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Stock Returns, Inflation, and the Volatility of Growth in the Money Supply: Evidence from Emerging Markets

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Abstract

A large body of work documents a negative relation between expected nominal stock returns and expected inflation in the U.S. and other developed countries. This paper argues that the volatility of expected growth in the money supply is an important determinant of this relation. Previous studies focus on markets that reside in countries with relatively stable monetary policies. Therefore, the effects of the volatility of expected growth in the money supply are not apparent. We take this investigation to a set of emerging stock markets. Many of these markets reside in economies that have experienced substantial volatility in expected money supply growth. We provide support for the proposition that as the volatility of expected growth in the money supply increases, the relation between movements in expected nominal returns and expected inflation should approach one-for-one.

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I. Introduction

Fisher's hypothesis applied to stock returns states that expected nominal returns should equal expected real returns plus expected inflation. Therefore, if expected real returns are either constant or uncorrelated with expected inflation, then expected nominal returns should move one-for-one with expected inflation. There is much evidence that rejects this proposition. Lintner (1975), Bodie (1976), Jaffe and Mandelker (1976), Nelson (1976), Fama and Schwert (1977), Modigliani and Cohn (1979), and Huizinga and Mishkin (1984) among others find that the relation between expected nominal returns and expected inflation is less than one-for-one, and in some periods negative. Branch (1974), Solnik (1983) and Gultekin (1983) provide similar evidence from other countries. These findings suggest that the assumption that expected real returns are uncorrelated to expected inflation is faulty.

Fama (1981) argues that both expected inflation and expected real stock returns are fundamentally tied to expected growth in future real activity[2]. Based on an unconventional model for the demand for money, Fama maintains that expected inflation is negatively related to expected growth in future real activity and positively related to expected growth in the nominal money supply. On the other hand, via a story about time varying risk premiums, he argues that expected real stock returns are positively related to expected growth in real activity. Thus, a negative relation between expected real stock returns and expected inflation is spuriously induced by the links to expected growth in future real activity.

[2] Some other explanations are given by Feldstein (1980a,b), Geske and Roll (1983), Day (1984), Stulz (1986), Pindyck (1987), and Marshall (1992).

A crucial assumption in Fama's argument is that monetary policy is independent of expected growth in future real activity. Kaul (1987) investigates the implications of pro-cyclical and counter-cyclical monetary policies on this model. He argues that in countries that follow pro-cyclical monetary policies[3], we should observe a weaker negative or even a positive relation between expected stock returns and expected inflation. U.S. data from the 1930's (a period of pro-cyclical monetary policy) provides empirical evidence in support of his propositions. In the spirit of Kaul, we investigate how an alternate assumption of the money supply process affects the relation between expected nominal stock returns and expected inflation.

The main contention of this paper is that as the volatility of expected growth in the money supply becomes large the relation between expected nominal returns and expected inflation should approach one-for-one. The logic behind this assertion is that as the volatility of the expected growth in the money supply increases, the effect of expected growth in real activity on expected inflation becomes of secondary importance. Therefore, two things happen, 1) the link between expected real returns and inflation weakens and 2) the volatility of inflation increases. Both of these factors induce a one-for-one relation between expected nominal stock returns and expected inflation.

We provide empirical support for this proposition from a set of emerging stock markets. The focus on emerging markets reflects the fact that these markets reside in economies where we expect to encounter the widest variety of monetary policies. Two of the countries, Argentina and Brazil, experienced hyperinflations during our sample period. We find that as we move from low volatility (of expected money supply growth)

[3] A procyclical monetary policy is one where the government prints more money when economic activity is

to high volatility countries, the estimated slope of a regression of nominal stock returns on expected inflation converges to one.

The paper proceeds as follows. Section II introduces a simple model of the relation between expected stock returns and inflation which has motivated much of the empirical work in this area. Here we provide a detailed explanation of how the volatility of expected growth in the money supply should affect the relation between expected nominal returns and expected inflation. Section III describes the econometric techniques used in this work. Here we depart slightly from traditional estimation methods due to data problems and the complex time series properties of the inflation and stock returns series for the countries we study. Section IV discusses the data. Section V describes how we obtain estimates for the volatility of expected growth in the money supply. Section VI presents the empirical results and section VII concludes.

II. Theory

II.1. A simple model for expected returns and inflation

In this section we develop a framework within which to think about the relation between stock returns and inflation. Fisher's hypothesis for stock returns states,

(1) $$E_t(R^N_{t+1}) = E_t(R^R_{t+1}) + E_t(I_{t+1})$$

where R^N_{t+1} and R^R_{t+1} represent the continuously compounded nominal and real returns from time t to time t+1 on an index of stocks, I_{t+1} represents the continuously compounded rate of inflation from time t to time t+1, and $E_t(.)$ represents expectations

high and less money when economic activity is low.

conditional on all available information at time t (below all expectations are meant to be conditional unless otherwise stated). Assuming expected real returns are constant,

(2) $$E_t(R^R_{t+1}) = \alpha,$$

we have a model that can be tested. The assumption of constant expected real returns may be unsatisfactory for stocks but for now we maintain it for its simplicity and to motivate the empirical tests. Below we will examine the effects of time varying expected real returns. Substituting (2) into (1) and parameterizing the relation between expected nominal returns and expected inflation, we obtain,

(3) $$E_t(R^N_{t+1}) = \alpha + \beta\, E_t(I_{t+1}).$$

Assumptions (1) and (2) imply that $\beta = 1$ in (3).

II.2. Previous work

If equation (3) holds and people have rational expectations, then realized returns should deviate from their expectations by a disturbance term that is orthogonal to all available information at time t. Therefore, a reasonable method for estimating equation (3) is to obtain an estimate of $E_t(I_{t+1})$ and run the following regression,

(4) $$R^N_{t+1} = \alpha + \beta\, E_t(I_{t+1}) + \varepsilon_{t+1}.$$

Fama and Schwert (1977) run regressions of this type on U.S. data using short term interest rates as their estimate of $E_t(I_{t+1})$. Solnik (1983) does the same for eight other major industrialized countries. Gultekin (1983) fits time series models to inflation series and uses the fitted values as his estimate of $E_t(I_{t+1})$ in similar regressions using a broader set of thirteen industrialized countries. In all cases they find estimates of β that are reliably different from one and often significantly negative.

II.3. Fama's proxy hypothesis

One explanation for the sound rejection of the model is given by Fama (1981). Fama argues that expected real returns vary over time and are correlated to variations in expected inflation. The story goes as follows: Using a rational expectations view of the quantity theory of money Fama posits the following model for the demand for real cash balances:

$$M_t - P_t = \lambda_0 + \lambda_1 E_t(A_{t+1}), \tag{5}$$

where $\lambda_1 > 0$, M_t represents the logged nominal money supply at time t, P_t represents the logged price level at time t, and A_{t+1} represents a measure of real activity at time t+1. The intuition is that the demand for real balances will be high when there are a lot of good ideas for which capital is needed. As these good ideas turn into measured real activity, real money demand is related to anticipated future real activity. Given that prices are endogenous to the model we can convert the money demand model into a model for expected inflation. By differencing (5) and taking conditional expectations we obtain,

$$E_t(I_{t+1}) = \gamma_1 E_t(\Delta A_{t+2}) + \gamma_2 E_t(\Delta M_{t+1}) \tag{6}$$

where ΔA_{t+2} represents the growth in real activity from t+1 to t+2 and ΔM_{t+1} represents the growth in the money supply from t to t+1. The model predicts that $\gamma_1 = -\lambda_1 < 0$ and $\gamma_2 = 1$. That is, expected inflation is negatively related to expected growth in real activity and positively related to expected growth in the money supply.

The second half of Fama's story comes from a model of expected real returns. Fama argues that increases in anticipated future activity puts pressure on the stock of capital, thus raising the required rate of return. For simplicity we model this as a linear relation,

(7) $$E_t(R^R_{t+1}) = \delta_0 + \delta_1 E_t(\Delta A_{t+2}) \text{ where } \delta_1 > 0.$$

This model finds empirical support in the work of Fama and French (1989) among others who provide evidence from U.S. data that expected real returns on stocks are high in business cycle troughs (when good times lie ahead) and low at business cycle peaks (when poor times lie ahead). Thus, it can be seen from (6) and (7) that both expected inflation and expected real returns are related in opposite ways to expected growth in real activity.

The OLS estimator from regression (4) converges in probability to,

(8) $$\hat{\beta} \underset{p}{\rightarrow} \frac{\text{cov}(E_t I_{t+1}, R^N_{t+1})}{\text{var}(E_t I_{t+1})}.$$

If we substitute equations (1), (6) and (7) into equation (8) it follows that,

(9) $$\hat{\beta} \underset{p}{\rightarrow} 1 + \frac{\gamma_1 \delta_1 \sigma_a^2 + \gamma_2 \delta_1 \rho_{am} \sigma_a \sigma_m}{\text{var}(E_t I_{t+1})}$$

where ρ_{am}=corr($E_t\Delta A_{t+2}$, $E_t\Delta M_{t+1}$), σ^2_a=var($E_t\Delta A_{t+2}$), and σ^2_m=var($E_t\Delta M_{t+1}$). Thus, $\hat{\beta}$ will not converge to one in general. Finally, Fama assumes that during post-war U.S. history monetary policy was largely independent of expected future real activity. We can take this to mean that ρ_{am}=0. Given this assumption we can see that since γ_1<0 and δ_1>0, $\hat{\beta}$ will converge to some number less than one. This is consistent with the empirical findings. Intuitively, the story simply states that the negative relation is driven by the fact that both expected stock returns and expected inflation are linked to expected growth in future real activity. Expected inflation is negatively related to expected future real activity by (6) and expected future stock returns are positively related to expected future real activity by (7).

Geske and Roll (1983) lend further support to this explanation by arguing that in the post-war period the U.S. government tended to follow counter-cyclical monetary policies. A counter-cyclical policy would imply that $\rho_{am}<0$. Therefore, by (9) we should observe a $\hat{\beta}$ that is even further below one. Following this line of thought, Kaul (1987) argues that when countries follow pro-cyclical monetary policies, that is, $\rho_{am}>0$, by (9) we should observe weaker negative or even positive $\hat{\beta}$'s. Looking at pre-war U.S. and Canadian data, a period when monetary policy was procyclical in both countries, Kaul finds some support for this proposition.

II.4. The volatility of the money supply growth

In the context of this model we can see what happens to the relation between expected nominal stocks returns and inflation as the volatility of expected growth in the money supply increases. We operationalize this idea by assuming that $\sigma_m \rightarrow 8$. In this case if we expand the variance of the expected inflation term in equation (9) we can write,

$$\text{(10)} \qquad \hat{\beta} \underset{p}{\rightarrow} 1 + \frac{\gamma_1\delta_1\sigma_a^2 + \gamma_2\delta_1\rho_{am}\sigma_a\sigma_m}{\gamma_1^2\sigma_a^2 + 2\gamma_1\gamma_2\rho_{am}\sigma_a\sigma_m + \gamma_2^2\sigma_m^2}.$$

Thus, holding the correlation between expected growth in real activity and expected growth in the money supply constant and holding the variance of expected growth in real activity constant, equation (10) implies that as $\sigma_m \rightarrow 8$, $\hat{\beta} \rightarrow 1$. We argue that as $\sigma_m \rightarrow 8$ movements in inflation primarily reflect movements in the growth of the money supply.

While expected real returns reflect anticipated future growth in real activity, changes in expected inflation primarily reflect changes in expected money growth. The idea is that as expected money growth becomes more and more volatile, the link between expected inflation and expected future growth in activity will become weaker and weaker. By weakening the spurious link between expected stock returns and expected inflation, we should be able to get a cleaner look at the Fisher hypothesis.

Moreover, we argue that as $\sigma_m \rightarrow 8$, the standard error of $\hat{\beta}$ should decrease. Intuitively, we are trying to estimate the population slope of the nominal stock return - expected inflation relation. Two things happen as $\sigma_m \rightarrow 8$, 1) the population slope approaches unity and 2) the variation in the independent variable (expected inflation) increases. Naturally, the increased variation in the independent variable yields a more precise estimate of the slope.

To develop this concept further, consider the case where the regression residual from equation (4), ε_{t+1}, is i.i.d. with zero mean and standard deviation σ. In this case the standard error of the slope coefficient can be expressed as,

(11) $$SE(\hat{\beta}) = \frac{\sigma}{\sqrt{var(E_t I_{t+1})}}.$$

Therefore, holding all else constant we can see from equation (6) that as $\sigma_m \rightarrow 8$, the denominator in (11) will grow causing the standard error to shrink.[4]

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[4] Strictly speaking, in our case we cannot assume that ε_{t+1} is i.i.d. and independent of the independent variable. Given Fisher's hypothesis, we can write

$$R^N_{t+1} = E_t R^R_{t+1} + E_t I_{t+1} + u_{t+1},$$

where u_{t+1} is the unanticipated component of the nominal return and consists of $[I_{t+1} - E_t I_{t+1}] + [R^R_{t+1} - E_t R^R_{t+1}]$. Given that

$$E_t R^R_{t+1} = ER^R + [E_t R^R_{t+1} - ER^R],$$

we can see that,

In sum, our story is that as $\sigma_m \rightarrow 8$, the slope coefficient will approach one and its standard error will approach zero. The implication of these two effects is that as we move from countries with small σ_m's to countries with large σ_m's, we should see increasing regression t-statistics (slope / standard error).

II.5. Cagan's model of the demand for money in hyperinflations

Before proceeding, we consider the implications of an alternate model for expected inflation. Although traditional money demand models state that the demand for money should be negatively related to the interest rate (a measure of the opportunity cost to holding money), Fama (1982) provides evidence from the U.S. that the impact of interest rates is empirically weak. However, Cagan (1956) suggests that during hyperinflations the opportunity cost of holding money is the most important factor driving the demand for real balances. Cagan specifies a model where the demand for real money is negatively related to expected future inflation. Using data from the hyperinflations in Europe during the first part of the 20th century, Cagan finds strong support for his proposition. Under additional assumptions that make Cagan's model consistent with rational expectations, Salemi and Sargent (1979) and Christiano (1987)

$$R^N_{t+1} = ER^R + E_tI_{t+1} + u_{t+1} + [E_tR^R_{t+1} - ER^R].$$

Thus, in regression (4) $\alpha = ER^R$ (the unconditional expected real return), $\beta = 1$, and the residual consists of $u_{t+1} + [E_tR^R_{t+1} - ER^R]$. The presence of the expected real return term in the residual causes dependence between the residual and the independent variable (by equations (6) and (7)). This problem explains why researchers have failed to produce unit β's in regressions of nominal stock returns on measures of expected inflation. The dependence between the residual and the independent variable biases the regression estimates.

However, we argue that as $\sigma_m \rightarrow \infty$, the impact of the problem will diminish. To see this notice that the correlation between the regression residual and the independent variable, expected inflation, comes from their common relation to expected growth in future activity via equations (6) and (7). However, as $\sigma_m \rightarrow \infty$, the impact of expected future growth in real activity on expected inflation will decrease, thereby reducing the correlation between the regression residual and the independent variable.

provide further evidence in support of Cagan's model. In light of this work and the fact that our sample includes two hyperinflationary economies, we consider the following model:

(12) $M_t - P_t = \psi_0 + \psi_1 E_t I_{t+1} + \psi_2 E_t A_{t+1}$ where $\psi_1<0$ and $\psi_2>0$.

This model is a combination of Fama's model and Cagan's model. It simply states that real money balances are negatively related to expected inflation and positively related to expected future real activity. If we assume that inflation is endogenous, then by differencing (12) and then solving recursively for expected inflation it follows that,

(13) $$E_t I_{t+1} = \frac{-1}{\psi_1 - 1} \sum_{i=0}^{\infty} \left(\frac{\psi_1}{\psi_1 - 1} \right)^i E_t \Delta M_{t+i+1} + \frac{\psi_2}{\psi_1 - 1} \sum_{i=0}^{\infty} \left(\frac{\psi_1}{\psi_1 - 1} \right)^i E_t \Delta A_{t+i+2} .$$

Note that as $\psi_1<0$ and $\psi_2>0$, expected inflation is positively related to expected future growths in the money supply and negatively related to expected future growths in real activity. Intuitively, this is roughly the same idea as Fama's model for expected inflation. If we maintain Fama's hypothesis that expected real returns are positively related to expected growth in real activity we can show in the same manner as we did above that as the volatility of the expected future money supply goes to infinity, the estimated slope coefficient, $\hat{\beta} \to 1$. The intuition is exactly the same as above. The extreme volatility of expected growth in the money supply dominates the spurious relation between expected real returns and expected inflation. Thus, we are left with a purer test of the Fisher hypothesis. Therefore in the context of Cagan's model, the empirical implications are unchanged.

III. Methodology

In the countries we study, estimation of equation (4) is hampered by the difficulties in obtaining reliable estimates of expected inflation. Therefore, unlike previous tests of the joint hypothesis of Fisher's equation and constant expected real returns given in equation (3), we do not perform regressions of nominal stock returns on a measure of expected inflation. Below we discuss some of the problems with estimating expected inflation and how we approach the task of estimating and testing the model.

III.1. Problems with traditional measures of expected inflation

Fama and Schwert (1977) and Solnik (1983) use short term nominal interest rates as proxies for expected inflation. Unfortunately, in many of our countries interest rate data are not available. Moreover, even when they are available, reported short term interest rates may not accurately reflect actual market interest rates. For example, in Argentina and Brazil, reported interest rates are often highly regulated by so called "usury laws". However, lenders and borrowers often find ways of circumventing these controls. Rather than charging high rates on loans, banks may charge high commissions and fees or they may require large "compensating balances". In the 50's and 60's Brazilian banks evaded interest rate controls by defining long term deposits as "participations" and the payments they made as dividends. For these reasons reported interest rates can vary widely from actual interest rates and thus we do not use interest rates as a proxy for E_tI_{t+1}.

We also decide not to use time series models to estimate E_tI_{t+1} as casual observation of plots suggest that constructing reliable time series models would be a difficult task. Here we opt for an approach that is less parametric.

II.2. Our approach

Let $r^N_{t+1} = R^N_{t+1} - ER^N$, $r^R_{t+1} = R^R_{t+1} - ER^R$, and $i_{t+1} = I_{t+1} - EI$ represent the demeaned values of each variable. Then we can rewrite equation (3) as,

(14) $$E_t(r^N_{t+1} - \beta i_{t+1}) = 0.$$

Suppose we have k instruments, $\mathbf{Z}_t$, that are part of the information set at time t. Then under the null,

(15) $$E_t((r^N_{t+1} - \beta i_{t+1}) \otimes \mathbf{Z}_t) = \mathbf{0}.$$

That is, given equation (14), $(r^N_{t+1} - \beta i_{t+1})$ must be orthogonal to any information that is known at time t. Taking unconditional expectations we have,

(16) $$E((r^N_{t+1} - \beta i_{t+1}) \otimes \mathbf{Z}_t) = \mathbf{0}.$$

We can estimate equation (16) using GMM. One nice feature of this approach is that we do not need to model expected inflation directly. However, as we will discuss below, the choice of $\mathbf{Z}_t$ can be important.

III.3. Some features of the estimation

The goal of this section is 1) to compare our estimation procedure to more traditional methods such as that employed by Fama and Schwert (1977) and others who perform regressions of nominal stock returns on proxies for expected inflation and 2) to evaluate the impact of our choices of instruments on our results.

Our estimation procedure can be interpreted as a regression of nominal stock returns on a measure of expected inflation. In this case the measure is actual inflation. To correct for the measurement error due to unexpected inflation, we perform an instrumental variables regression. We want to choose our instruments so that they are correlated with the signal (expected inflation) and uncorrelated with the measurement error (unexpected inflation). Any variable in the information set prior to the period that the unexpected inflation is observed qualifies as a good candidate as it will be uncorrelated to the measurement error.

In traditional regressions of nominal stock returns on proxies for expected inflation there exists an equivalence between the hypothesis that the slope coefficient equals one and that expected real returns are uncorrelated to the proxy for expected inflation. To see this we can write the estimated slope of a regression of nominal returns on a proxy for expected inflation, $\hat{\beta}$, as follows:

$$\hat{\beta} \rightarrow \frac{\mathrm{cov}(r^{N}_{t+1}, \hat{E}\ I_{t+1})}{\mathrm{var}(\hat{E}\ I_{t+1})} = \frac{\mathrm{cov}(r^{R}_{t+1} + I_{t+1}, \hat{E}\ I_{t+1})}{\mathrm{var}(\hat{E}\ I_{t+1})} = 1 + \frac{\mathrm{cov}(r^{R}_{t+1}, \hat{E}\ I_{t+1})}{\mathrm{var}(\hat{E}\ I_{t+1})}.$$

If $\mathrm{cov}(r^{R}_{t+1}, \hat{E}\, I_{t+1})=0$, than we can see that $\hat{\beta} \rightarrow 1$.[5]

In the appendix we show that our instrumental variables estimator can be written as follows:

$$\hat{\beta} \rightarrow 1 + \frac{E\left(i_{t+1} \otimes \mathbf{Z_t}\right)' \mathbf{W_0} E\left(r^{R}_{t+1} \otimes \mathbf{Z_t}\right)}{E\left(i_{t+1} \otimes \mathbf{Z_t}\right)' \mathbf{W_0} E\left(i_{t+1} \otimes \mathbf{Z_t}\right)}$$

where $\mathbf{W_0}$ is a k x k weighting matrix. We can see that under the null hypothesis given in equation (2) that expected real returns are constant, the $E(r^{R}_{t+1} \otimes \mathbf{Z}_t)$ term will equal zero. Therefore, under the null hypothesis, $\hat{\beta}$ will converge to 1. However, even if expected real returns are uncorrelated to expected inflation, $\hat{\beta}$ will not converge to 1 if

[5] Note that we are assuming that $I_{t+1} = \hat{E_t}\, I_{t+1} + u_{t+1}$ where u_{t+1} is uncorrelated to $\hat{E_t}\, I_{t+1}$.

our instrument set is correlated to expected real returns. Hence, in general, the hypothesis that $\beta = 1$ is not equivalent to the hypothesis that expected real returns on stocks are uncorrelated to expected inflation. Instead, the hypothesis that $\beta = 1$ is equivalent to the hypothesis that expected real returns are uncorrelated to the instruments. Only in the case where the instruments contain information pertaining to expected inflation exclusively, can we say that the hypothesis that $\beta = 1$ is equivalent to the hypothesis that expected real returns on stocks are uncorrelated to expected inflation.

IV. Data

The stock return data that are employed in this study come from the IFC's Emerging Markets Data Base. All returns are measured as of the end of the month and include dividends. The IFC indices are chosen to include stocks that are the most liquid and have the largest capitalization while also matching the industrial composition of the overall market. These indices represent from 36.2% (India) to 85.9% (Argentina) of the total market capitalization. The data for Japan and Germany are taken from MSCI and the index for the U.S. is the CRSP value-weighted market. To get some feel for the relative characteristics of these markets in table 1 we present some basic statistics on market size, trading activity, and market concentration. Emerging markets tend to be much smaller than developed markets. Compared to U.S.'s $ 4 trillion and Japan's $ 3 trillion stock markets, the capitalization of emerging markets ranges from $ 1.4 billion for Zimbabwe to $ 98.2 billion for Mexico. Although emerging markets as a whole tend to be less liquid than developed markets, many are quite active. As a measure of liquidity, we present the turnover ratio which equals the $ value of transactions in 1991 divided by the $ market capitalization at the end of 1991. Turnover ratios for Germany, Japan, and the U.S. are 208%, 32%, and 54% respectively while turnover ratios for emerging markets range from 1% for Nigeria to 89% for Korea. In addition, the emerging markets tend to be dominated by a few large firms. The share of the total market capitalization held by the 10 largest firms for Germany, Japan, and the U.S. are 39.4%, 18.7%, and 15.4% respectively whereas emerging market numbers range from 21.2% for India to 70.7% for Argentina.

Table 2 presents summary statistics for real returns on each country's market index. The emerging markets returns are characterized by large averages and variances. Average real returns for the emerging markets range from a low of -3% (annualized) for Turkey to a high of 35% for Venezuela. The three developed countries, Germany, Japan, and the U.S. report average returns of 5%, 8%, and 5% respectively. Demirguc-Kunt and Huizinga (1993) offer some evidence that expected stock returns (measured in U.S. dollars) are negatively related to the market capitalization / GDP ratio, suggesting some kind of premium to investing in a less developed stock market. The volatility of returns ranged from 13% for Pakistan to 112% for Argentina. Harvey (1993) and Roll (1992) present evidence that some of the cross-sectional dispersion in volatility can be explained by the degree of diversification of these indices.

In general, autocorrelations of stock returns in emerging markets appear higher than that in developed markets. In our sample, Venezuela and Mexico report the largest first order autocorrelations of 0.49 and 0.34 respectively; much higher than the 0.09, 0.08, 0.10 recorded for Germany, Japan, and the U.S. These numbers accord with our intuition that infrequent trading or stale prices may be more prevalent in some of these markets. Harvey (1993) finds that autocorrelation coefficients are negatively related to both size and trading activity.

We calculate dividend yields following the method presented in Fama and French (1988). At the end of each month we add up the total dividends paid over the previous year and divide by the current market capitalization. Table 3 presents summary statistics for the dividend yields. Average dividend yields range from a low of 1% for Argentina, Japan, and Venezuela to a high of 12% for Zimbabwe.

The data on inflation, money supply growth, industrial production growth, and interest rates are taken from several sources: the IMF tapes, the United Nations Monthly Statistical Bulletins, and various central bank publications. In the appendix to this chapter we present a more detailed explanation of the data sources. Here we discuss some of the basic features.

In all countries we measure inflation as the change in the logged level of the CPI.[6] Table 4 present the summary statistics for inflation. The annualized average rates of inflation range from 2% for Malaysia to 187% for Brazil. Almost half (7/16) of the emerging markets experienced average rates of inflation above 20%. Moreover, in most of the countries inflation appears highly autocorrelated.

Table 5 presents summary statistics for growth in the supply of money as defined by the change in the logged level of M1 (cash + deposits). The primary reason for focusing this study on emerging markets is to obtain a wide variety of money supply processes. Average growth for these markets ranges from 187% for Brazil to 10% for

[6] Liew (1993), chapter 2, argues that during hyperinflation, inflation can in certain respects be more accurately measured from exchange rates using PPP. We show that inflation measured in this manner is more timely than that measured with the CPI. However, to maintain consistency with the other countries, here we conduct the study using inflation based on changes in the CPI.

Thailand. In contrast, Germany, Japan, and the U.S. report average growth of 8%, 8% and 5% respectively. Volatility of money supply growth in emerging markets ranges from 65% for Brazil to 6% for Pakistan. Whereas for the Germany, Japan, and the U.S. they are 5%, 17%, and 6% respectively. The extensive cross-country variability in money supply characteristics should lead to more powerful tests of our propositions.

Table 6 exhibits summary statistics for growth in production. When available we used rates of change of industrial production. If industrial production was not available we used rates of change in manufacturing production (see the data appendix for the details). Notice the volatility of production in emerging markets is always higher than that of the three developed countries. Emerging market volatilities range from a low of 10% for Korea to a high of 36% for Chile, whereas we observe volatilities of 7%, 5%, and 3% for Germany, Japan, and the U.S.

Finally table 7 presents summary statistics for interest rates from each country. In most cases we had several choices of rates to choose from for each country. In every case we chose that series which appeared most "market determined." In other words, certain interest rate series were clearly managed as they moved in a stepwise manner. We chose the ones that appeared to move most freely. Admittedly, this is ad hoc. However, in this paper we employ interest rates only as instruments in our regressions. Therefore, as long as they are correlated with expected inflation they will serve the purpose. Argentina, Brazil, Mexico, Turkey, Venezuela, and Zimbabwe report average interest rates that are below their average inflation rates. Therefore, either real rates were negative at some point in time or reported rates do not reflect actual rates.

Table 8 reports country-by-country correlations for real stock returns, inflation, money supply growth and production growth. Recall that the theory also makes a statement about the correlation between realized values as well as expectations. If we difference equation (5) and solve for inflation, we can see that the model predicts a positive relation between ex-post inflation and growth in the money supply and a negative relation between ex-post inflation and changes in expectations of future real activity:

(17) $$I_{t+1} = \gamma_1(E_{t+1}A_{t+2} - E_tA_{t+1}) + \gamma_2\,\Delta M_{t+1} \text{ where } \gamma_1<0 \text{ and } \gamma_2=1.$$

Fama (1981) and (1990) presents evidence that ex-post real returns are positively related to changes in expectations of future real activity:

(18) $$R^R_{t+1} = \delta_0 + \delta_1(E_{t+1}A_{t+2} - E_tA_{t+1}) \text{ where } \delta_1>0.$$

Note that both equations (6) and (7) follow by taking conditional expectations of equations (17) and (18). The hypothesized negative relation between inflation and changes in anticipated future real activity and the positive relation between real stock returns and changes in anticipated future in real activity suggest a negative relation between inflation and real stock returns. These two equations suggest that the common influence of changes in expected future real activity should induce a negative relation between inflation and real returns. Table 8 shows that 17 of the 19 countries report negative correlations.

However, given the data on money and production we can address the implications of these equations in a more direct manner. To the extent that realized current growth in production contains information about changes in expectations about future growth in real activity, $(E_{t+1}A_{t+2} - E_tA_{t+1})$, the equations suggest that inflation should be negatively and stock returns should be positively correlated to growth in production. Of the 13 countries for which we have production data, 11 produce negative correlations between inflation and growth in production. Yet only 6 of the 13 countries report positive correlations between real stock returns and growth in production. There are several possible explanations for the weak showing of the stock return - production correlations. First, stock returns should be forward looking with respect to real activity. Therefore, current realized growth in production may not adequately capture changes in expectations of growth in future real activity. Second, many of the emerging stock markets in our study represent a very small portion of the total economic activity of the countries in which they reside. Therefore, low correlations between stock returns and measures of production may reflect the fact that cash flows to holding stocks are not well proxied by economic aggregates.

In addition, equation (17) states that inflation should be positively correlated to growth in the money supply. Nevertheless, only 7 of the 19 countries report positive correlations. Of course, the hypothesized positive partial correlations between inflation and growth in the money supply will not imply positive simple correlations if growth in the money supply is positively correlated to changes in expected growth in future real activity. If increases in expectations about future growth in real activity are associated with growth in the money supply, we can see from equation (17) that the correlation between inflation and money supply growth could go down. In our sample there are seven countries for which we observe negative simple correlations between money growth and inflation and for which we have production data: India, Jordan, Korea, Pakistan, Zimbabwe, Japan, and the U.S. In five of the seven, we observe positive correlations between production growth and money growth.

IV. Models of Expected Money Growth

Our story predicts that the slope coefficient in a regression of nominal stock returns on expected inflation should approach one as the volatility of expected growth in the money supply increases. However, in order to provide empirical support for our propositions we need a model for expected growth in the money supply. We obtain time series of expected money supply growth from the fitted values of a regression of the growth in money at time t on interest rates at time t-1 (when available) and growth in money at time t-1 and at time t-12. In order to minimize the risk of overfitting the data, we employ the same set of forecasting variables for each country. The use of interest rates in these models reflects the notion that in situations where governments use money creation as a means of generating revenue, interest rates should contain information pertaining to market expectations of future inflation, which in turn will be largely determined by expectations of future growth in the money supply. We employ the lagged growth rates of the money supply to capture simple time series behavior. Table 9 presents the regression results. For most countries, our simple models appear to adequately transform the highly autocorrelated money growth series into white noise. Moreover, for many of the countries a large percentage of the variation in the money supply can be explained by our lagged variables. Adjusted R-squares range from a high of 79% for the U.S. to a low of 1% for Germany. Note that the 12 month lagged money growth variable captures the strong seasonalities that exist in the money supply process of most countries. In 18 of the 19 countries the 12 month lagged money growth variable is significant at the 90% confidence level.

As an estimate of σ_m, the volatility of expected money growth, we use the volatility of the fitted values from the regression models depicted in table 9. We will refer to this estimate as $\hat{\sigma}_m$. In general, market expectations will be based on more information than is used in these regressions, so our measures will probably underestimate the true volatility of expected money supply growth. For this reason and in recognition of the crudeness of our models of expectations, we also present results using the volatility of realized money supply growth as an estimate of σ_m. We will refer to this estimate as $\tilde{\sigma}_m$. $\tilde{\sigma}_m$ will most likely overestimate σ_m due to the unanticipated component of realized money supply growth.

V. Results

Table 10 presents the results of estimates of equation (16) using the instrumental variables regression methods discussed above. Along with the slope coefficients and t-statistics we list the two estimates of σ_m for the 19 countries. Not surprisingly, Argentina and Brazil report the highest volatilities of expected and realized money supply growth. They are followed by Turkey, Chile, and Mexico. The country with the smallest volatility is Germany. Note that the two estimates of the volatility of expected money supply growth produce similar rankings; the correlation between $\hat{\sigma}_m$ and $\tilde{\sigma}_m$ is 0.92.

For each country, the estimation procedure uses lagged values of the dividend yield, interest rates (when available), production growth (when available), inflation, growth in the money supply and local currency stock returns as instrumental variables. In some circumstances we observe dividend yields that simply drift downwards over the entire period or interest rates that are pegged at a given level and then shoot up to a higher level and remain there for the duration of the time period. In these cases we discard these variables since nonstationary instruments violate the assumptions underlying the estimation technique (see Hansen (1982)).

Recall that our story states that as we move from countries with low σ_m to countries with high σ_m we should see estimated slope coefficients from equation (4) approach one. Figure 1 presents a plot of $\hat{\beta}$ versus $\hat{\sigma}_m$. The results are encouraging. For low values of $\hat{\sigma}_m$, the $\hat{\beta}$'s tend to be quite varied. Malaysia reports the highest $\hat{\beta}$ of 11.17 and Thailand reports the lowest of -3.86. Both these countries have $\hat{\sigma}_m$'s that are below the median. On the other side, we have Argentina and Brazil, the countries with the two highest $\hat{\sigma}_m$'s reporting $\hat{\beta}$'s of 1.40 and 1.26 respectively. The general pattern is funnel shaped where as $\hat{\sigma}_m$ gets larger, the estimates of $\hat{\beta}$ tend to cluster more tightly around one. Figure 2 presents the same plot except we replace $\tilde{\sigma}_m$, the volatility of actual growth in the money supply, for $\hat{\sigma}_m$. The general impression is the same.

As discussed above, the theory also implies that as σ_m increases, the precision with which we are able to estimate β should increase, i.e. the standard error of $\hat{\beta}$ should decrease. So we have two forces at work, as σ_m increases, $\hat{\beta}$ should approach 1 and the standard error of $\hat{\beta}$ should approach 0. Therefore, as σ_m increases we should see the t-statistic (= $\hat{\beta}/SE(\hat{\beta})$) increase.

Figure 3 presents a plot of the t-statistic versus $\hat{\sigma}_m$. The positive relation is apparent. A regression of the t-statistic on $\hat{\sigma}_m$ yields the following result:

$$\text{t-statistic} = -1.41 + 52.16\,\hat{\sigma}_m \quad \bar{R}^2=0.36.$$

$$(-2.01) \quad (3.33)$$

Figure 4 presents the plot for $\tilde{\sigma}_m$. A regression of the t-statistic on $\tilde{\sigma}_m$ yields the following result:

$$\text{t-statistic} = -1.71 + 34.03\,\tilde{\sigma}_m \quad \bar{R}^2=0.34.$$

$$(-2.16) \quad (3.23)$$

Thus, the relations are statistically significant and robust to the two estimates of σ_m. In sum, the results support our two propositions: that as we go from low to high volatility of expected money supply growth, we should see 1) estimates of β that approach one, and 2) t-statistics that increase.

VI. Conclusion

Fisher's hypothesis applied to stock returns states that expected nominal returns should equal expected real returns plus expected inflation. Therefore, if expected real returns are either constant or uncorrelated with expected inflation, we should observe a one-for-one relation between movements in expected nominal returns and expected inflation. There exists a large body of research that rejects this proposition. Evidence from a variety of countries suggests that the relation between expected nominal stock returns and expected inflation is less than one-for-one and often negative. However, these studies have focused on well developed countries where monetary policies are relatively stable. We argue that the volatility of expected growth in the money supply can be an important determinant of the relation between expected nominal returns and expected inflation. Evidence from a set of emerging markets, some of which reside in countries with extremely volatile monetary policies, suggests that as the volatility of the money supply process increases, the relation between expected nominal returns and expected inflation approaches one-for-one.

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Appendix

A.1. The details of the estimation

In this section we describe the estimation procedure in some detail in order to lay the ground work for a careful study of its properties when the assumption of constant expected real returns given in equation (2) is violated.

As we have a linear system, we can obtain a closed form solution for our GMM estimator. If we let $\underset{Txk}{\mathbf{Z}} = \begin{pmatrix} \mathbf{Z}_0' \\ : \\ \mathbf{Z}_{T-1}' \end{pmatrix}$, $\underset{Tx1}{\mathbf{I}} = \begin{pmatrix} i_1 \\ : \\ i_T \end{pmatrix}$, and $\underset{Tx1}{\mathbf{R}} = \begin{pmatrix} r_1^N \\ : \\ r_T^N \end{pmatrix}$ then our GMM estimate is given by,

(a1) $$\hat{\beta} = (\mathbf{I'Z\hat{W}_0 Z'I})^{-1}\,\mathbf{I'Z\hat{W}_0 Z'R}$$

where $\hat{\mathbf{W}}_0^{-1} = \mathbf{Z}'\begin{pmatrix} \hat{u}_1^2 & & \\ & : & \\ & & \hat{u}_k^2 \end{pmatrix}\mathbf{Z}$ and $\hat{u}_j^2$ is the jth diagonal element of

$T^{-1}\mathbf{Z'(R-I\hat{\beta})(R-I\hat{\beta})'Z}$. Note that this choice of the weighting matrix, $\hat{\mathbf{W}}_0$, provides an estimator that accounts for any form of conditional heteroscedasticity. As $\hat{\mathbf{W}}_0$ requires estimates of $\hat{\beta}$, we perform the estimation by beginning with $\hat{\mathbf{W}}_0 = \mathbf{I}$ and then iterate until $\hat{\beta}$ converges.

We conduct specification tests by computing the statistic,

$$\mathbf{(R-I\hat{\beta})'Z\,\hat{W}_0\,Z'(R-I\hat{\beta})}$$

which Hansen (1982) shows is asymptotically χ^2_{T-k} distributed under the null hypothesis that all the orthogonality conditions hold.

If **Z**, **I**, and **R** are all stationary variables, then it can be shown that,

$$\left(\frac{\mathbf{I'\,Z}}{\mathrm{T}}\right) \underset{p}{\rightarrow} \mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathrm{Z}_t\right),$$

$$\left(\frac{\mathbf{R'\,Z}}{\mathrm{T}}\right) \underset{p}{\rightarrow} \mathrm{E}\left(\mathrm{r}^{N}_{t+1} \otimes \mathrm{Z}_t\right), \text{ and}$$

$$\hat{\mathbf{W}}_{\mathbf{0}}^{-1} \underset{p}{\rightarrow} \mathbf{W}_{\mathbf{0}}^{-1} = \mathrm{E}((\mathrm{r}^{N}_{t+1} - \beta\, \mathrm{i}_{t+1}) \otimes \mathbf{Z}_t)((\mathrm{r}^{N}_{t+1} - \beta\, \mathrm{i}_{t+1}) \otimes \mathbf{Z}_t)'.$$

Therefore,

$$\text{(a2)} \qquad \hat{\beta} \rightarrow \frac{\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)'\,\mathbf{W}_{\mathbf{0}}\mathrm{E}\left(\mathrm{r}^{N}_{t+1} \otimes \mathbf{Z}_t\right)}{\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)'\,\mathbf{W}_{\mathbf{0}}\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)}$$

$$\rightarrow \frac{\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)'\,\mathbf{W}_{\mathbf{0}}\mathrm{E}\left((\mathrm{i}_{t+1} + \mathrm{r}^{R}_{t+1}) \otimes \mathbf{Z}_t\right)}{\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)'\,\mathbf{W}_{\mathbf{0}}\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)}$$

$$\rightarrow 1 + \frac{\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)'\,\mathbf{W}_{\mathbf{0}}\mathrm{E}\left(\mathrm{r}^{R}_{t+1} \otimes \mathbf{Z}_t\right)}{\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)'\,\mathbf{W}_{\mathbf{0}}\mathrm{E}\left(\mathrm{i}_{t+1} \otimes \mathbf{Z}_t\right)}$$

We can see that under the null hypothesis given in equation (2) that expected real returns are constant, the $\mathrm{E}(\mathrm{r}^{R}_{t+1} \otimes \mathbf{Z}_t)$ term will equal zero. Therefore, under the null hypothesis $\hat{\beta}$ will converge to 1.

A.2. Comparison to a two-step OLS procedure

In this section we provide some intuition on how the GMM procedure extracts the relation between *expected* returns and *expected* inflation. Note that by demeaning equation (4) we can see that we are interested in estimating β from the following regression:

$$\text{(a3)} \qquad \mathrm{r}^{N}_{i} = \beta\, \mathrm{E}_t \mathrm{i}_{t+1} + \varepsilon_{t+1.}$$

A natural approach to this problem would be to obtain an estimate for $E_t i_{t+1}$, and simply run a regression of stock returns on the estimate.

Consider the following two-step regression approach. First run a regression of inflation on past instruments:

(a4) $$i_{t+1} = \mathbf{Z}_t'\varphi + u_{t+1}$$

Then use the fitted values from this regression as our estimate of $E_t i_{t+1}$ and run regression (a3). Note that the fitted values from (a4) can be expressed as,

$$\mathbf{Z}\hat{\varphi} = \mathbf{Z(Z'Z)^{-1}Z'I}.$$

Therefore, the second step regression can be written in matrix notation as,

$$\mathbf{R} = \{\mathbf{Z(Z'Z)^{-1}Z'I}\}\beta + \varepsilon,$$

and the OLS estimate of β will be

$$\hat{\beta}_{2SOLS} = \mathbf{(I'Z(Z'Z)^{-1}Z'I)^{-1}I'Z(Z'Z)^{-1}Z'R}.$$

Note that this will be exactly the same as the GMM estimator given in (a1) if we assume that the weighting matrix $\hat{\mathbf{W}}_0 = (\mathbf{Z'Z})^{-1}$.

Data Appendix

Below we list the macroeconomic data that we employ in the study. Most of the data comes from the IMF tapes. The code represents the IMF's topic code. If the data come from a different source we place a footnote in the code column.

<u>Variable</u>	<u>Code</u>	<u>Dates Available</u>
Argentina		
Deposit Rate	60L	57:1-89:5,89:7-92:1
CPI	64	82:10-91:10
M1	A	75:1-91:7

A: Series is constructed by splicing series Money (34) 81:12-91:7 from the IMF tape and Medios de pago (M1) 75:1-81:11 series from Banco Central de la Republica Argentina Memoria Anual.

Brazil		
Bank Rate	60	57:1-90:1,90:3-92:1
CPI	64	85:2-92:1
Money (M0)	B	75:2-91:8
Industrial Production	C	78:7-92:9

B: Growth in the monetary base for Brazil from Boletin Mensal, Banco Central Do Brasil (called Papel moeda emitido (currency issued) until 84:9, afterwards it's called papel-modeda em circulacao). Missing data from 86:8-86:12 is replaced with growth in m1(64) from IMF. I am working on getting a better series.

C: Industrial production for Brazil from U.N. Monthly Statistical Bulletin. 78:7-92:9 monthly

Turkey		
Money (M1)	34	64:1-91:11
Interbank Money Market Rate	60B	86:4-91:11
CPI	64	69:1-91:11

Chile		
Money (M1)	34	68:11,69:3,69:5-76:12,77:12,78:12-91:6
Deposit Rate	60L	77:1-92:1
CPI	64	74:7-92:1
Manufacturing Production	66EY	58:1-92:1

Mexico		
Money (M1)	34	57:1-91:11
Treasury Bill Rate	60C	78:1-86:7,86:10-92:1
CPI	64	57:1-92:1
Industrial Production	66	70:1-91:10
Greece		
Money (M1)	34	57:1-91:9
CPI	64	57:1-91:7
Manufacturing Production	66EY	57:1-91:7
Philippines		
Money (M1)	34	57:1-83:12,84:12,85:12,86:12-92:1
Treasury Bill Rate (91DAYS)	60C	76:1-92:1
CPI	64	57:1-92:1
Japan		
Money (M1)	34	64:1-92:1
Call Money Rate	60B	57:1-92:1
CPI	64	57:1-92:1
Industrial Production, s.a.	66..C	59:1-92:1
Korea		
Money (M1)	34	57:1-92:2
Money Market Rate	60B	76:8-92:2
CPI	64	70:1-92:2
Industrial Production, s.a.	66C	57:1-92:2
Nigeria		
Money (M1)	34	64:1-91:5
CPI	64	60:1-91:12
Zimbabwe		
Money (M1)	34	79:1-91:8
Treasury Bill Rate	60C	77:12,78:12-89:5,89:8-91:3,91:6-91:10, 91:12-92:1
CPI	64	78:1-92:1
Manufacturing Production	66EY	78:1-88:9
Thailand		
Money (M1)	34	57:1-91:10
Call Money Rate	60B	77:1-91:12
CPI	64	65:1-91:11

Pakistan

Money (M1)	34	57:1-92:1
Call Money Rate	60B	64:1-92:1
CPI	64	57:1-92:1
Manufacturing Production	66EY	77:7-91:6

Malaysia

Money (M1)	34	57:1-91:5
Money Market Rate	60B	68:1-68:3,68:7-90:12
CPI	64	57:1-91:12
Industrial Production	66	71:1-91:12

Jordan

Money (M1)	34	65:1-91:11
CPI	64	76:1-91:12
Industrial Production	66	71:11-91:12

India

Money (M1)	34	57:1-91:12
Call Money Rate	60B	57:1-88:11,89:2-92:1
CPI	64	57:1-92:1
Industrial Production	66	60:1-70:11,71:2-91:10

Venezuela

Money (M1)	34	57:1-91:12
90 Day Deposit Rate	60L	84:3-92:1
CPI	64	57:1-92:1

Germany

Money (M1)	34	69:1-91:12
Interbank Deposit Rate	60BS	69:1-91:12
CPI	64	69:1-91:12
Industrial Production, s.a.	66..C	69:1-91:12

Table 1

Some Characteristics of Emerging Stock Markets

Country	Market capitalization ($ billions)	Number of listed companies	Value of transactions ($ billions)	Turnover[a] (%)	Market concentration[b] (%)
Argentina	18.5	174	4.82	26	70.7
Brazil	42.8	570	13.37	31	31.9
Chile	28.0	221	1.90	7	49.3
Greece	13.1	126	2.44	19	47.3
India	47.7	6500	24.30	51	21.2
Jordan	2.5	101	0.43	17	54.9
Korea	96.4	686	85.46	89	31.2
Malaysia	58.6	321	10.66	18	36.0
Mexico	98.2	209	31.72	32	55.0
Nigeria	1.9	142	0.01	1	52.7
Pakistan	7.3	542	0.65	9	37.8
Philippines	10.2	161	1.51	15	62.6
Thailand	35.8	276	30.09	84	32.2
Turkey	15.7	134	8.57	55	42.9
Venezuela	11.2	66	3.24	29	69.8
Zimbabwe	1.4	60	0.08	6	42.0
Germany	393.5	667	818.6	208	39.4
Japan	3130.9	2107	995.94	32	18.7
U.S.	4180.2	6742	2254.98	54	15.4

Source: IFC Emerging Stock Market Factbook 1992, data for 1991
[a] $ value traded / $ market capitalization
[b] Share of market capitalization held by ten largest stocks

Table 2: Annualized Real Returns

	date	mean	std	r1	r3	r6	r12
Argentina	85:01-91:08	0.22	1.12	-0.21	0.02	0.11	-0.16
Brazil	85:02-91:08	-0.01	0.84	-0.14	-0.12	0.07	-0.02
Chile	79:02-91:07	0.19	0.32	0.14	-0.07	0.25	0.13
Greece	77:01-91:05	-0.01	0.34	0.15	-0.03	0.01	-0.03
India	76:02-92:01	0.15	0.23	0.00	0.02	0.03	-0.03
Jordan	80:01-91:12	0.06	0.17	0.01	0.08	0.05	-0.09
Korea	77:01-92:02	0.09	0.31	-0.04	0.00	-0.09	0.14
Malaysia	86:01-91:06	0.14	0.29	0.05	-0.10	-0.18	-0.12
Mexico	78:02-91:11	0.15	0.44	0.34	-0.01	0.05	-0.02
Nigeria	86:01-91:06	0.14	0.18	0.29	0.13	0.00	0.20
Pakistan	85:02-91:07	0.16	0.13	0.18	0.18	-0.10	0.07
Philippines	87:02-92:02	0.01	0.42	0.21	-0.09	-0.13	0.09
Thailand	77:02-91:11	0.13	0.26	0.14	0.00	-0.10	0.02
Turkey	88:01-91:12	-0.03	0.64	0.21	0.16	0.07	-0.22
Venezuela	86:01-92:01	0.35	0.42	0.49	0.20	0.07	-0.10
Zimbabwe	79:03-88:10	0.10	0.35	0.09	0.19	0.08	-0.01
Germany	71:01-92:01	0.05	0.19	0.09	0.07	-0.20	-0.01
Japan	71:01-92:02	0.08	0.19	0.08	-0.02	0.05	0.03
U.S.	57:03-91:01	0.05	0.15	0.10	0.01	-0.04	0.02

Table 3 Dividend Yields

	date	mean	std	r1	r3	r6	r12
Argentina	85:01-91:08	0.01	0.02	0.76	0.54	0.40	0.35
Brazil	85:02-91:08	0.03	0.02	0.81	0.59	0.42	-0.13
Chile	79:02-91:07	0.06	0.02	0.93	0.81	0.70	0.42
Greece	77:01-91:05	0.06	0.04	0.92	0.81	0.72	0.40
India	77:01-92:01	0.03	0.01	0.93	0.87	0.79	0.58
Jordan	80:01-91:12	0.04	0.02	0.91	0.73	0.41	0.04
Korea	77:01-92:02	0.05	0.03	0.96	0.88	0.74	0.58
Malaysia	86:01-91:06	0.02	0.00	0.64	0.03	-0.30	0.14
Mexico	78:02-91:11	0.05	0.04	0.95	0.85	0.65	0.23
Nigeria	86:01-91:06	0.08	0.03	0.91	0.73	0.34	-0.25
Pakistan	85:02-91:07	0.07	0.01	0.79	0.45	0.11	-0.17
Philippines	87:02-92:02	0.02	0.06	-0.41	0.01	0.00	-0.01
Thailand	77:02-91:11	0.07	0.03	0.95	0.88	0.78	0.59
Turkey	88:01-91:12	0.06	0.03	0.77	0.57	0.45	-0.05
Venezuela	86:01-92:01	0.01	0.01	0.90	0.69	0.46	-0.15
Zimbabwe	79:03-88:10	0.12	0.06	0.95	0.84	0.65	0.30
Germany	71:01-92:01	0.02	0.01	0.98	0.94	0.87	0.74
Japan	71:01-92:02	0.01	0.01	0.94	0.88	0.81	0.68
U.S.	57:03-91:01	0.04	0.01	0.97	0.92	0.84	0.69

Table 4 Annualized Inflation

	date	mean	std	r1	r3	r6	r12
Argentina	85:01-91:08	1.79	0.63	0.70	0.10	0.18	0.03
Brazil	85:02-91:08	1.87	0.42	0.79	0.38	0.15	0.14
Chile	79:02-91:07	0.20	0.05	0.22	0.17	0.01	0.10
Greece	77:01-91:05	0.17	0.05	0.06	0.00	0.56	0.73
India	76:02-92:01	0.08	0.03	0.46	0.06	-0.29	0.36
Jordan	80:01-91:12	0.07	0.06	0.05	0.05	-0.08	0.16
Korea	77:01-92:02	0.08	0.03	0.52	0.34	0.30	0.41
Malaysia	86:01-91:06	0.02	0.01	0.14	-0.02	0.13	0.16
Mexico	78:02-91:11	0.42	0.09	0.81	0.62	0.49	0.36
Nigeria	86:01-91:06	0.23	0.12	0.31	0.19	-0.06	0.26
Pakistan	85:02-91:07	0.07	0.03	0.08	0.16	-0.12	0.34
Philippines	87:02-92:02	0.12	0.02	0.51	-0.07	0.19	0.13
Thailand	77:02-91:11	0.06	0.02	0.34	0.24	0.25	0.31
Turkey	88:01-91:12	0.50	0.07	0.26	-0.37	0.15	0.54
Venezuela	86:01-92:01	0.32	0.09	0.51	0.13	0.07	-0.11
Zimbabwe	79:03-88:10	0.12	0.06	0.01	0.02	0.07	-0.05
Germany	71:01-92:01	0.04	0.01	0.43	0.26	0.04	0.48
Japan	71:01-92:02	0.05	0.03	0.27	0.17	0.29	0.50
U.S.	57:03-91:01	0.05	0.01	0.65	0.52	0.49	0.51

Table 5 Annualized Growth in Money (M1)

	date	mean	std	r1	r3	r6	r12
Argentina	85:01-91:08	1.76	0.54	0.54	0.26	0.26	0.19
Brazil*	85:02-91:08	1.87	0.65	0.26	0.39	0.17	0.26
Chile	79:02-91:07	0.22	0.29	-0.17	-0.13	-0.16	0.31
Greece	77:01-91:05	0.17	0.21	-0.42	-0.19	0.26	0.59
India	76:02-92:01	0.13	0.11	-0.12	-0.04	0.19	0.22
Jordan	80:01-91:12	0.11	0.07	0.25	-0.01	-0.02	0.53
Korea	77:01-92:02	0.18	0.22	-0.20	0.27	0.05	0.54
Malaysia	86:01-91:06	0.11	0.11	-0.08	0.01	0.03	0.38
Mexico	78:02-91:11	0.44	0.23	0.01	-0.12	0.13	0.56
Nigeria	86:01-91:06	0.21	0.22	-0.45	0.05	-0.16	0.08
Pakistan	85:02-91:07	0.14	0.06	0.07	-0.06	0.00	0.40
Philippines	87:02-92:02	0.17	0.17	-0.11	-0.17	-0.16	0.67
Thailand	77:02-91:11	0.10	0.13	0.34	-0.02	-0.54	0.61
Turkey	88:01-91:12	0.38	0.27	-0.28	-0.14	-0.09	0.55
Venezuela	86:01-92:01	0.20	0.23	-0.08	0.15	-0.05	0.13
Zimbabwe	79:03-88:10	0.13	0.16	-0.10	0.09	-0.13	0.35
Germany	71:01-92:01	0.08	0.05	-0.02	0.04	0.10	0.06
Japan	71:01-92:02	0.08	0.17	-0.31	0.46	0.46	0.76
U.S.	57:03-91:01	0.05	0.06	-0.11	0.14	0.25	0.87

* For Brazil we use M0.

Table 6 Annualized Growth in Industrial Production

	date	mean	std	r1	r3	r6	r12
Argentina	na	na	na	na	na	na	na
Brazil	85:02-91:08	0.04	0.30	-0.09	-0.03	-0.39	0.40
Chile	79:02-91:07	0.04	0.36	-0.41	0.03	-0.30	0.74
Greece	77:01-91:05	0.01	0.30	-0.35	0.00	0.09	0.69
India	76:02-92:01	0.05	0.25	-0.43	0.17	0.04	0.79
Jordan	80:01-91:12	0.05	0.32	-0.37	0.06	-0.14	0.46
Korea	77:01-92:02	0.11	0.10	-0.36	-0.02	-0.04	-0.04
Malaysia	86:01-91:06	0.09	0.29	-0.62	-0.08	-0.01	0.52
Mexico	78:02-91:11	0.04	0.13	-0.53	-0.03	-0.41	0.45
Nigeria	na	na	na	na	na	na	na
Pakistan	85:02-91:07	0.00	0.35	0.16	-0.06	-0.37	0.46
Philippines	na	na	na	na	na	na	na
Thailand	na	na	na	na	na	na	na
Turkey	na	na	na	na	na	na	na
Venezuela	na	na	na	na	na	na	na
Zimbabwe	79:03-88:10	0.05	0.28	-0.24	-0.12	-0.07	0.48
Germany	71:01-92:01	0.02	0.07	-0.40	0.08	-0.06	-0.03
Japan	71:01-92:02	0.04	0.05	-0.22	0.32	0.15	0.01
U.S.	57:03-91:01	0.03	0.03	0.47	0.20	0.00	-0.13

Table 7 Annualized Interest Rates

	date	mean	std	r1	r3	r6	r12
Argentina	85:01-91:08	1.35	1.36	0.54	0.25	0.04	0.07
Brazil	85:02-91:08	1.80	1.23	0.77	0.52	0.16	0.31
Chile	79:02-91:07	0.27	0.11	0.76	0.42	0.31	0.14
Greece	na	na	na	na	na	na	na
India	77:01-92:01	0.10	0.03	0.76	0.51	0.55	0.38
Jordan	na	na	na	na	na	na	na
Korea	77:01-92:02	0.13	0.04	0.97	0.92	0.85	0.76
Malaysia	86:01-91:06	0.05	0.02	0.84	0.61	0.30	-0.13
Mexico	78:02-91:11	0.37	0.19	0.95	0.85	0.74	0.61
Nigeria	na	na	na	na	na	na	na
Pakistan	85:02-91:07	0.07	0.01	0.59	0.31	0.18	0.05
Philippines	87:02-92:02	0.17	0.04	0.90	0.75	0.61	0.41
Thailand	77:02-91:11	0.11	0.03	0.94	0.78	0.67	0.48
Turkey	88:01-91:12	0.44	0.11	0.73	0.48	0.21	-0.10
Venezuela	86:01-92:01	0.17	0.09	0.96	0.83	0.68	0.36
Zimbabwe	79:03-88:10	0.07	0.02	0.97	0.90	0.82	0.59
Germany	71:01-92:01	0.07	0.03	0.98	0.91	0.77	0.45
Japan	71:01-92:02	0.06	0.02	0.98	0.92	0.79	0.43
U.S.	57:03-91:01	0.06	0.01	0.95	0.89	0.83	0.74

Table 8
Country-by-Country Correlation Matrix of Economic Variables

Country	date	σ(R,I)	σ(R,M)	σ(R,A)	σ(I,M)	σ(I,A)	σ(M,A)
Argentina	85:01-91:08	-0.32	-0.10	na	0.67	na	na
Brazil	85:02-91:08	-0.32	-0.26	-0.05	0.52	-0.18	-0.31
Chile	79:02-91:07	-0.19	0.15	-0.09	0.03	0.10	0.02
Greece	77:01-91:05	-0.19	0.04	0.01	0.24	0.36	-0.07
India	76:02-92:01	-0.08	0.04	0.00	-0.16	-0.17	0.14
Jordan	80:01-91:12	-0.16	-0.01	-0.04	-0.03	-0.05	-0.12
Korea	77:01-92:02	-0.22	0.01	0.07	-0.02	-0.09	0.18
Malaysia	86:01-91:06	0.23	0.05	-0.08	0.12	-0.38	-0.04
Mexico	78:02-91:11	-0.03	-0.13	-0.05	0.06	-0.08	0.02
Nigeria	86:01-91:06	-0.72	0.00	na	-0.02	na	na
Pakistan	85:02-91:07	-0.27	0.12	0.06	-0.21	-0.21	0.27
Philippines	87:02-92:02	0.01	0.11	na	-0.09	na	na
Thailand	77:02-91:11	-0.09	-0.02	na	-0.11	na	na
Turkey	88:01-91:12	-0.08	-0.02	na	-0.40	na	na
Venezuela	86:01-92:01	-0.41	0.04	na	0.00	na	na
Zimbabwe	79:03-88:10	-0.20	-0.02	0.16	-0.14	-0.03	0.12
Germany	71:01-92:01	-0.12	0.10	-0.04	0.03	-0.03	0.06
Japan	71:01-92:02	-0.23	0.02	0.08	-0.09	-0.04	-0.18
U.S.	57:03-91:01	-0.24	0.05	0.02	-0.06	-0.12	0.02

σ(R,I): Correlation between real stock returns and inflation
σ(R,M): Correlation between real stock returns and money supply growth
σ(R,A): Correlation between real stock returns and production growth
σ(I,M): Correlation between inflation and money supply growth
σ(I,A): Correlation between inflation and production growth
σ(M,A): Correlation between money supply growth and production growth

Table 9 Regression Models of Expected Growth in the Money Supply

Country	Constant	int(t-1)	gm(t-1)	gm(t-12)	R^2-adj.	ρ1	ρ3	ρ6	ρ12
Argentina	-0.01 (-0.82)	0.08 (5.00)	-0.03 (-0.24)	0.33 (4.23)	0.57	0.04	0.13	0.04	0.17
Brazil	-0.01 (-0.41)	0.07 (4.11)	-0.09 (-0.98)	0.30 (3.01)	0.38	-0.01	0.25	0.19	0.20
Chile	-0.00 (-0.24)	0.07 (0.87)	-0.16 (-1.60)	0.37 (4.20)	0.14	-0.06	-0.13	-0.07	-0.05
Greece	0.01 (2.70)		-0.22 (-3.63)	0.55 (7.83)	0.43	-0.02	-0.15	0.11	-0.22
India	0.01 (1.40)	0.02 (0.30)	-0.12 (-1.59)	0.23 (1.71)	0.05	-0.02	-0.01	0.09	-0.04
Jordan	0.00 (4.02)		0.20 (3.44)	0.40 (7.55)	0.23	-0.01	0.04	0.05	-0.06
Korea	-0.00 (-0.31)	0.09 (0.92)	-0.10 (-1.59)	0.57 (8.68)	0.33	-0.11	0.05	-0.03	-0.14
Malaysia	0.02 (2.05)	-0.19 (-1.26)	-0.21 (-1.58)	0.42 (2.79)	0.17	-0.19	0.01	0.03	0.08
Mexico	0.00 (0.69)	0.02 (1.24)	-0.01 (-0.19)	0.71 (7.68)	0.42	0.05	-0.04	0.09	-0.15
Nigeria	0.02 (3.50)		-0.46 (-2.76)	0.14 (1.68)	0.20	-0.05	0.12	-0.10	0.04
Pakistan	0.00 (0.32)	0.07 (0.46)	-0.01 (-0.05)	0.38 (4.83)	0.16	-0.08	0.05	-0.03	-0.03
Philippines	-0.01 (-0.27)	0.04 (0.31)	-0.08 (-0.75)	0.83 (7.35)	0.63	-0.15	-0.16	-0.08	-0.25
Thailand	0.01 (1.30)	-0.08 (-1.06)	0.07 (1.02)	0.62 (8.43)	0.41	-0.19	0.07	-0.14	-0.24
Turkey	0.03 (1.51)	-0.03 (-0.78)	-0.13 (-1.42)	0.77 (8.28)	0.72	-0.16	0.04	-0.07	-0.15
Venezuela	0.00 (0.35)	0.06 (0.71)	-0.10 (-0.81)	0.20 (1.23)	0.01	-0.02	0.14	-0.05	0.01
Zimbabwe	0.01 (0.52)	0.03 (0.16)	-0.17 (-1.88)	0.46 (6.19)	0.17	-0.12	0.13	-0.10	-0.09
Japan	0.01 (1.45)	-0.07 (-1.11)	-0.16 (-4.43)	0.80 (22.48)	0.68	-0.22	0.17	0.19	-0.15
Germany	0.01 (5.31)	-0.05 (-1.57)	-0.04 (-0.61)	0.10 (1.64)	0.01	0.00	0.04	0.08	0.02
U.S.	0.00 (2.21)	-0.29 (-1.47)	-0.02 (-0.83)	0.90 (31.20)	0.79	0.14	0.09	0.07	-0.28

Dependent variable is the growth in the nominal supply of money at time t. T-statistics reported below coefficients are adjusted for heteroscedasticity. ρ1,ρ3,ρ6, and ρ12 represent residual autocorrelation coefficients at lags 1,3,6, and 12 months.

INT(t-1): Interest rate observed at time t-1
GM(t-1): Growth in the nominal money supply a time t-1

Table 10
Test of Ex-ante Fisher Hypothesis

Country	Date	b	t	$\hat{\sigma}_m$	$\tilde{\sigma}_m$
Argentina	85:01-91:08	1.40	4.02	0.11	0.16
Brazil	85:03-91:09	1.26	6.11	0.10	0.19
Chile	79:02-91:07	2.71	1.59	0.03	0.08
Greece	77:01-91:05	-1.60	-1.02	0.04	0.06
India	76:02-92:01	1.28	1.28	0.01	0.03
Jordan	80:01-91:12	1.81	1.29	0.01	0.02
Korea	77:01-92:02	-2.12	-1.56	0.04	0.06
Malaysia	86:01-91:06	11.17	1.75	0.01	0.03
Mexico	78:02-91:11	1.77	4.34	0.04	0.07
Nigeria	86:01-91:06	-0.35	-1.78	0.03	0.06
Pakistan	85:02-91:07	-0.87	-0.76	0.01	0.02
Philippines	87:02-92:02	2.07	0.92	0.04	0.05
Thailand	77:02-91:11	-3.86	-2.32	0.02	0.04
Turkey	88:01-91:12	2.05	0.72	0.07	0.08
Venezuela	86:01-92:01	-2.55	-4.22	0.01	0.07
Zimbabwe	79:03-88:10	-1.44	-0.48	0.02	0.05
Germany	71:01-92:01	-2.11	-0.91	0.00	0.01
Japan	71:01-92:02	-0.82	-0.98	0.04	0.05
U.S.	57:03-91:01	-1.50	-1.43	0.01	0.02

Model:

$$E((R^N_t-\alpha-\beta I_t)\otimes Z_{t-1})=0, ,$$

where Z_{t-1} is a given combination of the following set of instruments: the nominal return on the stock market at time t-1, the inflation rate at time t-1, the growth in M1 at time t-1, interest rates at t-1 (when available), growth in production at time t-1 (when available), and the dividend yield observed at time t-1 (DP). Estimates are adjusted for a general form of heteroscedasticity using White's (1980) method. b represents the estimate of β and t represents the corresponding t-statistic. $\hat{\sigma}_m$ represents the standard deviation of expected growth in the money supply based on the models in table 9. $\tilde{\sigma}_m$ represents the standard deviation of realized growth in the money supply.