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Causality Between Stock Returns and Macroeconomic Variables in Emerging Markets

The relationship between stock prices and macroeconomic variables has been predominantly investigated assuming that macroeconomic fluctuations are influential on stock prices through their effect on future cash flows and the rate at which they are discounted (Chen et al. 1986; Geske and Roll 1983; Fama 1981). A number of macroeconomic factors have been used to represent risk in mature stock markets. Earlier studies were mainly motivated by the Arbitrage Pricing theory (Ross 1976), and could be perceived as global asset pricing models (Ferson and Harvey 1998). Some of the popular factors used in these models were industrial production, inflation, interest rates, and oil prices (Hamao 1988; Harris and Opler 1990). The objective, there, was to explain expected returns over time. The logic and methodologies used, therefore, are based on the understanding that expected returns are dependent upon these risk factors. The direction of the relationship is thus assumed to be unidirectional, and from macroeconomic variables to stock returns.

Dynamic linkages between stock markets and macroeconomic variables are equally important. However, such linkages have been investigated only recently and extensively for developed markets (Mukherjee and Naka 1995; Lee 1992). Dynamic linkages in the emerging markets

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of less developed countries have been ignored, with a few exceptions. Such relationships are considerable, however, mainly due to the overwhelming influence of governments in economic activity. Stock markets have been established only recently, the volume of trade is low, and company-specific information is not always timely or of high quality (Bekaert and Harvey 1998; Muradoglu et. al 1998). Therefore, stock markets are prone to influence from economic policy. Again, the relationship is assumed to be unidirectional, from macroeconomic variables to stock returns.

Empirical work has provided evidence for the effect of a number of macroeconomic variables on stock returns. Exchange rates have been shown to influence stock prices through the terms of trade effect (Geske and Roll 1983). The depreciation of domestic currency increases the volume of exports. Provided that the demand for export goods is elastic, this in turn causes higher cash flows for domestic companies, and thus causes stock prices to increase. The relationship between inflation and stock returns is highly controversial. However, empirical studies have mainly documented a negative relationship between inflation and stock returns (Fama and Schwert 1977; Geske and Roll 1983). An increase in inflation has been expected to increase the nominal risk-free rate, which in turn will rise the discount rates used in valuating stocks. If cash flows increase at the same rate, the effect of the higher discount rate is will be neutralized. Otherwise, if contracts are nominal and cannot adjust immediately, the effect will be negative. The effect of nominal interest rates on stock prices is also expected to be negative, in this argument (Chen et al. 1986). The level of real economic activity is expected to have a positive effect on future cash flows, and thus will affect stock prices in the same direction (Fama 1990).

Recent work on the relationship between stock returns and macroeconomic variables has employed techniques, such as VAR and VECM, that take into account dynamic linkages. Lee (1992) investigated causal relations and dynamic interactions among asset returns, real activity, and inflation in the post-war United States. Lee's main results indicate that real stock returns help explain movements in real activity. Inflation is not explained by real stock returns. Real stock returns explain little variation in inflation, but interest rates explain a substantial fraction of the variation in inflation. Inflation explains little variation in real activity. Lee's findings are compatible with Fama's (1990) explanation for negative stock return-inflation relationship.

Mukherjee and Naka (1997) investigated the co-integration relationship between stock returns and six macroeconomic variables in Japan. They employed a VECM in a system of seven equations. They reported that a co-integrating relationship exists and stock returns contribute to this relationship. The signs of long-term elasticity coefficients are also consistent with those predicted by the cash flow hypothesis described above.

Ajayi and Mougoue (1996) studied the dynamic relationship between stock prices and exchange rates, employing a bivariate error-correction model. They investigated both the short-run and the long-run relationships between the two variables in the "Big Eight" stock markets, including Canada, France, Germany, Italy, Japan, Netherlands, the United Kingdom, and the United States. The results reveal that an increase in domestic stock prices has a negative short-run effect on the value of the domestic currency. Yet, sustained increases in the domestic stock prices in the long run will appreciate the domestic currency, since the demand for the currency will be driven up.

Graham (1996) investigated the relationship between stock returns and inflation for the United States during the period 1953–90. The relationship is unstable, in the sense that it was negative before 1976 and after 1982, and positive in between those years. This instability may be the result of a shift from counter-cyclical to pro-cyclical monetary policy in 1976, and back to counter-cyclical policy in 1982.

Rahman and Mustafa (1997) investigated the relationship between the Standard-&-Poors 500 and short-term corporate bond rates in the United States. Short-term rates and U.S. stock prices tend to approach each other in the long run. This may be due to the substitutability between U.S. common stocks and short-term corporate bonds, in terms of average holding periods, liquidity, convertibility, and risk structures. A two way Granger causality and reversible feedback between these markets is observed in the short run. In their analysis, short-term corporate bonds were considered to be very close substitutes for common stocks, in terms of average holding period, liquidity risk, and default-risk. Hashemzadeh and Taylor (1998) examined the direction of causality between the money supply, stock prices, and interest rates in the United States. The relationship between money supply and stock prices is characterized by a feedback system, with money supply causing some of the observed variation in stock price levels, and vice versa. Causality runs from interest rates to stock prices, but not the other way.

Emerging markets are defined by the IFC as any market belonging to low- and middle-income less-developed countries, with the implication that all have the potential for development. Some of these markets tend to be very small in size, with a very low volume of transactions, and a lack of high quality accounting data and other market information. Others are large or expanding rapidly. Yet the properties of stock returns and risk-return characteristics may be quite different. Compared to their mature counterparts, in emerging markets yields and volatilities are higher, and returns are auto-correlated and not integrated into global markets. The stock markets have a limited function as a source of financing for firms, as long as the cost of capital is high and integration with the rest of the world is low.

The dynamic relationship between macroeconomic variables and stock returns have been investigated for the emerging markets only recently, as a consequence of the rapid developments in these markets and the availability of reliable data from the IFC. The rapid expansion of international trade and liberalization efforts of these countries in the past two decades, as well as the diversification needs of international portfolio managers, are some of the factors that contribute to the increased attention focused on emerging markets. The liberalization efforts in these countries are expected to integrate them to the world economy, and thus reduce the cost of capital. The process of integration is very much related to the macroeconomic policies adopted in these countries. Also, the macroeconomic policies employed are related to the level of global integration of the country. Therefore the cause-and-effect relationship between macroeconomic variables and stock returns is crucial for a better understanding of emerging markets.

In emerging markets, the studies that have investigated the relationship between macroeconomic variables and stock returns have usually been in the form of country studies. Bailey and Chung (1995) studied the systematic influence of exchange rate fluctuations and political risk on stock returns in Mexico. The major findings are consistent with time-varying equity market premium for exposure to the changes in free market dollar premium. Abdalla and Murinde (1996) investigated the interactions between exchange rates and stock prices in India, Korea, Pakistan, and the Philippines using Granger causality, and monthly data over the period from January 1985 to July 1994. Unidirectional causality is observed from exchange rates to stock prices in all countries except the Philippines, where stock prices Granger cause stock prices.

Muradoglu and Metin (1998) studied the co-integration relationship between macroeconomic variables and stock returns in Turkey. They indicated that the variables explaining stock prices might change over time, and that the influence of monetary expansion and interest rates disappear, while foreign currency prices re-gain significance over time, as the market becomes more mature.

On the other hand, studies investigating emerging markets as a group have emphasized characteristics of stock returns such as distributional properties (Bekaert al. 1998), volatilities (Bekaert and Harvey 1997), and changes in those properties over time (Bekaert and Harvey 1995). The limited number of studies using macroeconomic variables for emerging markets as a group have used them for asset pricing purposes (Ferson and Harvey 1998), and thus in a unidirectional manner. Bekaert and Harvey (1998), for example, argued that if restrictive measures are initiated or the political and economic environment is not conducive to international investors, capital flows should dry up. It is therefore also important to carefully consider the particular economic and political environments within each country.

Previous studies on emerging markets have recognized the importance of causal relationships, and have discussed them with respect to specific countries. However, a number of drawbacks remain. First, can we come up with regularities for emerging markets, as a whole? To our knowledge, ours is the first study to investigate the causal relationship between macroeconomic variables and stock returns in all of the nineteen emerging markets. In doing so, we have refrained from using panel data, and have estimated each country separately. Our framework accounts for country-specific attributes. Second, previous country studies in emerging markets either have assumed the direction of causality, or have introduced variables into the VAR system in bivariate causal tests. We tested for the direction of the causal relationship. Besides, tests based on bivariate causal tests may not be robust in a larger system of variables (Sims 1980). To our knowledge, we are the first researchers to investigate the causal relationship between macroeconomic variables and stock returns in the nineteen emerging markets, using a multivariate approach. The causal linkages between stock returns in emerging markets and macroeconomic variables have implications for the ongoing attempts to develop stock markets, on the one hand, and simultaneously for moving toward a policy shift to integrate them into world markets.

Data and Results

The data used in this study consists of the monthly time series observations of nineteen emerging markets, covering the twenty-year period from 1976 through 1997.[1] The data for stock prices are represented by the monthly closing values of index levels in domestic currency units, and comes from the IFC. Kang and Stulz (1997) have shown that foreign investors are more likely to invest in securities that are large and well known. The IFC indices have some advantage here over more comprehensive local indices, because of the IFC's focus on large relatively liquid securities. The IFC index attempts to cover 70 percent of market capitalization (Bekaert and Harvey 1995), and is calculated for all of the nineteen emerging markets in a similar fashion, making international comparisons possible. Stock returns (*R*) are defined as the first differences of log levels.

For each country, stock returns (*R*), exchange rates (*FX*), and interest rates (*I*) are assumed to be linear in a set of local and global information variables, whereas inflation (*INF*) and industrial production (*PROD*) are assumed to be linear in a set of local information variables only. The global information variable is the return on the Standard-&-Poors 500 index (S&P), which represents the world market portfolio, and controls for the degree of market liberalization.[2] Local information variables are returns on country indices (*R*), exchange rates (*FX*), interest rates (*I*), inflation (*INF*), and industrial production index (*PROD*), which is a measure of general economic activity and proxies for GDP.

The monthly closing values of the S&P index are from Datastream. Similar to the emerging markets, returns on the S&P index are calculated as the first differences of the log levels. The inflation (*INF*) variables are computed from the consumer price indices of each country. For interest rates (*I*), the monthly compounded value of time deposit rates in each country is used. Real economic activity (*PROD*) is represented and measured by the industrial production index of each country. Exchange rates (*FX*) are defined as the national currency per special drawing rights (SDR). This definition captures the effect of a basket of currencies on the stock market, instead of a single foreign currency. The data for macroeconomic variables comes from the international financial statistics (IFS) database of the International Monetary Fund. Interest rates are given in percentages. For other macroeconomic variables, the first differences of log levels are used to account for their growth rates. [3]

The focus of the paper is on investigating the causal relationship between the stock returns and the macroeconomic variables in the emerging markets. In order to establish the causal ordering, Granger causality tests are employed where, for two time series, $\{y_t\}$ and $\{x_t\}$, the series x_t fails to Granger cause y_t, in a regression of y_t on lagged y's and lagged x's, if the coefficient of the latter is zero. This test indicates the precedence or the predictive power among the variables.

In investigating the causal ordering of the stock returns and macroeconomic variables in the emerging markets, the following equation is estimated for each country, to determine whether any of the macroeconomic variables Granger cause the stock returns:

$$R_t = a_o + \sum_{i=1}^{3} a_{1i} R_{t-i} + \sum_{i=1}^{3} a_{2i} INF_{t-i} + \sum_{i=1}^{3} a_{3i} I_{t-i} + \sum_{i=1}^{3} a_{4i} PROD_{t-i} + \sum_{i=1}^{3} a_{5i} FX_{t-i} + \sum_{i=1}^{3} a_{6i} SNP_{t-i} + e_t$$

If the coefficients of any the lagged macroeconomic variables is jointly significant, then one can conclude that this variable Granger causes the stock returns. According to Table 1, which summarizes the results obtained from Equation 1,[4] estimated for the nineteen countries in the sample, inflation and interest rates in Argentina and Brazil, and only interest rates in Pakistan and Zimbabwe, Granger cause the stock returns. In countries such as Brazil, Colombia, Greece, Korea, Mexico, and Nigeria, exchange rates precede stock returns; only in Colombia, Mexico, and Portugal do domestic stock returns follow the S&P index (denoted by SNP in equation above).

The precedence among the macroeconomic variables can be established by estimating the above equation, where the left-side variable is replaced by one of the macroeconomic variables, and by testing the joint significance of the coefficients of the lagged values of the other macroeconomic variables and stock returns. Since one will not expect to see an effect from the S&P index toward the domestic macroeconomic variables, the lagged values of the S&P index variable are not included into these regressions. The results of the Granger causality tests are summa-

Table 1

Macroeconomic Variables That Granger Cause Stock Returns

Variables	Countries
INF	Argentina, Brazil
I	Argentina, Brazil, Pakistan, Zimababwe
PROD	None
FX	Brazil, Colombia, Greece, Korea, Mexico, Nigeria
S&P	Colombia, Mexico, Portugal

Table 2

Macroeconomic Variables That Are Granger Caused by Stock Returns

Variables	Countries
INF	Argentina, Jordan, Zimbabwe
I	Argentina, Korea, Mexico
PROD	India, Mexico
FX	Mexico

rized in Table 2.[5] Domestic stock returns Granger cause domestic inflation in Argentina, Jordan, and Zimbabwe, and interest rates in Argentina, Korea, and Mexico. The real sector and domestic production follow the stock returns in countries such as India and Mexico. Exchange rates are also Granger caused by stock returns in the latter country.

The results of the study are important in several respects. First, out of nineteen emerging markets, only twelve exhibit any type of causal relationship with stock returns. These countries are: Argentina, Brazil, Columbia, and Mexico from South America; Portugal and Greece from Europe; Korea from the Pacific rim; Jordan, Pakistan, and India from Asia; and Nigeria and Zimbabwe from Africa. These countries may be characterized as the leading countries in their geographical locations. They have higher per capita income, compared to other lower-income developing countries (LDC) on their continents. They started the liberalization process earlier. They have reduced capital controls before their LDC counterparts in their regions; and thus, their stock markets are less insulated from global markets. In the process of liberalization, the stock exchanges were established at an earlier period; and thus, today, they enjoy higher

volumes of trade, mainly due to the participation of foreign investors.

Bekaert and Harvey (1998)[6] reported that all of these countries, except Argentina, experienced dividend yield decreases during the 1990s in the process of financial liberalization. They argued that the change in the marginal investor from local to international is expected to decrease dividend yield, which is intricately linked to the required rate of return and the cost of capital. With the exception of Mexico and Pakistan, all of these countries have experienced appreciation of local currencies during the liberalization process, which seems to be led by the capital flows into these countries (Bekaert and Harvey 1998).

Second, only two countries, Argentina and Mexico, exhibit bi-directional causality between stock returns and macroeconomic variables. These are the top two countries in terms of the level of foreign equity holdings (Bekaert and Harvey 1998). It is argued that the process of liberalization provides the foundation for increases in capital flows, and this is possible if the market becomes truly integrated with the world. Market integration will enable projects with identical risk to earn identical expected returns across different markets. Investors will not be investing in inefficient domestic companies, as long as they can invest in efficient foreign companies.

In Argentina, interest rates and inflation cause stock returns; and, at the same time, stock returns cause interest rates and inflation. During the research period, Argentina experienced the highest overall inflation rates among the nineteen emerging markets. Presumably, investors incorporate changes in interest rates into their stock price evaluations. A rise in interest rates reduces the present value of future cash flows in the form of dividends and capital gains. If stock investments and deposits were substituted, a rise in interest rates would depress stock prices. Thus causality, should run from interest rates to stock prices. If the two markets were integrated and volume of trade in the stock market were high enough, the reverse would also be true, leading to the feedback relationship we observe in Argentina.

In Mexico, foreign exchange rates and U.S. returns cause stock returns, and stock returns cause interest rates, foreign exchange rates, and industrial production. This situation may best be explained by the high level of equity holdings in the country and related world integration. The stock market is well integrated globally, as indicated by the world returns Granger causing local returns, and by the two-way causality between stock returns and foreign exchange rates. The stock market is

well integrated into the other local markets, as well. Stock returns lead industrial production, indicating their integration with the real economy. Stock returns also Granger cause interest rates, showing that they could be perceived as substitutes for fixed-income instruments.

Third, in eight countries besides Argentina and Mexico, we observe unidirectional causality from U.S. returns, and macroeconomic variables to stock returns. In Columbia, world returns and foreign exchange rates Granger cause local returns. In Brazil, inflation, interest rates, and foreign exchange rates cause stock returns. Similar to other Latin American markets, this may in fact be due to the high integration of the stock market in Columbia and Brazil into world markets, and to the high volume of trade by foreigners. In Portugal, U.S. returns cause stock returns. As one of the emerging markets of Europe that was the earliest to enter the European Union, Portugal is affected by world information, and its stock market is integrated to the global economy. In Greece, Korea, and Nigeria foreign exchange rates cause stock returns. These countries are among the successful ones in the process of liberalization in Europe, Asia-Pacific, and Africa, respectively. Granger causality from exchange rates to stock prices indicates that the firms in these countries are linked to the rest of the world through exports. More than half of the average increase in trade surplus to GDP in all the emerging markets during 1990s can be attributed the two European countries of Greece and Portugal (Bekaert and Harvey 1998). Since exchange rates affect firms' exports and, after a while, their stock prices, governments must be cautious in the choice and implementation of their exchange rate regimes. In Pakistan and Zimbabwe, interest rates cause stock returns. One possible reason for this type of relationship may be the substitutability of investments in bank deposits and stocks. At initial stages of the establishment of stock markets, these two investments are known to be perceived as substitutes by investors (Muradoglu 1999).

Fourth, in four countries besides Argentina and Mexico, we observe unidirectional causality from stock returns to macroeconomic variables. Unidirectional causality, from stock returns to macroeconomic variables is more difficult to interpret. Stock returns might simply be leading macroeconomic variables, in which case the relationship must be understood as one of a lead-lag relationship. In this case, stock returns might be used as a barometer. Being able to adjust to information regarding government policy rather instantaneously, changes in stock returns might be the indicators of changes in other variables. An alternative

explanation might be related to the size of the stock markets in these countries. If stock markets were not thin, they might serve as a proxy for the financial wealth in the country. In that case, unidirectional causality from stock returns to macroeconomic variables must be interpreted as the effect of changes on financial wealth on these variables.

In Jordan and Zimbabwe, stock returns Granger-cause inflation. Given the thin market characteristics of these two countries and their relatively low volume of trade, we would expect changes in stock returns to signal changes in inflation and related expansionary policies. In Korea, stock returns cause interest rates. Given the relatively high volume of trade in the Korean stock market and the early liberalization efforts of the country, we would expect the unidirectional causality from stock returns to interest rates to be due to the substitution effect. If the rates in equity investments were lower, investors would switch to fixed income instruments. In India, stock returns cause industrial production. India has one of the largest stock markets in Asia. Its stock market might well be a proxy for financial wealth in the country. Rates of return in the stock market might presumably be able to adjust to information instantaneously, and thus are leading changes in industrial production.

Conclusions

We were motivated to investigate the causal interactions between two components of emerging markets. Stock returns represent the activity in stock markets. Macroeconomic variables such as inflation, interest rates, foreign exchange rates, and industrial production represent economic activity and government policy action. The contributions of our study are threefold. First, we investigated the compatibility of economic policy and stock returns. Unlike previous research that focused mainly on one economic policy variable, we employed a set of macroeconomic variables. Second, as our testing ground, we took the set of all emerging markets as defined by the IFC. These countries have attracted attention from investors as well as academics during the past few decades. Unlike previous studies that explored small and coherent groups of emerging markets, investigating all of them has given us a better understanding of emerging markets as a whole. Third, we employed Granger-type causality tests for each country, rather than on panel data, and this approach has shown that county-specific issues are important in determining stock returns. The results of the study have shown that the two-way interac-

tion between stock returns and macroeconomic variables is mainly due to the size of the stock markets, and their integration with the world markets, through various measures of financial liberalization. Policymakers around the world are thus advised to create an environment that attracts, rather than that repels, foreign portfolio investors.

Further research in this field should expect to tackle two issues. First, the changing characteristics of emerging markets must be considered. Possible changes in the bivariate causality between stock returns and macro-economic variables must be investigated at different stages of financial liberalization. The calendars for the liberalization of exchange rates and interest rates should be used as alternative measures of the degree of liberalization and attempts for global integration. Second, an alternative approach might be to use panel data. Despite the well-known limitations of this approach, combining cross-sectional and time series information into a single data set might yield more systematic results with respect to the causal relationship between the variables.

Notes

1. Appendix 1 gives a list of the nineteen emerging markets used in this study, the data period for each country, and missing variables, if any.

2. See Errunza and Miller (1998) for the use of a value-weighted U.S. index in a similar fashion in measuring market segmentation and cost of capital in international markets.

3. Appendix 2 reports the summary statistics of the variables defined as the first difference of log levels.

4. Appendix 3 reports the computed F-statistics for the countries where the restriction that $a_{ji} = 0$, for $i = 1,2,3, j = 1,...,6$ is rejected in Equation 1; and hence, one can conclude that the mentioned macroeconomic variable Granger causes the stock returns in that country.

5. Appendix 4 reports the F-statistics where the restriction that the restriction that $a_{ji} = 0$, for $i = 1,2,3, j = 1,...,5$ is rejected.

6. The sample used in Bekaert and Harvey (1998) does not contain Jordan, Nigeria, and Zimbabwe.

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Appendix 1

Country	Start period	End period	Missing variable
Argentina	11/1987	08/1997	–
Brazil	11/1984	05/1997	–
Chile	12/1978	09/1997	–
Colombia	01/1986	10/1997	Industrial production
Greece	01/1976	03/1997	–
India	01/1976	03/1997	–
Indonesia	01/1990	05/1997	–
Jordan	01/1978	12/1996	Deposit rate
Koria	01/1976	10/1997	–
Malaysia	01/1985	11/1996	–
Mexico	01/1978	05/1997	–
Nigeria	01/1985	06/1996	–
Pakistan	01/1985	06/1992	–
Philippines	12/1986	08/1997	Industrial production
Portugal	01/1986	10/1994	–
Thailand	01/1977	02/1996	Industrial production
Turkey	01/1987	02/1996	–
Venezuela	01/1985	09/1997	–
Zimbabwe	01/1979	12/1992	–

Appendix 2

Descriptive Statistics of the Variables Used in Granger Causality Tests

INFLATION

Country	Sample size	Mean	Median	Std.Dev.	Skewness	Kurtosis	Jarque-Bera	ADF test
Argentina	117	0.077	0.0078	0.1682	3.4873	16.7359	1,156.94	–4.0044
Brazil	150	0.1456	0.1274	0.1351	1.1374	5.9842	87.9992	–3.4613
Chile	224	0.0114	0.0076	0.0485	–10.7667	147.4722	19.9135	–27.5426
Colombia	141	0.018	0.0161	0.0091	0.1707	3.043	**0.6958	*–5.7774
Greece	254	0.0126	0.013	0.0147	–0.3364	4.4418	26.7905	–13.1547
India	254	0.0069	0.0069	0.0086	–0.4733	3.4746	11.8691	–8.9664
Indonesia	88	0.0068	0.0053	0.0062	1.109	4.3137	24.3652	–6.4217
Jordan	226	0.0055	0.0051	0.0171	0.6978	6.5897	139.6813	–9.1953
Korea	261	0.0066	0.005	0.008	1.627	6.5127	249.3376	–7.3056
Malaysia	142	0.0025	0.0026	0.0035	0.0156	3.6704	**2.6648	–8.2491
Mexico	232	0.0293	0.0162	0.0735	0.9667	69.9287	43,337.51	–12.6447
Nigeria	137	0.0243	0.0177	0.0312	1.7145	9.5579	312.617	–4.7723
Pakistan	89	0.0062	0.0056	0.0085	0.4385	4.2974	**9.0940	–7.0043
Philippines	128	0.0078	0.0073	0.0065	1.1177	4.8729	45.36	–6.1268
Portugal	105	0.0073	0.0064	0.0049	0.4188	3.1703	**3.1965	–5.0379
Thailand	239	0.0048	0.0041	0.0066	1.0597	5.9573	131.8275	–8.6097
Turkey	109	0.0454	0.0439	0.0274	2.4386	16.6493	954.159	–7.1459

(*continues*)

Appendix 2 (*continued*)

INTEREST RATE

Country	Sample size	Mean	Median	Std.Dev.	Skewness	Kurtosis	Jarque-Bera	ADF test
Venezuela	152	0.0302	0.0261	0.0241	2.9042	17.6148	1,566.431	–5.7656
Zimbabwe	151	0.0135	0.0089	0.0179	3.2512	21.3478	2,384.066	–8.4722
Argentina	118	0.0678	0.0124	0.1236	3.7239	19.999	1,679.114	–4.3367
Brazil	151	0.1752	0.1417	0.1452	1.1266	4.206	40.8193	–3.2459
Chile	225	0.0194	0.0182	0.0093	0.8631	3.7448	32.9921	–4.9118
Colombia	142	0.0228	0.023	0.0028	–0.257	2.1441	**5.8550	*–1.8094
Greece	255	0.0119	0.0121	0.0025	–0.4324	2.5703	**9.8703	*–1.3399
India	255	0.0082	0.008	0.0008	0.5727	1.957	25.4006	*–0.4233
Indonesia	89	0.0134	0.0133	0.0024	0.3855	2.8158	**2.3305	*–2.2336
Jordan	–	–	–	–	–	–	–	–
Korea	262	0.009	0.008	0.0028	1.0254	2.5285	48.1517	*–1.4563
Malaysia	143	0.0049	0.0053	0.0015	–0.3695	2.3559	**5.6862	*–2.2616
Mexico	233	0.0272	0.0245	0.0156	0.9245	3.4512	34.8664	–2.7563
Nigeria	138	0.0114	0.0107	0.003	0.6866	3.0511	10.7777	**–1.9441
Pakistan	90	0.0073	0.0067	0.0014	1.6056	3.8034	40.6349	**–0.5468
Philippines	129	0.0096	0.009	0.0031	0.7987	2.8041	13.8131	*–1.7133
Portugal	106	0.0105	0.0108	0.0018	–0.5607	3.8541	**8.7750	*–1.7218
Thailand	240	0.0085	0.008	0.0016	0.1245	1.9038	12.5849	*–2.1702
Turkey	110	0.0402	0.0421	0.0093	0.6949	4.6132	20.591	*–2.5749
Venezuela	153	0.0182	0.0184	0.0097	0.4635	2.3378	**8.2191	**–1.9247
Zimbabwe	152	0.0105	0.0104	0.0018	–0.3482	2.9519	**3.3899	*–1.1010

INDUSTRIAL PRODUCTION

Argentina	117	0.005	0.0059	0.0542	0.2828	11.2388	332.4615	–13.8235
Brazil	150	0.0013	0.0005	0.0813	–0.0651	5.1117	27.9753	–7.6938
Chile	224	0.0032	–0.0095	0.2769	0.3037	85.7132	63,857.2	
Colombia	–	–	–	–	–	–	–	–
Greece	254	0.001	–0.0094	0.0857	1.1185	4.6843	82.9838	–17.0251
India	254	0.0054	0.0081	0.0729	–1.1031	6.5368	183.9001	–15.8085
Indonesia	88	0.0011	0	0.0603	0.0242	2.6997	*'0.3393	–9.2507
Jordan	226	0.0054	0.008	0.0882	–0.0971	3.0589	**0.3875	–13.6699
Korea	261	0.0089	0.0093	0.0315	0.4956	10.376	602.3379	–15.6712
Malaysia	142	0.008	0.0029	0.0687	0.086	3.0696	**0.2038	–14.8732
Mexico	232	0.0028	–0.0024	0.0392	0.2388	3.0206	**2.2099	–14.9426
Nigeria	137	0.0027	0.0064	0.0902	–0.4805	5.8599	51.9592	–10.597
Pakistan	89	0.0011	0.006	0.1005	–0.087	2.4471	**1.2498	–4.8209
Philippines	–	–	–	–	–	–	–	–
Portugal	105	–0.0007	0.0025	0.0929	–0.7286	9.2886	182.3071	–10.0771
Thailand	–	–	–	–	–	–	–	–
Turkey	109	0.003	0.0082	0.0768	–0.285	2.9285	**1.4992	–8.7775
Venezuela	152	0.0043	0.0066	0.0596	–0.2119	4.2518	11.0621	–13.2086
Zimbabwe	151	0.002	0.0097	0.0889	–0.1372	5.2745	33.024	–11.8537

(*continues*)

Appendix 2 (*continued*)

FOREIGN EXCHANGE RATE

Country	Sample size	Mean	Median	Std.Dev.	Skewness	Kurtosis	Jarque-Bera	ADF test
Argentina	117	0.068	132	0.24	4.2394	22.1116	2,131.072	–4.7737
Brazil	150	0.1406	0.1294	0.1274	0.5138	2.549	**7.8710	–3.4946
Chile	224	0.0109	0	0.0944	6.2579	88.2721	69,327.77	–12.7614
Colombia	141	0.0157	0.0157	0.0245	–0.9697	7.6107	146.9934	–6.9379
Greece	254	0.0086	0.0051	0.0207	3.9113	28.1452	7,339.253	–10.8867
India	254	0.0062	0.0046	0.0239	4.313	35.8324	12,195.95	–10.5425
Indonesia	88	–0.004	–0.005	0.0163	0.4586	4.1258	*7.7316	–6.1745
Jordan	226	–0.0043	0	0.0308	–11.8903	162.331	244,380.2	–9.6741
Korea	261	0.0033	0.002	0.0208	2.2127	22.2053	4,224.176	–10.3619
Malaysia	142	0.0028	0.0041	0.0192	–0.4351	3.278	**4.9378	–6.9672
Mexico	232	–0.0258	–0.0142	0.0732	–5.2625	40.5816	14,723.81	–9.1907
Nigeria	137	0.0267	0.0103	0.1007	5.3426	40.7589	8,790.285	–8.7156
Pakistan	89	0.0097	0.0084	0.0178	–0.083	2.797	**0.2549	–7.281
Philippines	128	0.0039	0.0015	0.0276	0.2715	3.2955	**2.0385	–6.3578
Portugal	105	0.003	0.0019	0.018	1.601	9.5569	232.9466	–6.1887
Thailand	239	0.0019	0.0015	0.0179	2.745	25.5327	5,356.213	–11.0207
Turkey	109	0.0426	0.0267	0.1129	1.6754	20.4444	1,433.051	–9.2957
Venezuela	152	0.0298	0.0093	0.1135	5.3612	35.3928	7,373.65	–9.566
Zimbabwe	151	0.0133	0.0076	0.0341	4.2146	28.7785	4,628.028	–7.1138

RETURNS

Sample	size	Mean	Median	Std.Dev.	Skewness	Kurtosis	Jarque-Bera	ADF test
Argentina	117	0.0204	0.0149	0.2179	–0.0695	12.1385	407.218	–9.7651
Brazil	150	0.0126	0.0084	0.1862	–0.5624	5.5587	48.8258	–8.427
Chile	224	0.0121	0.0071	0.0883	–0.2057	3.5142	**4.0466	–8.495
Colombia	141	0.023	0.0115	0.0811	1.0818	5.4295	62.1801	–6.772
Greece	254	–0.0017	–0.0049	0.0924	0.9318	7.4555	246.8548	–9.3307
India	254	0.0084	0.0096	0.0781	0.2635	4.4337	24.6952	–10.793
Indonesia	88	0.002	–0.0084	0.0852	–0.1053	3.0000	**0.1626	5.7659
Jordan	226	0.0052	–0.0006	0.0493	0.6147	5.0545	53.9806	–10.5023
Korea	261	0.0061	–0.0052	0.106	3.8035	36.6785	12,964.16	–11.7551
Malaysia	142	0.0088	0.0094	0.0771	–0.9074	6.1747	79.1207	–7.1941
Mexico	232	0.0093	0.023	0.1396	–2.1086	13.0907	1,156.202	–10.3096
Nigeria	137	–0.0033	0.015	0.1718	–3.0971	26.1843	3,287.302	–8.6758
Pakistan	89	0.0133	0.005	0.0588	2.2292	12.2983	394.3298	–8.0621
Philippines	128	0.0126	0.0085	0.0967	–0.1226	5.5988	36.3397	–7.234
Portugal	105	0.0183	0.0035	0.1207	0.81	6.3022	59.1898	–6.5249
Thailand	239	0.0072	0.0018	0.0804	–0.363	6.5784	132.7619	–9.0967
Turkey	109	0.0104	–0.0066	0.1907	0.3612	2.8409	**2.4846	–6.0444
Venezuela	152	0.0124	0.0103	0.1407	–1.2825	8.9253	264.0228	–7.1123
Zimbabwe	151	–0.0081	0.0033	0.1029	–0.3674	4.6625	20.7867	–6.7048

*The series contain unit root.

**Normality is rejected.

Appendix 3

F-Statistic values for the Restriction $a_{ji} = 0$ for $i = 1,2,3$ Are Jointly Equal to Zero

Countries	*INF*	*I*	*PROD*	*FX*	S&P
Argentina	*** .7019	***7.3206			
Brazil	***3.7065	***4.3264		***5.3729	
Chile					*2.1508
Colombia				**2.7804	**2.6191
Greece			*2.3321	***5.0286	
India					
Indonesia					
Jordan					
Korea				**2.6125	
Malaysia					
Mexico				***22.8399	***4.9206
Nigeria				***17.6979	
Pakistan		***9.5604			
Philippines					**3.6023
Portugal				*2.0676	
Thailand					
Turkey					
Venezuela					
Zimbabwe		***3.7770			

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.
Reported figures in the table are only for cases where the joint restriction is rejected.

Appendix 4

F-Statistic Values for the Restriction $a_{ji} = 0$ for $i = 1,2,3$ Are Jointly Equal to Zero

Countries	*INF*	*I*	*PROD*	*FX*
Argentina	**2.8652	***3.9081		
Brazil				
Chile				
Colombia				
Greece			*2.2809	*2.4048
India			***3.9929	
Indonesia				
Jordan	***3.6011			
Korea		**2.8661		
Malaysia				
Mexico		***7.9373	**2.8609	***3.6749
Nigeria				
Pakistan			*2.2813	
Philippines				*2.3499
Portugal			*2.5166	
Thailand				
Turkey				
Venezuela		*2.2421		
Zimbabwe	***5.2490			

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.
Reported figures in the table are only for cases where the joint restriction is rejected.