial production in First log difference		Interest rate in level		Interest rate in First level difference	
	C	CandT	C	CandT	C	CandT	C	CandT	C	CandT	C	CandT
Oil price	-12.413 ^{a}	-12.373 ^{a}										
US ($/euro)	-10.658 ^{a}	-10.726 ^{a}	-10.658 ^{a}	-10.726 ^{a}	-0.588	-2.740	-8.560 ^{a}	-8.546 ^{a}	-1.532	-1.935	-7.548 ^{a}	-7.546 ^{a}
UK	-9.036 ^{a}	-9.048 ^{a}	-9.036 ^{a}	-9.048 ^{a}	0.109	-2.149	-8.120 ^{a}	-8.222 ^{a}	-0.534	-1.389	-7.209 ^{a}	-7.315 ^{a}
Italy	-10.870 ^{a}	-10.889 ^{a}	-10.870 ^{a}	-10.889 ^{a}	-0.662	-2.657	-5.928 ^{a}	-5.907 ^{a}	-2.376	-2.519	-5.957 ^{a}	-5.949 ^{a}
Belgium	-8.492 ^{a}	-8.500 ^{a}	-8.492 ^{a}	-8.500 ^{a}	-0.687	-3.825	-6.597 ^{a}	-6.576 ^{a}	-1.731	-1.857	-6.017 ^{a}	-6.087 ^{a}
France	-10.349 ^{a}	-10.34 ^{a}	-10.349 ^{a}	-10.34 ^{a}	-0.491	-2.928	-6.403 ^{a}	-6.381 ^{a}	-1.828	-1.954	-5.686 ^{a}	-5.753 ^{a}
Germany	-11.052 ^{a}	-11.023 ^{a}	-11.052 ^{a}	-11.023 ^{a}	-1.027	-3.194	-3.314 ^{b}	-3.289 ^{c}	-1.863	-1.966	-5.712 ^{a}	-5.778 ^{a}
Portugal	-10.119 ^{a}	-10.083 ^{a}	-10.119 ^{a}	-10.083 ^{a}	-1.153	-2.837	-7.084 ^{a}	-7.060 ^{a}	-2.205	-2.499	-4.526 ^{a}	-4.552 ^{a}
Sweden	-10.478 ^{a}	-10.447 ^{a}	-10.478 ^{a}	-10.447 ^{a}	0.452	-2.298	-11.335 ^{a}	-11.360 ^{a}	-2.091	-2.784	-4.670 ^{a}	-4.673 ^{a}
Spain	-10.583 ^{a}	-10.603 ^{a}	-10.583 ^{a}	-10.603 ^{a}	-0.104	-2.542	-6.538 ^{a}	-6.547 ^{a}	-2.095	-2.313	-5.651 ^{a}	-5.634 ^{a}
Norway	-9.920 ^{a}	-9.896 ^{a}	-9.920 ^{a}	-9.896 ^{a}	-0.713	-3.215	-9.316 ^{a}	-9.277 ^{a}	-2.133	-2.624	-4.194 ^{a}	-4.274 ^{a}
Switzerland	-10.222 ^{a}	-10.207 ^{a}	-10.222 ^{a}	-10.207 ^{a}	-0.252	-1.039	-11.195 ^{a}	-11.162 ^{a}	-1.607	-1.661	-9.583 ^{a}	-9.576 ^{a}
Canada	-9.978 ^{a}	-9.943 ^{a}	-9.978 ^{a}	-9.943 ^{a}	-2.205	-1.196	-2.070	-2.770	-1.048	-1.904	-6.340 ^{a}	-6.517 ^{a}
Denmark	-10.550 ^{a}	-10.516 ^{a}	-10.550 ^{a}	-10.516 ^{a}	-1.768	-1.991	-11.125 ^{a}	-11.129 ^{a}	-2.092	-2.263	-4.764 ^{a}	-4.819 ^{a}
Greece	-10.799 ^{a}	-10.769 ^{a}	-10.799 ^{a}	-10.769 ^{a}	-2.857	-2.552	-8.734 ^{a}	-9.217 ^{a}	-1.240	-1.239	-4.212 ^{a}	-4.153 ^{a}
Netherlands	-10.676 ^{a}	-10.657 ^{a}	-10.676 ^{a}	-10.657 ^{a}	-0.915	-2.992	-4.219 ^{a}	-4.204 ^{a}	-1.825	1.930	-5.776 ^{a}	-5.864 ^{a}
Russia	-10.104 ^{a}	-10.066 ^{a}	-10.104 ^{a}	-10.066 ^{a}	-2.915	-1.271	-8.845 ^{a}	-9.154 ^{a}	-4.274	-4.895	-12.018 ^{a}	-11.990 ^{a}
Japan	-5.471 ^{a}	-5.453 ^{a}	-5.471 ^{a}	-5.453 ^{a}	-1.811	-1.581	-6.867 ^{a}	-6.916 ^{a}	-1.455	-2.087	-14.147 ^{a}	-14.149 ^{a}
Korea	-11.354 ^{a}	-11.319 ^{a}	-11.354 ^{a}	-11.319 ^{a}	-1.153	-2.837	-7.084 ^{a}	-7.060 ^{a}	-2.205	-2.499	-4.526 ^{a}	-4.552 ^{a}
China	-11.018 ^{a}	-11.172 ^{a}	-11.018 ^{a}	-11.172 ^{a}	-2.955	3.341	-11.447 ^{a}	-11.441 ^{a}	-2.716	-2.423	-6.449 ^{a}	-6.571 ^{a}
Indonesia	-8.969 ^{a}	-9.243 ^{a}	-8.969 ^{a}	-9.243 ^{a}	-2.691	-3.870	-3.737 ^{a}	-3.958 ^{b}	-2.856	-2.632	-3.286 ^{b}	-3.596 ^{b}
Malaysia	-9.345 ^{a}	-9.472 ^{a}	-9.345 ^{a}	-9.472 ^{a}	-1.656	-2.488	-1.940	-1.932	-2.421	-2.510	-8.935 ^{a}	-8.433 ^{a}
Singapore	-10.868 ^{a}	-10.896 ^{a}	-10.868 ^{a}	-10.896 ^{a}	-2.087	-4.121 ^{a}	-6.562 ^{a}	-6.551 ^{a}	-3.323	-3.372	-8.427 ^{a}	-8.432 ^{a}
HongKong	-10.412 ^{a}	-10.413 ^{a}	-10.412 ^{a}	-10.413 ^{a}	-2.123	0.953	-1.609	-11.579 ^{a}	-1.273	-2.190	-16.413 ^{a}	-16.371 ^{a}
Thailand	-12.131 ^{a}	-12.282 ^{a}	-12.131 ^{a}	-12.282 ^{a}	-1.111	-2.966	-6.662 ^{a}	-6.642 ^{a}	-1.748	-1.622	-7.908 ^{a}	-7.919 ^{a}
Venezuela	-11.951 ^{a}	-11.912 ^{a}	-11.951 ^{a}	-11.912 ^{a}	-2.058	-2.402	-8.366 ^{a}	-8.594 ^{a}	-1.701	-2.605	-9.551 ^{a}	-9.520 ^{a}
Argentina	-11.121 ^{a}	-11.101 ^{a}	-11.121 ^{a}	-11.101 ^{a}	-1.176	-1.907	-11.031 ^{a}	-11.001 ^{a}	-5.192 ^{a}	-5.175 ^{a}	-10.447 ^{a}	-10.410 ^{a}
Brazil	-11.659 ^{a}	-11.709 ^{a}	-11.659 ^{a}	-11.709 ^{a}	-1.362	-2.387	-11.216 ^{a}	-11.201 ^{a}	-1.493	-3.058	-9.248 ^{a}	-9.219 ^{a}

Source: (own)

Notes: ADF—Dickey and Fuller (1981); C—constant; T—trend. Superscripts a, b, and c, denote rejection of the null hypothesis of a unit root at the 1%, 5%, and 10%, level of significance, respectively.

Table 2. Cointegration test

Country	Hypothesis	r=0	r=<1	r=<2	r=<3	Country	Hypothesis	r=0	r=<1	r=<2	r=<3
Russia	Trace test	117.728 ^{a}	72.130 ^{a}	30.835	9.326	**Greece**	Trace test	106.010 ^{a}	70.485 ^{a}	41.557 ^{a}	20.710 ^{b}
	λ max test	45.597 ^{a}	41.295 ^{a}	21.509	8.971		λ max test	35.524 ^{b}	28.928 ^{b}	20.846	12.493
Canada	Trace test	95.014 ^{a}	55.907 ^{b}	25.747	8.695	**Switzerland**	Trace test	89.827 ^{b}	52.180	27.399	10.735
	λ max test	39.107 ^{a}	30.159	17.052	8.629		λ max test	37.647	24.780	16.663	8.117
Norway	Trace test	104.701 ^{a}	61.24	30.297	15.138	**Germany**	Trace test	94.350 ^{b}	57.665	37.233	22.754
	λ max test	43.460 ^{b}	30.943	15.158	9.516		λ max test	36.685	20.432	14.478	11.814
Malaysia	Trace test	127.42 ^{a}	74.423 ^{a}	38.684 ^{b}	13.131	**Spain**	Trace test	76.277 ^{b}	45.145	18.707	7.794
	λ max test	52.997 ^{a}	35.738 ^{a}	25.552 ^{b}	9.287		λ max test	31.132	26.438	10.913	6.665
Venezuela	Trace test	77.995 ^{a}	41.105	15.541	4.239	**Japan**	Trace test	77.015 ^{b}	37.100	18.784	7.939
	λ max test	36.890 ^{b}	25.563	11.302	3.958		λ max test	38.914 ^{b}	18.315	10.845	5.928
Argentina	Trace test	122.734 ^{a}	73.671 ^{a}	32.535	13.535	**Korea**	Trace test	106.382 ^{b}	51.477	30.433	12.525
	λ max test	49.063 ^{a}	41.135 ^{a}	18.999	13.535		λ max test	54.904 ^{a}	21.044	17.908	8.296
UK	Trace test	99.106 ^{a}	67.414 ^{b}	39.522	17.775	**Hong Kong**	Trace test	91.933 ^{a}	51.591	30.768	12.437
	λ max test	31.692	27.891	21.747	12.912		λ max test	40.341 ^{b}	20.823	18.330	11.068
US	Trace test	98.642 ^{a}	64.164 ^{b}	33.862	10.319	**China**	Trace test	102.26 ^{a}	64.151 ^{a}	27.435	11.709
	λ max test	34.477	30.302	23.542	7.396		λ max test	38.110 ^{b}	36.715 ^{a}	15.726	11.509
France	Trace test	92.115 ^{a}	57.605 ^{b}	30.321 ^{b}	13.907	**Indonesia**	Trace test	123.02 ^{a}	83.633 ^{a}	46.729 ^{b}	22.797
	λ max test	34.510 ^{b}	27.283	16.414	13.907		λ max test	39.386 ^{b}	36.904 ^{b}	23.932	18.002
Italy	Trace test	115.81 ^{a}	73.964 ^{a}	46.535 ^{b}	26.354 ^{b}	**Singapore**	Trace test	125.166 ^{a}	64.998 ^{a}	35.290 ^{b}	7.985
	λ max test	41.854 ^{b}	27.429	20.181	18.841		λ max test	60.168 ^{a}	29.707	27.305 ^{b}	4.821
Denmark	Trace test	82.674 ^{b}	54.191 ^{b}	35.639 ^{b}	20.00	**Thailand**	Trace test	134.253 ^{a}	72.382 ^{a}	21.580	7.376
	λ max test	28.482	18.551	15.639	12.926		λ max test	61.870 ^{a}	50.802 ^{a}	14.203	5.678
Belgium	Trace test	115.51 ^{a}	75.214 ^{a}	47.334 ^{b}	26.303 ^{b}	**Netherlands**	Trace test	125.695 ^{a}	79.352 ^{a}	47.254 ^{b}	23.812
	λ max test	40.303 ^{b}	27.879	21.030	16.231		λ max test	46.342 ^{a}	32.097	23.442	14.878
Portugal	Trace test	114.845 ^{a}	75.067 ^{a}	38.495	13.953	**Brazil**	Trace test	90.790 ^{a}	46.502 ^{b}	17.366	3.956
	λ max test	39.778 ^{a}	36.571 ^{a}	24.542	10.070		λ max test	44.288 ^{a}	29.135 ^{a}	13.410	3.453
Sweden	Trace test	131.663 ^{a}	80.020 ^{a}	45.300 ^{b}	23.737						
	λ max test	51.643 ^{a}	34.719 ^{b}	21.563	17.429						

Notes: Johansen and Juselius (1990) test statistic for cointegration. The number of cointegrating vectors is indicated by r. Superscripts a and b denote rejection of the null hypothesis at the 1% and 5% levels of significance, respectively.

4.2. Impact of oil price shock on stock markets

4.2.1. Orthogonalized impulse response functions

This section investigates the impact of oil price shock on stock returns by examining orthogonalized impulse responses. Figure 5 presents orthogonalized impulse responses, with 95% confidence bounds, of stock market returns to one oil return shock standard deviation derived from the VAR (*ip*, *opr*, *r*, *rex*, *rsr*). Figure 5.a and Figure 5.b concern respectively oil exporting and importing countries. To facilitate the results analysis, Table 3 presents for each country a summary of orthogonalized impulse response results. In Table 3 an *n (p)* indicates negative (positive) orthogonalized impulse response.

Table 3. Orthogonalized impulse response of stock market return to oil price shock
VAR (*ip*, *opr*, *r*, *rex*, *rsr*)

Panel A : Oil exporting countries							
	Canada	**Norway**	**Russia**	**Venezuela**	**Malaysia**	**Argentina**	
Shock to op	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	
Panel B : Oil importing countries							
	US	**UK**	**France**	**Germany**	**Greece**	**Denmark**	**Netherlands**
Shock to op	$p^{\#}$	$n^{\#}$	$n^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$
	Switzerland	**Sweden**	**Italy**	**Portugal**	**Spain**	**Belgium**	**China**
Shock to op	$n^{\#}$	$n^{\#}$	$n^{\#}$	$n^{\#}$	n	$p^{\#}$	$p^{\#}$
	Japan	**HK**	**Indonesia**	**Singapore**	**Thailand**	**Korea**	**Brazil**
Shock to op	$n^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	p	$p^{\#}$	$p^{\#}$

Source: (own)
Notes: n (p) indicates negative (positive) statistically significant orthogonalized impulse response. The superscript # indicates that statistic significance is at 5% level

Orthogonalized impulse response functions show that oil exporting countries have a similar response pattern of stock returns to the oil price shocks. Indeed, all countries have a significant positive response of stock markets returns to oil price shocks at the 5% level in the same month and/or within one month. Following immediately oil price shock, Norway (Venezuela) has the larger (smaller) stock market returns response.

For the oil importing countries, we cannot find a consensus for the response of stock market to oil price shocks. An oil price shock has a positive and statistically significant impact on stocks markets returns at the 5% level for US, Germany, Netherlands, Belgium, Greece, Denmark, China, Indonesia, Hong Kong, Singapore, Korea, and Brazil markets. By contrast, a statistically significant negative response of stock returns to an oil price increase is shown in UK, France, Italy, Portugal, Sweden, Switzerland and Japan markets.

The contribution of oil price shocks to variability in stock returns in the US and most other countries is greater than that of interest rate.

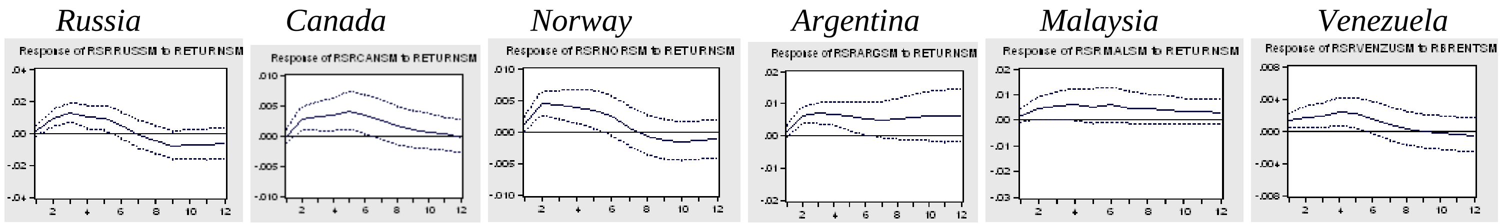

Figure 5.a. Oil exporting countries

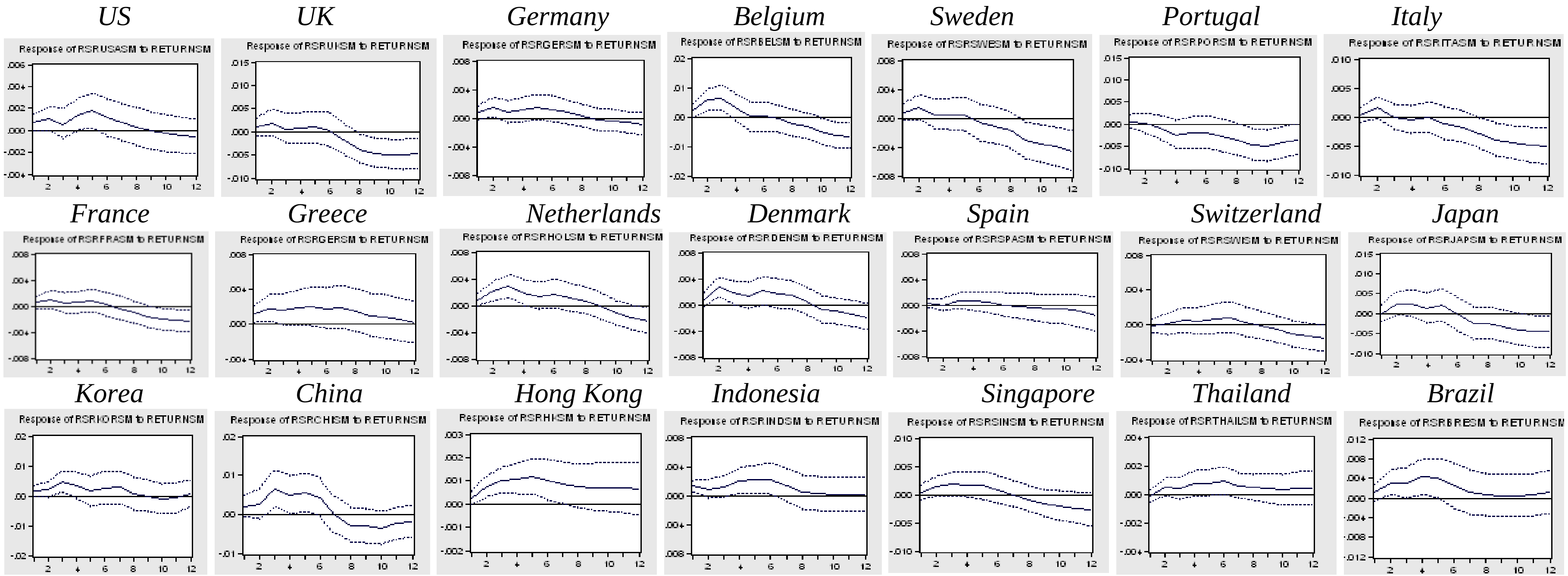

Figure 5.b. Oil importing countries

Figure 5. Orthogonalized impulse response function of stock market returns to oil price shocks in VAR (ip, opr, r, rex, rsr)

Source:(own)

4.2.2. Variance decomposition

Table 4 presents the forecast error variance decomposition of stock returns respectively for oil exporting countries (Panel A) and oil importing countries (Panel B). Variance decomposition illustrates how much of the unanticipated changes of variance stock returns are explained by log of industrial production (*ip*), oil price returns (*opr*), short-term interest rate on level (*r*), exchange rate returns (*rex*) and stock market returns (*rsr*). Results show that the volatility of stock market return is principally caused by itself specially for importing countries. Moreover, oil price shocks are a considerable source of variance for stock returns in a basic VAR model. Specifically, the contribution of oil price shocks to the stock market movement is greater than that of industrial production, short-term interest rate on level, exchange rate returns in most of oil importing countries (UK, Italy, France, Greece, Netherlands, Portugal, Sweden, Switzerland, Japan, and China). This contribution is greater than that of industrial production, exchange rate returns in all oil exporting countries except for Canada. This means that oil price shocks is a significant factor explaining price variation when the variation stock market return is taken into account.

Table 4. Variance decomposition after 12 periods of stock markets returns

			Panel A : Oil exporting countries			
	S.E.	**ip**	**opr**	**r**	**rex**	**rsr**
Russia	0.048669	3.598291	**28.84789**	17.18834	26.99728	23.36820
Canada	0.021240	15.78427	**14.92821**	2.047020	17.06354	50.17697
Norway	0.021503	14.07943	**17.08612**	35.47378	10.00951	23.35117
Malaysia	0.045310	2.418523	**11.81991**	48.01764	3.849826	33.89409
Argentina	0.034394	1.825027	**33.15582**	1.405014	9.848131	53.76601
Venezuela	0.009223	1.697596	**10.07453**	24.52561	10.06881	53.53345
			Panel B : Oil importing countries			
	S.E.	**ip**	**opr**	**r**	**rex**	**rsr**
US	1.483027	8.704128	**7.530733**	3.525689	6.923595	73.31586
UK	0.025253	4.349613	**18.41933**	11.81184	12.27918	53.14004
Italy	0.020132	4.650812	**25.32598**	2.409535	18.05702	49.55665
Spain	0.015394	8.444261	**2.351576**	5.788963	16.91829	66.49691
Germany	0.013091	8.628686	**6.065220**	13.94701	6.844314	64.51477
France	0.012829	5.188717	**13.18500**	10.59062	11.10499	59.93068
Belgium	0.035349	5.138971	**17.63417**	13.52648	22.57018	41.13020
Greece	0.035900	4.023666	**23.52993**	3.251569	12.57374	56.62109
Netherlands	0.013903	2.699734	**17.76142**	7.103068	3.455125	68.98065
Denmark	0.015520	6.184752	**12.04104**	16.54230	11.06714	54.16477
Portugal	0.025320	3.391794	**17.25512**	2.669921	6.788112	69.89506
Sweden	0.018349	0.311618	**20.11535**	17.51874	13.64145	48.41284
Switzerland	0.010983	1.992292	**6.279672**	4.828378	2.499700	84.39996
Japan	0.026790	2.913320	**13.75516**	6.383307	20.45656	56.49165
Korea	0.036179	7.713874	**4.236325**	13.27055	17.05560	57.72366
Hong Kong	0.006926	3.862455	**17.76050**	4.084152	0.365070	73.92782
China	0.032827	7.661722	**15.46614**	3.779580	4.090436	69.00212
Indonesia	0.017709	12.15339	**6.143973**	5.910437	52.94330	22.84890
Singapore	0.014638	8.206076	**5.934587**	8.241957	5.363092	72.25429
Thailand	0.009508	8.795557	**3.671715**	7.571539	4.552299	75.40889
Brazil	0.027824	0.816137	**8.178990**	1.328535	45.02630	44.65004

Source: (own)

The results in the table 4 show that the contributions of oil price to variance of stocks markets returns vary between 2,35% for Spain and 33,15% for Argentina.

4.3. Impact of oil price volatility on stock markets volatilities

With regard to the response stock market returns to oil price shocks, one interesting issues is the impact of oil price volatility on stock markets volatilities. Using orthogonalized impulse responses and variance decompositions, this sub-section examines the impact of oil price volatility on stock market volatilities.

4.3.1. Orthogonalized impulse response functions

Figure 6.a and Figure 6.b present respectively orthogonalized impulse responses, with 95% confidence bounds, of stock market volatility to one oil return volatility standard deviation of oil exporting and importing countries. We consider the VAR (*ip*, *Vol.op*, *r*, *rex*, *Vol.rsr*) model. Table 5 summarizes the results of Figure 6.a and Figure 6.b. In this table *n (p)* indicates negative (positive) orthogonalized impulse response. Oil price volatility has a positive and statistically significant impact on stocks markets volatilities for all oil exporting countries. Also, the stocks markets volatilities responses positively and significantly to oil price volatility for all importing countries expect for Korea and Brazil.

Table 5. Orthogonalized impulse response of stock markets volatilities to oil price volatility VAR (ip, Vol.op, r, rex, Vol.rsr)

Panel A : Oil exporting countries							
	Canada	**Norway**	**Russia**	**Venezuela**	**Malaysia**	**Argentina**	
Shock to op	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	
Panel B : Oil importing countries							
	US	**UK**	**France**	**Germany**	**Greece**	**Denmark**	**Netherlands**
Shock to op	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$
	Switzerland	**Sweden**	**Italy**	**Portugal**	**Spain**	**Belgium**	**China**
Shock to op	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$
	Japan	**HK**	**Indonesia**	**Singapore**	**Thailand**	**Korea**	**Brazil**
Shock to op	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	$p^{\#}$	p	p

Source: (own)

Notes: *n* (p) indicates negative (positive) statistically significant orthogonalized impulse response at 5% level of real stock return to oil price shock at first and/or second lag. The superscript # indicates that statistic significance is at 10% level.

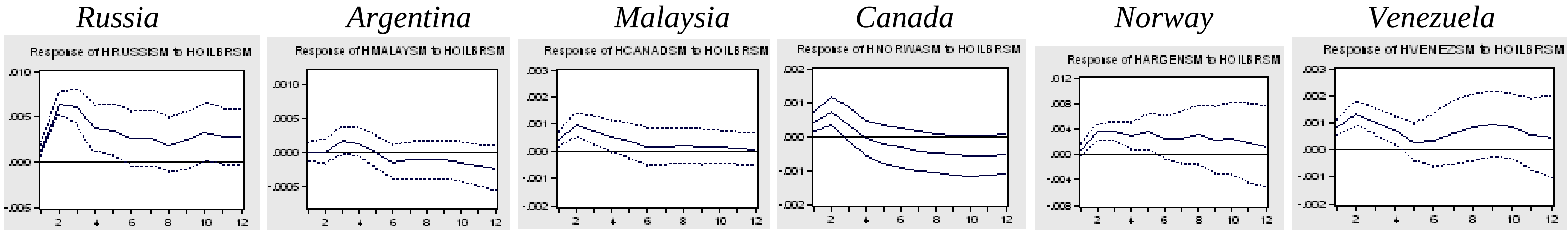

Figure 6.a. Oil exporting countries

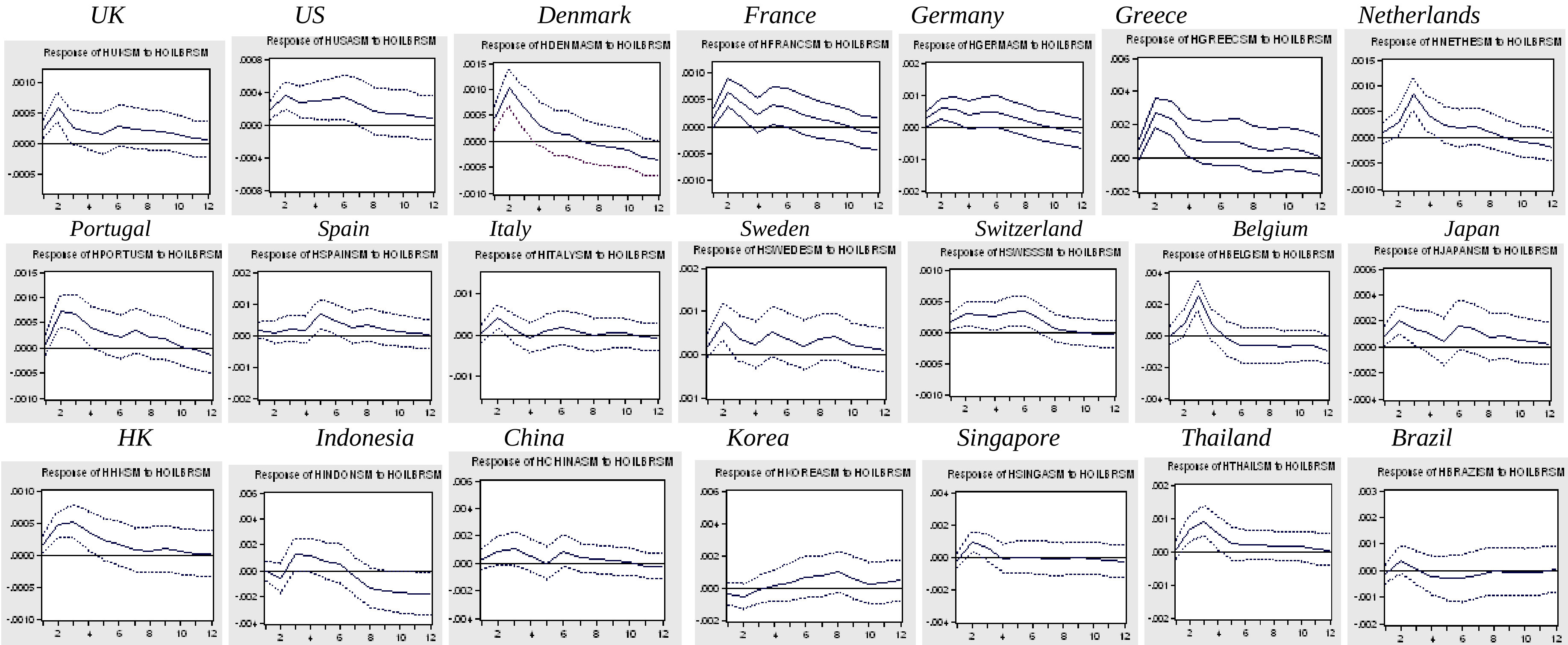

Figure 6.b. Oil importing countries

Figure 6. Orthogonalized impulse response function of stock market volatilities to oil price volatility in VAR (*ip*, *Vol.op*, *r*, *rex*, *Vol.rsr*).

Source:(own)

4.3.2. Variance decomposition

The results for variance decomposition analysis of stocks markets volatilities are shown in the Table 6. For oil importing countries, the contributions of oil price volatility to variance of stocks markets volatilities vary between 4,126% for Brazil and 54,99% for Argentina.

Oil price volatility constitutes the main important factor of stocks market volatilities variance for Argentina and Russia. For importing countries, the variance of stock volatilities is principally caused by itself. The production index constitutes the second factor that explains volatilities for UK, US, Belgium, France, Germany Italy Netherlands Portugal, Portugal, Spain Hong Kong and Singapore. Moreover, oil price volatility is a considerable source of stock returns volatility in a basic VAR model only for Denmark, Greece and Switzerland. Consequently, oil price volatility contributes marginally to the stock market volatilities of oil importing countries.

Table 6. Variance decomposition after 12 periods of stocks markets volatilities

Panel A : Oil Exporting countries						
	S.E.	**ip**	**Vol.op**	**r**	**rex**	**Vol.rsr**
Russia	0.016599	10.69600	**54.99783**	2.149585	14.73412	17.42247
Canada	0.004830	8.064172	**9.504972**	12.13614	40.64133	29.65339
Norway	0.004381	9.914516	**14.28615**	27.19950	16.96048	31.63935
Argentina	0.014352	9.533286	**40.02472**	0.835691	26.17101	23.43529
Malaysia	0.002368	5.543950	**4.126831**	23.62496	31.02832	35.67594
Venezuela	0.005376	9.412141	**24.90010**	7.429063	7.920404	50.33830
Panel B : Oil Importing countries						
	S.E.	**ip**	**Vol.op**	**r**	**rex**	**Vol.rsr**
UK	0.002157	17.20312	**16.51627**	6.132652	11.17642	48.97154
US	0.002153	31.05376	**13.94290**	2.266130	7.027004	45.71021
Belgium	0.007813	19.98441	**17.92096**	12.23483	17.94896	31.91084
Denmark	0.002972	7.989487	**23.42657**	6.256056	15.25754	47.07034
France	0.002675	22.83390	**14.75755**	3.859346	6.701721	51.84748
Germany	0.003156	15.86421	**14.51114**	6.437823	6.299630	56.88720
Greece	0.009423	0.480960	**20.51351**	6.692232	9.919652	62.39365
Italy	0.003104	20.61639	**2.674038**	5.243945	8.967860	62.49776
Netherlands	0.002606	14.95229	**17.10752**	8.707203	10.12213	49.11086
Portugal	0.002807	10.99734	**18.23930**	5.395742	6.406916	58.96070
Spain	0.003759	14.83967	**6.800051**	14.62087	9.229530	54.50988
Sweden	0.003733	9.784151	**11.17414**	13.56245	14.21873	51.26053
Switzerland	0.001540	1.410858	**21.73455**	8.766567	2.720325	65.36770
Japan	0.001266	8.535478	**8.871173**	9.736731	4.966928	67.88969
China	0.007741	3.239820	**5.316587**	12.19767	5.718664	73.52726
Hong Kong	0.002371	27.23823	**13.13987**	14.89263	21.14836	23.58090
Indonesia	0.011844	14.89805	**12.62717**	7.339441	19.05068	46.08465
Korea	0.009308	8.802346	**3.615004**	14.34398	51.17564	22.06303
Singapore	0.007434	21.61520	**2.597125**	9.454868	0.617896	65.71491
Thailand	0.004441	14.07657	**8.855432**	4.783268	16.69343	55.59130
Brazil	0.005736	2.106632	**1.299921**	11.76666	48.19676	36.63002

Source: (own)

5. Conclusion

The vast literature establishing robust results across many countries on the connection between oil price shocks and aggregate activity implies that connections should also hold between oil price shocks and stocks markets. This study estimates the impacts of oil price shocks on the stock market returns of the 6 oil importing and 21 oil exporting countries over 1997:1–2009:8 using a multivariate VAR analysis. We find that oil price shocks have a significant impact on stock market returns in most countries. However, the impacts of oil price shocks on the stock market are different between oil exporting countries and oil importing countries.

The study of the impact of oil price shock on stock market returns, by examining orthogonalized impulse responses and variance decomposition, shows that oil exporting countries (Russia, Norway, Canada, Malaysia, Venezuela and Argentina) have a significant positive response of stock markets returns to oil price shocks at the 5% level in the same month and/or within one month. Also, the contribution of oil price shocks to the variance of stock market returns is greater than that of industrial production, exchange rate returns in all oil exporting countries except for Canada.

For the oil importing countries, we can not find a consensus for the response of stock market to oil price shocks. Indeed, for US, Germany, Netherlands, Belgium, Greece, Denmark, China, Indonesia, Hong Kong, Singapore, Korea, and Brazil an oil price shock has a positive and statistically significant impact on stocks markets returns at the 5% level in the same month and/or within one month. By contrast, UK, France, Italy, Portugal, Sweden, Switzerland and Japan have a statistically significant negative response of stock returns to an oil price increase.

Moreover, variance decomposition shows that the contribution of oil price shocks to the stock market variance is greater than that of industrial production, short-term interest rate and exchange rate returns in most of oil importing countries (UK, Italy, France, Greece, Netherlands, Portugal, Sweden, Switzerland, Japan, and China).

Empirical results from the impact of oil price volatility on stock volatilities show that oil price volatility has a positive and statistically significant impact on stocks markets volatilities for most oil importing and exporting countries.

Overall, oil price shocks have a significant impact on the stock market returns and volatilities in most countries, and the impacts in oil importing countries are fairly different from those in oil exporting countries.

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THE ANNUAL FINANCIAL STATEMENTS – SOURCE OF INFORMATION FOR DETERMINING COMPANY PERFORMANCE

Teodor **HADA**
,,1 Decembrie 1918'' University Alba Iulia, Faculty of Science, **Romania**
teohada@yahoo.com

Abstract

This study begins with definitions for the concept of performance and its components. Also, based on the profit and loss account for the period 2004-2010 of company X, we determined the performance indicators for frozen assets, current assets and the performance given by the rates of return. The research methods used in this study were documentation and economic analysis. The novelty of this study consists in the specific calculation of performance indicators based on annual financial statements, as well as establishing a correlation between fixed assets and the turnover, meaning the role played by investments in the size of the turnover from year to year.

Key words: financial statements, balance sheet, performance, profit and loss account, efficiency.

JEL classification: C; M41

1. Introduction

The etymology of the word performance originates in the Latin word 'performare', which means 'form completely'(Jianu 2007). In English, the verb 'to perform' means 'to execute something, method and application, to excel, to accomplish in a convenient manner' (Jianu 2007).

The economic and financial performance is defined by Gheorghe O. Bistriceanu in Finance, Banks and Insurance Lexicon, volume III, Economica Publishing House, Bucharest, 2001, p. 31, as being a high quality level of the economic and financial activity conducted by economic agents, which is computed with the help of several indicators, such as: turnover, return on capital, labour productivity, yield on capital, gross and net profit, annual renewal rate of fixed capital, the efficient use of fixed assets, etc.

Recently, Iulia Jianu showed that 'performance is a state of competitiveness of the enterprise, which ensures its sustainable presence on the market. Performance is the indicator of a potential of future results, which emerges as result of meeting the strategic objectives. Therefore, performance doesn't describe a temporary situation, but refers to the future'.

We believe that company performance is a complex concept, which may be measured through a series of indicators and which shows its position within the competitive environment.

2. Content

a. Annual financial statements – source of information for determining company performance

To calculate performance indicators, we will use data from company X (real data), processed as follows:

A. Short version balance sheet

Table 1. Short version balance sheet (in lei)

ASSETS	2004	2005	2006	2007	2008	2009	2010
Frozen assets, total	51131	58122	1198990	1386777	1620691	3260987	3834286
Current assets, total	35606	95758	191500	555897	881477	1933344	2168465

ASSETS	2004	2005	2006	2007	2008	2009	2010
Accrued expenses	-	-	3242	5013	8782	18114	41701
Equity capital	-53199	-51563	818486	920265	962017	1331002	705422
Debts older than one year	-	-	170669	121193	105992	802507	1069096
Debts due in one year or less	139936	205443	404577	789013	1338351	2326975	3610245
Provisions	-	-	-	-	-	-	-
Deferred income	-	-	-	117016	104590	751961	659689
Total assets=Total liabilities	86737	153880	1393732	1947687	2510950	5212445	6044452
Net current assets (working capital)	-104330	-109685	-209835	-228303	-448092	-375517	-1400079

B. The profit and loss account is processed to determine the intermediate management balances

Table 2. The profit and loss account (in lei)

No.cr.	INDICATORS	PERIOD/ YEARS						
		2004	2005	2006	2007	2008	2009	2010
1	Net turnover, of which:	8746	100226	301173	1250997	1679710	3491678	3976006
	1.1 Sales of good purchased for resale	0	0	123383	557395	914261	1617957	1677187
	1.2 Revenue from sold production	8746	100226	177790	693602	765449	1873721	2298819
2	Revenue from work in progress	9322	8758	35204	53195	158154	555343	9845
3	Production achieved for own used and capitalized	1883	0	66699	101708	195238	139110	140100
4	The year's production (12+2+3)	19951	108984	279693	848505	1118841	2568174	2448764
5	Other operating revenues	0	0	3174	35145	295563	531634	1225738
6	Operating revenues (1+2+3+5)	19951	108984	406250	1441045	2328665	4717765	5351689
7	Expenses related to goods for resale	0	0	99636	519827	820994	1225256	1353888
8	Total material expenses	32071	83942	201164	505929	670725	1424739	2065496
9	Other external expenses	5549	0	220	1710	13551	31467	47410
10	Other material expenses	0	13081	23968	78937	323263	621776	1581980
11	Value added (4+11-7-8-9-10)	-17669	11961	78088	299497	204569	882893	-922823
12	Personnel expenses	1205	1227	18456	66683	128242	158350	195091
13	Indirect expenses	4796	1675	307	726	6473	17042	8010
14	Gross operating surplus (11-12-13)	-23670	9059	59325	232088	69854	707501	-1125924
15	Other operating revenues	0	0	3174	35145	295563	531634	1225738
16	Adjustment expenses	576	594	10280	40145	78883	191139	294155
17	Other operating expenses	727	6573	39798	80019	219577	541383	335586

18	The result of the exploitation (14-15-16-17)	-24973	1892	12421	147069	66957	506613	-529927
19	Financial revenues	5	48	8647	1867	4151	31459	98586
20	Financial expenses	0	0	5572	27992	29038	129144	187789
21	Financial result	5	48	3075	-26125	-24887	-97685	-89203
22	Extraordinary revenue	0	0	0	0	0	0	0
23	Extraordinary expenses	0	0	0	0	0	0	0
24	Extraordinary result	0	0	0	0	0	0	0
25	Total revenue	19956	109032	414897	1442912	2332816	4749224	5450275
26	Total expenses	44924	107092	399401	1321968	2290746	4340296	6069405
27	Total result	-24968	1940	15496	120944	42070	408928	-619130
28	Income tax	0	304	2747	19165	8446	63877	6450
29	Other tax elements	131	0	0	0	0	0	0
30	Net profit	-25099	1636	12749	101779	33624	345051	-625580

b. Performance indicators for frozen assets

Table 3. Performance indicators for frozen assets (in lei)

No.cr.	INDICATORS	PERIOD / YEARS						
		2004	2005	2006	2007	2008	2009	2010
1	Equity capital	-53199	-51563	818486	920265	962017	1331002	705422
2	Fixed assets/Frozen assets	51131	58122	1198990	1386777	1620691	3260987	3834286
3	Permanent capital	-53199	-51563	989155	1041458	1068009	2133509	1774518
4	Total assets	86737	153880	1393732	1947687	2510950	5212445	6044452
5	Gross profit	-24968	1940	15946	120944	42070	408928	-619130
6	The rate of equity to fixed assets(1/2)			0.68	0.66	0.59	0.41	0.18
7	Net turnover	8746	100226	301173	1250997	1679710	3491678	3976006
8	The rate of permanent capital to fixed assets(3/2)	-	-	0.82	0.75	0.66	0.65	0.46
9	The expenditure rate of fixed assets(2/4)	-	-	0.86	0.71	0.65	0.63	0.63
10	The rate of fixed assets(5/2)	-	0.03	0.01	0.09	0.03	0.13	
11	The rate of fixed assets based on turnover(7/2)	0.17	1.72	0.25	0.90	1.04	1.07	1.04

The data above show that the rate of fixed assets registered a downward trend from 0.86 in 2006 to 0.63 in 2010, which is due to an increase of current assets within total assets. It's important to mention that the rate of fixed assets based on turnover had an upward trend, recording a coefficient of 1.07 in 2009 due to the fact that inputs of fixed assets from year to year increased the turnover. Therefore, we will calculate the correlation coefficient between frozen assets and turnover as follows:

The data used for calculation were:

Turnover	Frozen assets
100226.0	58122.0
301173.0	1198990.0
1250997.0	1386777.0
1679710.0	1620691.0
3491678.0	3260987.0
3976006.0	3834286.0

A. To check the correlation between the two variables, we used the econometric model that is based on the following formula:

$$r = \frac{N * \sum X * Y - \sum X * \sum Y}{\sqrt{N * \sum X^2 - (\sum X)^2} * \sqrt{N * \sum Y^2 - (\sum Y)^2}} \qquad (1)$$

where: r – correlation ratio; N – number of subjects;

After analyzing the data above, we obtained for correlation between the two variables the value r = 0.983685; very good correlation, r [-1;1].

B. To check the correlation between the two variables, we used the SPSS software (www.spss.com)

Using the same series of data, we obtained the following results with the help of SPSS:

Correlations

		V1	V2
V1	Pearson Correlation	1	.972**
	Sig. (2-tailed)		.001
	N	6	6
V2	Pearson Correlation	.972**	1
	Sig. (2-tailed)	.001	
	N	6	6

**. Correlation is significant at the 0.01 level (2-tailed).

There is a direct correlation between the two variables.

c.Performance indicators for current assets

Table 4. Performance indicators for current assets (in lei)

No.cr.	INDICATORS	PERIOD / YEARS						
		2004	2005	2006	2007	2008	2009	2010
1	Current assets, of which:	35606	95758	191500	555897	881477	1933344	2168465
2	Inventories	25663	58224	77895	241296	534283	1133662	349862
3	Claims	5333	34270	110736	245518	307297	683961	670457

4	Shirt-term financial investments	0	0	0	0	0	0	0
5	Petty cash and accounts in lei	4610	3264	2869	68883	39897	115721	148146
6	Accrued expenses	0	0	3242	5013	8782	18114	41701
7	Net current assets (FRN)	-104330	-109685	-209835	-228303	-448092	-375517	-1400079
8	Percentage of inventories in current assets	72.07	60.80	40.68	43.44	60.64	58.64	62.25
9	Total percentage of claims in current assets	14.98	35.79	57.82	44.17	34.86	35.38	30.92
10	Short-term financial investments in current assets – total	-	-	-	-	-	-	-
11	Petty cash and bank accounts in current assets	12.95	3.41	1.50	12.39	4.50	5.98	6.83
12	Total net turnover	8746	100226	301173	1250997	1679710	3491678	3976006
13	Speed of turnover (in days)	1465.60	343.95	232.78	203.18	190.80	201.20	200.12
14	Gross profit	-24968	1940	15946	120944	42070	408928	-619130
15	Net profit	-25099	1636	12749	101779	33624	345051	-625580
16	Gross profit related to current assets		0.02	0.08	0.22	0.05	0.21	
17	Net profit related to current assets		0.02	0.07	0.18	0.04	0.18	
18	Current assets related to the net turnover	4.07	0.96	0.64	0.44	0.52	0.55	0.55

By analyzing the data above, we conclude that the working capital during the reporting period recorded negative values each year, reaching the value -1.400.079 lei in 2010, which shows that the company doesn't have resources to finance current assets.

The largest share within current assets belongs to inventories, which recorded shares between 40% and 72.07%, with values of approximately 60% in the last three years analyzed in this study.

The speed of turnover (speed expressed in days) recorded values below 200 days during the analyzed period, showing that current assets turn slowly (less than two rotations per year), hindering the production cycle.

By correlating current assets with the turnover, it will emerge that current assets hold over 50% of turnover, with the exception of 2007.

d. Indicators of profitability

For the calculus of these indicators, we will use the data presented in the table below:

Table 5. Indicators of profitability

No. cr.	INDICATORS	PERIOD / YEARS						
		2004	2005	2006	2007	2008	2009	2010
1	Value added	-17669	11961	78088	299497	204569	882893	-922823
2	Gross surplus of exploitation	-23670	9059	59325	232088	69854	707501	-1125924
3	The result of exploitation	-24973	1892	12421	147069	66957	506613	-529927
4	Gross result	-24968	1940	15946	120944	42070	408928	-619130
5	Net profit	25099	1636	12479	101779	33624	345051	-625580
6	Equity capitals	-53199	-51563	818486	920265	962017	1331002	705422
7	Total frozen assets	51131	58122	1198990	1386777	1620691	3260987	3834286

No. cr.	INDICATORS		PERIOD / YEARS						
			2004	2005	2006	2007	2008	2009	2010
8	Total assets		86737	153880	1393732	1947687	2510950	5212445	6044452
9	Net turnover		8746	100226	301173	1250997	1679710	3491678	3976006
10	Social capital		200	200	38200	38200	38200	38200	38200
11	Permanent capital		-53199	-51563	989155	1041458	1068009	2133509	1774518
12	Current profit		-24968	1940	15496	120944	42070	408928	-619130
13	Expenses related to goods for resale				99636	519827	820994	1225256	1353888
14	Sale of goods				123383	557395	914261	1617957	1677187
15	Margin trading				23747	37568	93267	392701	323299
16	A. The ration between means and results: gross profit/fixed assets			3.33	1.32	8.72	2.60	12.54	
17	B. Rates of return	B.1.Renturn on capital		1.26	1.14	6.21	1.68	7.85	
18		B.2.Retrun on equity			1.95	13.14	4.32	30.72	
19		B.3. Return on social capital		970.00	41.74	316.61	110.13	1020.49	
20		B.4. Rate of return based on turnover		1.94	5.29	9.67	2.50	11.71	
21		B.5.Return on permanent capital			1.61	11.61	3.94	19.17	
22	C. Return on assets			5.89	4.26	11.92	2.78	13.57	
23	D. Financial return rates	D.1.Financial return before tax			1.52	11.06	3.50	25.92	
24		D.2.Financial rate of return			1.89	13.14	4.37	30.72	
25	E. Commercial rates of return	E.1. Commercial rates of return; margin trading rate			19.24	6.73	10.20	24.27	19.28
26		E.1. Commercial rates of return; margin trading rate		1.63	4.14	8.14	2.00	9.88	

The data related to profitability indicators show that the company had the highest net profit of 345.051 lei in 2009, and in 2010 it registered a loss of 625.580 lei even though the turnover in 2010 increased by 484.328 lei compared to 2009, but the operating expenses were higher and tipped the scale.

3. Conclusions

The presented data show that company performance is measured through specific indicators for frozen assets, current assets and profitability, resulting that the results of the company are determined by the investment effort put in to withstand the competitive environment of the market.

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IMPACT OF CRUDE OIL PRICE VOLATILITY ON WORLD EQUITY MARKETS BEHARVIUR

Rakesh **KUMAR,**
University of Delhi, Deparment of Business Studies, Deen Dayal Upadhyaya College, **India**
saini_rakeshindia@yahoo.co.in
Mohammad **TAMIMI**
Islamic Azad University, Department of Management, Dezfoul Branch, Dezfoul, **Iran**
tamimi.mohammad@gmail.com

Abstract

In the age of globalization, it has become very important to find out the economic and non-variables which are significantly responsible for volatility in stock markets. Investors have become largely sensitive to these factors which results in change their investment strategy at the time of emergence on national and international level. The present study is an attempt to measure how equity markets of developed and developing countries respond to volatility in international crude oil price. To investigate the problem, the study uses a set of ten stock markets from developed countries and seven stock markets from developing countries. To analysis how investors react to crude oil price volatility which results in volatility in stock market, two stages GARCH (1,1) model is used. In the first stage, GARCH (1,1) is used to estimate the conditional volatility of crude oil price expressed in dollar, thereafter in the second stage, the estimated conditional volatility of crude oil price is used as independent regressor to estimate the conditional volatility of world equity markets in question by running GARCH (1,1) model. The data set used in the study involves the monthly prices of stock exchange listed indices for the period ranging from January 1995 through December 2007. In brief, the research methodology applied in the study includes application of Jarque-Bera test to determine the normality of data, Ljung-Box to examine the cross correlation in stock returns, GARCH (1,1) estimation of asymmetric volatility, and finally correlation to examine the volatility integration between world equity markets returns and crude oil price in the international market. The results reveal the following-

- *Oil prices are normally distributed during the study time period,*
- *The significance of Jarque Bera statistics indicates that out of developed countries, Japan stock market and out of developing countries, India and China stock markets returns are normally distributed,*
- *On an average, stock markets of developing countries have offered higher average return to the investors,*
- *The first stage GARCH (1,1) results of oil price exhibit that oil price volatility is significantly influenced by unexpected events in international markets and volatility in preceding time periods,*
- *The second stage GARCH (1,1) results exhibits that crude oil price volatility significantly determines the stocks markets return volatility of both developed and developing countries. The direct observations can be made here that investors are largely sensitive to fluctuations in crude oil prices in the international market,*
- *Correlation matrix of stock markets return volatility and crude oil price volatility in case of both developed and developing countries exhibit a higher degree of correlation. These results bring out the corresponding relation between crude oil price volatility and stock markets return volatility.*

Keywords: conditional volatility, GARCH, volatility integration, autocorrelation, world equity market, expected volatility, unexpected volatility.

JEL Classification: C52, E3, C1, C4

1. Introduction

A forecast of oil price volatility works important input into macroeconomic econometric models for the assessment of risk and return of financial markets, and modeling of volatility. Recent empirical works suggest that oil price shocks tend to have an adverse impact on the macro economy as a whole and stock market as particular. This paper provides empirical support for this proposition by showing the correlation of a set of world equity markets return volatility and crude oil price volatility, measured by conditional variance of oil prices, which helps to forecast stock market movements. A part of the asymmetric movements in stock returns reported in previous studies can be explained by taking crude oil price volatility as independent regressor in forecasting the stock market volatility.

In fact, with starting the deregulation phase of financial sector, world equity markets are reporting integration to large or less extent. Researchers and policy makers are largely interested in exploring the economic and non-economic factors responsible for stimulating the investors to respond in the same line over the development of these factors. Stock prices are generally believed to be determined by some fundament macro-economic variables such as interest rate, exchange rate, and inflation rates. For global and domestic investors, a highly integrated world equity market indicates that returns of securities are similarly priced internationally in response to global economic and non-economic factors. The emergence of this phenomenon reduces to earn risk premium in diverting funds from one market to another and potential opportunities for global diversification. For corporate, a highly integrated world equity market signifies that there are little opportunities to raise capital at lower cost across the border markets, however, as a matter of fact, the dominate factors are out of explanation yet which are promoting world equity market integration. The present study attempts to investigate the volatility in world equity markets caused by fluctuations in crude oil prices in international market. Oil price volatility creates uncertainty among the investors and their investment decisions therefore tend to become sensitive to volatility in crude oil prices. In the post war period especially after 1986, oil price hikes have reported a significant and deterministic effect on stock markets.

The study also attempts to measure the integration in volatility of stock markets with respect to crude oil prices. A substantial work is found in case of interdependency of developed stock markets, however very less efforts are made to explore the dynamics between crude oil price volatility and stock market returns volatility. Studies (Hamao *et al.*. 1990; Kumar and Mukhopadya 2002) employed two stages GARCH model to study the dynamic relationship across the stock markets wherein day time and overnight returns are used. They firstly extracted the unexpected shocks from the day time returns of one market and used it as a proxy for volatility surprise while modeling the other markets overnight returns in the second stage of modeling. Further, number of studies (Cheung and Mak 1992; Karolyi and Stulz, 1996; Masih and Masih 2001) employed co-integration and Gragnger causality test and held that US stock market contributes dominate role in world stock market integration. Studies (Mcclure *et al.*., 1999; Huang Yang and Hu, 2000; Jong and Roon, 2001; Mukherjee and Mishra, 2007) examined group stock markets and held a strong interdependence across the stock markets. Further, number of empirical studies examines the integration of stock markets and possible dynamics like interest rate, foreign investment, trade relations, inflation which integrates the markets (Black and Fraser, 1995; Bracker *et al.*., 1999; Wu, 2001; Pretorius, 2002; Liu *et al.*., 2006). The recent liberations of financial system and accelerating trade relations, have also integrated the world equity markets as whole to more or lesser degree. . Cheung *et al.*. (1998) apply co-integration technique in finding out long run co-movements between five national stock market indices and measures of aggregate real activity including the real oil price, real consumption, real money, and real output. Real returns on these indexes are typically related to transitory deviations from the long run relationship and to changes in the macroeconomic variables. Further, the constraints implied by the co-integration results yield some incremental information on stock return variation that is not already contained in dividend yields, interest rate spreads, and future GNP growth rates.

Ewing *et al*.. (1999) examined how the North America Foreign Trade Agreement (NAFTA) affected the level of market integration in North America, it however found no evidence of integration in member markets even after the NAFTA agreements was embedded. Sasaki *et al*.. (1999) examined the dynamic relationship in accordance with the monetary policies and found significant evidence that monetary variables affect the international interdependencies across stock markets. In conclusions, majority of studies suggested that market integration has increased significantly over the years, however, number of studies yet questions over this phenomenon, and failed to report any dynamic relationship (Cheung and Lee, 1993; King *et al*.., 1994; McClure *et al*.., 1999, Ewing *et al*.., 1999). Gjerde (1999) investigates the utility of the results on relations among stock returns and macroeconomic factors from major markets on a small and open economy by applying multivariate vector autoregressive (VAR) approach on Norwegian stock market data. Consistent with US and Japanese findings, real interest rate changes affect both stock returns and inflation, and the stock market responds accurately to oil price changes. On the other hand, the stock market shows a delayed response to changes in domestic real activity.

Sadorsky (1999) employs vector auto regression to examine the dynamics between crude oil prices, interest rate and stocks returns. The study reports that oil prices and oil price volatility both play important roles in affecting real stock returns. After 1986, oil price movements explain a larger fraction of the forecast error variance in real stock returns compare to interest rates. There is also evidence that oil price volatility shocks have asymmetric effects on the economy. Study of Darrat and Zhong (2001) however produced the opposite results wherein markets of US, Canada, Mexico were examined. By applying the co-integration tests their results suggested NAFTA enhanced the linkages across member stock markets. Some empirical studies hold monetary variables as dynamics of linkages between stock markets. Papapetrou (2001) attempts to shed light into the dynamic relationship among oil prices, real stock prices, interest rates, real economic activity and employment for Greece by using the multivariate auto regression model. The empirical evidence suggests that oil price changes affect real economic activity and employment. Oil prices are important in explaining stock price movements; however stock returns do not lead to changes in real activity and employment. Sadorsky (2006) study further uses univariate and multivariate models to estimate forecasts of daily volatility in petroleum futures price returns wherein the out-of-sample forecasts are evaluated using forecast accuracy tests and market timing tests. The T-GARCH model fits well for heating oil and natural gas volatility and the GARCH model fits well for crude oil and unleaded gasoline volatility. Simple moving average models seem to fit well in some cases provided the correct order is chosen. The study reports that used models out perform a random walk and there is evidence of market timing. Non-parametric models outperform the parametric models in terms of number of exceedences in backtests.

2. Data and resecarch methodology

This paper investigates how world equity markets behave in response to volatility in crude oil price in international market. To examine this problem, the data set used in the study is the stock exchange listed indices and crude oil prices in the international market expressed in dollar per barrel. The study uses the monthly prices of the ten stock exchanges from developed and seven stock exchanges from developing countires for the period ranging from January 1995 to December 2007. Table 1 briefly outlines the name of stock exchanges, time period and name of indices which are used for the purpose of analysis. The entire data is taken from www. finance.yahoo.com. With the given data set, fluctuations in stock returns mark volatility in stock market. Let P_t is the price of index in time period t, P_{t-1} is the price of index in preceding time period t-1, the rate of return R_{it} investors will realize in 't' time period as follow:

$$R_t = [Log_e(P_t) - Log_e(P_{t-1})]*100 \tag{1}$$

In the same fashion, the rates of fluctuations in crude oil price are also measured which can symbolically written as:

$$X_t = [Log_e(P_t) - Log_e(P_{t-1})]*100 \tag{2}$$

Where , X_t is rate of fluctuations in crude oil price, P_t is the price of crude oil expressed in dollar in time period t, P_{t-1} is the price of price of crude oil expressed in dollar in preceding time period t-1.

Table 1. Sample and Data Period

	Country	Index	Sample Period
Developed Countries			
1	Australia	All Ordinaries	January 1995-December 2007
2	Hong Kong	Hang Sang	January 1995-December 2007
3	Japan	Nikkei 225	January 1995-December 2007
4	Singapore	Straits Times	January 1995-December 2007
5	France	CAC 40	January 1995-December 2007
6	Germany	DAX 30	January 1995-December 2007
7	Spain	IBEX 35	January 1995-December 2007
8	Canada	S&P/TSX	January 1995-December 2007
9	USA	Dow Jones Composite	January 1995-December 2007
10	UK	FTSE 100	January 1995-December 2007
Developing Countries			
11	India	BSE 100	January 1995-December 2007
12	Indonesia	Jakarta Composite	January 1998-Decemebr 2007
13	Malaysia	KLSE Composite	January 1995-December 2007
14	Philippines	PSEI	January 1998-Decemebr 2007
15	Sri Lanka	MPI	January 1995-Decemebr 2005
16	Pakistan	KSE 100	January 1998-Decmber 2007
17	China	SSEI	January 2000-December 2007

3. Measurement of Conditional Volatility

The realized return consist a set of two components-expected return $E(R_t)$ and unexpected return ε_t. Expected return is attributed by stock and economic fundamentals, while unexpected return arises due to good or bad news pertaining to stocks. Symbolically, it can be written as follow:

$$R_t = E(R_t) + \varepsilon_t \tag{3}$$

An upswing in ε_t (unexpected rise in return) suggests arrival of good news, on the contrary, a downswing in ε_t (unexpected decline in return) is a mark of bad news. Volatility in stock market resultant to expected return is marked expected volatility, while volatility resultant to unexpected return is marked unexpected volatility (French *et al*.. 1987). Engle (1982) suggests that the conditional variance (σ^2) is a function of the lagged ε's. It implies that volatility can be forecasted by inclusion the past news as a function of conditional variance. This process is called autoregressive conditional heteroskedasticity which can be written as follow:

$$\sigma^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + \dots\dots\dots\dots\alpha_p\varepsilon_{t-q}^2 \tag{4}$$

Where, $\alpha_0 > 0,\ \alpha_1, \alpha_2 \dots\dots \alpha_p \geq 0$. All things being equal, α_i carries more intense influence as compared to α_j. That is, older news bears less impact on current investment decisions which results volatility, than the current news. Bollerslev (1986) generalized the ARCH (q) model to the GARCH (p,q) in which conditional variance depends upon both the squared residuals and its own lagged value which symbolically can be written as-

$$\sigma^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \tag{5}$$

The significance of α_1 and β_1 provides that investment decisions are significantly influenced by past good or bad news, and volatility in the preceding time period. A large number of studies advocate the use of GARCH (1,1) and holds it enough to capture volatility in time series data (Bollerslev *et al.* 1992; Aggarwal *et al.*. 1999; Sah and Omkarnath 2006; Nath 2006; Dhankar and Chakraborty 2007; Mala and Reddy 2007).

The present study uses two stages GARCH (1,1) model to examine the impact of volatility of crude oil prices on the volatility in stock markets under questions. In the first stage, the study involves the estimation of conditional volatility of crude oil prices in international market by applying the equation 5. In the second stage, the conditional volatility of crude oil prices in used as independent regressor in estimation of conditional volatility of all developed and under developing stock markets by applying the equation 6.

$$\sigma_{Rt}^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 \sigma_{t(OILPRICE)}^2 \tag{6}$$

4. Empirical findings

4.1. Preliminary Results

Some of the stochastic properties of the stocks return of developed and under developing stock markets are listed in table 2, which highlights the distribution of risk and returns in these markets for study time period. The average returns of all the markets except Japan are positive, highlights the fact that stock indices tend to increase over the period. Table 2 clearly indicates that Pakistan stock market has offered highest return (1.844) in all given set of stock markets, which is followed by Indonesia stock market. In developed countries Hong Kong stock market has offered highest average return (0.922) with 7.451 standard deviation, which is followed by Australia with 3.142 standard deviation. Interesting the skewness of all developed stock markets are negative, indicating that returns are negatively skewed-returns distribution of the markets have higher probability of providing negative returns. The skewness, however, of Philippines, Srilanka and China stock markets returns are positive- returns are positively distributed. The kurtosis of India, Japan, and china is leporathic as compared to 3, exhibits return is approximately standard normally distributed, however, the high kurtosis of other markets exhibits heavier tail than the standard normal distribution-returns are concentrated to one level. The study uses Jarque-Bera test to examine the normal distribution characteristics of all stock markets. The ‘p’ value of Japan, India and China are not significant at five percent level of significance, highlighting that returns of these markets are normally distributed. However, for rest of stock markets it is significant at five percent level of significance. It questions the normal distribution of returns thereby the random walk behaviour of stock prices movements are not holding true. Table 2 also indicates that the descriptive statistics of rate of change in the crude oil prices over the study time period. The J-B test is not significant at five percent level of significance indicating the fact that the crude oil prices are normally distributed during the study time period.

Table 2. Descriptive Statistics of Developed and Developing Countries

	Returns	Mean	Median	Max.	Mini.	St.Dev	Skewness	Kurtosis	J-B Test
0	Oil Price	1.03	1.97	19.93	-18.92	7.52	-0.23	2.68	2.034** (0.362)
Developed Countries									
1	Australia	0.831	1.303	7.312	-11.56	3.142	-0.803	4.147	25.183* (0.000)
2	Hong Kong	0.922	1.302	25.313	-34.82	7.451	-0.453	6.285	75.282* (0.000)
3	Japan	-0.161	0.403	13.874	-14.92	5.433	-0.224	2.504	2.872** (0.238)
4	Singapore	0.342	1.041	24.852	-21.72	7.122	-0.192	5.883	55.024* (0.000)
5	France	0.721	1.312	12.583	-19.22	5.422	-0.674	4.244	21.65* (0.000)
6	Germany	0.904	1.633	19.364	-29.33	6.551	-0.985	6.263	94.585* (0.0000)
7	Spain	1.031	1.302	14.972	-23.87	5.883	-0.683	5.012	38.693* (0.000)
8	Canada	0.803	1.443	11.182	-22.57	4.454	-1.302	7.543	177.823* (0.000)
9	USA	0.802	1.002	9.261	-14.63	3.864	-0.932	5.082	51.204* (0.000)
10	UK	0.492	0.773	8.481	-12.73	3.733	-0.905	4.443	34.614* (0.000)
Developing Countries									
11	India	1.173	2.092	16.902	-23.504	7.892	-0.432	2.924	4.974** (0.800)
12	Indonesia	1.447	2.434	25.015	-34.124	8.523	-0.603	5.043	27.934* (0.000)
13	Malaysia	0.365	0.956	29.446	-28.465	7.904	-0.054	5.802	50.673* (0.000)
14	Philippines	0.637	0.544	33.175	-29.895	7.882	0.124	6.012	45.683* (0.000)
15	Sri Lanka	0.346	0.756	31.933	-24.264	9.004	0.223	4.412	12.042* (0.000)
16	Pakistan	1.844	2.224	24.116	-40.673	9.855	-0.702	5.523	43.514* (0.000)
17	China	1.392	1.638	24.252	-20.070	7.505	0.189	4.009	4.648** (0.097)

4.2. Measurement of Conditional Volatility

The ‘Q’ test, reports significant non linear dependence in the stock returns of developed and under developing stock markets.. The ‘Q’ statistics holds volatility clustering in the stock returns of all stock markets-serial correlation is stock returns. With tracing this phenomenon, the next task is to fit a best model in world equity markets returns which significantly explain the conditional volatility in these markets. Table 3 outlines the results of fitted GARCH (1,1) model for all stock markets. Here to fit the best model, various criteria like Akaike information and Schwarz criterion are used. Table 4 reports the estimated models with their coefficients and ‘p’ values for all stock markets. It is clear from the table that coefficients α_1 and β_1 of oil price are significant at five percent level of significance. The direct observations can be made here that oil price in current is significantly affected by past good or bad news, and volatility in the oil price in preceding time period, and investors react variably to expected and unexpected good and bad news. Out of the sample of developed countries, stock markets of Japan, France, and UK. are not significantly influenced by prevailing volatility in crude oil price as their β_2 coefficient is not significant. Whereas from developing countries, stock markets of India, Sri Lnaka and China are not significantly governed by fluctuations in crude oil prices. The direct observations can be made here, that investors of this set of stock exchanges are invariable to fluctuations in crude oil price. They don't tend to alter their investment decisions with regard to volatility in crude oil price.

4.3. Correlation between Crude Oil price Volatility and Stock Markets Return Volatility

This section outlines the correlation between crude oil price volatility and stock markets return volatility-to what extent stock markets of developed countries vary with regard to volatility in crude oil price. In fact, correlation coefficient measures the degree of sensitiveness of stock markets return volatility with regard to crude oil prices. Table 4 also exhibits that stock markets volatility of developed countries to lesser or more degree vary in the same line. It implies that large upswings or downswings in crude oil price volatility tend to bring corresponding movements in stock market returns of developed countries. It documents the fact that investors in these stock markets are largely sensitive to oil price in international market. The stock markets of Spain, Hong Kong, Singapore and Canada are reporting high degree of integration to crude oil price volatility, whereas stock markets of Australia, Germany, and USA are lesser degree integrated with crude oil price volatility. The table also provides the integrations among equity markets of developed countries. Almost all the stock markets returns volatility is strongly integrated. Figure 1, is depicting the graphical representations of the movements in volatility of developed countries stock markets returns and crude oil price. It clearly indicates the volatility clustering of stock markets in question and crude oil price. It is observed that the time period 1995 to 2002 witnesses' high volatility in crude oil price and later period is exhibited very less volatility. A careful examination of the graph clearly brings out the fact that developed countries' stock markets are also reporting high volatility for the period from 1995 to 2002, whereas in the later time period less volatility is observed.

Table 6 measures the degree of relationship between crude oil price volatility and stock markets return volatility of developing countries. The results reveal that all the stock markets except Bangladesh are showing high degree sensitiveness with regard to crude oil price fluctuations in international market. The direct observation can be made here that, investors in these markets give large weightage to oil price fluctuations in valuation of stocks and their portfolios. Figure 2 which is measuring the trends of crude oil price volatility and stock markets return volatility also report high degree of co-movements between the volatilities of two.

Table 4. Statistical Summary of Conditional Volatility of World Equity Markets

Sr.		α_0	α_1	β_1	β2
0	Oil price	3.612* (0.027)	-0.081* (0.000)	1.024* (0.000)	
Developed Countries					
1	Australia	-0.012** (0.917)	-0.104* (0.000)	1.022* (0.000)	0.020* (0.000)
2	Hong Kong	-8.542* (0.000)	-0.049* (0.006)	0.953* (0.000)	0.236* (0.000)
3	Japan	-0.607** (0.436)	-0.061** (0.182)	1.017* (0.000)	0.030** (0.178)

Sr.		α_0	α_1	β_1	β2
0	Oil price	3.612* (0.027)	-0.081* (0.000)	1.024* (0.000)	
4	Singapore	-2.494* (0.061)	0.087* (0.066)	0.830* (0.000)	0.105* (0.026)
5	France	-0.771** (0.771)	0.213* (0.045)	0.698* (0.000)	0.064** (0.394)
6	Germany	-2.490** (0.226)	0.134* (0.025)	0.815* (0.005)	0.084** (0.101)
7	Spain	-13.97* (0.000)	-0.026** (0.260)	-0.175 (0.283)	0.907* (0.000)
8	Canada	-1.377* (0.000)	-0.074* (0.000)	1.026* (0.000)	0.045* (0.000)
9	USA	-0.941* (0.001)	-0.061* (0.028)	1.016* (0.000)	0.028* (0.000)
10	UK	-0.332** (0.632)	0.119* (0.031)	0.801* (0.000)	0.026** (0.214)
Developing Countries					
11	India	20.059** (0.320)	-0.116* (0.000)	0.191 (0.746)	0.662** (0.212)
12	Indonesia	-7.202* (0.050)	-0.065 (0.093)	0.976* (0.000)	0.232* (0.042)
13	Malaysia	-7.794* (0.000)	0.022** (0.338)	0.926* (0.000)	0.187* (0.000)
14	Philippines	-4.614* (0.000)	-0.101* (0.000)	1.028* (0.000)	0.150* (0.000)
15	Sri Lank	20.165** (0.544)	0.051** (0.577)	0.626 (0.259)	0.088** (0.591)
16	Pakistan	-4.014** (0.105)	-0.081* (0.004)	1.028* (0.000)	0.161* (0.008)
17	China	3.748** (0.784)	0.165** (0.159)	0.764* (0.000)	0.026** (0.919)

Note: * significant at 5 percent level of significance; ** not significant at 5 percent level of significance; p value in bracket.

Table 5. Correlation Matrix of Oil price Volatility and Developed Stock Markets' Volatility

INDICES	ALLORD	CAC40	DAX30	DOWJONES	FTSE100	HANGSANG	IBEX35	NIKKEI	ST.TIMES	S&P/TSX	OILPRICE
ALLORD	1.00										
CAC40	-0.12** (-1.50)	1.00									
DAX40	-0.23* (-2.93)	0.89* (24.22)	1.00								
DOWJONES	0.32* (4.19)	0.37* (4.94)	0.33* (4.33)	1.00							
FTSE100	-0.19* (-2.40)	0.91* (27.23)	0.93* (31.39)	0.46* (6.42)	1.00						
HANGSANG	0.41* (5.41)	0.52* (7.55)	0.45* (6.25)	0.84* (19.21)	0.56* (8.38)	1.00					
IBEX35	0.16** (2.02)	0.52* (7.55)	0.28* (3.61)	0.40* (5.41)	0.47* (6.60)	0.61* (9.55)	1.00				
NIKKEI	0.41* (5.57)	0.36* (4.78)	0.30* (3.90)	0.79* (15.99)	0.40* (5.41)	0.83* (18.46)	0.41* (5.57)	1.00			
ST.TIMES	-0.08** (-0.99)	0.61* (9.55)	0.48* (6.78)	0.60* (9.30)	0.65* (10.61)	0.75* (14.07)	0.76* (14.51)	0.58* (8.84)	1.00		
S&P/TSX	0.21* (2.66)	0.24* (3.06)	0.20* (2.53)	0.63* (10.07)	0.38* (5.09)	0.70* (12.16)	0.63* (10.08)	0.61* (9.55)	0.68* (11.50)	1.00	
OILPRICE	**0.14** (1.75)**	**0.56* (8.38)**	**0.32* (4.19)**	**0.41* (5.57)**	**0.51* (7.35)**	**0.63* (10.06)**	**0.99* (87.09)**	**0.43* (5.91)**	**0.79* (15.99)**	**0.63* (10.07)**	**1.00**

Note: -* significant at 5 percent level of significance; ** not significant at 5 percent level of significance; t value in bracket.

Table 6. Correlation Matrix of Oil price Volatility and Developing Stock Markets' Volatility

INDICES	BSE100	JAKRTACOM	KLSECOM	KSE100	MPI	PSEI	SSECOM	OILPRICE
BSE100	1.00							
JAKRTACOM	0.35* (4.05)	1.00						
KLSECOM	0.29* (3.76)	0.85* (17.52)	1.00					
KSE100	0.37* (4.32)	0.89* (21.20)	0.75* (10.86)	1.00				
MPI	-0.13** (-1.48)	0.19** (2.10)	0.09** (0.98)	0.10** (1.09)	1.00			
PSEI	0.28* (3.17)	0.82* (15.56)	0.90* (22.42)	0.83* (16.17)	0.08** (0.88)	1.00		
SSECOM	0.33* (3.38)	0.39* (4.10)	0.37* (4.10)	0.23* (2.30)	-0.04* (-0.39)	0.11** (1.07)	1.00	
OILPRICE	**0.56* (8.38)**	**0.60* (12.31)**	**0.75* (12.31)**	**0.63* (8.81)**	**-0.11** (-1.26)**	**0.63* (8.81)**	**0.42* (4.48)**	**1.00**

Note: -* significant at 5 percent level of significance; ** not significant at 5 percent level of significance; t value in bracket.

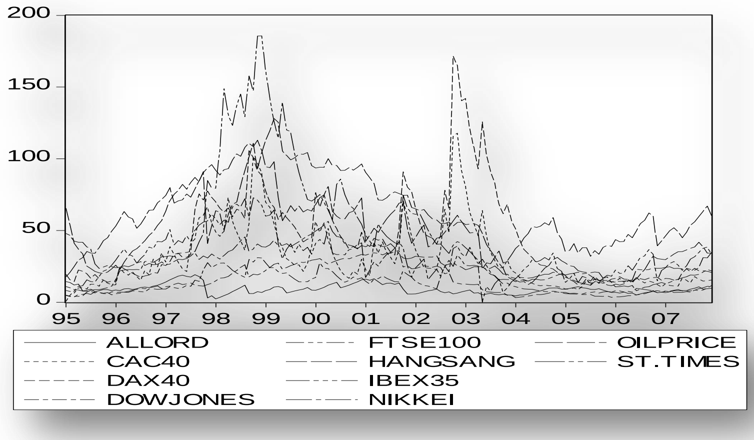

Figure 1. Relationship between Oil price Volatility trends and Developed Stock Markets Return Volatility

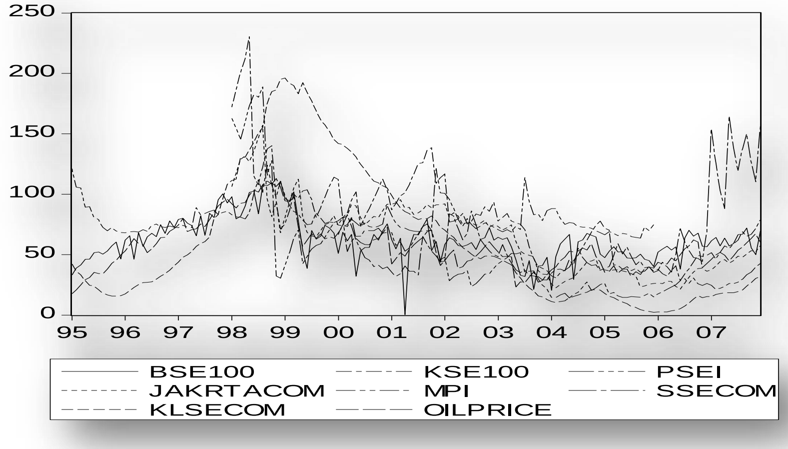

Figure 2. Relationship between Oil price trends and Developing Stock Markets

5. Conclusion and implication of study

In this paper attempts are made to examine the impact of crude oil price volatility in international market on world equity markets by taking a sample of stock markets from developed and developing countries. It also examines the degree of sensitiveness between crude oil price volatility and world equity markets return volatility. Additionally the paper also provides the integration in world equity markets. With entering into globalization era, stock markets have created enormous opportunities for investments which results in reducing of risk through diversification of funds across the stock markets. The mean returns clearly indicating that stock markets from developing countries have offered higher returns to the investors as compared to developed countries.

The Ljung-Box statistics which tests the autocorrelation in stock returns strongly reject the null hypothesis and hold the presence of autocorrelations in stock markets returns under question. The significant autocorrelations question the random walk behaviour of stock returns, suggesting world equity markets are informationally inefficient. The holding of such phenomenon provides that prevailing stock prices have not absorbed the historical and available information pertinent to stocks. The inference can be made here that investors current investment decisions are strongly influenced by previous time period decisions. These findings are consistent with previous research, which finds non linearity and seasonal variations in stock returns in world equity markets (Lee, 1992; Ho and Cheung, 1994; Moorkejee and Yu, 1999; Rothlein and Jarrett, 2002; Jarrett and Kyper, 2005a; 2006; Faff and Mckenzie, 2007). The study brings out the important facts when impact of crude oil price volatility is measured on stock markets return volatility. The study provides a significant relationship and holds crude oil price volatility a strong determinate in explaining the stock markets returns volatility. The positive significant relationship provides that investors are largely sensitive to crude oil price volatility and redesign their portfolio and investment decisions in the light of ups and downs in crude oil price in international market.

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STAKEHOLDER APPROACH STAKEHOLDERS MENTAL MODEL A VISUALIZATION TEST WITH COGNITIVE MAPPING TECHNIQUE

Garoui **NASSREDDINE**
University of Sfax
Faculty of Economics and Management (FSEG)
Higher Institute of Business Administration (ISAAS), **Tunisia**
garoui.nassreddine@yahoo.fr

Jarboui **ANIS**
University of Sfax
Higher Institute of Business Administration (ISAAS), **Tunisia**
anisjarboui@yahoo.fr

Abstract

The idea of this paper is to determine the mental models of actors in the firm with respect to the stakeholder approach of corporate governance. The use of the cognitive map to view these diagrams to show the ways of thinking and conceptualization of the stakeholder approach.The paper takes a corporate governance perspective, discusses stakeholder model. It takes also a cognitive mapping technique.

Keywords: corporate governance, stakeholder model, cognitive mapping.

JEL Classification: G32, G34, C42

1. Introduction

One way to help overcome the limitations of shareholder model is the approach proposed by Charreaux and Desbrières (1998). It is consist with the stakeholder model as it integrates all the stakeholders who contribute to create value (suppliers, subcontractors, clients). From the perspective of contractual approaches, the firm is conceived as a production team that creates value (the organizational rent) through synergies between the different factors of production.

Evolution, in relation to the shareholder model is at the distribution of value: the rent sharing is extended to all participants in the nexus of contracts.

The underlying assumption is that the parties 'production factor' will be encouraged to contribute to the creation of value only if they receive a portion of the rate. In this sense, corporate governance only affects the creation and the distribution of value. It is akin to a set of rules governing the ex post bargaining that takes place between the partners to share the rent (Zingales, 1998). The theory of the firm specialized (Demsetz, 1988) has the advantage of providing a link with the cognitive theories. It allows you to exceed the fixed view of the stakeholder model 'standard' by trying to integrate the dynamic productive.

However, like all the contractarian approach, it remains insufficiently explanatory factors for understanding how all the actors that constitute an organization are likely to capture the issues of corporate social responsibility.

2. Literature review

The stakeholder model turns to all stakeholders

The notion of stakeholder has been deepened by Freeman (1984) which defines stakeholder as any individual or group that could influence or be influenced itself by the organizational activity, 'a stakeholder in a organization is (by definition) Any group or Individual Who Can Affect Or Is Affected by the achievement of the organization's objective '. Schematically, this concept is represented by a circle whose center is the company and stakeholders, the radii (Freeman and Reed, 1983; Freeman, 1984). Each group represented in a bubble is biased, a stake (a stake) in the company, hence the name of a party, a holder of issue (stakeholder). New institutional sociological theory shows the importance of the institutional environment in understanding the behavior of organizations (M.Capron, andF. Quairel-Lanoizelée, 2004). 'The conditions of the environment cannot be separated from the perception of the actors, Weick (1969) in his theory of enaction says that it is the managers' decisions that give meaning and construct reality: the parties stakeholders are in fact staged and defined by the importance given to them by the leaders '(M. Capron, and F.Quairel-Lanoizelée, 2004). There are two diametrically opposed visions of CSR. The minimalist view of Friedman (1970) which reduces CSR at the sole economic responsibility. For him the responsibility of a company is limited to profit maximization for shareholders. Conversely, the purists of the stakeholder theory of CSR include requests for all social groups that are directly or indirectly affected by the activities of the company.

The word stakeholder is composed of stake, in other words, the interests or claims that an individual or group carries on the business. These stakes of the stakeholders are not always obvious or explicit (J.W.Weiss, 1998) but the goal is to show that the partners other than shareholders have a stake in the company, the term stakeholders or 'stakeholders' has undoubted heuristic value (D.Cazal and A. Dietrich, 2005).

The key concepts of the stakeholder approach

Value creation and abandonment of the opportunity as exogenous

If we adopt this vision for value creation, one of the most important problems is to develop an appropriate vision of the future. This means abandoning the traditional assumption in finance that all opportunities would be an exogenous and objective, to make way for an approach that some opportunities are created of authentic leaders. Charreaux (2000) concludes that the cognitive perspective leads to a reinterpretation of the role of directors, rather than just supervisors, may 'help the manager to build his vision - by comparing the mental models of the directors - or at detect, if not to build growth opportunities '.

The firm as a specific investment node

Most of the partnership approach is to challenge the exclusive status of residual claimant and owner to shareholders. It must be extended to all parts of the nexus of contracts involved in the creation of value because it is not fair to say that only shareholders suffer a cost when they discontinue their relationship with the company. Managers can be encouraged to increase their personal investment in specific human capital, thus creating additional value. Too much discipline may reduce the incentive for effort and initiative. The managerial rents may decrease. Employees, neglected in the standard approach, are being rethought as a specific asset. They develop skills and know-how are not transferable to other firms and they may lose on the termination of the contract.

The same is true for providers who develop cooperative relations with their principal and who face bankruptcy in the event of breach of contract. All parties bear the risks associated with their specific investments. To be encouraged to specialize, so they should participate in the sharing of the surplus. (Blair,1995).

The firm is under Rajan and Zingales (1998) a 'node-specific investments, that is to say' a combination of assets and people each specialty. 'These investments accumulate around a specific skill' critical ', the manager. It exercises control over all the stakeholders. It influences the accumulation of assets and attempts to implement the complementarities between the resource and managerial expertise of other persons.

Multiple accountability: power and legitimacy

The boundary facing the application of agency theory is its bipolarity: the confrontation between managers and shareholders defines space power as the result of a set of calculations based on the transfer of information to the market. The leader, a sovereign space associated with its expertise in management, shareholders, an evaluation space, associated with the level of profit is their pay according to their residual claim. However, this bipolarity is bursting with the ownership of mass, the rise of institutional and, more generally, the new form of economy of corporate finance. First, the notion of shareholders' interests must be carefully considered depending on the nature of shareholders, their time horizons and their power relations on the other hand, the legitimacy of the leader is challenged for his expertise in management is now shared by financial analysts, rating agencies when it is not the journalists or advice 'proxies'.

The agency relationship involved a clear separation of responsibilities for functions and calculations can be done to separate between principal and agent, as distinct skills. This is where the sovereign power made sense. With its crumbling, it would then consider an agency theory more complex; the principal-agent relationships are different in nature according to the shareholders who are now as diverse as the stakeholders of the company. Become complex and systemic (Charreaux, 1997), modeling of behavior depending on a variety of interests is not compatible with the framework imposed by the bipolar model of the agency. Clearly, a government in power management ‘controlled’, that is to say, involving both the rationale for decisions and their effective control, with responsibility taken split into multiple actors.

Maximizing profit and residual claim

If, as we have seen, the new deal gives the agenda the issue of ‘private ownership of means of production,’ it poses to the agency theory, academically dominant, considerable problems.

For the theory to work effectively, it is assumed that the conflict between shareholders and managers can balance the responsibilities effective managerial firm as it defines the sovereign power of the leader. This hypothesis assumes that shareholders have a behavior function based on maximizing the profit from their residual claim on the company.

Stakeholder value and independence to the pension and distribution

This presentation of the stakeholder value, consistent with the definition of rent (or quasi-rent) can highlight certain features of the organizational game:

• The manager creates value if the difference between the sales prices of opportunity and opportunity costs is positive. In this sense, to increase value creation, the leader must act simultaneously on the prices and opportunity costs. The price level depends on whether the scarcity of particular goods and services offered by the firm and dependency of clients in relation to it. A strong innovation is often an important source of value creation, all things being equal. Symmetrically, the creation of value can also go through a lower opportunity cost, for example, to pay any required by lenders due to a lower risk or a partnership agreement with suppliers reduces the risk of opportunism.

• The conditions underlying the Coase theorem is not met, value creation is not independent of the distribution. Rent (Ricardian rent or annuity or efficiency) for a provider of resources is equal to the additional compensation received from the minimum compensation required for the establishment of the transaction, and it appreciates against the entry cooperation. It is normally linked to the scarcity factor. Thus, an officer receives a pension if his salary is higher than the earnings opportunity, this supplement is linked to the scarcity of managerial skills meant to create more value.

Conflict of interest in contractual theories

Theories assume that organizations contractual relations between actors are Potentially Responsible for conflicts to explain the establishment of governance mechanisms.

These are, indeed, to channel the actions of the leader (Charreaux, 1997), so as to reduce the extent of deviant behavior. The result is a theoretical efficiency gain, because governance is to reduce the costs associated with behaviors that originate from divergent interests. The confrontational nature of relations between partners of the firm is a central premise of contract theory to explain the phenomena of GE.

Information asymmetry

The phenomenon of information asymmetry is the result of the delegation of management of the company to professional managers. Naturally, information held by the agent is more relevant than that held by the shareholders to the extent that the leader acts as the operational management. Contracts signed by both parties are necessarily incomplete, because it is impossible ex ante to predict all situations that may arise.

Indeed, according to Arrow (1965), information asymmetry gives rise to two phenomena. The first ‘adverse selection’, or adverse selection concerns the uncertainty about the quality or characteristics of the object of an exchange that led to the possibility of fraud, because they can be expected by victims potential lead to complex strategies to protect themselves. In this situation, the shareholder does not necessarily have any useful information to define precisely the contract. The second ’moral hazard’ concerns situations in which one side of the market can observe the behavior of the other.

The agency theory

The separation of ownership and the decision suggested by Berle and Means (1932), if understandable in the Anglo-Saxon system, characterized by high dispersion of ownership among several small shareholders, it ‘appears if not erroneous, at least incomplete ’for the French context (Charreaux, 2006).

According Charreaux (2006), ’the emphasis on the role of provider of financing led shareholders to question the centrality accorded to them since the share of investment financed by capital increases financial markets is minimal.’

The theory of the roots

The theory of the roots was developed by Morck, Vishny and Shleiffer in the late1980. It is based on the premise of active behavior of the leader whose goal is ‘to destroy or weaken the control mechanisms set up by the shareholders or stakeholders’ (Allouche and Amann, 2002). Leaders try to implement strategies of influence ’... to increase their discretionary space using the means at their disposal, that is their human capital but also the company’s assets, to neutralize the systems control and increase the dependence of all the partners of the firm to the resources they control (specific human capital, information asymmetry) Alexander (2000). Rooting assumes that the means of control and incentive of the manager are not perfectly efficient in the firm, but also that the leader adopts an opportunistic behavior.

3. Research Methodology

Methodological tools

I chose to approach the performances of the actors of the company by using a common technique in cognitive approaches, that of cognitive mapping. This is a graphical modeling technique of cognition used in numerous studies in management sciences.

The cognitive map is not the only tool for analyzing the managerial cognition, but it is the most popular for the presentation of cognitive structures.

Cognitive mapping is a technique now well established capture the minds of the players about a problem or situation. A cognitive map allows you to view certain ideas and beliefs of an individual on a complex area such as corporate governance. A cognitive map is usually defined as the graphical representation of a person’s beliefs about a particular field.

A map is not a scientific model based on an objective reality, but a representation of a part of the world as seen by an individual.

Description of the empirical investigation

To meet the research objectives mentioned above, a survey was conducted among players in the company of Tunisia. I have chosen as exploratory approach using multiple case studies.

The multiple case studies seek a better understanding of the phenomenon. They are to study a phenomenon in its natural setting by working with a limited number of cases. They are particularly interesting in the case of exploration of little-known phenomena. The case studies thus allow multiple accounts the specificities and characteristics of corporate governance. The data come from10 firms. The decision to base my study on a sample of firms from various sectors is based on the assumption that a variety of issues will be addressed as well.

The output is a cognitive map for actors reflecting their perceptions vis-à-vis the stakeholder approach of corporate governance. The method used to create cognitive maps is the questionnaire.

Presentation of the questionnaire

The questionnaire is divided into two parts: the first identifies the company and the second deals with corporate governance.

For the second part, relating to corporate governance, we interview actors from the firm on stakeholder approach of corporate governance by providing a list of concepts for each approach with systematic exploration grids and matrices cross.

Systematic exploration of the grid is a technique for collecting materials.

Each player is encouraged to explore their own ideas or cognitive representations in relation to its strategic vision. The subject is asked to identify important factors that he said will have an impact on the key concept related to an approach to corporate governance.

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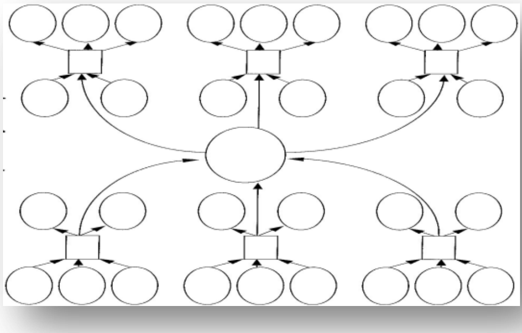

Figure1. Grid systematic exploration

Regarding the cross-matrix, it is also a technique of data collection and the basis for the construction of the cognitive map. The matrix is presented in the form of a table with n rows and n columns. Box of index (i, j) indicates the relationship between concept i and concept j.

The actors manipulate the key concepts and assign pairs of concepts depending on the nature and degree of proximity sensed between these concepts.

Table1. Adjacency matrix

	Concept1	Concep2	……	Concept n
Concept1	1			
Concept2	L21	1		L2n
……			1	
Concept n	Ln1	Ln2		1

Proposal for modeling cognitive maps

When it is difficult to identify the goals, an integrated approach of performance provides a holistic view in which the performance is analyzed by the processes that lead, through the performances of the actors. These representation processes are two problems of implementation: the sharing of representations of actors and the identification of dominant representations in the organization in order to act upon them (Halgand, 1999).

The construction of this representation necessarily requires a model that allows understanding to act is 'an action of intentional design and construction, for composition of symbols, patterns that would make a complex phenomenon intelligible perceived.

In this context, the use of cognitive maps seems relevant, because they can take into account the complexity and comprehensiveness of the system in which [the behavior] is embedded, while maintaining access to the analysis' (Komocar 1994, 157). The value of the tool is instrumental (Audet, 1994), it allows both improving their actions and making sense.

Cognitive mapping is used as a tool for representation of an idiosyncratic schema (Cossette, 1994), a pattern is 'a cognitive structure that guides the cutting of reality, the interpretation of events, and action individuals ', pattern unique to each individual, causing it to have its own behavior.

The construction of cognitive maps

We will see at first step that allowed the construction of concepts, methodological approach that we discuss. Then we will examine how the cards were dealt.

Concepts

We addressed this issue by the representations constructed by players using the method of cognitive maps, a method that can be applied to poorly structured situations. An analysis based on cognitive maps can understand this process of structuring, as this model is to build or rebuild the mental simultaneously modeling. This construction takes the form of a structure, carrier for clarification.

It helps to identify ways to implement to achieve a given goal, the same way it helps to identify the goals justifying the use of such means. Finally, it facilitates communication and negotiation. There are two major trends in the construction method of the cards: the determination of the concepts can be ex ante, or subsequent interviews with respondents for whom the cards are built. Komocar (1994) links the question of determining nodes - or concepts - and links to two paradigms. In the phenomenological paradigm, the universe is largely unknown. The emphasis is on describing the world from the experiences of people who experience it.

Nodes and links are determined directly by the participants that advocate Cossette and Audet (1994), not to deprive the subject of representations: the questions should be invitations for the respondent verbalizes his thoughts on what he considers important subject of research (Cossette, 1994). In addition, the researcher cannot force the subject to consider every possible link because the links must be made spontaneously or in response to open questions, so that the subject constructs its reality (Cossette and Audet, 1994). In the normative paradigm, the universe is more or less determined. The focus is on operational definitions and research plans reproducible. Observers, different participants, may determine the relationship between variables and nodes that can be.

Komocar proposes to take account of these two paradigms by adopting the following position: the nodes are determined a priori, and the links between these nodes are determined by the participants (Bougon *et al.*. 1977; Komocar, 1994; Markoczy, 2001).

We selected 19 concepts for the partnership approach to their ability to describe the field of governance. We were guided in this by a literature review and an exploratory study based on a questionnaire made up of grids of systematic exploration and cross-matrices. The concepts presented in the table below.

Table2. Key concepts for stakeholder approach

1) Creating value (CV)	11) Annuity (R)
2) Opportunity (opp)	12) Distribution (Rep)
3) Contract node (Nc)	13) Conflict (C)
4) Specific Investment (inv sp)	14) Asymmetric information (AI)
5) Specific human capital (C H S)	15) Property (prop)
6) Responsibility multiple (Res Mul)	16) Decision (D)
7) Power (pou)	17) Dispersion of property (Dis pro)
8) Legitimacy (Leg)	18) Business strategy (S Ese)
9) Profit (pro)	19) Business assets (A Ese)
10) Residual claim (C R)	

4. Materials and methods of structural analysis

Analysis of the results led initially by a preliminary investigation of perceptions that are players in the Tunisian company vis-à-vis the stakeholder approach of governance.

This investigation was limited to the analysis of a collective cognitive map for all company, prepared on the basis of systematic exploration grids completed by the actors of the company.

From cognitive maps, we could identify and qualify the designs are the actors of the field of corporate governance.

The development and analysis of cognitive maps were made using the Mic-Mac software.

Our initial investigation focused on two elements: the relative importance of concepts and analysis of the dynamics of influence / dependence concepts (or variables) in the cognitive universe of players in the company. The relative importance of concepts was evaluated from the MIC. Mic-Mac program allowed us to rank the concepts in order to 'balance' and 'dependency.'Thus arise the ideas that dominate in the cognitive universe of players.

Overview of structural analysis method

The main objective of structural analysis is to identify the most important variables in determining the evolution of the system.

Inspired by graph theory, structural analysis is based on the description of a system using a matrix linking all its components. By weighting these relationships, the method highlights the key variables to changes in the system. As a tool, we opted for the software 'Micmac' (cross-impact matrices, Multiplication Applied to Classification).

The first step of the method MICMAC is to identify all the variables characterizing the system under study (both external and internal variables). The second step involves the linking of variables in the construction of the matrix of direct influence and potential. Indeed, this approach is supported by the fact that in a systemic approach, a variable exists only through its network of relationships with other variables.

It is from this matrix what has identified the key variables. Indeed, we obtain the classification by the direct sum row and column. If the total connections line indicates the importance of the influence of a variable on the overall system (direct motor level), the total column shows the degree of dependence of one variable (level of direct dependence). The ranking against indirect detects hidden variables through a matrix multiplication program applied to indirect classification. 'This program allows us to study the distribution of impacts by the paths and feedback loops, and therefore to prioritize the variables in order of influence.'

Matrices and processing MICMAC method

All structural analysis matrices above have been established only from direct relationships between variables. However, it is clear that a variable can also exert influence on other variables indirectly, or through another variable ('path' of order 2), or through several others exercising their influence cascaded through 'paths' for longer and longer, and can also loop over themselves. The classification of motor skills may be significantly altered, and understanding the mechanisms of the system similarly.

Establish direct relations matrices indirect paths of length two, then three ... then N would quickly become intractable.

A relatively simple mathematical processing (multiplication of a matrix by itself, and elevation of the power matrices N) solves this problem.

Benefiting from the spread of computers and personal computer, the method MICMAC (cross-impact matrix-multiplication applied to classification) is a commercial version.

As expected, the rankings of variables by motor / decreasing influence (or dependence) generally find it changed. But experience has shown that these rankings become almost stable after three or four students to the power, and they are clearly the importance of some new variables in terms of their indirect influences.

Map and analyzed at the collective level, the map is the collective model of mental representations of several people on a research topic identified. In some cases, the cards are developed by collective aggregation of individual cards and in other cases they are developed directly by building a group card. In the first case, the card is called collective and composite map is constructed by superimposing individual maps (M.G. Bougon and J.M. Komocar, 1994; M.G. Bougon, 1977; J.Fordand H. Hegarty, 1984). While in the second case, the cards are called strategic and more individuals come to gether to create a community card. It then seeks to map the shared perceptions of a group of individuals on a particular area.

The strategy map is at the organizational level (K. Langfield-Smith, 1992). But how to decide in a strategic map? 'When the goal is to make a collective card, a decision usually a link of influence unites two concepts when a significant number of subjects claim the presence of such a link' (P.Cossette, 2004).

PRESENTATION OF VARIABLES
LIST OF VARIABLES

Creating value (CV)
Opportunity (opp)
Contract node (Nc)
Specific Investment (inv sp)
Specific human capital (C H S)
Responsibility multiple (Res Mul)
Power (pou)
Legitimacy (Leg)
Profit (pro)
Residual claim (C R)
Annuity (R)
Distribution (Rep)
Conflict (C)
Asymmetric information (AI)
Property (prop)
Decision (D)
Dispersion of property (Dis pro)
Business strategy (S Ese)
Business assets (A Ese)

THE INPUT

This step was to compile a matrix of direct influence between these variables in a scoring session. Matrix of direct influence (MID) which describes the relationship of direct influence between the variables defining the system and the Matrix Influences MIDP represents the potential direct influences and dependencies between existing and potential variables.

The scoring has developed the input matrix 'matrix of direct influences (MID).

The influences are rated from 0 to 3, with the ability to report potential influences.

MATRIX OF DIRECT INFLUENCES (MID)

Matrix of direct influence (MID) describes the relationship of direct influences between the variables defining the system.

Table 3. Matrix of direct influences

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
CV	0	1	0	2	0	3	0	1	0	P	0	2	0	0	2	0	1	0	0
Opp	1	0	0	0	0	0	0	0	0	0	0	P	0	0	0	2	0	0	0
N C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Inv sp	2	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	2	0
C H S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0
Res Mul	3	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0
Pou	0	0	0	2	0	0	0	0	0	0	0	0	P	0	0	0	P	0	3
Lég	1	0	3	0	0	0	0	0	P	0	0	0	0	0	0	1	0	0	0
Pro	0	0	0	0	P	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C R	P	0	0	0	1	0	0	3	0	0	0	0	0	2	0	0	P	0	0
R	0	0	0	0	2	0	0	0	P	0	0	0	0	0	0	1	0	0	2
Rép	2	0	0	1	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0
C	0	0	P	0	0	3	0	0	0	2	0	0	0	0	0	0	1	0	1

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
A I	0	0	0	1	0	0	0	P	0	0	0	0	0	0	1	0	0	0	0
Prop	0	0	3	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0
D	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0
Dis Pro	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
S Ese	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	P	0	0	0
A Ese	0	0	0	0	0	3	0	0	0	P	0	0	0	0	2	0	0	0	0

The influences are rated from 0 to 3, with the ability to report potential influences:
0: No influence
1: Low
2: Average
3: Strong
P: Potential

MATRIX OF DIRECT POTENTIAL INFLUENCES (MIDP)

The Matrix Influences MIDP represents the potential direct influences and dependencies between existing and potential variables.

It complements the matrix MID also taking into account possible relationships in the future.

Table 4. Matrix of potential direct influences

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
CV	0	1	0	2	0	3	0	1	0	3	0	2	0	0	2	0	1	0	0
Opp	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	0
N C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Inv sp	2	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	2	0
C H S	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0
Res Mul	3	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0
Pou	0	0	0	2	0	0	0	0	0	0	0	0	3	0	0	0	3	0	3
Lég	1	0	3	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0
Pro	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0
C R	3	0	0	0	1	0	0	3	0	0	0	0	0	2	0	0	3	0	0
R	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0	1	0	0	2
Rép	2	0	0	1	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0
C	0	0	3	0	0	3	0	0	0	2	0	0	0	0	0	0	1	0	1
A I	0	0	0	1	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0
Prop	0	0	3	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0
D	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0
Dis Pro	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
S Ese	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
A Ese	0	0	0	0	0	3	0	0	0	3	0	0	0	0	2	0	0	0	0

The influences are scored from 0 to 3:
0: No influence
1: Low
2: Average
3: Strong

5. Results of the study

DIRECT INFLUENCES

Characteristic of MID

This table shows the number of 0, 1, 2, 3,4 of the matrix and displays the filling ratio calculated as the ratio between the number of MID values different from 0 and the total number of elements of the matrix.

Table 5. Characteristic of MID

Indicator	Size of matrix	Number of iterations	Number of zero	Numbre of one	Number of two	Number of three	Number of P	Total	Fill rate
Value	19	2	291	25	20	12	13	70	19,39058%

Stability from MID

If it is shown that any matrix must converge to stability after a certain number of iterations (usually 4 or 5 for a matrix of size 30), it was interesting to monitor the stability during the successive multiplications.

In the absence of established criteria mathematically, it was chosen to rely on the number of permutations (bubble sort) necessary to classify each iteration, influence and dependence, all the variables of the matrix MID.

Table 6. Stability from MID

Itération	Influence	Dépendence
1	90 %	98 %
2	104 %	103 %

Sum of rows and columns of MID

This table is used to enter the sums in row and column of the matrix MID

Table 7. Sum of rows and columns

N°	Variable	Total of rows	Total of columns
1	Value creating	12	10
2	Opportunity	3	1
3	Contract node	2	10
4	Specific investment	9	7
5	Specific human capital	3	4
6	Responsibility multiple	10	9
7	Power	5	2

N°	VARIABLE	TOTAL OF ROWS	TOTAL OF COLUMNS
8	Legetimacy	5	6
9	Profit	1	1
10	Residual claim	6	3
11	Annuity	5	1
12	Distribution	7	6
13	Conflict	7	5
14	Asymetric information	2	7
15	Property	7	7
16	Decision	3	4
17	Dispersion of property	6	8
18	Business strategy	3	2
19	Business assets	5	8
	Totals	**101**	**101**

POTENTIAL DIRECT INFLUENCES

Characteristic of MIDP

This table shows the number of 0, 1, 2, 3.4 and MIDP matrix displays the filling ratio calculated as the ratio between the number of MID values different from 0 and the total number of elements of the matrix.

Table 8. Characteristic of MIDP

INDICATOR	VALUE
Size of matrix	19
Number of iterations	2
Number of zero	291
Number of one	25
Number of two	20
Number of three	25
Number of P	0
Total	**70**
Fill rate	19,39058%

Stability from MIDP

If it is shown that any matrix must converge to stability after a certain number of iterations (usually 4 or 5 for a matrix of size 30), it was interesting to monitor the stability during the successive multiplications.

In the absence of established criteria mathematically, it was chosen to rely on the number of permutations (bubble sort) necessary to classify each iteration, influence and dependence, the set of variables.

Table 9. Stability from MIDP

ITÉRATION	INFLUENCE	DÉPENDENCE
1	93 %	91 %
2	101 %	103 %

Sum of rows and columns of MIDP

This table is used to enter the sums in row and column of the matrix MIDP.

Table 10. Sum of rows and columns

N°	VARIABLE	TOTAL OF ROWS	TOTAL OF COLUMNS
1	Value creating	15	13
2	opportunity	6	1
3	Contract node	2	13
4	Specific investment	9	7
5	Specific human capital	3	7
6	responsibility multiple	10	9
7	power	11	2
8	legetimacy	8	9
9	profit	4	7
10	Residual claim	12	9
11	annuity	8	1
12	distribution	7	9
13	conflict	10	8
14	Asymetric information	5	7
15	property	7	7
16	decision	3	7
17	dispersion of property	6	14
18	Business strategic	6	2
19	Business assets	8	8
	Totals	**101**	**101**

INDIRECT INFLUENCES

Matrix of indirect influences(MII)

The matrix of indirect influences (MII) is the matrix of direct influences (MID) high power, by successive iterations. From this matrix, a new classification of variables high lights the most important variables of the system. Indeed, it reveals the hidden variables through a matrix multiplication program applied to indirect classification.

This program allows us to study the distribution of impacts by the paths and feedback loops, and therefore to prioritize the variables in order of influence, taking into account the number of paths and loops of length 1, 2,. .. n from each variable in order of length, taking into account the number of paths and loops of length 1, 2, ...n arriving on each variable. The ranking is stable in general from an increase in the order 3, 4 or 5.

Table 11. Matrix of indirect influences

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
CV	25	20	18	68	9	102	4	28	3	25	3	40	18	12	74	0	51	4	42
Opp	20	0	23	2	5	0	4	0	0	0	0	14	12	12	0	5	9	4	6
N C	6	1	0	6	0	9	0	1	0	1	0	2	9	3	12	0	8	0	0
Inv sp	62	0	55	4	2	18	26	0	0	0	0	21	24	50	12	10	18	26	4
C H S	3	2	9	6	0	18	0	2	0	3	0	4	00	0	18	3	12	0	0
Res Mul	82	3	77	12	11	33	12	15	0	3	0	30	48	40	28	9	60	12	14
Pou	27	4	36	26	0	12	0	12	0	0	0	26	18	6	14	0	31	0	12
Lég	23	0	35	2	6	0	4	0	0	0	0	19	12	14	0	4	9	4	10
Pro	2	2	0	5	0	15	2	2	0	6	0	4	0	3	5	0	5	2	3
C R	6	3	10	6	3	9	4	6	3	0	3	12	0	10	18	0	12	4	4
R	22	0	35	0	8	0	0	6	0	0	0	16	12	9	0	1	18	0	10
Rép	72	2	61	17	11	15	10	24	0	0	0	19	42	36	13	6	47	10	16
C	24	10	48	24	9	54	0	10	0	15	0	26	6	2	36	6	39	0	24
A I	6	2	0	17	0	6	0	6	0	0	0	4	9	3	11	0	5	0	6
Prop	11	6	18	15	3	45	8	6	0	18	0	24	0	16	15	0	15	8	15
D	8	0	0	5	0	6	0	0	1	2	1	0	12	4	9	0	7	0	0
Dis Pro	42	0	55	2	6	0	4	3	0	0	0	24	24	18	0	3	27	4	10
S Ese	0	4	0	17	0	12	0	8	2	0	2	8	0	0	19	0	10	0	6
A Ese	21	9	18	26	9	45	0	9	0	12	0	18	18	6	32	0	27	0	24

The values represent the rate of indirect influences

Sum of rows and columns of MII

This table is used to enter the sums in row and column of the matrix MII.

Table 12. Sum of rows and columns

N°	Variable	Total of rows	Total of columns
1	Value creating	546	462
2	opportunity	116	68
3	Contract node	58	498
4	Specific investment	332	260

N°	VARIABLE	TOTAL OF ROWS	TOTAL OF COLUMNS
5	Specific human capital	80	82
6	responsibility multiple	489	399
7	power	224	78
8	legitimacy	142	138
9	profit	56	9
10	Residual claim	113	85
11	annuity	137	9
12	dispersion	401	311
13	conflict	333	264
14	asymetric information	75	244
15	property	223	316
16	decision	55	47
17	dispersion of property	222	410
18	Business strategic	88	78
19	Business assets	274	206
	Totals	**101**	**101**

POTENTIAL INDIRECT INFLUENCES

Matrix of potential indirect influences (MIIP)

The Matrix of Potential Indirect Influences (MIIP) is the matrix of direct influences Potential (MIDP) high power, by successive iterations.

From this matrix, a new classification of variables highlights the potentially most important variables of the system.

Table 13. Matrix of potential indirect influences

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
CV	49	29	99	95	27	129	4	85	30	121	3	61	39	15	98	21	78	4	60
Opp	35	6	50	17	14	45	10	24	9	36	0	29	12	27	15	5	33	10	15
N C	6	1	0	6	0	9	0	4	0	10	0	2	9	3	12	0	8	0	0
Inv sp	95	0	112	4	14	36	26	18	51	30	6	27	24	62	18	19	42	26	22
C H S	6	5	15	12	3	27	0	11	9	30	0	10	0	0	24	3	15	0	6
Res Mul	121	3	77	12	20	33	12	42	9	36	0	39	48	58	34	9	105	12	14
Pou	102	7	60	32	18	48	0	78	0	51	0	32	48	36	53	12	139	0	18
Lég	38	0	35	5	12	0	4	9	6	9	0	22	21	23	0	4	36	4	10
Pro	17	2	21	5	9	15	2	14	0	12	0	4	0	9	5	0	14	2	15
C R	102	6	79	18	42	36	16	36	30	39	3	54	36	58	42	15	84	16	10

	CV	opp	N c	Inv sp	C H s	Res Mul	pouv	lég	pro	C R	R	Rép	C	A I	prop	D	Dis Pro	S Ese	A Ese
R	52	0	35	3	17	0	0	24	3	9	0	16	21	24	0	1	60	0	10
Rép	111	2	70	17	17	15	10	51	15	15	0	25	48	48	22	15	98	10	16
C	42	16	93	36	21	72	0	37	18	69	0	47	6	11	48	6	54	0	42
A I	6	5	0	23	27	15	0	21	3	15	3	19	15	3	29	6	23	0	6
Prop	14	6	54	15	3	45	8	15	9	36	0	24	0	16	15	3	15	8	15
D	8	0	0	5	9	6	0	3	1	11	1	3	12	4	9	0	13	0	0
Dis Pro	72	0	55	2	15	0	4	30	3	0	0	27	24	36	0	3	57	4	10
S Ese	0	4	9	17	33	12	0	17	11	12	2	26	6	3	19	9	16	0	12
A Ese	39	18	81	50	18	72	0	42	27	69	0	36	18	6	56	9	42	0	42

The values represent the rate of indirect potential influences

Sum of rows and columns of MIIP

Ce tableau permet de renseigner sur les sommes en ligne et en colonne de la matrice MIIP

Table 14. Sum of rows and columns

N°	VARIABLE	TOTAL OF ROWS	TOTAL OF COLUMNS
1	Value creating	1047	915
2	Opportunity	392	110
3	Contract node	70	945
4	Specific investment	632	374
5	Specific human capital	176	319
6	Responsibility multiple	684	615
7	Power	734	96
8	Legitimacy	238	561
9	Profit	146	234
10	Residual claim	722	610
11	Annuity	275	18
12	Distribution	605	503
13	Conflict	618	387
14	Asymetric information	219	442
15	Property	301	499
16	Decision	85	140
17	Dispersion of property	342	932
18	Business strategic	208	96
19	Business assets	625	323
	Totals	101	101

6. Conclusions and implications of the research

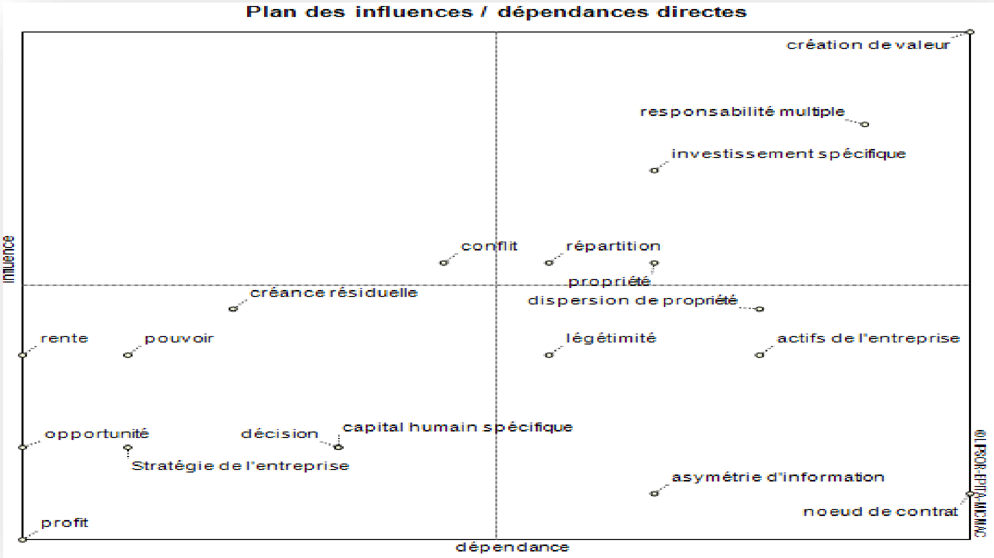

Figure 2. Cognitive mapping across the plane of the influence depends

Concepts (or variables) cognitive structuring the universe of players can be projected in terms of influence / dependence. The distribution of the point cloud variables in this plan, particularly in relation to different quadrants allow to distinguish four broad categories of variables.

The first quadrant includes the most prominent concepts in the dynamics of the thought of the actors. For the actors of that organization, the notion of ‘conflict’ is the most dominant in their cognitions reflecting an intention based on a partnership approach focused on conflicts of interest. Returning to the systematic exploration of grids for each actor, there is a balance of concepts expressing their orientation.

For example an actor, this concept is expressed through statements such as ‘property’, ‘Judgement’, ‘delegation.’ Thus reflecting an agency logic orientation.

In logic of agency, that is to say separation of ownership and decision-making and delegation of authority, the conflict is rooted in the possibility of agent behavior (leader) does not comply the interests of the principal (shareholder). One then finds the current practices of contestation of all power, both in its exercise of its legitimacy. The result is a cost of conflict management that it is latent or it bursts open. Assuming that individuals could live naturally in harmony, the establishment of governance structures would be meaningless.

For the actor 2, this orientation is expressed through statements such as ‘specialization’, ‘organization’, ‘targets’, ‘production’ reflecting a productive logic. Indeed, the increasing specialization in the firm is the origin of conflicting objectives and from this point of view, this view presents more similarities with the approaches ‘contract’ with approaches that see the organization as ‘a cognitive community ‘ .Thus, there is the idea that the firm is the headquarters of the opposition between different approaches, the organization of the firm consists of two dimensions: the organization of production whose function is efficient and productive sales organization whose function is to value the assets of the company by buying and selling. These two types of functions performed by the respective actors of the firm, may conflict because they are not established on the same criteria for evaluating economic efficiency. Industrial logic and logic have the same financial basis as they are of practices and habits of thought different. The first combines the richness in the production of use value on goods and services produced for the market, the second involves the creation of wealth in the monetary value of production (with the growth of external funding) in assets the company.

The second approach requires sometimes scarce production to support prices, slowing innovation to avoid the obsolescence of capital, and between and in opposition to the first while, conversely, support productivity and innovation can lead to overproduction or the devaluation of capital.

Concepts related to the logic of agency resources are most cited by the players, tried explaining the concept of ‘conflict’.

The second quadrant includes the relay variables that are by definition both very influential and very dependent. By analyzing the level of influence / dependence, there are players for the concepts or ideas that illustrate the concepts of ‘value creation’, ‘multiple liabilities’, ‘Specific Investment,’ ‘distribution’ and ‘property’. The ideas of the players in the Tunisian firms tend to focus on three basic concepts that are ‘owned’, ‘investment’ and ‘value creation’.

In this sense, the performance results from the creation of wealth that comes from making an investment that creates value. This achievement depends on the ability of each individual involved in the investment process to derive a satisfactory gain.

This concept of extended value to different stakeholders has the interest to highlight that the creation of value not only the result of capital contributions by shareholders but the combined efforts of all partners. Different approaches to the creation of stakeholder value are possible. Charreaux and Desbrières (1998) propose a method for measuring stakeholder value creation, based on an overall measure of the rents created by the company in connection with the stakeholders and not just shareholders.

The third quadrant contains the dependent variables or resulting. They are both influential and very little dependent and therefore particularly sensitive. They are the result of which is explained by the variable motor and relay. Thus there are the high dependence of a number of factors such as the variables of legitimacy, information asymmetry and dispersion of ownership. The fourth quadrant includes the independent variables are simultaneously little influence and little dependent. They are relatively excluded from the dynamics of thinking by the company of Tunisia. The plan review influences / dependencies shows the existence of a number of independent variables such as variables related to the decision, business strategy, residual claim, profit, etc..

• The number of links of influence is an indicator of the degree of integration of the cognitive map.

• The degree of interconnection is an indicator of the density of the cognitive map. It can be calculated in a simple way by dividing the number of links (l) by the number of concepts (n) or more elaborate way by dividing the number of links present in the maximum number of possible links. According to Eden and Ackermann (1998), a level of integration such a cognitive map computed by the simple ratio (l / n) should be between 1.15 and 1.25.

Cossette (2004) to analyze the main aspect of the topography of a cognitive map from: The relative importance of each concept: from the number of concepts to which a concept is directly or indirectly connected. It seeks to assess the centrality of a concept in the discourse. We have, from the total, in line expressing the total weight of the variable influence, and column length.

Table 15. Total of rows and columns

N°	VARIABLE	TOTAL OF ROWS	TOTAL OF COLUMNS
1	Value creating	12	10
2	Opportunity	3	1
3	Contract node	2	10
4	Specific investment	9	7
5	Specific human capital	3	4
6	responsability multiple	10	9
7	Power	5	2
8	Legitimacy	5	6
9	profit	1	1

N°	Variable	Total of rows	Total of columns
10	Residual claim	6	3
11	Annuity	5	1
12	Distribution	7	6
13	Conflict	7	5
14	Asymetric information	2	7
15	Property	7	7
16	Decision	3	4
17	Dispersion of property	6	8
18	Business strategic	3	2
19	Business assets	5	8
	Total	**101**	**101**

Let W = W l + W c with Wl: total weight of the variable influence, Wc: total weight dependence.

The relative importance of variables will be calculated and the results is in this table

Table 16. Relative importance of variables

Variables	**Poids**
Value creating	22
Opportunity	4
Contract node	12
Specific investment	16
Specific human capital	7
Responsability multiple	19
Low	7
Legitimacy	11
Profit	2
Residual claim	9
Annuity	6
Distribution	13
Conflict	12
Asymetric information	9
Property	14
Decision	7
Dispersion of property	14
Business strategic	5
Business assets	13

At this stage of analysis and based on the study of the relative importance of concepts in cognition of Tunisian players in the company vis-à-vis the stakeholder approach of corporate governance, it is possible to forward the following conclusions: Actors perceive the partnership approach of corporate governance at the concepts of ‘value creation’, ‘multiple liability. ’, ‘ Dispersion of ownership ‘. But the distribution of the point cloud variables, one can distinguish the first quadrant which includes the most prominent concepts in the dynamics of thought of the actors. For the actors of that organization, the notion of ‘conflict’ is the most dominant in their cognitions reflecting an intention based on a partnership approach based conflicts of interest. The design they make the partnership approach is through different logics: one based on the value of logic of agency and that based on the valuation of a productive logic value. The logic of agency can be explained by the concept of ownership; the conflict is rooted in the possibility of agent behavior (leader) not in the interests of the principal (shareholder). We can now common practice for challenging all power, both in its exercise of its legitimacy.

The logic of productive value is explained by the notion of value creation, we find the idea that the firm is the headquarters of the opposition between different logical organization of the firm consists of two dimensions: the organization of production which function is efficient and productive commercial organization whose function is to value the assets of the company by buying and selling. These two types of functions performed by the respective actors of the firm, may conflict because they do not establish the same criteria for evaluating economic efficiency.

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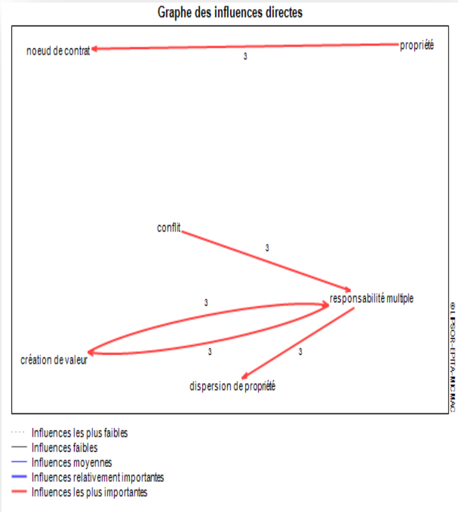
Appendix



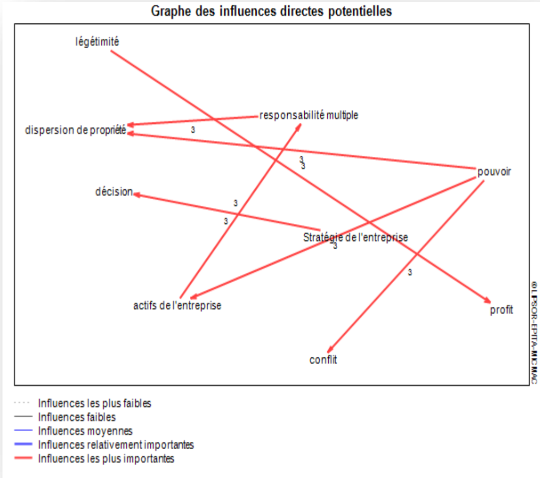
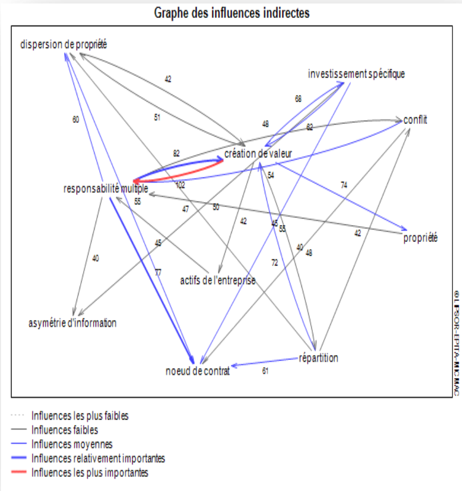


Figure A1 Direct infuences graph

Figure A2 Direct potential influences graph



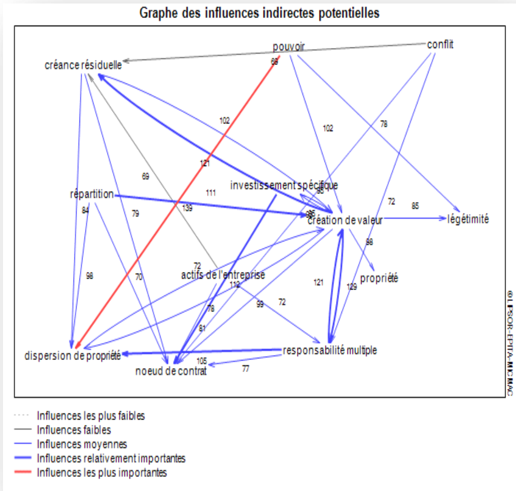


Figure A3. Indirect influences graph

Figure A4. Indirect potential influences graph

CORRELATION AND VOLATILITY TRANSMISSION ACROSS INTERNATIONAL STOCK MARKETS: A BIVARIATE GARCH ANALYSIS

P. **SAKTHIVEL**
University of Hyderabad, **India**
Research Faculty, Department of Economics
Gokhale Institute of Politics and Economics
sakthi_hcu@yahoo.co.in
B. **KAMAIAH**
University of Hyderabad, **India**
Department of Economics

Abstract

The study empirically examines correlation and volatility transmission across international stock markets by employing Bivariate GARCH model. The study uses weekly data for major five stock indices such as S&P 500, BSE 30, FTSE 100, Nikkei 225 and Ordinary share price index from 3th January, 2000 to 30th November, 2009. Long run and short run integration are investigated through Johansen cointegration and Vector error correction models respectively. The results of Johanson test show that long run integration is found across international stock indices prices. Further, results suggests that any external news arrives simultaneously received by US and Japan stock markets and then transmits to other Asian and European stock markets. The results of bivariate GARCH model reveal that there is bidirectional volatility spillover between US and Indian stock markets. This is due to fact that these two economies are strongly integrated through international trade, foreign direction investment (FDI) and foreign portfolio investment. Finally, results show that a unidirectional volatility spillover from Japan and United Kingdom to India.

Keywords: Johansson Cointegration Test, vector Error Correction Model, Bivariate GARCH and Volatility Spillover.

JEL Classification: G32, G34, C42

1. Introduction

The world financial markets and economics have becoming increasingly interrelated due to free flow capital and international trade during globalization regime. Further, the important outcome of globalization is also increased co movement in stock prices across international markets. This co movement, of course, also stimulates vulnerability to market shocks. Therefore, shocks originated in one market not only affected own market but are also transmitted to other equity markets. Some argue that these linkages could even be destroying the very benefits that diversification offered in the first place.

There has been debate between two groups of studies how correlation of international stock markets changes over period of time. Some studies argued that correlations across international stock markets are not constant over time due to change in economics, political and market environments among countries. For example, (Baharumshah, Sarmidi, and Tan (2003) Shamsuddin and Kim (2003) Voronkova (2004), Bekaert and Harvey (2003); Bekaert and Harvey (2000) Errunza and Losq,(1985). Specially, Corhay, *et al.* (1995) study the stock markets of Australia, Japan, Hong Kong, New Zealand and Singapore and find no evidence of a correlation among these markets. Nath and Verma (2003) studied the market indices of India, Singapore and Taiwan. They demonstrated no correlation between these indices. While Cheung and Mak (1992) and Masih and Mash 1997 b) found evidence that international stock markets are strongly correlated. Specifically, they found that the US is a global factor affecting both the developed and developing markets. Therefore, study made an attempt to examine cross border interrelation between international stock markets.

Second, the study investigates volatility transmission across international markets. There are studies which have been examined on this issue. For instance, Theodossiou *et al.*. 1997, Yiuman Tse and Booth, 1996; Mansor and Mahmoodof, 2003; Savva, 2008; Shiun and Hsueh, 1998; have found that significant mean and volatility spillovers from the US market to other international markets.

Koutmos and Booth (1995) examine the price and volatility spillovers among US, Japanese and British stock markets in a multivariate EGARCH model. They found significant asymmetric volatility spillovers from NY and London to Tokyo, from Tokyo and NY to London and from London and Tokyo and NY.

However, some studies reveal that weaker or no volatility spillover effects from US to Asia (For instance Ng, 2000; Baele, 2002; Bae and Karolyi, 1994). Ng (2000) studied volatility spillovers the between Japan and the US stock markets and found that there is no volatility transmission from USA to Japan. Baele (2002) investigated the time-varying nature of the volatility-spillover effects between the US (global effects) and European stock markets and found volatility spillover from European to US stock markets. The most of studies are inconclusive on this issue.

Therefore, the study proposed to examine how common news (external news) driving both the Asia and European stock markets including BSE (India) and also how these news are transmitted from one market to another. Specially, BSE 30 sensex conditional variance is conditional upon on the innovations from the US and the Asian Markets. Further, change in conditional variance from one market will also change variance in another market because these markets are basically auto correlated.

The correlation and volatility transmission between stock markets is important for risk managers and policy makers for following reasons. The correlation of stock markets is useful to design of a well-diversified portfolio for investors. Changes in international correlation patterns call for an adjustment of portfolios. Policy makers are interested in volatility transmission across markets because its implications for the stability of the global financial system. For instance, if volatility spillovers are significant between markets, a shock originating from one market may have a destabilizing impact on other markets. Hence, it is important for policy makers understand the inter relations and volatility spillovers between financial markets.

The remainder of the study is organized as follows. Section 2 provides some empirical evidence on interrelation and volatility transmission across international stock markets. Section 3 describes methodology and the data used. Section 4 presents results and discussion. Section 5 provides a summary and conclusion of the study.

2. Some Empirical Evidences

Ng, (2000) investigated the magnitude and changing nature of the return and volatility spillovers from Japan and the US to the Pacific–Basin markets using bivariate GARCH model. The empirical results show that there are significant volatility spillovers from both the Japanese and US markets to Malaysia, Singapore, Taiwan and Thailand. Apart from the significant volatility spillovers, Malaysia, Singapore and Thailand also experience significantly positive mean spillovers from the US. No significant volatility spillover from the US to Hong Kong is found.

Angelos Kanas (1998) examined volatility spillovers across the three largest European stock markets, namely London, Frankfurt and Paris by employing the Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) model. Using daily closing prices from 1984 to 1993 and he found that reciprocal spillovers are found to exist between London and Paris, and between Paris and Frankfurt, and unidirectional spillovers from London to Frankfurt. Finally, his results show that spillovers are asymmetric in the sense that bad news in one market has a greater effect on the volatility of another market than good news.

In Indian context, international linkages have been sparsely studied and mostly investigated with US and some developed Asian market like Japan, Korea etc. Using cross-spectral analysis, Rao and Naik (1990) examined the correlation among US, Japanese, and Indian stock markets and found that the relationship of the Indian market with international markets is poor. They concluded that integration of Indian market with US and Japan was weak, because of heavy controls and restrictions on trade and capital flow in India.

Nath and Verma (2003) studied the market indices of India, Singapore and Taiwan. They demonstrated no correlation between these indices. Kaur (2004) studied the return and volatility spillover between India (Sensex and Nifty) and US (NASDAQ and S&P 500) markets by using EGARCH and TGARCH volatility models. Their results shows that mixed evidence of return and volatility spillover between the US and the Indian markets. The significant correlation between US and Indian markets was time specific.

Ahmad Zubaidi and Boon Tan (2003*)* examine the dynamic interrelationship among the major four countries stock markets such as Malaysia, Thailand, Taiwan and South Korea. The short run and the long run relationship also were examined using Johansen co integration and vector error correction models.. The empirical results suggest that all the Asian markets are closely linked with each other and with the world capital markets, such as the US and Japan.

Gunasekarage and Power (2005) examined return and volatility spillovers from the US and Japanese stock markets to three South Asian capital markets – (i) the Bombay Stock Exchange, (ii) the Karachi Stock Exchange and (iii) the Colombo Stock Exchange. The sudy used univariate EGARCH spillover model that allows the unexpected return of any particular South Asian market to be driven by a local shock, a regional shock from Japan and a global shock from the USA. The study discovers return spillovers in all three markets, and volatility spillovers from the US to the Indian and Sri Lankan markets, and from the Japanese to the Pakistani market.

Mukherjee, and Mishra, (2008) investigate return and volatility spillover among Indian stock market with 12 other developed and emerging Asian countries by applying the Multivariate GARCH model. The study used both Daily opening and closing prices from November 1997 to April 2008. The results show, Hong Kong, Korea, Singapore and Thailand are found to be the four Asian markets from where there is a significant flow of information in India. Similarly, among others, stock markets in Pakistan and Sri Lanka are found to be strongly influenced by movements in Indian market. Though most of the information gets transmitted among the markets without much delay, some amount of information still remains and can successfully transmit as soon as the market opens in the next day.

Victor Fang *et al.* (2006) investigate volatility transmission between Stock and Bond Market, by employing BEKK bivariate GARCH (1, 1). Daily data of stock and bond indices are used for both the US and Australia period from 1998 to 2003. The results of bivarate GARCH model reveal that spillovers between the stock markets of the US and Australia, and the same effects are present in the bond markets of both countries. Their evidence supporting that bidirectional information flows between two markets.

Savva (2008) investigates the price, volatility spillovers and correlations between the US and the major European stock markets by employing a bivariate VAR model. The study uses daily prices (USA), FTSE-100 (UK), DAX-30 (Germany), CAC-40 (France), MIBTEL-30 (Italy) and IBEX-35 (Spain) from August 3, 1990 to April 12, 2005. The estimated results show there is strong co integration relationship between US and European stock markets. As far as the volatility spillover effects are concerned, the study finds effects not only from US to Europe but also from Europe to US.

Shiun Pan and Hsueh (1998) examine the nature of transmission of stock returns and volatility between the US and Japanese futures markets. They used daily opening and closing futures prices on the S&P 500 and Nikkei 225 ndex for the period of January 3, 1989 through December 30, 1993. By employing a two-step GARCH approach, the results show that there are unidirectional contemporaneous return and volatility spillovers from the US to Japan. Further the US's influence on Japan in returns is approximately four times as large as the other way around. Finally, results show that there is no significant lagged spillover effects in both returns and volatility from the Osaka market to the Chicago market, while a significant lagged volatility spillover is observed from the US to Japan.

The above reviews show that most of studies have been inconclusive on this issue. Further, methodologically, most of the studies are limited to cointegration, causality test or univariate GARCH. Application of Bivariate GARCH model is limited in investigating volatility spillover. Hence, study addresses issues related correlation and volatility transmission across international stock markets

3. Data and Methodology

A. Nature and Sources of Data

Nowadays, India economy (Indian financial markets) is increasing integrated with other countries through foreign trade and investment. Thus, any news originated in one market affects its own market and then transmits to others. For this purpose, the study has chosen indices from India's four major trading and investment partners; the United States, the United Kingdom, Japan and Australia. US have been the major route for FDI inflows into India after Mauritius. FDI by US has jumped into 42,190. 39 crore during 2000- 2011 compared to during 1991- 1995 which was only 16,454 crore Similarly, UK FDI flows also increased from 10,978 crore during 1991-1995 to

28,298.45 crore during period of 2001-2009. The India' country wise FDI and foreign trade are given by figure 1 and 2. The two figures shows that India is increasing integrated with other developed countries through trade and investment.

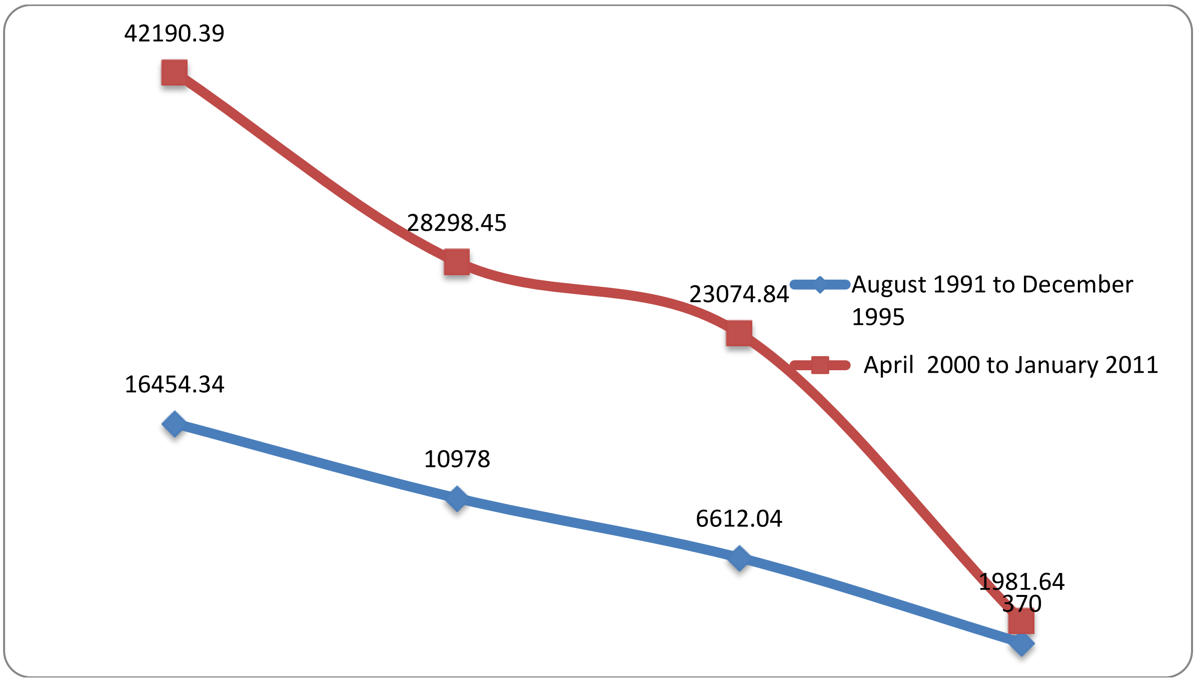


Figure 1. Country wise India's Foregin Direct Invesment Units in crore

Sources of Data : RBI website

The US is India's largest trading partner among others and plays a dominant role in India's trade, accounting for 22.7 per cent of India's exports and around 7.69 per cent of India's imports. India's exports to USA have more than doubled during the period 2000 -01 to 2008-09. During 2000-01, India's exports to USA at $ 9,301 million and then increased to $ 20,972.3 million in year of 2008-2009. India's exports to UK also jumped manifold into $ 6,597 million during 2008 -09 compared to 2000-01 which was $ 2,298.7 million. You can see India's country wise exports from figure 2

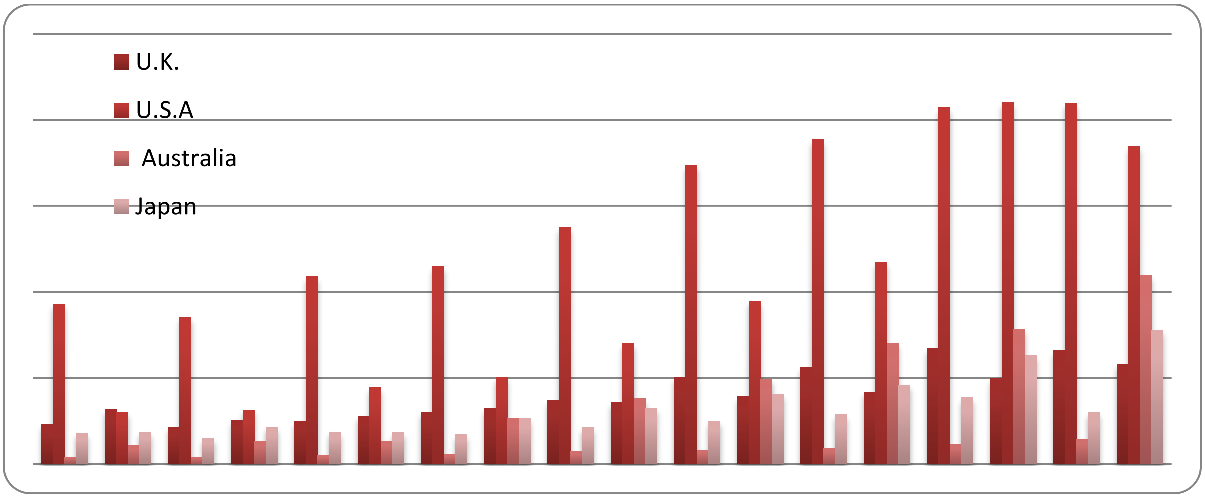


Figure 2. India's foreign Trade with Selected Partners Million dollars

Source of Data : RBI website

The weekly data was collected for each index from yahoo finance, to examine information transmission across international stock markets. The study used the indices from five major countries namely; the United States, the United Kingdom and Japan, Australia and India. Each index represents one country, such as BSE 200 (India), S&P 500 (the United States), FTSE 100 (the United Kingdom) and Nikkei 225. Our weekly data of five indices are covered from1st January 1998 to 30th November, 2009. The weekly indices rather than daily data are used for avoiding representation bias from some thinly traded stocks, i.e., the problems of non-trading and non-synchronous trading and to avoid the serious bid/ask spreads in daily data.

B. Methodology

Augmented Dickey-Fuller Test

The study proposes to apply unit root tests to verify whether a series is stationary or non-stationary. Before proceeding cointegration test, we need to check following two conditions must be fulfilled. 1) All variables should be non-stationary. 2) Each variable must be same integration order. If the variables are same integration order, than we test for the possibility of a cointegrating relationship using the Johansen and Juselius (1990) procedure. In order to verify whether a series are same integrated order or not, unit root test proposed by Dickey and Fuller (1979) is used. The ADF test is based on the estimate of the following regression.

$$\Delta y_t = \alpha_0 + \phi_1 y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \varepsilon_t \qquad (1)$$

If $\varepsilon = 0$, implies that series have a unit root and is nonstationary. Hence, if the hypothesis, $\varepsilon \neq 0$, indicts that series does not have a unit root and is integrated of order zero, i.e. it has stationarity properties.

Once same integration order is confirmed for each series then we need to employ Johansan and Juselius cointegration test to examine long run relationship across international stock markets. If the two or more series are found to be co-integrating, then they are said to have common stochastic trend. They tend to move together in the long run but may divergence in short run. According to the Granger representation theorem, a VECM can be used to describe the relationships exhibited by cointegrated price series:

$$\Delta X_t = C_0 + \alpha\beta' X_{t-i} + A(L)\mathrm{X}_{t-1} + \varepsilon_t \qquad (2)$$

$$\varepsilon|\Omega_{t-1} \sim \mathrm{distr}(0_t, H_t)$$

where $X_t=(X_{1t}, X_{2t}, X_{3t}, X_{4t}$ and $X_{5t})$, C_0 is a 5×1 constant vector, the A(L) is a5×5 matrices of polynomials in the lag operator, L. α and β are 5×4matrices with α being the error correction vector and β being the cointegrating vector. Vector has zero mean and serially uncorrelated innovations with covariance matrix Ω. Typically, A(L) and α are used to measure the effects of the arrival of news. The A (L) measure the short-run effects as captured by lagged returns and α shows how the prices arrive at a new equilibrium aftershocks.

Bivariate GARCH Model

The univariate GARCH analysis limited itself by investigating among two markets volatilities separately. It will not allow volatility spillovers between the two markets, which are initially identified by the strong auto correlations across international stock returns which shown in Table 1. Recognizing the link between the two markets is important because both markets share a common information set and information may flow from one market to another.

This paper uses bivariate GARCH model to overcome the limitations of univariate GARCH analysis. Use of bivariate GARCH model the spillover effect can be directly estimated from the specification of the transmission mechanism in this model. Finally, bivariate GARCH model provides link between variances and covariance of two stock returns.

To investigate volatility transmissions among two markets, a bivariate - GARCH -EC model is employed. For example, there are two stock markets one is US and another one is India. The bivariate GARCH(1, 1) model can be written as follows.

$$R_{1t} = \theta_{10} + \theta_{11} R_{1t-1} + \theta_{12} \varepsilon_{2t-1} + \upsilon_{t1} \tag{3}$$

$$R_{2t} = \theta_{20} + \theta_{21} R_{1t-1} + \theta_{22} \varepsilon_{1t-1} + \upsilon_{t2} \tag{4}$$

Where the error terms $\begin{bmatrix} \upsilon_{t1} \\ \upsilon_{t2} \end{bmatrix}$ are distributed as N (0, H_t). The return or mean spillover the parameters are θ_{12} and θ_{22}. R_{1t} is the S&P 500 returns depending on its own past values and ε_{2t-1}, is residuals (ECT) from vector error correction model to check mean spillover from US to India. Similarly, R_{2t-1}, is BSE 30 returns depending on its own past values including residuals are derived from vector error correction model.

Where the residual terms are distributed as N (0, H_t). In a diagonal representation, the 2 x 2 conditional variance-covariance matrix H_t under a GARCH (1,1) specification is given by

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon_{t-1}^{'} A + B' H_{t-1} B \tag{5}$$

(OR)

$$H_t = \begin{pmatrix} h_{11,t} \\ h_{22,t} \\ h_{11,t} \end{pmatrix} + \begin{pmatrix} c_{11} \\ c_{22} \\ c_{12} \end{pmatrix} + \begin{pmatrix} a_{11} 0 0 \\ 0 \quad a_{12} 0 \\ 0 \quad 0 a_{22} \end{pmatrix} + \begin{pmatrix} \varepsilon_{2,t-1}^{1} \\ \varepsilon_{1,t-1}\varepsilon_{2,1-1} \\ \varepsilon_{2,t-1}^{2} \end{pmatrix} + \begin{pmatrix} \beta_{11} 0 0 \\ 0 \quad \beta_{12} 0 \\ 0 \quad 0 \beta_{22} \end{pmatrix} + \begin{pmatrix} h_{11,t-1} \\ h_{22,t-1} \\ h_{12,t-1} \end{pmatrix}$$

To capture the volatility spillover between markets, we introduce Error Correction (ECT) terms in conditional variance equations. The expansion of the matrix H_t is structured as:

$$h_{,11t} = c_{11} + \alpha_{11}\varepsilon_{1\ t-1}^{2} + \beta_{11} h_{t-1} + \gamma_{11}\varepsilon_{1\ ,t-1}^{2} \tag{6}$$

$$h_{22t} = c_{22} + \alpha_{22}\varepsilon_{1\ t-1}^{2} + \beta_{22} h_{t-1} + \gamma_{22}\varepsilon_{2\ ,t-1}^{2} \tag{7}$$

$$h_{12t} = c_{12} + \alpha_{12}\varepsilon_{1\ t-1}^{2} + \beta_{12} h_{t-1} + \gamma_{12}\varepsilon_{2\ ,t-1}^{2} \tag{8}$$

The Equation (6) is conditional variance for US market includes a function of past lagged value of residuals from VECM as well as own lagged value of residuals including past conditional variance. In this equation, γ_{11} is the coefficient spillovers from US (market 1) to India (market 2). In Equation (7) (conditional variance equation for India), γ_{22} is the coefficient of spillovers from India (market 2) to USA (market 1)

The bivariate specification allows the conditional variances ($h_{11,t}$ and $h_{12,t}$) and covariance ($h_{12,t}$) of two markets returns to influence each other. The volatility spillover is measured by the parameters of γ_{11} and γ_{22}. The standard square residuals of $\varepsilon_{1\ ,t-1}^{2}$ and $\varepsilon_{2\ ,t-1}^{2}$ are obtained from Vector Error Correction (VCEM) Model.

4. Empirical Results

Table 1 presents summary of statistics for Sand P 500, FTSE 100 and NIKKEI 225, BSE 30 and Ordinary share price index. The daily mean returns are positive, in case of Sand P 500, FTSE 100 and NIKKEI 225. But it is negative for BSE 30 and All Ordinaries Shares. The standard deviation of Sand P 500 and NIKKEI 225 are higher among five stock indices. This shows that higher volatility in these two markets compared to other. The measures for skewness and excess kurtosis indicate that the distributions of returns for all five markets are positively skewed and leptokurtic relative to non normal distribution. The Jarque Bera (denoted by JB) statistic rejects normality at 1% level of significance in all cases. The Ljung Box statistic for 16 lags applied on returns (denoted by LB (16)) and squared returns (denoted by LB^2 (16)) indicate that significant linear and nonlinear dependencies exist. The LM test statistic shows that there is evidence for ARCH effect and time varying volatility.

The results of correction matrix are presented in table 2. The results reveal five stock indices are highly correlated each other since correlation coefficients are high. Particularly, S&P 500 index is highly correlated with European and Asian stock indices. The weekly stock returns of India (BSE 200), US (S&P 500), UK (FTSE 100) and Japan (NIKKEI 225) are presented from Figure 1 to 5 and their stationary property are reported in Table 3. The results of ADF show all series are non stationary at level forms since null hypothesis is accepted in all cases. However, all stock prices are stationary at first difference, which are same integrated order one. Similar results observed in Phillips-Perron Test are given by table 5.

Table 4 provides results of Johansen cointegration test. All test equations contain two lag for the endogenous variables chosen by Akaike Information Criteria (AIC), Final Prediction Error (FPE) and Schwarz Information Criteria. The Johansen results indicate that there are two cointegration vectors in five variables system which cannot be rejected null hypothesis at 5% level under trace and maximum eigen value. This implies there are two long run relationships among five stock indices prices.

The results of causality based on vector Error Correction Model are given in Table 5. The results show that the coefficients of Error correction terms are not statistically significant in case of Nikki 225 and S&P 500, but it is significant for BSE 30, FTSE 100 and All Ordinaries Shares. This indicates that whenever stock indices such as Nikki 225 and S&P 500 deviate from equilibrium level, other markets (BSE 30, FTSE 100 and All Ordinaries Shares) tend to correct back to towards equilibrium level in long run. The results show that stock markets such as US and Japan leads other markets suggesting that any external news arrives simultaneously get affected by both stock markets and then transmits other Asian and European stock markets.

The results of Bivariate GARCH model are reported in Tables 6, 7, 8 and 9. The significant volatility spillover from US market to Indian market (0.00979) and from the India to US stock market (0.00521). In other words, there is bidirectional volatility spillover between two markets. This is due to the fact that co-movements information flows exist between prices in the two markets. However, there is unidirectional volatility transmission from Japan and United Kingdom to India. On the other hand, there is no reverse volatility spillover is found from India to Japan and United Kingdom. Finally, results show that volatility spillover between Australia and India are not found. The positive spillover coefficients (γ_{11} and γ_{22}) indicate that shocks to one market increase the conditional variance of another in the next period.

The spillover coefficient from US to India (0.00979) is greater than the spillover coefficient from India to US (0.00521). Similarly, coefficient from Japan to India (0.00846) is larger than the coefficient from India to Japan (0.00427). Overall, these results indicate that US and Japan stock markets are exporting their volatility to India, with London exports volatility which has comparatively the negative influence.

5. Final Remarks

The study investigates interdependent and volatility spillover across international stock markets using bivariate GARCH model. The weekly closing prices of the S&P500 (US), FTSE 100 (the United Kingdom, the Nikkei 225 (Japan) and BSE (India) are used from January 3, 2000 to 30, November 2009. Employing Johansan and Juselius co integration and Vector Error correction Models, study found that there is strong long run relationship across international stock indices prices. Further, results reveal that stock markets such as S&P and Nikkei 225 deviate from equilibrium level, but three markets of BSE 30, FSTE and ordinary share price index tend to make all correction to reestablish equilibrium in long run. This implies that US and Japan stock markets lead other markets suggesting that any external news arrives simultaneously received by both markets and then transmits to other international stock markets. In case volatility transmission, the study finds a bidirectional volatility spillover between US and Indian stock markets. This may be because; these two economies are strongly interrelated through international trade, foreign direction investment (FDI) and foreign portfolio investment. Finally, the results show that a unidirectional volatility spillover is found from Japan and UK to India.

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TWO NEW MEASURES OF HOUSEHOLD-LEVEL INVESTMENT RISK

Laurence G. **TAFF**
Taff and No Associates, 648 Mistland Trail
Ruckersville, VA 22968-6000, **USA**.
larrytaff@embarqmail.com

Abstract:

This paper defines two new measures of household investment risk acceptance/rejection and demonstrates their extremely close linkage to total financial assets. The pair of novel risk indicators is based on different sub-sets and functions of a household's portfolio composition. The best fitting relationships between each asset mixture-based assessment of risk tolerance and the division of financial assets are power law functions. Why this outcome occurs is a mystery: power laws have no scale and money certainly does. Lastly, the two novel risk tolerance measures are tightly related even though they derive from different aspects---and transformations---of a household's portfolio composition. Indeed, the main utility of this discovery is an original viewpoint of the risk averse investment behavior of a household as a function of its investment choices. This is especially true because the population frequency distribution of the more refined household risk propensity measure almost perfectly follows a lognormal distribution. Also demonstrated is a puzzling, very nearly linear, relationship between a household's accumulated stock of wealth and current annual household income. The data come from the 2004 edition of the Survey of Consumer Finances. Since its asset categories are broad, why the connections are so strong and the residuals from the fits so small, is difficult to understand.

Keywords: Portfolio composition, ass*et al.*location, risk aversion, wealth, income

JEL Classification: CO2, D14, D31, G11

1. Background

The Survey of Consumer Finances is a triennial effort between the Board of Governors of the Federal Reserve and the Statistics of Income Division of the Internal Revenue Service. The Federal Reserve's principal publications regarding the Surveys include some comparisons between the current and earlier editions (e.g., Bucks, *et al*.. 2006 and 2009). However, neither Federal Reserve personnel, nor others publishing in the academic or professional literature, discuss portfolio composition as a separate topic. A thorough literature search uncovered about two dozen papers on the general subject of asset mixture. They were mostly concerned with portfolio composition and income taxes or portfolio composition and a (some) demographic parameter(s). In addition, papers on asset mixture and housing and asset mixture and risk acceptance/rejection were available. No paper examined the connection between asset mixture and financial assets *per se* and that is what this paper does.

In more detail, using the data in the 2004 edition of the Survey[1], this paper investigates the links between two functions of portfolio composition and total financial assets and the link between annual household income and total financial assets. Because of the remarkably good fits to the empirical data with simple functions, these measures provide an especially accurate insight into a household's investment risk avoidance/acceptance tendencies.

2. Asset Categories

Following the Survey of Consumer Finances in general, I used seven categories in which to place financial assets. This septuplet is presented in the order from riskiest to least risky (my assignments and paraphrasing):

[1]The 2007 edition of the Survey of Consumer Finances was released as this paper was being prepared. A quick comparison between it and the 2004 edition shows no significant differences for this research. In addition, the 2007 report is slightly contaminated as the authors' tried to include the early effects of the sub-prime housing debacle. The 2010 questionnaire contains a substantial set of new questions relating to the hostility of the Obama administration to small businesses in particular and job formation in general. Hence, the 2004 version is the last of its kind until our country's economic malaise has been cured for several years.

1) 'Other'; a heterogeneous category of less common financial contracts.
2) Individual shares of publicly traded common and preferred stock.
3) Individual Federal government, municipal government, Agency, corporate, and foreign bonds.
   a. This category includes 'mortgage-backed bonds' by which is almost certainly meant mortgage-backed securities and not true mortgage-backed bonds.
   b. I also placed savings bonds in this category.
4) Mutual funds; that is non-money market pooled investment funds.
5) Annuities.
6) Keogh and IRA accounts and other pension accounts from which withdrawals or loans may be taken, e.g., 401(k) accounts. And,
7) Transaction accounts; e.g., savings, checking, and money market deposit accounts, money market mutual funds, and call accounts.
   a. I also placed Certificates of Deposit in this category.

3. Basis for the Analysis

When looking for a simple, well-known, function to serve as a risk indicator of portfolio composition, I co-opted the Herfindahl Index. After minor modifications, this construction successfully served as a springboard for creating a powerful new measure of a household's asset mixture and thence risk taking/avoidance behavior. The new quantity-named the Portfolio Composition Parameter-is extraordinarily closely related to a household's total financial assets. Thus, there is now a simple way to either predict a household's investment risk/reward trade-off policy from the allocation of its stock of wealth or to forecast its stock of wealth from a broad indicator based on the composition of its holdings.

3.1 The Definition of the Herfindahl Index

The Herfindahl Index is defined as the sum of the squares of the percentages of the market shares of a set of firms in a specific segment of the economy. The larger the Herfindahl Index, the higher the level of dominance by a fewer number of firms. Conversely, the smaller the Herfindahl Index, the less concentrated the market shares of the companies are. As real life examples, both the US Government and the European Union use the Herfindahl Index as one guide as to whether or not to approve mergers between rival commercial enterprises.

In symbols, suppose that there are $N > 1$ firms in an industry. Number them by $n = 1, 2, \ldots, N$. Indicate the market share of each company, in percentage terms, by p_n, $n = 1, 2, \ldots, N$; $0 \leq p_n \leq 1$ for all $n \in [1, N]$. The definition of the Herfindahl Index (HI) is

$$HI = p_1^2 + p_2^2 + \bullet\bullet\bullet + p_N^2, \qquad HI \in [1/N,1]. \tag{1}$$

Note that the Herfindahl Index is computed under a constraint; since the market shares are expressed as percentages, the sum of the market shares must be 100%, that is

$$\sum_{n=1}^{N} p_n = 1. \tag{2}$$

3.2 An Alternative Interpretation

Instead of considering N companies in the same market niche, consider N assets of a specific household's financial portfolio. Rather than have p_n represent the market share of the n'th firm, it will now represent the share of the n'th asset category: percentage or dollar amount?

When computing the Herfindahl Index, given its purpose, it only made sense to consider the $\{p_n\}$ as percentages. However, it is now possible to think about a p_n as being the dollar amount devoted to the n'th asset type rather than its percentage of the total stock of financial wealth. Which to choose? To decide the issue think about two $1 million portfolios. One is completely invested in Certificates of Deposit, the other in small capitalization stocks. Using percentages both would have an equal value of Portfolio Composition Parameter (as will be seen below). This would be very misleading. On the contrary, if dollar amounts were used---while both would still have the same value of the Portfolio Composition Parameter---the probability of a million dollar portfolio being so conservatively invested is very low. With a more realistic ass*et al.*location commensurate with the two hypothetical households, a dollar-based Portfolio Composition Parameter will, in almost all cases, be more revealing than a percentage-based version could ever be. Hence, the Portfolio Composition Parameter is computed using dollar amounts.

4. The Definition of the Portfolio Composition Parameter

The quadratic nature of the Herfindahl Index will produce extremely large numbers when dollar amounts are used. So, to bring the results back into a more reasonable numerical range, namely 1-10, I normalized the sum of the squares of the $\{d_n\}$ (d now for dollars) by a combination of first dividing by a large number and then taking an irrational root---equal to about one tenth---of the quotient.

To make the discussion more concrete, focus on one household. Divide its financial assets into N (= 7 as done by the Survey of Consumer Finances) mutually exclusive categories. Let d_n be the amount of dollars invested in the n'th asset type for n = 1, 2, … , N. Compute the sum of the squares of the $\{d_n\}$, namely

$$d_1^2 + d_2^2 + \bullet\bullet\bullet + d_N^2. \qquad (3)$$

Divide the result by a large number, say 10^{10}. Now take a small irrational root of the reduced sum of the squares. The result is the Portfolio Composition Parameter.

In a less abstract manner:

1) Let the dollar amount invested in 'Other' be denoted by \$OTHER.
2) Let the dollar amount invested in individual shares of common and preferred stock be denoted by \$STK.
3) Let the dollar amount invested in individual bonds be denoted by \$BNDS.
4) Let the dollar amount invested in non-money market mutual funds be denoted by \$MF.
5) Let the dollar amount invested in annuities be denoted by \$ANN.
6) Let the dollar amount invested in Keogh and IRA accounts and so on be denoted by \$RET. And,
7) Let the dollar amount invested in transaction accounts be denoted by \$TRANS.

Then, to begin the computation of the Portfolio Composition Parameter, first calculate

$$(\$OTHER)^2 + (\$STK)^2 + (\$BNDS)^2 + (\$MF)^2 + (\$ANN)^2 + (\$RET)^2$$
$$+ (\$TRANS)^2. \qquad (4)$$

After this step divide the result by a large number. Finally, to complete the computation, the Portfolio Composition Parameter is a small irrational root of the just obtained quotient.

5. The Portfolio Composition Parameter and Total Financial Assets

Every adjusted record in the 2004 edition of the Survey of Consumer Finances was placed in a wealth bin. The bins were \$25,000 wide below \$2 million, \$50,000 wide between \$2 and \$5 million, and then \$2.5 million wide from there to \$20 million. All entries above \$20 million were grouped together. After that Figure 1 was created.

Figure 1 is an Excel-generated plot, showing its least squares fit to a power law function, of the connection between the Portfolio Composition Parameter and total financial assets. Based on the coefficient of linear correlation the power law fit is perfect. Why a power law function fits the data is so well is unfathomable to me. (Power laws have no scale---or are said to be scale invariant---which is not what I would expect when discussing an absolute quantity such as money.)

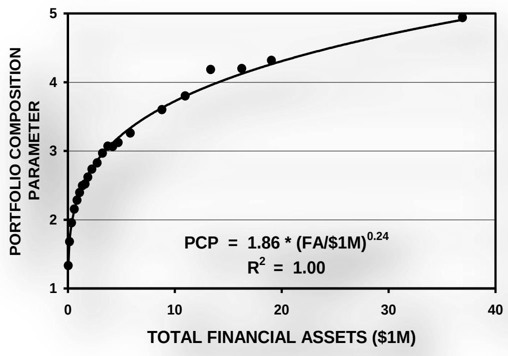

Figure 1. Portfolio Composition Parameter vs. Total Financial Assets.

It is very important to note the extremely large range of accumulated funds this relationship holds over; essentially from the poorest to the quite well-off (e.g., $30+ million pre-sub-prime mortgage mess and its attendant financial effects). Finally, the rarity of such small residuals from such a simple curve---utilizing financial data---is also noteworthy. (All the Figures in this paper were generated using Excel and all the numerical results were computed using Excel's automated fitting functions. The Excel output has been truncated.)

To demonstrate that this extremely tight relationship is not dominated by the wealthiest bins, only those with total financial assets less than $5 million were analyzed and the Portfolio Composition Parameter's fit to a power law function. The outcome is presented in Figure 2. Observe that both the multiplicative constant and the exponent are very near those obtained when all the information was included.

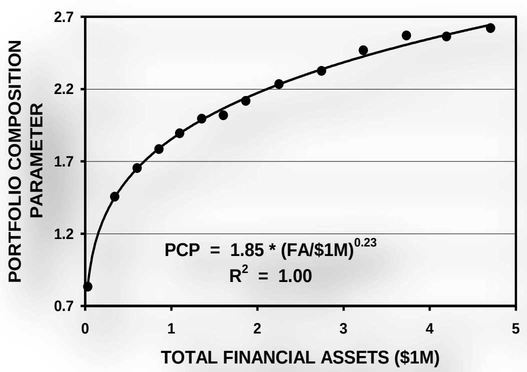

Figure 2. Portfolio Composition Parameter vs. Total Financial Assets (Amounts ≤ $5M).

These two astonishing goodness of fit outcomes imply that if one knows a household's Portfolio Composition Parameter's value, then one knows the sum of financial assets held by that household and vice versa. However, knowing the Portfolio Composition Parameter's value may not be able to divide finely the distribution of funds among the various investment types. The reason is, as defined, it appears only be to a broad, and somewhat probabilistic, measure of holdings and therefore financial risk acceptance/rejection tendency. In contrast, the Asset-Based Risk Ratio, introduced below, has a sharper focus. Using it I can validate the overall utility of the simpler Portfolio Composition Parameter.

5.1 The Central Moment Portfolio Composition Parameter

The Portfolio Composition Parameter is a measure based on the absolute dollar amounts allocated to different asset categories in one household's investment portfolio. The reader might, instead, be interested in the central moment of the Portfolio Composition Parameter. This statistic would reveal how far away a particular household's asset levels were from the mean of its type. Utilizing the notation introduced above, the expression for the kernel of the Central Moment Portfolio Composition Parameter is given by

$$(\$OTHER - <\$OTHER>)^2 + (\$STK - <\$STK>)^2 + (\$BNDS - <\$BNDS>)^2 + (\$MF - <\$MF>)^2 + (\$ANN - <\$ANN>)^2 + (\$RET - <\$RET>)^2 + (\$TRANS - <\$TRANS>)^2, \quad (5)$$

where the angular brackets signify an average value and the dollar sign continues to denote the dollar amount of the abbreviation. As above, after division of the sum by the same large number---and then with the same root extraction---the result is the Central Moment Portfolio Composition Parameter. Subsequent to performing the indicated calculations, Figure 3 was prepared.

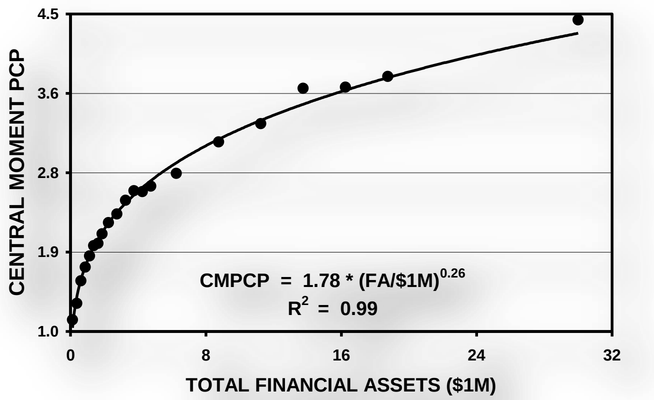

Figure 3. Central Moment Portfolio Composition Parameter vs. Total Financial Assets.

Given how low the mean amount of accumulated savings was across the country's populace in 2004, compared to the upper limit used herein, we could anticipate that the numerical values of this power law fit would be similar to those shown in Figure 1. If, instead, the highest values are used as the amount to pivot against, then the graph looks quite different as are the numerical estimates of the formula's parameters.

5.2 1 x Many Portfolio Composition Parameters

An alternative method of examining asset mixture is to focus on one external parameter, say age group or annual income bin. Suppose that there are M age groups. Consider computing the Portfolio Composition Parameter between age groups #n and #m with n < m and n,m ϵ [1,M]. In other words, the core of this number is evaluated from

$$(\$OTHER_n - \$OTHER_m)^2 + (\$STK_n - \$STK_m)^2 + (\$BNDS_n - \$BNDS_m)^2 + (\$MF_n - \$MF_m)^2 + (\$ANN_n - \$ANN_m)^2 + (\$RET_n - \$RET_m)^2 + (\$TRANS_n - \$TRANS_m)^2 . \quad (6)$$

Continuing to execute the computations as indicated above, but this time for a set of 10 year wide age groups, allows one to generate Figure 4.

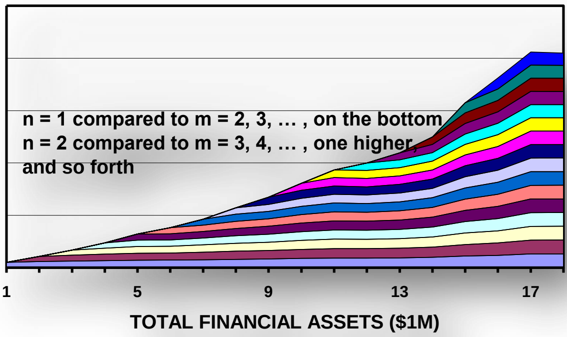

Figure 4. n < m, n,m є [1,M] Portfolio Composition Parameter Distribution vs. Total Financial Assets (10 Year Age Groups).

Note how similar each distribution is to its nearest neighbors and most of them are to each other. It is only when the higher wealth levels are reached is there a significant departure from this pattern (i.e., the rich are different from the rest of us with regard to their financial asset holdings).

6. Annual Household Income and Total Financial Assets

To see if there is a close connection between annual household income and total financial assets I divided annual household into several bins. I commenced with a bucket size of $25,000 per year up to a quarter of a million dollars per year. The next step size was $125,000 per year until earnings of three-quarters of a million dollars per year was reached. After this level of yearly income, I utilized two more groups---each $250,000 per year wide. Lastly, all those above $1 million per year thrown together. The dependence of annual household income on the total stock of wealth is portrayed in Figure 5.

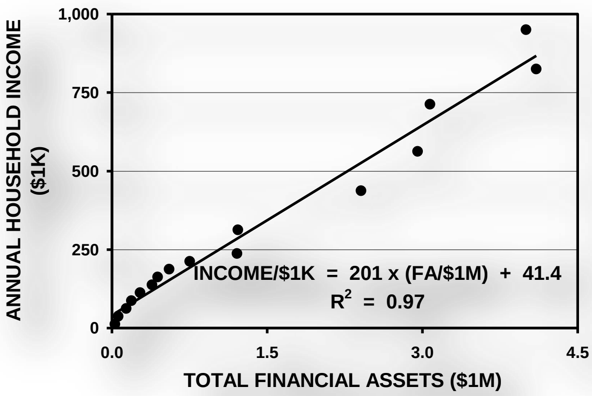

Figure 5. Annual Household Income vs. Total Financial Assets.

This Figure shows a very tight connection between *accumulated* financial assets and *current* annual household income. Why this should be is not obvious to me. Rather, I would expect today's total savings to be related---in a extremely complicated fashion---to the time histories of annual household income, savings behavior, money allocation, investment returns, capital gains and income taxes, and 'dis-saving' activity.

7. Portfolio Composition Parameter and Annual Household Income

Following the completion of Figure 5, I investigated the relationship between the Portfolio Composition Parameter and annual household income. Given the outcome just shown, the appearance of Figure 6 should not be surprising:

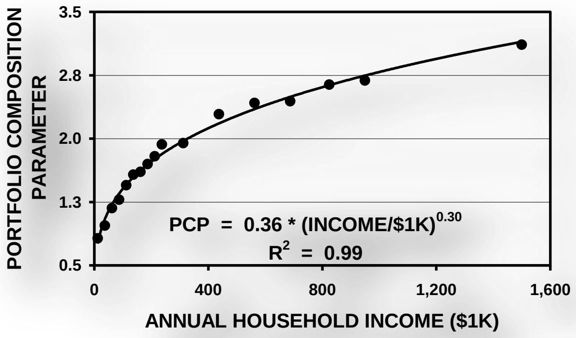

Figure 6. Portfolio Composition Parameter vs. Annual Household Income.

8. More Experimentation

Encouraged by these successes, I wondered if there was another financial quantity---already in the literature---that could be used to assess a household's level of risk acceptance or rejection with respect to its investment choices. Moreover, if such could be found, how would it compare against the Portfolio Composition Parameter? Knowing of the work by Schooley and Worden (1996), who used something close to the Sharpe Ratio for their research, I examined the Sharpe and Treynor Ratios looking for a means to connect investment risk behavior with total financial assets. Unfortunately, these ratios contain one too many elements to be easily converted into something useful for my purposes. Therefore, I looked for ways of directly manipulating the 'beta' of a portfolio. The Capital Asset Pricing Model formula provides one.

8.1 The Capital Asset Pricing Model Formula

One form of the Capital Asset Pricing Model formula uses:

1) The annual expected rate of return from an asset, R.
2) The annual risk-free rate of return, R_F.
3) The annual average rate of return, for the appropriately defined market, that this asset type belongs to, $R_{<m>}$, where the angular bracket still signifies an average. And,
4) Beta, β, a normalized measure of the covariance between this asset's (undefined) time history of price movements and those of its relevant market.

In terms of these quantities the Capital Asset Pricing Model formula takes the form

$$R = R_F + \beta \times (R_{<m>} - R_F). \tag{7}$$

Now imagine two portfolios. Label them A and B to differentiate between them. Their Capital Asset Pricing Model formulas will have the same form as above, except for subscripts A and B, respectively, on their rates of return R and on their values of beta. Solve their separate Capital Asset Pricing Model equations for their β's:

$$\beta_A = \frac{R_A - R_F}{R_{<m>} - R_F}, \qquad \beta_B = \frac{R_B - R_F}{R_{<m>} - R_F}. \tag{8}$$

There are two straightforward ways to compare the values of the beta's: by considering their quotient or their difference. The difficulty with the quotient is that it is unbounded. The problem with the difference is that it can also be ambiguous---especially if one of the betas is negative. A better way to generate a more easily grasped measure of the two asset mixture's relative risk levels is to normalize the difference between the betas by their sum as in

$$\frac{\beta_A - \beta_B}{\beta_A + \beta_B} = \frac{R_A - R_B}{R_A + R_B - 2 \times R_F}. \tag{9}$$

This is an improvement but still unsatisfactory because of the double presence of the risk-free rate of return in the denominator. This feature will present an interpretative conundrum if even one rate of return is near the risk-free rate of return. Removing the term containing the risk-free rate produces a more transparent quantity bounded above by +1 and below by -1:

$$\frac{R_A - R_B}{R_A + R_B}. \tag{10}$$

9. The Asset-Based Risk Ratio

These manipulations led me to the idea of partitioning a household's portfolio into two parts, one consisting of the riskiest assets and the other containing the least risky assets. In terms of the order given above, that put the first four items in the risky category and the last three in the less risky category. The definition of the Asset-Based Risk Ratio is given by[2]

This partition is impractical to carry out using the information in the Survey of Consumer Finances. To do so effectively one would need at least 20 sub-divisions of a portfolio into easily identifiable risk categories. Moreover, there are six different ways to combine the three categories. Hence, there may not be a unique, best, grouping to reveal risk-taking behavior *per se*. (There would also be redundancy.)

$$\text{Asset-Based Risk Ratio} = \frac{(\$\text{Most Risky}) - (\$\text{Least Risky})}{(\$\text{Most Risky}) + (\$\text{Least Risky})}. \tag{11}$$

The dollar sign, as above, continues to indicate the amount of funds dedicated to that symbol. Note that the denominator is just the total amount of financial assets.

9.1. The Portfolio Composition Parameter and the Asset-Based Risk Ratio

First, I examined the trend of the Portfolio Composition Parameter with the Asset-Based Risk Ratio with the total amount of accumulated funds as the independent variable. This is shown in Figure 7.

[2] Bertaut and Starr-McCluer (2000) proposed a similar method to examine the degree of jeopardy an investor would accept or reject. They suggested a sub-division of an individual's assets into three categories:

1) Least risky.
2) Medium risky. And,
3) Most risky.

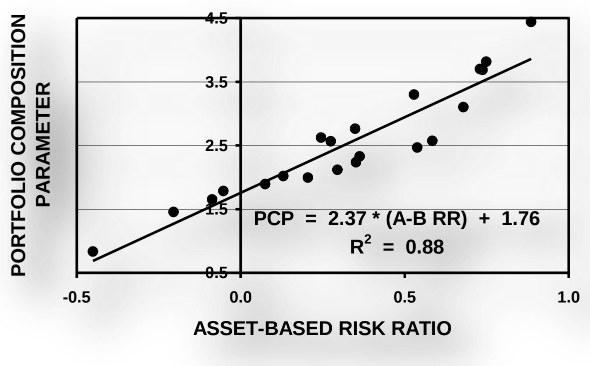

Figure 7. Portfolio Composition Parameter vs. Asset-Based Risk Ratio.

That there is a strong link between the Portfolio Composition Parameter and the Asset-Based Risk Ratio should not be too unexpected: in different ways they are measuring the same thing about a household's risk tolerance. Indeed, the tight, nearly linear, relationship proves that the Portfolio Composition Parameter, despite possible ambiguities, does do an excellent job at distinguishing between risk averse and risk accepting households based on their investment choices.

A graph of the Asset-Based Risk Ratio versus total stock of wealth turns out to be another simple curve with small residuals. However, to develop it as a power law function, first 1 has to be added to the Asset-Based Risk Ratio. (The power law function of a real positive variable with real parameters cannot produce a negative number.) The result is shown in Figure 8:

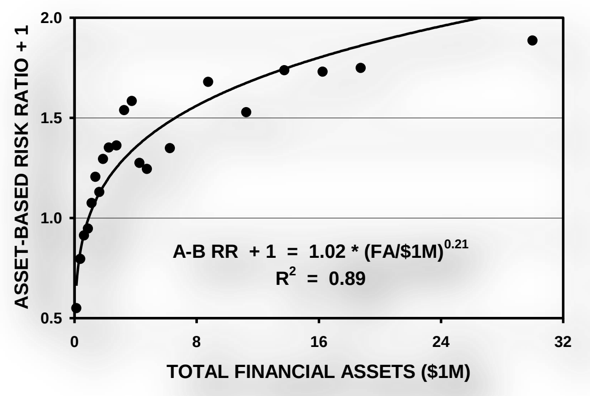

Figure 8. Asset-Based Risk Ratio + 1 vs. Total Financial Assets.

When I attempted to fit the Asset-Based Risk Ratio and the sum of financial assets with a logarithmic relationship this also worked fairly well as can be seen in Figure 9.

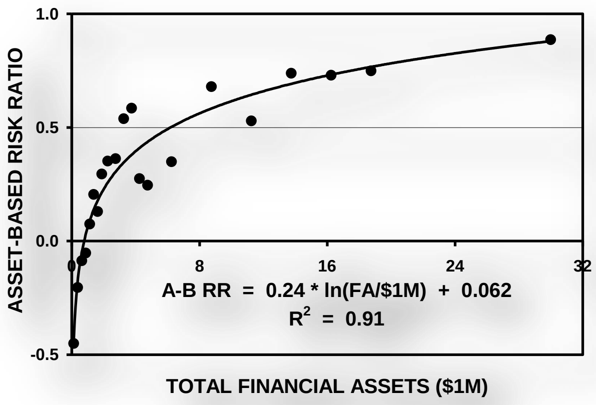

Figure 9. Asset-Based Risk Ratio vs. Total Financial Assets.

Observing this result, I re-did all the other data fits included in this paper using a logarithm function and found similar outcomes.)

10. A Transaction-Based Risk Ratio

It would be informative to repeat this type of analysis but for the sub-set of asset types within Transactions. However, the separation into only four, relatively risk-less, sub-categories in the Survey of Consumer Finances does not offer enough breadth to produce further elucidation. I suspect that---with a finer sub-division of investment possibilities---it too would demonstrate concomitant aspects of risk taking/rejecting behavior and a household's division of its cash especially for the less wealthy.

11. The Frequency Distribution of the Asset-Based Risk Ratio

The most surprising thing to me was the frequency distribution of the Asset-Based Risk Ratio. This is shown in the last Figure along with a fit to a lognormal distribution---the 'holy grail' of mathematical finance. It is only at the most extreme cases of ±1 does the essentially picture perfect fit fail.

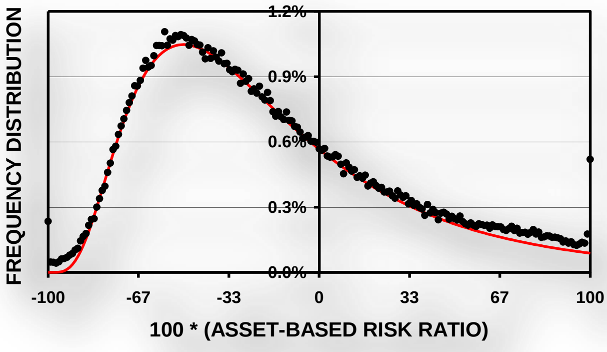

Figure 10. Asset-Based Risk Ratio Frequency Distribution with a Lognormal Fit.

18. Conclusion

This paper introduces two new measures of a household's propensity to accept or reject investment risk. The new measures are simple functions of the household's financial asset mixture. Standard applied finance tools, namely the Herfindahl Index and the Capital Asset Pricing Model, served as the motivation for the development of the novel indicators. Power law functions fit all the data extremely well except for the nearly linear link between this innovative duo. Most extraordinary is the lognormal functional form of the distribution of the empirical Asset-Based Risk Ratio. Finally, the fact that there is a nearly linear relationship between the sum of accumulated financial assets and current annual household income is inexplicable to me

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INVENTORY INVESTMENT VOLATILITY AND TRADE CREDIT

Xiaolou **YANG**
Youngstown State University, **USA**
xyang@ysu.edu

Abstract

This paper investigates the impact of trade credit on firm's inventory investment behavior by incorporating trade credit as a source of external finance into the traditional production smoothing inventory model. Due to imperfect information, alternative types of funds are not perfect substitutes and hence the choice and availability of external funds depend on the strength of firm's balance sheet condition. When bank loan becomes more difficult to obtain, firms use trade credit to overcome liquidity shortages. This study provides evidence showing that the use of trade credit, as an offsetting factor, can smooth out the impact of tight money and make the reduction of inventory investment less severe. This identification from the supply side provides support for a potential channel of monetary transmission, which can offset the tight monetary policy and reduce aggregate inventory investment fluctuations. This finding has important implications for both monetary policy and corporate financing management.

Keywords: Inventory, Investment, Volatility

JEL Classification: G30

1. Introduction

It is a well-known fact that inventory volatility accounts for a significant portion of business cycle fluctuations. Blinder and Maccini (1991) document that in the average US postwar recession declines in inventory investment accounted for about 87% of the total drop in GDP. While after mid-1980s, the volatility of inventories had a striking decline and same thing happens in the volatility of the aggregate output. Thus after mid-1980s, US economy has experienced a period of remarkable stability despite the slowdown after 2001. So it will be interesting to trace out what determine firm's inventory behavior and why the inventory volatility decline after 1980s.

One popular explanation attributes the diminished variability of economic activity to information-technology that led improvements in inventory management. However, McCarthy *et al.*. (2003) shows that the changes in inventory dynamics since the mid-1980s played a reinforcing-rather than a leading-role in the volatility reduction. Although the volatility of total inventory investment has fallen, the decline occurred well before the mid-1980s.

Inventory is mainly financed by short-term debt or trade credit. Recent research has ensured that market imperfections have a significant impact on real economic activities. Especially, in the imperfect capital market, alternative types of funds cannot be regarded as perfect substitutes and hence financial constrained firms most likely have difficulty to raise fund and thus have to cut investment. Given the low adjustment costs and high liquidity, inventories are thus more likely to be much more sensitive to the source of fund like trade credit than physical investment or RandD investment. Trade credit[1] is often related to financing inventories. Rajan and Zingales (1995) and Kohler *et al.* (2000) stated that the use of trade credit increased significantly after 80s. 55% of the total short-term credit received by firms during 1983-95 took the form of trade credit. In 1991, trade credit represented 18% of total assets for US firms. In 1993, 16% of total assets of small US businesses were funded by trade credit.

However, the above listed studies generally focus on the determinants of trade credit and its behavior over the business cycles, without looking at how trade credit actually relates to firms' real activities. When external finance becomes more difficult to obtain and more costly, firms make use of another source of finance to overcome liquidity shortages, namely trade credit. It is therefore possible, that even in periods of tight monetary policy and recession, when bank loans are harder to obtain and more costly, firms are not forced to reduce their inventory holdings too much as they can finance

[1] Trade credit (i.e., accounts payable) is given by short-term loans provided by suppliers to their customers upon purchase of their products. It is automatically created when the customers delay payment of their bills to the suppliers.

investments with trade credit, which can alleviate the impact of tight monetary policy and smooth out inventory investment fluctuations. The purpose of this paper is to address the question that whether the use of trade credit attributes to the decline of inventory volatility by incorporating trade credit into the traditional production smoothing inventory framework.

This paper contributes to the literature by providing, for the first time, rigorous analysis of the corporate inventory investment behavior in imperfect capital market when trade credit is included among the sources of external finance. I incorporate trade credit into the traditional production smoothing inventory framework, and develop a tractable linearized equation based on the firm's optimization model which describes the joint evolution of inventory investment and financial variables. This study provides evidence showing a significant effect of using trade credit on firms' inventory investment behavior. This suggests that using trade credit can help firms to offset liquidity problems. This identification from the supply side provides support for a potential channel of monetary transmission, which can offset the tight monetary policy and reduce aggregate inventory investment fluctuations. This finding has important implications for both monetary policy and corporate financing management.

The paper is organized as following. First I derive a generalized inventory model with trade credit in section 2. The data set is reported in section 3. Section 4 discusses the econometric methodology, and empirical results are reported in section 5. Section 6 discusses the impacts of trade credit on inventory investment using sensitivity analysis. I conclude the paper in section 7.

2. The Model

I start with the traditional production smoothing inventory model without trade credit as a benchmark model and then generalized the model by introducing trade credit.

2.1. Benchmark Inventory Model

I use the linear-quadratic model, followed by Yang (2010), for finished goods inventories as a benchmark model. In this model, a representative firm chooses the level of inventories to maximize the expected present discounted value of dividend subject to a cost function and production identity. Formally the model is

$$V(S_t, I_{t-1}) = \underset{I_t}{Max}\, D_t + E_{S_{t+1}|S_t} \beta V(S_{t+1}, I_t), \qquad \forall S_t, I_t \tag{1}$$

subject to

$$\begin{aligned} D_t &= S_t - C_t, \\ C_t &= (\alpha_0/2)(\Delta Q_t)^2 + (\alpha_1/2)Q_t^{\,2} + (\alpha_2/2)(I_t - \alpha_3 S_t)^2, \\ Q_t &= S_t + I_t - I_{t-1}, \end{aligned} \tag{2}$$

where $V(\cdot)$ is the value function, D_t is firm's dividend, I_t is real end of period finished goods inventories in period t, S_t is real sales, Q_t is real production, and β is the discount factor. The cost function, Ct, allows for two motives for maintaining inventories: to smooth production, and to target inventory levels to sales. The first two terms of the cost function captures the gains of smoothing production. The first term is the cost of changing production, and the second reflects the cost of production. The third term captures the cost of deviating from the target level of inventory. It includes the costs of carrying inventories and of stock-outs or backlogged orders. The cost parameters $\alpha_0, \alpha_1, \alpha_2$ and α_3 are assumed to be positive. Sales are stochastic, and follows an AR(1) process. The benchmark model has the implicit assumption of perfect capital markets. It assumes that internal and external funds are perfect substitutes, so the cost of finance and hence the marginal cost of holding inventories does not depend upon the source of finance. Therefore, there are no financial frictions in the model. Because of this, the benchmark inventory model usually has very poor model performance to capture market imperfections.

Solving the dynamic programming inventory model, the Euler equation is

$$E_t[\alpha_0 \Delta Q_t + \alpha_1 Q_t + \alpha_2 (I_t - \alpha_3 S_t) + \alpha_0 \beta^2 \Delta Q_{t+2} - 2\alpha_0 \beta \Delta Q_{t+1} - \alpha_1 \beta Q_{t+1}] = 0. \tag{3}$$

This is a necessary condition for profit maximization. The cost of holding an extra unit of inventory equals the marginal gain of producing one unit today instead of tomorrow. It indicates that the firm balances the cost of producing one unit of the good today and storing it against the cost of producing the good tomorrow.

2.2. Inventory Model with Trade Credit

In this section, I extend the linear quadratic structural model of inventory to explicitly incorporate trade credit. In the imperfect capital market, trade credit can work as an indicator of credit market condition—risk-averse debt holders demand an external finance premium, which is an increasing function of the amount borrowed. It captures the feature of increasing cost of funds. So when firms do not have sufficient amount of internal funds for inventory investment, they have to borrow subject to a costly risk premium. In order to capture the agency cost with financial friction, I add a non-negativity constraint on firm's dividend payment. The model is

$$V(S_t, R_t, I_{t-1}, TC_{t-1}) = \underset{I_t, TC_t}{Max}\, D_t + E_{S_{t+1}, R_{t+1} | S_t, R_t} \beta V(S_{t+1}, R_{t+1}, I_t, TC_t), \qquad \forall S_t, R_{t+1}, I_t, TC_{t-1} \tag{4}$$

subject to

$$D_t = S_t + \Delta TC_t - C_t,$$

$$C_t = (\alpha_0/2)(\Delta Q_t)^2 + (\alpha_1/2)Q_t^{\,2} + (\alpha_2/2)(I_t - \alpha_3 S_t)^2 + \left[R_t + \left(\frac{TC_{t-1}}{I_{t-1}}\right)^{\phi}\right] TC_{t-1},$$

$$Q_t = S_t + I_t - I_{t-1},$$

$$D_t \geq 0, \tag{5}$$

Maintaining the same features of the traditional inventory model, I allow financial friction by adding an extra term in the cost function—the cost of financing inventory or external finance premium. It has two components: R_t is the risk free rate of return which is common to all firms. The second component captures the risk premium due to asymmetric information. The risk premium is an increasing function of firm's previous period's trade credit to inventory ratio. The idea is that high ratio firms have to pay an additional premium to compensate debt holders for increased costs due to information problem. It is similar way as Gilchrist and Himmelberg (1998) used to build financial frictions into investment model. By adding the non-negativity constraint into the model, I create a state-dependent discount factor that depends on the firm's balance sheet condition.

Let λ_t be the Lagrange multiplier for the non-negativity constraint on dividends. The λ_t multiplier indicates the shadow price of paying a 'negative' dividend. It can be interpreted as the shadow cost of internally generated funds. The role of this shadow cost in the firm's investment decision is presented in the underlying Euler equation for inventory investment:

$$E_t\{\alpha_0 \Delta Q_t + \alpha_1 Q_t + \alpha_2 (I_t - \alpha_3 S_t) + \beta^2 \left(\frac{1+\lambda_{t+2}}{1+\lambda_t}\right) \alpha_0 \Delta Q_{t+2}$$
$$- \beta \left(\frac{1+\lambda_{t+1}}{1+\lambda_t}\right)\left(2\alpha_0 \Delta Q_{t+1} + \alpha_1 Q_{t+1} + \phi \left(\frac{TC_t}{I_t}\right)^{\phi+1}\right)\} = 0, \tag{6}$$

If $\lambda_{t+2} = \lambda_{t+1} = \lambda_t$ =0 and ϕ =0, the shadow cost of internal funds is one, which is the case that the Euler equation is identical to the one provided by the perfect-capital markets model. On the other hand, when capital market is imperfect, λ_t is state-dependent and time varying. The first-order condition for debt is

$$E_t\left\{\beta \left(\frac{1+\lambda_{t+1}}{1+\lambda_t}\right)\left(1 + R_{t+1} + (1+\phi)\left(\frac{TC_t}{I_t}\right)^{\phi}\right)\right\} = 1, \tag{7}$$

The marginal cost of debt determines the shadow cost of funds today vs.
tomorrow (i.e., λ_t v.s. λ_{t+1}), and provides a state dependent discount factor that depends on the level of debt to inventory ratio. This structure allows us to identify the sensitivity of inventory investment to changes in the use of trade credit. With financial frictions in the model, I will show that inventory investment displays sensitivity to the present value of financial variables because these variables influence the future shadow cost of funds and thus the future marginal product of inventories (MPI).

Rewrite the first-order conditions for above model with financial frictions, I get

$$\frac{\partial C(S_t, I_t, TC_{t-1})}{\partial I_t} = E_t\left\{\beta \left(\frac{1+\lambda_{t+1}}{1+\lambda_t}\right)\frac{\partial D_{t+1}}{\partial I_t} + \beta^2 \left(\frac{1+\lambda_{t+2}}{1+\lambda_t}\right)\frac{\partial D_{t+2}}{\partial I_t}\right\}, \tag{8}$$

where
$$\frac{\partial C(S_t, I_t, TC_{t-1})}{\partial I_t} = \alpha_0 \Delta Q_t + \alpha_1 Q_t + \alpha_2 (I_t - \alpha_3 S_t),$$
$$\frac{\partial D_{t+1}}{\partial I_t} = 2\alpha_0 \Delta Q_{t+1} + \alpha_1 Q_{t+1} + \phi \left(\frac{TC_t}{I_t}\right)^{\phi+1},$$
$$\frac{\partial D_{t+2}}{\partial I_t} = -\alpha_0 \Delta Q_{t+2},$$

rewrite equation (8) to get

$$\frac{\partial C(S_t, I_t, TC_{t-1})}{\partial I_t} = E_t \sum_{s=1}^{\infty}\left(\beta^s \prod_{k=1}^{s}\left(\frac{1+\lambda_{t+k}}{1+\lambda_{t+k-1}}\right)\right) MPI_{t+s}, \tag{9}$$

Because it is not possible to solve this model analytically, I used the methodology in Gilchrist and Himmelberg (1998)[2]. They showed how the resulting model, which is nonlinear, can be linearized to obtain a tractable dynamic system of equations. I will use their technique to show a linearized version of system that describes the joint evolution of inventory investment and trade credit. This framework includes the standard quadratic inventory model as a special case.

[2] The difference is that they apply this method in investment model and I apply it into the inventory model.

First, denote the stochastic component as $\Theta_{t,t+s} = \prod_{k=1}^{s}(1+\lambda_{t+k})/(1+\lambda_{t+k-1})$. In general, it will be a function of firm-level variables. Then we get

$$\frac{\partial C(S_t, I_t, TC_{t-1})}{\partial I_t} = E_t \sum_{s=1}^{\infty} \beta^s \Theta_{t,t+s} MPI_{t+s}, \tag{10}$$

Because the mean of $\Theta_{t,t+s}$ should be a value near one, I use a first-order Taylor approximation around $E(\Theta_{t,t+s}) \approx 1$ and $E(MPI_{t+s}) \approx \delta$ to write

$$\Theta_{t,t+s} MPI_{t+s} \approx \delta_0 + \delta\Theta_{t,t+3} + MPI_{t+s} \tag{11}$$

Furthermore, I approximate the expression for $\Theta_{t,t+s}$ to get

$$\begin{aligned}
\Theta_{t,t+s} &= \prod_{k=1}^{s}\left(\frac{1+\lambda_{t+k}}{1+\lambda_{t+k-1}}\right) \\
&\approx 1+\sum_{k=1}^{s}\left(\frac{\lambda_{t+k}-\lambda_{t+k-1}}{1+\lambda_{t+k-1}}\right) \\
&\approx conts.+\sum_{k=1}^{s}\Phi TC_{t+k},
\end{aligned} \tag{12}$$

Where assuming that $(\lambda_{t+k} - \lambda_{t+k-1})/(1+\lambda_{t+k-1}) = \delta_0 + \delta TC_{t+k}$ is a linear approximation. It represents the dependence of the shadow discount term on a financial state variable represented by TC_{t+k}. This approximation allows us to specify TC as net financial liabilities, for instance external finance premium, which can be proxy by the marginal cost of funds. Substituting the above approximations for $\Theta_{t,t+s} MPI_{t+s}$ and $\Theta_{t,t+s}$ into the present value and collecting constant terms yields

$$\begin{aligned}
\frac{\partial C(S_t, I_t, TC_{t-1})}{\partial I_t} &= E_t \sum_{s=1}^{\infty} \beta^s \Theta_{t,t+s} MPI_{t+s} \\
&= const.+\delta E_t \sum_{s=1}^{\infty} \beta^s \Theta_{t,t+s} + E\sum_{s=1}^{\infty} \beta^s MPI_{t+s} \\
&= const.+\delta\Phi E_t \sum_{s=1}^{\infty}\sum_{k=1}^{s} \beta^s TC_{t+k} + E_t \sum_{s=1}^{\infty} \beta^s MPI_{t+s},
\end{aligned} \tag{13}$$

We can obtain the marginal cost of inventory from the cost function, which is

$$-(\alpha_0 \Delta Q_t + \alpha_1 Q_t + \alpha_2 (I_t - \alpha_3 S_t)),$$

The present value of the future expectation of marginal production of inventory is

$$2\alpha_0 \beta \Delta\tilde{Q}_{t+1} - \alpha_0 \beta^2 \Delta\tilde{Q}_{t+2} + \alpha_1 \beta \tilde{Q}_{t+1},$$

Variables with tilta mean expectation. Substituting them into the equation yields

$$const.+\alpha_0\Delta Q_t+\alpha_1 Q_t+\alpha_2\left(I_t-\alpha_3 S_t\right)+2\alpha_0\beta\Delta\tilde{Q}_{t+1}-\alpha_0\beta^2\Delta\tilde{Q}_{t+2}+\alpha_1\beta\tilde{Q}_{t+1}$$
$$+\delta\Phi E_t\sum_{s=1}^{\infty}\sum_{k=1}^{s}\beta^s TC_{t+k}=0. \tag{14}$$

Collecting terms and putting inventory on the left hand side yields

$$I_t=const.-(\alpha_0/\alpha_2)\Delta Q_t-(\alpha_1/\alpha_2)Q_t+\alpha_3 S_t-2\beta(\alpha_0/\alpha_2)\Delta\tilde{Q}_{t+1}$$
$$+\beta^2(\alpha_0/\alpha_2)\Delta\tilde{Q}_{t+2}-\beta(\alpha_1/\alpha_2)\tilde{Q}_{t+1}-\delta\Phi E_t\sum_{s=1}^{\infty}\sum_{k=1}^{s}\beta^s TC_{t+k}, \tag{15}$$

Again, we go back to the situation we derived before. In summary, we get

$$I_t=const.+\underbrace{\sum_{l=0}^{2}\Psi_{0,s}\Delta Q_{t+s}+\sum_{l=0}^{1}\Psi_{1,s}\Delta Q_{t+s}+\alpha_3 S_t}_{Traditional\quad Model}-\underbrace{\delta\Phi E_t\sum_{s=1}^{\infty}\sum_{k=1}^{s}\beta^s TC_{t+k}}_{Financial\quad Frictions},$$

where

$$\Psi_{0,0}=-\left(\frac{\alpha_0}{\alpha_2}\right),\Psi_{0,1}=-2\beta\left(\frac{\alpha_0}{\alpha_2}\right),\Psi_{0,2}=\beta^2\left(\frac{\alpha_0}{\alpha_2}\right),\Psi_{1,0}=-\left(\frac{\alpha_1}{\alpha_2}\right),\Psi_{1,1}=-\beta\left(\frac{\alpha_1}{\alpha_2}\right) \tag{16}$$

Equation (16) splits the explanatory variables into two sources, one from the traditional model and the other from financial factors. Further, since at equilibrium, marginal cost of debt equals the marginal benefit of debt, therefore, marginal cost of debt is a good proxy for future expected return of funds, which is

$$R_t+(1+\phi)\left(\frac{TC_{t-1}}{I_{t-1}}\right)^{\phi}$$

Adding subscript *i* to distinguish firms, I can derived the exact reduced-form estimation equation from the structure model

$$I_{i,t}=const.-(\alpha_0/\alpha_2)\Delta Q_{i,t}-(\alpha_1/\alpha_2)Q_{i,t}+\alpha_3 S_{i,t}-2\beta(\alpha_0/\alpha_2)\Delta\tilde{Q}_{i,t+1}$$
$$+\beta^2(\alpha_0/\alpha_2)\Delta\tilde{Q}_{i,t+2}-\beta(\alpha_1/\alpha_2)\tilde{Q}_{i,t+1}$$
$$-(1/\alpha_2)\delta\Phi R_t-(1/\alpha_2)\delta\Phi(1+\phi)\left(\frac{TC_{i,t-1}}{I_{i,t-1}}\right)^{\phi}+\mu_i+\upsilon_t+\varepsilon_{i,t}. \tag{17}$$

μ_i represents a firm-specific effect and υ_t represents a time-specific effect that are controlled for in the estimation. $\varepsilon_{i,t}$ captures the expectational error that has been introduced in the equation because of the replacement of expected with actual future variables. There are two additional terms appear in this equation compared to the one derived from the standard linear quadratic model—the term with *Rt* and the term with short-term debt to inventories ratio. It implies a negative relationship between risk free rate, debt to inventory ratio and inventory investment. The higher the risk free rate the lower the inventory investment and the higher the debt to inventory ratio the lower the inventory investment.

The above equation explains the intuition underlying many of the empirical specifications in the literature. Specifically, it shows that inventory equations based on the benchmark contain an omitted variable in the error term, so that inventory will appear to be 'excessively sensitive' to any explanatory variable that helps to predict current or future values of financial variables. This equation also shows that investment can be excessively sensitive even to 'non-financial' variables like cost shocks, provided such variables help to predict future financial conditions.

3. Data

The data used in this paper is COMPUSTATA quarterly data. I restrict my attention to the manufacturing sector finished good inventory data from 1970-2005. I use the companies that had complete (i.e., nonzero and nonmissing) data on assets, sales, inventories, and trade credit. Then I eliminate the roughly 30 percent of companies that reported mergers or acquisitions during this period, because these events can induce discontinuities in the balance sheet items, thus the data used is a balanced panel. Finally, I dropped firms with less than five years of continuous observation. After all these screens, I am left with 1026 companies. All variables were deflated using output price indices in 1982 base year. The data summary statistics are reported in Table 1.

Table 1. Summary Statistics of Data[3]

Data Summary		
	mean	std
Assets	3279	6581
Output	670	2628
Sales	625	2534
Inventory	348	3396
D/I ratio	13.5	471

4. Econometric Specification

In this section I will use General Method of Moments (GMM) to estimate the structural parameters of the model with and without trade credit.

GMM estimates of the structural parameters are typically obtained from the Euler equation. Followed Fuhrer, Moore and Schuh (1995), I substitute realization of future data for expectations and apply generalized method of moments directly to the Euler equation.

GMM estimator is obtained by

$$\hat{\theta} = \arg\min_{\theta} \overline{m}(\theta)' \hat{W} \overline{m}(\theta)$$

where $\overline{m}(\theta) = \frac{1}{T}\sum_{i=1}^{n} m_i(\theta)$ is the sample mean of the moments, T is the number of observations. $\hat{W}$ is a $\kappa \times \kappa$ weighting matrix, where κ is the number of moments. I use the Newey and West (1987) estimate of $\hat{W}$ with lag length of 4. The overidentifying restriction test statistic is,

$$J_{STAT} = T\overline{m}(\hat{\theta})' \hat{W}^{-1} \overline{m}(\hat{\theta}).$$

Reject the null if $J_{STAT} > \chi^2(\kappa - \dim\theta)$ holds.[6]

5. Empirical Results

Since the structural parameters are not separately identified, it is necessary to specify a parametric normalization which is equivalent to choosing a left-hand-side variable.[7] Therefore, all

[3] All data reported based on million $.

[6] The degree of freedom is one in this case: the number of moments minus the number of parameters.

results are reported as a ratio to α_2. The discount factor β is calibrated to 0.995. Since α_3 is fixed at 0.5 for either production smoothing, neutral or bunching model in the literature, the value of α_3 is calibrated to be 0.5.[8] The 3-month Treasury bill is used as the risk free rate. I estimate all my equations in first differences in order to eliminate the firm-specific time-invariant effect.

First, I start with the benchmark inventory model. The structural parameter estimation is based on equation (3). The parameter set is $[\alpha_0/\alpha_2, \alpha_1/\alpha_2]$. For the benchmark model, I set the instrument set as $Z_t = [1, I_{t-1}, S_{t-1}]$. All results are reported in Table 2.

Table 2. Structural Parameters Estimations of Benchmark Model

α_0/α_2	α_1/α_2	J-Stat (1)
8.26	15.82	32
(16.19)	(24.31)	

The structural parameters of α_0/α_2 and α_1/α_2 are positive, which are consistent with the literature. But all of the coefficients are insignificant. The J-Stat is 32, which implies that the benchmark model may contain missing variable in the error term and cannot fit the data. The benchmark model is rejected by the J-statistics.

The generalized inventory model with trade credit developed in section 2 captures a missing variable in the baseline inventory model when the capital market is imperfect and therefore is expected to improve the model performs.

The structural parameters estimation for the inventory model with financial friction is based on equation (17). The parameter set for the generalized model is $[\alpha_0/\alpha_2, \alpha_1/\alpha_2, (\delta\Phi)/\alpha_2, \phi]$. The instrument set is $Z_t = [1, I_{t-1}, S_{t-1}, (I_{t-1} - S_{t-1}), (B_{t-2}/I_{t-2})]$. These instruments provide information informative the structure parameters. For instance, the difference between inventory and sales reflects the target inventory motive. The debt to inventory ratio captures the external finance premium in imperfect capital markets. The results are reported in Table 3.

Table 3. Estimates of the Structural Parameters

α_0/α_2	α_1/α_2	$(\delta\Phi)/\alpha_2$	ϕ	J-Stat (1)
0.46	1.48	0.43	1.22	3.2
(0.015)	(0.028)	(0.012)	(0.097)	

The structural parameters α_0/α_2 and α_1/α_2 are positive and significant, this is consistent with the literature. The coefficient of the interest rate is significantly different from zero. This suggests that firms are sensitive to the interest rate changes on average. A few papers suggest that inventory investment is insensitive to the interest rate changes. Those arguments are not confirmed by this study. The coefficient of the trade credit ϕ is significantly different from zero. It is 1.22. This suggests that the inventory is quite sensitive to the use of trade credit. Finally, the J-statistics cannot reject the overidentifying restriction and accept the inventory model with trade credit.

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[7] *See*, Fuhrer, Moore and Schuh (1995).
[8] *See* Krane and Braun (1991); Blinder and Maccini (1991).

6. Sensitivity Analysis

Having derived the structural model, I can gauge the empirical contribution of trade credit to inventory investment. I did this by shocking the sales and risk-free rate to construct the forecast and tracing out the time path for all variables in the model with and without trade credit. The results are reported in Figure 1 and Figure 2. In these figures, I examined the sensitivity analysis of inventory investment to an interest rate shock and a sales shock.

6.1. Impulse Response Function to an Interest Rate Shock

Figure 1 compares the impulse responses of the benchmark model and trade credit model to a positive interest rate shock.

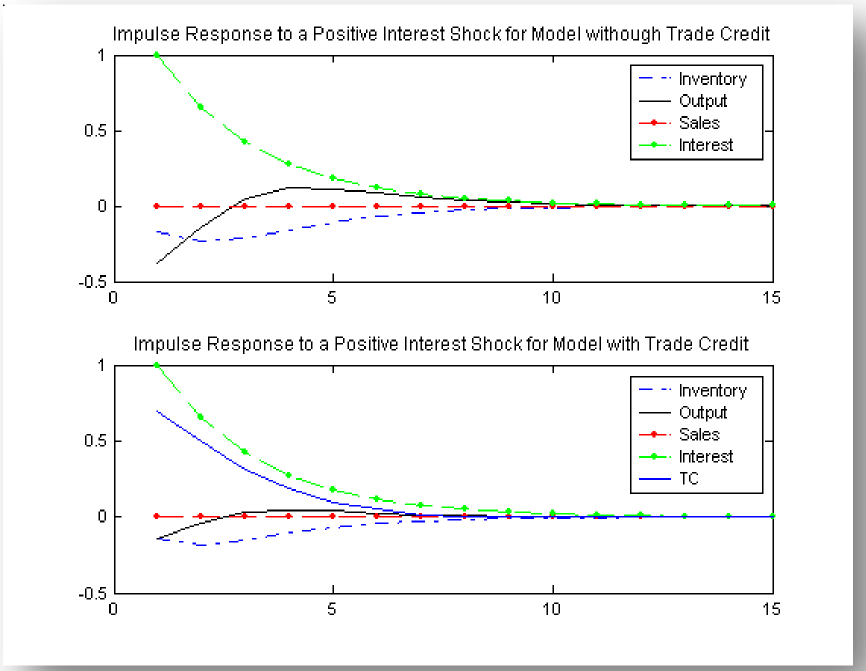

Figure 1. Impulse Response to a Positive Interest Rate Shock

The top picture shows the impulse responses to a positive interest rate shock for the model without trade credit. Inventory and production are all decreasing when the interest rate increases. That implies that the firms do face financial difficulties to get funds to finance their investment plan when interest rate increases, and therefore forced to reduce their production and inventory investment. The bottom picture is the impulse responses to a positive interest rate shock for the model with trade credit. When interest rate increases, the trade credit-to-inventory ratio increases instead as source of funds. Therefore, the use of trade credit fills out the gap of short of funds when money is tight and ensures the production and inventory investment plans that otherwise will be cut off. So we can see in the bottom picture that the reduction of both production and inventory become much less severe than the case without the use of trade credit. It suggests that trade credit provides a channel of monetary transmission which dampens the impacts of contractionary monetary policy and makes the reduction of inventory investment less severe.

7. Conclusions

This study incorporates trade credit into the traditional production smoothing inventory model and provide new evidence confirming the role of trade credit as a buffer to smooth inventory fluctuations. It can be interpreted as evidence that firms are credit constrained and have to use trade credit when suffering from a restrained access to bank finance. This point is confirmed by the fact that credit rationing and information asymmetry proxies do have a positive influence on the use of trade credit by firms. It is in favor of the fact that the trade credit channel weakens the credit channel. These findings are important as they suggest that the trade credit channel is likely to dampen the effects of contractionary monetary policies, and more in general to make the recessions that generally follow these policies less severe.

The benchmark model has the implicit assumption of perfect capital markets. It assumes that internal and external funds are perfect substitutes, so the cost of finance and hence the marginal cost of holding inventories does not depend upon the source of finance. Therefore, there are no financial frictions in the model. Because of this, the benchmark inventory model usually has very poor model performance to capture market imperfections. The empirical results based on COMPUSTAT data showed that the model performance of the benchmark inventory model is poor, which implies that the model contains missing variable in the error term and therefore cannot fit the data. The model is rejected by J-statistics. However, the generalized model with trade credit captures a missing variable in the baseline inventory model when the capital market is imperfect. The J-stat is very small, which is 3.2. It shows that the overall model performance for the generalized model is superb and matches inventory data very well.

The results also propose a signaling role of trade credit when firms do not have any long-term relationship with banks—trade credit is used when firms cannot have access to bank debt and may simultaneously enhance this access to the banking market. Their restrained access to bank debt leads them to use trade credit more frequently. This, in turn, increases a firm's visibility to the banks. Accordingly, banks may update their information regarding the firm's financial status and fund some projects that would not have been funded otherwise. In other words, there exists a dynamic relationship between trade credit and bank debt for credit-rationed firms. This paper has important implication of monetary policy and corporate management. From the theoretical point of view, it underlines the benefits of models which take into account the influence of trade credit in inventory investment dynamics.

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