The Stock Returns-Inflation Causality Revisited: Analyzing the Evidences for 31 Developed and Emerging Countries.

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Resumo: Este artigo investiga a relação de causalidade entre inflação, retorno acionário, taxa de juros e atividade real, em uma amostra de 16 países emergentes e 15 países desenvolvidos. Os principais achados indicam que as diferenças entre os grupos não são claras como inicialmente presumido. As evidências encontradas para os países desenvolvidos são difusas, enquanto que a Reverse Causality Hypothesis é suportada para os países emergentes. No entanto, tal distinção não é nítida como desejado, e a frequência de apoio às teorias não possui robustez na amostra.

Abstract: This paper investigates the causality relationships among inflation, stock returns, interest rates, and real activity in a sample of sixteen developing countries and fifteen industrial countries, totaling thirty one countries. The main findings indicate that the differences between industrial and developing countries are not as sharp as one might initially presume. Support found for the developed markets are mixed, while the Reverse Causality Hypothesis is best fitting for the emerging markets. However, such distinction is not as clear cut as one might wish and the frequency of support for each theory not as robust across countries.

Keywords: Inflation, Stock Returns, Causality, Fisher Hypothesis, Emerging Markets, Developed Markets, Vector Auto regression.

Palavras Chave: Inflação, Retorno Acionário, Hipótese de Fisher Causalidade, Mercados Emergentes, Países Desenvolvidos, Vetor Auto Regressivo.

JEL Classification: E44, E31, F30, C32, O16, O54.

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The Stock Returns-Inflation Causality Revisited: Analyzing the Evidences for 31 Developed and Emerging Countries.

Introduction

The relationship between stock returns and inflation has inspired both theoretical and empirical studies. Most empirical research employed exclusively United States (U.S.) data in the analysis. Some papers extended the investigation to other country samples, but only a few employed emerging markets data. Since inflation used to be – and in large extent it still is – a major concern in many emerging markets, be it in Latin America or the Oriental Europe, additional in-depth investigation on this subject is certainly welcome.

In this paper, we extend the work of James, Koreisha, and Partch (1985) and Lee (1992) to a multi-country sample. The causal relations among inflation, real stock returns, real interest rates, and real activity are studied in the context of 16 emerging countries, and the results are compared to those obtained for a Group of fifteen industrial countries, as well as to the findings of other empirical studies.

This paper adds to the literature in several ways: in contrast to most previous studies which focus only in the United States, developed market, or single country data, we explore the topic in a multi-country sample, including some major emerging markets. We include often disregarded countries either from Central America, Far east and Central Europe. No other paper has of yet utilized data in this topic for a higher amount and variety of countries than this paper. Instead of using actual variables, we use expected versions of actual variables, which is more in tune with the theory. Instead of arbitrarily determining the order of the Vector Autoregressions, we determine it by employing a selection criterion. Finally, we test for causal relationships using the Granger Causality test, an objective measure of precedence between variables.

The main findings indicate that the differences between industrial and developing countries are not as sharp as one might initially presume. Some support is found for the Proxy-Hypothesis for the developed markets even though such evidences are mixed, while the Reverse Causality Hypothesis is best fitting for the emerging markets. However, such distinction is not as clear cut as one might wish and the frequency of support for each theory not as robust across countries.

The remainder of the paper is organized as follows: the next section presents the theoretical framework and previous empirical evidence. Section 2 explains the variables used in the empirical study, the data sources, and details the empirical model. Section 3 presents and discusses the results obtained from the Latin American data, and compares it to the results obtained for the Group of Seven. The last section concludes the paper.

1. Theoretical and Empirical Background

Irving Fisher (1930) hypothesized that the ex-ante nominal interest rate should fully anticipate movements in expected inflation, in order to yield the equilibrium real interest rate. This hypothesis can be easily extended to real assets returns which, as part of the real sector of the economy, should move in a one-to-one basis with expected inflation rates. However, much evidence obtained so far have concluded that stock returns and expected inflation are negatively related. This is puzzling given that “...common stocks, representing ownership of the income generated by real assets, should be a hedge against inflation” (Fama, 1981, p.545). Here, we briefly survey the theory and recent empirical evidence on this subject.
1.1. The Fisher Hypothesis and the Returns-Inflation Puzzle

According to Fisher (1930), the expected real interest rate is determined by real factors such as the productivity of capital and time preference of consumers, and is independent of the expected inflation rate. Therefore, real assets should provide an efficient hedge against changes in the nominal monetary aggregates. In principle, the Fisher Hypothesis could be extended to any real asset, such as real estate, commons stock, and other risky securities.

The empirical relationship between inflation and common stocks was first investigated by Jaffe and Mandelker (1976), Bodie (1976), and Nelson (1976). Although employing different empirical approaches, these authors all concluded for a significant negative relationship between the proxies of inflation and stock returns. Following these pioneer studies, Fama and Schwert (1977) investigate the inflation effect on asset returns in a number of assets. They conclude that, similar to previous studies, common stocks seem to perform poorly as hedge against both expected and unexpected inflation. Since these earlier studies, the empirical literature on the Fisher Hypothesis has been prolific, and the findings have been largely similar (e.g. Gertler and Grinols, 1982; Buono, 1989; Park, 1997).

The early studies on the Fisher Hypothesis mentioned above are mainly concerned in documenting and describing the nature of the relationship between stock returns and inflation, and not in suggesting any explanation for the puzzling results obtained. Several alternatives to the Fisher Hypothesis have emerged in the literature. The Tax-Effect Hypothesis proposed by Feldstein (1980) argues that inflation generates artificial capital gains due to the valuation of depreciation and inventories (usually nominally fixed) subject to taxation. This increases corporate tax liabilities and thus reduces real after-tax earnings. Rational investors would take into account this effect of inflation by reducing common stock valuation. In this sense, inflation “causes” (i.e., precedes) movements in stock prices. Although appealing, the Tax-Effect Hypothesis depends mainly on the United States tax regime, and there is evidence of negative stock returns and inflation relationship in countries with different tax laws, in which adjusted values of inventories and depreciation are considered for tax purposes.

Fama (1981) hypothesizes that the anomalous relationship observed between real stock returns and inflation in the United States is a consequence of a “spurious” relationship: negative stock returns-inflation relations are induced by the positive correlation between stock returns and real activity and the negative correlation between inflation and real activity – the Proxy Hypothesis. The argument hinges on the money demand behavior of rational agents who perceive a fall in economic activity and therefore a decrease in money demand (implied by the unwillingness to hold increasingly worthless money) that causes an excess money stock and thus inflation. In this sense, measures of real activity – such as output and capital expenditure – should dominate measures of inflation when both are used as explanatory variables for real stock

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1 The assets included are: equally and value-weighted NYSE common stock portfolios, treasury bills returns, long-term United States government bonds returns, human capital income, and return on residential real estate.

2 This is the case of Brazil and Israel, for instance.

3 In the sense that real stock returns “proxy” for real activity measures.

4 Ely and Robinson (1989) remark that Fama’s (1981) argument is not a common one in monetary models. Moreover, Fama (1981) assumes an exogenous interest rate, an assumption that is also questioned by some authors, in particular Lee (1992).
returns in testing the Fisher Hypothesis. Fama (1981) provides some, but not definite, evidence on the validity of the Proxy Hypothesis. Moreover, the author does not provide evidence on the causality relations between the variables.

Elaborating on Fama’s work, Geske and Roll (1983) propose that, besides money demand, a money supply linkage that may help explain the phenomenon. The authors propose a chain of macroeconomic events that leads to a “spurious” correlation between stock returns and inflation. They suggest that stock prices’ reaction in anticipation of future economic activity (Fama’s model) is highly correlated to government revenue, so that the government faces a deficit when economic output decreases. In order to balance the budget, the Treasury either borrows or issues money through the central bank, causing inflation. Thus, stock returns and inflation are negatively related due to a fiscal and monetary linkage – the Reverse Causality Hypothesis. The authors find some evidence in support to their framework, especially the signaling from stock returns to changes in nominal interest rates and changes in expected inflation. They also find little evidence for a real interest rate effect.


International tests of the Fisher Hypothesis and its explanations have also spawned a fruitful literature, although a consensus is yet to be achieved. Gultekin (1983) tests the Fisher Hypothesis in a sample of 26 countries using time series and cross-sectional analyses. His time series results are not favorable to the Fisher Hypothesis, while the cross-sectional study finds that countries with high inflation rates are associated with high nominal stock returns and this appears to be in contrast to the time series results. In a multi-country study, Solnik (1983) tests an extended version of the Fisher and Geske-Roll’s models and finds strong support for the Reverse Causality Hypothesis, although the author does not investigate the causal direction of the stock returns-inflation relationship. Wahlroos and Berglund (1986) test the Fisher and Proxy Hypotheses using Finnish data, and reject both of them. Cozier and Rahman (1988) test the Proxy Hypothesis in Canada and again a negative relationship between real stock returns and inflation emerges. Canadian data provides a better support for the Proxy Hypothesis than Fama (1981) obtains using U.S. data. McCarthy, Najand, and Seifert (1990) reject the Proxy Hypothesis for the United States, Germany, and the United Kingdom. Using a multi-country sample of developed countries, Ely and Robinson (1994) employ multivariate cointegration analysis to test the alternative explanations and find little evidence on the cointegrating relationship. The hypothesis that common stocks are a good hedge against inflation is also soundly rejected for every case examined. Amihud (1996) examines the effects of unexpected inflation on stock

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5 In another paper, Fama (1990) finds evidence that expected returns and real activity measures account for up to 59% of the variance in stock returns from a value-weighted NYSE portfolio.

6 Nine industrialized countries: G-7 except Italy, plus Switzerland, Belgium, and the Netherlands.

7 Australia, Austria, Belgium, Canada, Finland, France, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States.
prices using a bond market-based measure of unexpected inflation\(^8\) with Israeli daily data, that the author contends as an ideal setting for the testing of these hypotheses,\(^9\) and concludes that unexpected inflation has a strongly negative effect on stock prices. Liu, Hsueh, and Clayton (1993) provide a comprehensive test of the Proxy Hypothesis for the United States, Germany, Canada, and the United Kingdom and find strong evidence against the Proxy Hypothesis. Ammer (1994) findings favor tax-related theories in 10 developed countries\(^10\). Finally, Solnik and Solnik (1997) test the Fisher relation in 8 developed countries,\(^11\) and cannot reject the Fisher model for those countries for periods ranging from 1 to 12 months.

Recent studies have provided a glimpse of the behavior of inflation and stock returns in emerging markets. Kwon, Shin, and Bacon (1997) find that nominal variables such as inflation and nominal interest rates are mostly insignificant for the South Korean case. Lee (1998) rejects the Proxy Hypothesis for Hong Kong, Singapore, South Korea, and Taiwan. Adrangi, Chatrath, and Raffiee (1999) reject the Proxy Hypothesis in the short-run for Mexico and South Korea. Finally, Henry (2001) investigates the reaction of 25 emerging markets to 81 inflation stabilization plans, and concludes that stabilizing high inflation yields a significant market increase, while the results of stabilizing moderate inflation are economically weak and statistically insignificant.

### 1.2. Causality and Hypothetical Explanations

A sensible way to test which hypothesis (Tax-Effects, Proxy, or Reverse Causality) better explains the empirical relationship between inflation and stock returns is to explore the causality implications of each model. As shown in Figure 1, the direction of causality is an indication of which explanation better suits the data. An early study by Cozier and Rahman (1988) employed the Granger (1969) technique in order to determine the direction of causality between inflation and stock returns. Their findings suggest support for the Proxy Hypothesis in Canada. James, Koreisha, and Partch (1985) noted that Geske-Roll’s equation-by-equation estimation procedure is inappropriate for what is essentially a system of equations. The authors investigate the Reverse Causality Hypothesis using a Vector Autoregression Moving Average (VARMA) approach in order to estimate jointly the links between stock returns and inflation as well as the direction of the causality. The authors find support for the Reverse Causality Hypothesis, consistent with Solnik (1983). Lee (1992) uses a Vector Autoregression (VAR) residuals approach to investigate the Granger (1969) causality and dynamic interactions among the variables in the United States. His findings support Fama’s version of the Proxy Hypothesis and, contrary to James, Koreisha, and Partch (1985), do not support Geske-Roll’s Reverse Causality Hypothesis.

In summary, a large and rich stream of literature has been dedicated to investigate the Fisher Hypothesis’ empirical anomalies. Alternative explanations of the phenomena have been

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\(^8\) The bond market-based measure of unexpected inflation was the price reaction of CPI-linked bonds on the day following the announcement of the official CPI.

\(^9\) The characteristics of Israeli data cannot support nominal-contracting, tax-effects, and inflation-induced wealth transfer hypotheses because most of the contracting in Israel used to be in real rather than nominal terms.

\(^10\) G-7 plus Belgium, the Netherlands, and Switzerland.

\(^11\) The same ones studied in Solnik (1983), with the exception of Belgium. Interestingly, both Solnik (1983) and Solnik and Solnik (1997) left Italy out of their samples, the developed country in which inflation has been the most pronounced over their periods of study.
proposed and several empirical studies have been conducted with the purpose of establishing which one better describes real world regularities. So far, the debate remains unsettled. We believe that investigating the causality relationships in multi-country data is a promising research path.

2. Data, Variables, and Model

2.1. Data and Variables

In this study we focus on sixteen emerging economies (Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Israel, Malasia, Mexico, Peru, Philippines, Poland, South Africa, South Korea and Turkey, henceforth EM-16). These countries represent a very diverse group that is slowly catching up to their richer peers, and are responsible for the major part of real output, foreign trade, stock market capitalization, and international capital flows. We also wanted a selection of countries that comprised most continents and a wider set of cultures as possible, which will make more robust any systematic finding. Moreover, these countries have experienced very diverse economic environments in a relatively short period of time: hyperinflation, deep recession, generalized protectionist measures, opening up to international trade and capital flows, macroeconomic stabilization plans, privatization, deregulation, and re-regulation.

Also, we replicate the analysis for a group of fifteen industrial countries (Austria, Belgium, Canada, Denmark, France, Germany, Greece, Italy, Japan, Netherlands, Norway, Spain, Sweden, United Kingdom, and the United States, henceforth DM-15) as a “control” group. Our intent here is to compare the dynamics between these two groups of countries as well as among individual countries and especially contrast our findings with those of previous studies focused in the United States.

Data sources are as follows: stock market indices for all thirty one countries are from the Morgan Stanley Capital Index (MSCI). Consumer price indices are obtained from IFS for all countries. Interest rates are also from IFS for all countries, but their definition varied according to availability. Whenever available, we chose the yield in short-term government bills (Austria, Belgium, Canada, France, Germany, Greece, Italy, Japan, Mexico, Netherland, Spain, Sweden, the United Kingdom, and the United States). Short-term bank deposit rates are used for Chile, Czech Republic, Denmark, Malasia, and Turkey. Central Bank discount rates are used for Brazil, Chile, China, Colombia, Hungary, India, Israel, Norway, Peru, Philippines, Poland, South Africa and South Korea.

Finally, the industrial production indices are from IFS for all countries. The DM-15, Brazil, Czech Republic, Hungary, Israel, Mexico, Poland and Turkey were all the industrial production series seasonally adjusted available directly at the IFS. For China, India, Malaysia and South Korea the Industrial production not seasonally adjusted was used. For Chile, Colombia, Peru,

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Philippines and South Africa the manufacturing production not seasonaly adjusted series was utilized. In order to make the series comparable, we seasonally adjusted the all production indices that weren’t already available adjusted as well. Period covered is between 1990 and 2009, monthly observations.

The variables used in this study are presented as monthly rates computed from the original series. Inflation rates \( INF_{it} \) are computed by the end of period according to:

\[
INF_{it} = \ln \left( \frac{CPI_{it}}{CPI_{i,t-1}} \right)
\]

(1)

where \( CPI_{it} \) stands for the end of period \( t \) consumer price index of country \( i \), and is the natural logarithm of the argument. The nominal rate of return on the stock market \( RET_{it} \) is obtained according to:

\[
RET_{it} = \ln \left( \frac{SMI_{it}}{SMI_{i,t-1}} \right)
\]

(2)

where \( SMI_{it} \) is the nominal stock market index by the end of period \( t \) for country \( i \) in local currency. Similarly, the growth rate of industrial production \( GIP_{it} \) is computed as:

\[
GIP_{it} = \ln \left( \frac{IPI_{it}}{IPI_{i,t-1}} \right)
\]

(3)

where \( IPI_{it} \) is the industrial production index\(^{14} \) by the end of period \( t \) for country \( i \). Nominal interest rates \( INT_{it} \) are obtained by re-scaling the original annual rate in its monthly nominal effective rate, i.e.:

\[
INT_{it} = (\frac{12}{12}NIR_{it} - 1)
\]

(4)

where \( NIR_{it} \) is the annualized short-term nominal interest rate at the end of period \( t \) for country \( i \).

Periods covered by the data for each country and their descriptive statistics are available at request from the authors, and kept out of this article due to data constraints. For the sample periods studied here, inflation rates reached very high levels for some emerging countries and are also highly volatile. Interest rates, by contrast, have lower levels and variability most of the time. As expected, the stock returns present much higher volatility than the inflation and interest rates series. Skewness and excess kurtosis are pronounced in most series, suggesting non-normal distributions.

The average growth in real activity for the EM-16 is in general well above the average growth of the DM-15 Finally, the volatility of the nominal variables, as well as that of inflation, for the EM-16 is, on average, substantially larger than those observed for the DM-15.

2.2. Empirical Model

This paper employs a four-variable Vector Autoregression (VAR) system in order to explore the causality relations between inflation, real stock returns, real interest rates, and real

\(^{14} \text{Manufacturing production indices are used for Peru and Chile.} \)
activity. This approach provides a parsimonious yet insightful specification to treat a given problem. Although some critics remark that such method may resemble econometrics without a backing economic theory (Pesaran and Wickens, 1995), VAR analysis has been employed in a wide range of economic problems where the dynamic impact of shocks need to be estimated, mostly in macroeconomics (Canova, 1995; Watson, 1994).

Recalling Fisher (1930), the expected nominal return on stocks should fully anticipate expected inflation, i.e. the Fisher Hypothesis states that, in the regression of expected returns on expected inflation, it should have a unity coefficient. This means that, if common stock is a hedge against inflation, its ex-ante nominal return should fully anticipate any expected inflation. Notice that this is different from postulating a unity coefficient for realized inflation in the regression of realized returns, since such formulation would define the ex-post relationship. This theoretical aspect has important empirical implications. McCarthy, Najand, and Seifert (1990), for instance, argue that previous tests of the Proxy Hypothesis are misspecified, since they have used actual values instead of expected values for the variables.

Therefore, in order to test the theory properly, one needs to analyze expected rather than actual variables. This is a common problem faced by empirical researchers, since it is often difficult to pinpoint expectations. Assumptions have to be made in order to make this problem empirically tractable. One easy way out would be to assume that actual realized variables proxy the expected variables. However, in such a setting, there is no room for forecast errors and erroneous expectations. Forecasting inflation with the short-term interest rate (or its changes), has been a solution employed by many researchers (Solnik, 1983; James, Koreisha, and Partch, 1985; Domian, Gilster, and Louton, 1996; and Randall and Suk, 1999; among others). However, such solution implies a fixed real interest rate, which is a rather strong assumption. Indeed, Lee (1992) provides evidence of a non-negligible real interest rate effect. Another solution is to use survey data on expectations (Hasbrouck, 1984) or market reaction to announcements (Amihud, 1996). Availability of reliable and credible survey data, however, is an issue, and establishing market reaction to announcements is only feasible with high frequency data. Finally, a common way to deal with this problem is to assume that expectations are formed according to some simple rule, such as rational expectations. Many previous studies relied on time series techniques in order to generate expectational variables (e.g. Wahlroos and Berglund, 1986; Cozier and Rahman, 1988; Loo, 1988; Buono, 1989; McCarthy, Najand, and Seifert, 1990; Lee, 1992; Wei and Wong, 1992; Liu, Hsueh, and Clayton, 1993; Ammer, 1994; Boudoukh, Richardson, and Whitelaw, 1994; Lee, 1998; Hess and Lee, 1999; Adrangi, Chatrath, and Raffiee, 1999; and Park and Ratti, 2000; among others). The techniques mostly employed are ARIMA, ARCH/GARCH, the Hodrick-Prescott Filter, and the Kalman Filter.

We choose to estimate expected nominal variables with a standard Kalman Filter in a VAR(p) specification where the endogenous variables are described according to equations (1) to (4), that is:

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15 Forecast errors may be of particular relevance in economic environments where large and unexpected shifts in nominal variables are frequent, which is the case for many Emerging Markets over the sample period studied.

16 The Kalman Filter is appropriate in this setting because, as a recursive procedure, it mimics fairly well the decision-making of a rational agent as new information is being released. For a more in-depth discussion of the Kalman Filter’s properties and applications in finance please see Wells (1995).
\[
\begin{bmatrix}
EINF_{it}
\\
ERET_{it}
\\
EINT_{it}
\\
EGIP_{it}
\end{bmatrix}
= \alpha_0 + \sum_{p=1}^{p} \alpha_p \begin{bmatrix}
INF_{i-p}
\\
REI_{i-p}
\\
INT_{i-p}
\\
GIP_{i-p}
\end{bmatrix}
\]  

(5)

where \(\alpha_0\) and \(\alpha_p\) are the recursively estimated coefficients. Notice that the empirical model includes, besides expected real stock returns and expected inflation, expected real activity and the expected real interest rate. The former is because of the Proxy and Reverse Causality Hypotheses, which require a measure of real activity in order to sort out the “spurious” empirically observed correlation. The latter, enters because of Lee (1992) documentation of a significant real interest rate effect for the United States.

The order \((p)\) of the VAR is determined for each country by the Schwarz-Bayesian Information Criterion (SBIC), according to Schwarz (1978). Such criterion is chosen because, according to Pesaran and Pesaran (1996), it usually selects more parsimonious specifications than the Akaike Information Criterion (AIC, Akaike, 1974).\(^{17}\) The SBIC selects two lags for Brazil, Denmark, Greece, Israel, Italy, Malaysia, Mexico, Peru, Poland, South Africa, Spain, UK and US and one lag for all other countries.

Once the expected nominal variables have been estimated, we proceed to compute the real variables that should enter the final specification. Expected real variables are computed by subtracting expected inflation from the expected nominal variable obtained previously, that is:

\[
REIT_{it} = ERET_{it} - EINF_{it}
\]

and,

\[
REINT_{it} = EINT_{i,t-1} - EINF_{it}
\]

Of course, this is true only for nominal interest rates and nominal stock returns, since the change in industrial production is a physical volume measure. Notice that since interest rates are given in the end of each period, in order to obtain the expected real yield in a given period we must subtract the respective inflation rate from the preceding period’s nominal interest rate. In summary, the four variables that are included in the final VAR are the expected inflation rate \((INF_{it})\), the expected real stock returns \((MER_{it})\), the expected real interest rate \((JUR_{it})\), and the expected growth in real activity \((PRD_{it})\) for each country \(i\) in each period \(t\). A constant is used as the sole exogenous variable. Again, the order of each VAR system is determined according to the SBIC as follows:

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\(^{17}\) Given the data span limitations for some countries, a parsimonious empirical specification is desirable.
EM 15 | # Lags (Months) | DM- | # Lags (Months)
--- | --- | --- | ---
Brazil | 2 | Austria | 1
Chile | 1 | Belgium | 1
China | 1 | Canada | 1
Colombia | 1 | Denmark | 2
Czech Republic | 1 | France | 1
Hungary | 1 | Germany | 1
India | 1 | Greece | 2
Israel | 2 | Italy | 2
Malaysia | 2 | Japan | 1
Mexico | 2 | Netherlands | 1
Peru | 2 | Norway | 1
Philippines | 1 | Spain | 2
Poland | 2 | Sweden | 1
South Africa | 2 | United Kingdom | 2
South Korea | 1 | United States | 2
Turkey | 1 | | |

The final empirical model is therefore represented by:

\[
\begin{bmatrix}
EINF_{it} \\
RERET_{it} \\
REINT_{it} \\
EGIP_{it}
\end{bmatrix} = \alpha_0 + \sum_{p=1}^{P} \alpha_p \begin{bmatrix}
EINF_{it-p} \\
RERET_{it-p} \\
REINT_{it-p} \\
EGIP_{it-p}
\end{bmatrix} + \varepsilon_t
\]

All final series seem stationary. They are tested for unit root by using the Augmented Dickey-Fuller test, and the null hypothesis of unit root is rejected for all of them, with the exception of Peru’s inflation rate (results not reported for the sake of concision, but are available upon contact with the authors). It may be due to the severe high-inflation of the 1980’s that continued until 1992. Therefore, results for this country should be taken with caution.

3. Empirical Results

A. Granger Causality Results

The intuition of the test proposed by Granger (1969) and later modified by Sims (1972) is that a variable \( Y \) is said to cause another called \( X \), when that later can be better explained using past values of \( X \) and \( Y \), then only past values of \( X \). In this sense, \( Y \) Granger causes \( X \), if the F-test rejects he null hypothesis of no granger causality, i.e., rejects the hypothesis that past values of \( Y \) are unable to better explain the \( X \) variable. There can also be a bidirectional granger causality when both variables are capable of improving the explanation of the other one. And the last case, is one none of the variables granger causes the other. It's important to note that the sentence “\( x \) granger causes \( y \)” does not mean that \( y \) is the effect, a function or the result of \( x \). Granger causality tests precedence and informational content, but does not indicate causality on the conventional use of the word.

INSERT TABLE 1 HERE
Table 5 and 6 show the Granger causality test results of the 16 emerging markets and the 15 developed countries included in the sample. It is noteworthy to mention that for 11 of the 16 emerging countries no granger causality was found between inflation and stock returns. Hence, the Fisher Hypothesis of stock returns being a hedge against inflation is not verified for the developing countries. Also the Tax-Hypothesis is rejected since inflation should, in such theory, precede stock returns is not corroborated by the test. For Brazil, China, Mexico and South Korea, inflation is caused by stock returns supporting the Reverse Causality Hypothesis. 11 of the 16 countries present no relation between inflation and real activity contradicting the Fama’s Proxy Hypothesis. For 8 of the 16 EM the stock returns precede real activity, supporting the Reverse Causality Hypothesis.

If causality runs from inflation to stock returns, that can be interpreted in support of the Tax-Effects Hypothesis. If causality runs the other way round, it suggests the Reverse Causality Hypothesis. For the Developed Markets, inflation causes stock returns for 7 of the 15 countries, supporting the Tax Effect Hypothesis. However, in the Reverse causality hypothesis, stock returns should precede (granger cause) real activity which is what occurs for 7 of 15 developed countries. Hence, the evidence is mixed for the Developed Markets.

B. Estimation Results

The model is estimated according to the VAR (p) specification determined in equation (8). Ordinary Least Squares (OLS) estimation is used. Because lagged values of the same dependent variables are present in the right-hand side in all equations in the system, OLS estimation is consistent and efficient (Hall and Cummins, 1997). For the sake of concision and the amount of equations (124 total), estimated coefficients and respective heteroskedasticity-consistent standard errors 18 (White, 1980), along with the adjusted R² statistic for each equation are withhold from this paper, and are available upon request. The specification fits the EM-16 slightly better than the DM-15. The VAR approach does not perform homogeneously across countries and variables however, suiting some better than others. For example, stock returns and real activity is less well explained by the model than the other variables. The variables do not seem to be significant across the VAR estimated. The variables seem to be highly dependent of its past values, with the other variables not being consistently significant in each country. Most significance of the other variables seem erratic without any distinguishable pattern.

For Brazil, Mexico and South Korea the evidence is strong in favor of the Reverse Causality Hypothesis. There is a positive relation between stock returns and real activity, and a negative relation between inflation and stock returns. Also, stock prices granger cause real activity and inflation. Both are in support of the Reverse Causality Hypothesis. There is no

18 Given the different economic regimes experienced by the countries over most of the sample period, we expect heteroskedasticity to be present.
support for any of the other Hypothesis, for the emerging markets, according to the relationships presented by the data. For the developed countries, since the VAR analysis showed little relation between inflation and stock returns, but some relation between real activity and inflation, real activity and stock returns, it represents a higher support for the Proxy Hypothesis.

4. Conclusion

This paper employs a VAR approach to investigate the causality relationships between real inflation rates, real stock returns, real interest rates, and changes in real activity in a sample of seven Latin American developing countries and seven industrial countries. The methodology is based mainly upon Vector Autoregression analysis, but other techniques are also employed in order to gain insight on the robustness of the results.

The main findings confirm the poor inflation hedge characteristics of stocks that have been observed by previous studies. Also, there are fewer differences between developed and developing countries than one could initially presume, given the sharp differences in the levels and volatility of the variables in those two groups of countries. Some support is found for the three major explanatory hypotheses, although the robustness of these findings is relatively weak. Causation is often observed between inflation and stock, which suggests that the Reverse Hypothesis performs better than the other ones, in particular for emerging countries. For the developed countries, the VAR analysis does not indicate a significant correlation between inflation and stock returns, suggesting, at the bottom line, that the Proxy hypothesis and the spurious regression is supported. This evidence suggests that active monetary management by central banks does not has an effect over asset prices and raises the discussion of whether monetary authorities should continue to not take such effects into account when outlining monetary policy. Overall, the results of this paper suggest that existing theories of the empirical Fisher Hypothesis are not able to adequately explain the phenomenon, and further theoretical investigation is necessary. In particular, different empirical techniques employed here raise the question of whether the observed negative stock returns-inflation relationship is a short-term phenomenon, and – if that is the case – what are the determinants of an optimal horizon for effective hedging.

In addition, a few comments should be made regarding the empirical methods employed here. First, it is important to note that U.S. data used in previous research covered a larger period than the data used in this study (e.g., James, Koreisha, and Partch, 1985, covered the period between 1962-1981 while Lee, 1992, covered the period between 1947-1987). The comparisons made here should therefore be taken with caution. James, Koreisha, and Partch (1985) use 240 observations while Lee (1992) has around 492 observations with a similar specification. Also, the robustness of the results presented in this study with respect to different orders of the VAR system is not precisely known, and should be an interesting empirical question to be investigated in the future. This paper has the advantage of determining VAR orders by employing selection criteria instead of arbitrarily defining it as previous research do. However, a further look in the properties of such techniques is necessary before any definite conclusions can be drawn. Similarly, the sensitivity of the results reported here regarding different sample periods is not explored.\textsuperscript{19} It would be interesting to verify how such results behave as different time spans are

\textsuperscript{19} Mostly by limitations of time series span.
chosen. In particular for the EM-15, it is important to investigate if these results are robust to periods of hyperinflation versus periods of monetary stability. Finally, and perhaps more importantly, the data employed here are essentially first-difference versions of the underlying economic measures (consumer prices, industrial production, and stock indices). If these series are integrated, then we are ignoring potentially useful information regarding the long-run equilibrium adjustment. Therefore, cointegration techniques may be useful to further explore this problem.  

These are left as a suggestion for further research.

In closing, it seems clear from the empirical results of this paper that existing theoretical models cannot so far provide a good universal explanation for the observed phenomena. The need to develop new theoretical models, therefore, is the main challenge that results from this empirical exercise.

References


Notice however that Ely and Robinson (1994) employ cointegration analysis precisely for the same type of problem – the Fisher Hypothesis in a multi-country sample – and their results strongly reject the short-term disequilibrium hypothesis.


### Table 1: Granger Causality test for the emerging countries

<table>
<thead>
<tr>
<th>Inflation</th>
<th>Stock Returns</th>
<th>Interest Rate</th>
<th>Real Activity</th>
<th>Stock Returns</th>
<th>Interest Rate</th>
<th>Real Activity</th>
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<td>No Relation</td>
<td>Brazil</td>
<td>Bicausal**</td>
<td>Cause***</td>
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<td>Cause***</td>
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<td>Cause***</td>
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<td>Caused*</td>
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</tr>
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<td>Cause***</td>
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<td>Cause*</td>
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** and *** represent significance at 10%, 5%, e 1%, respectively.
<table>
<thead>
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<th>Table 2: Granger Causality test for the developed countries</th>
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<tr>
<td><strong>Interest Rate</strong></td>
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</table>

*:*** and *** represent significance at 10%, 5%, e 1%, respectively.