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# Inflation and Financial Market Performance: What Have We Learned in the Last Ten Years?

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The last decade has witnessed a great deal of theoretical and empirical research on the relationships between inflation, financial market performance, and economic growth. This paper provides a survey of that literature and presents new cross-country empirical results on this topic. We find that inflation is negatively associated with banking industry size, real returns on financial assets, and bank profitability. We also discover a positive relationship between asset return volatility and inflation.

**JEL Classification:** E40, E44, O16
**Key Words:** inflation, financial markets, economic growth, banking,financial assets

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# 1 Introduction

This study investigates the relationship between inflation and financial market performance. Largely, our objective is to review the extensive literature that has grown up on this topic over the last ten years or so. We also provide a few new empirical findings, primarily on the association between inflation and interest rates, and between inflation and bank profits. Our review of the theory is relatively brief, compared to what it could be. This is not because the theory literature is small or unimportant, but rather because an excellent review piece was written by our friend and colleague, Bruce D. Smith, just before his untimely death in 2002.

Why the recent interest in inflation and financial markets? The empirical finding of a negative association between inflation and real economic growth (for example Barro 1995) generated enormous interest and much subsequent work. An obviously important issue was to determine if this association really existed and, after that had been done, to try to explain why. Another important empirical finding at about the same time was that financial intermediaries (banks and markets) seem to play a key role in economic development (Levine and King 1993a, b, Levine and Zervos 1998). This finding, too, generated a great deal of subsequent interest and follow-up research. The obvious link between the two findings is the possibility that inflation might be affecting real growth *through* the financial markets—specifically, by damaging financial markets or impeding their operation. Several of the theoretical models that we discuss in the following section allow for this possibility. And much of the empirical work reviewed or presented later looks for evidence of such effects.

For two reasons, we spend much more time investigating banks and banking markets than we do looking at stock and bond markets. The first is simply that there has been relatively more work on the former than on the latter. The second is that, in many respects, banks are a more "substantial" component of the financial sector. Relatively poor countries often have very primitive markets for equity, with no trading on organized exchanges. Bond markets are also uncommon. Only about twenty-five percent of the sample countries we look at have government bonds outstanding, and an even smaller fraction have significant private bond issues. But all countries, rich and poor, have banks.

If this study in some part achieves two objectives, we would view it as a resounding success. The first is to make empiricists better aware of recent advances in the theory of financial intermediation, money and inflation. The second is to make monetary and macro theorists more aware of recent empirical findings. The body of relevant empirical literature on inflation and finance is growing exceptionally rapidly, and work is now being done by finance scholars as well as by economists. One unfortunate result of this recent outpouring is that there are surely excellent studies that we have neglected to mention here. To the aggrieved, we apologize.

The rest of this study proceeds as follows. Section 2 contains a brief review of the theory literature on inflation and financial markets. Sections 3 and 4 review empirical work on inflation and markets for traded financial securities, e.g. stocks and bonds. Section 5 looks at empirical work on inflation and commercial banking. Section 6 investigates inflation and asset return volatility. Finally, Section 7 summarizes our findings.

# 2 Recent Theoretical Studies

## 2.1 Macro Models without a Role for Banking

Smith (2002) argues that macroeconomic models that ignore banking lead to "some fairly embarrassing results" (Smith 2002, p. 2). These models either generate a Mundell-Tobin effect in which higher permanent inflation leads to higher real economic activity or to superneutrality, where higher inflation has no effect on real interest rates or real activity. These results contradict the empirical results that demonstrate above a certain level, inflation and real economic activity are negatively correlated.

Another result that emerges from macroeconomic models that ignore financial intermediation is optimality of the Friedman rule. This finding does not appear to be empirically interesting since periods of low nominal interest rates often are associated with suboptimal economic performance. The case of the Great Depression in the United States and Japan currently come to mind. Furthermore, as discussed below, models that include intermediation often exhibit suboptimality of the Friedman rule.

## 2.2 Models of Financial Intermediation and Economic Growth

Gurley and Shaw (1955, 1960, 1967) noted that at low levels of economic development, most capital investment is self-financed. Only with higher levels of per-capita income do banks arise and play an important role in investment finance. With further increases in per-capita income, sophisticated financial markets, such as equity markets, facilitate capital creation. A conclusion suggested by the Gurley-Shaw observations is that without the development of financial institutions and financial markets, the allocation of funds to productive investment is restrained. The resultant lower levels of capital investment inhibit economic growth. Furthermore, their observations imply that financial development and economic growth are jointly determined.

The theoretical literature of the last decade or so has attempted to incorporate the Gurley-Shaw observations in the form of models emphasizing the importance of bank provision of liquidity as a factor promoting economic growth. One such early model is that of Bencivenga and Smith (1991). This model demonstrates that liquidity provision by banks can affect the composition of savings in such a manner that promotes the accumulation of private capital.

It may also be that monetary policy plays a role in the low levels of financial development in developing countries. Developing countries tend to have relatively high levels of nominal interest rates. At first glance, high nominal interest rates would seem to encourage the development of banks. However, this ignores the fact that banks must insure against depositors' need for liquidity. Bencivenga and Smith (2003) present a model in which high nominal interest rates caused by high money growth rates imply that banks are unable to adequately insure against the liquidity needs of agents and, hence, are not utilized. Economic development suffers as a result. They point to historical episodes in which monetary reforms that caused substantial declines in money growth rates and nominal interest rates spurred the development of banks.

## 2.3 The Impact of Nominal Interest Rates and Inflation on Financial Development

Two important observations come out of the empirical literature. First, low nominal interest rates tend to be associated with low levels of real investment and low economic growth rates. This may call into question the optimality of the Friedman rule. Second, permanently higher levels of inflation, above a certain rate, adversely affect economic growth. This appears inconsistent with the Mundell-Tobin effect that arises in many standard macro models. How can we understand these observations? Many of the theoretical models discussed below have, to a great extent, attempted to explain these empirical observations.

The level of nominal interest rates affects bank portfolio decisions. Low nominal interest rates lower the opportunity cost of bank holdings of cash reserves, resulting in less investment in productive capital. In essence, with low interest rates, money becomes "too good" of an asset, and banks have little incentive to make productive investments. This, in turn, hinders economic growth. In such cases, a monetary policy that adheres to the Friedman rule may be suboptimal.

High levels of inflation potentially can also adversely affect economic growth. If, as some empirical studies suggest, higher inflation does not tend to result in proportionately higher nominal interest rates, high inflation results in lower real rates of return (Barnes, Boyd, and Smith 1998). This increases the demand for loanable funds, but reduces their supply. More importantly, sufficiently high inflation rates may exacerbate credit market frictions. Empirical evidence suggests that credit market frictions are stronger in developing countries than developed countries (McKinnon 1973, Shaw 1973). In a world with credit market frictions, higher inflation can lead to heightened rationing of credit and lower overall investment. Smith (2002) presents a model with costly state verification in which high rates of inflation cause credit rationing and lower investment. Azariadis and Smith (1996) also show that credit market frictions may bind with sufficiently high levels of inflation. This is consistent with the empirical observation that there is a critical inflation level above which higher inflation adversely affects economic growth.

Smith and van Egteren (2003) suggest another mechanism by which inflation can impact real output. In their model, inflation both lowers the real value of internal funds used by firms to make investment and distorts firms' incentives to accumulate internal funds. This causes firms to rely more heavily on external sources of funds, exacerbating informational frictions in financial markets. This adversely impacts the level and efficiency of investment, resulting in lower real output. These effects arise not only with higher inflation, but with greater volatility in inflation.

The effect of inflation on real economic activity appears to be nonmonotone. For example, Bullard and Keating (1995) show that for economies with an initially low level of inflation, a permanent increase in the rate of inflation can stimulate long-run economic activity. But, consistent with the above-mentioned steadies, in economies with relatively high initial inflation rates, further increases in inflation lead to reductions in economic activity.

Another potential linkage between high inflation and lower levels of financial development is through reserve requirements. High rates of inflation can serve as a significant tax on banks, especially in those developing countries with high levels of reserve requirements.

## 2.4 The Impact of Inflation on Crises and Economic Volatility

The empirical literature also notes an important relationship between high, sustained rates of inflation and financial crises (Demirguc-Kunt and Detragiache 1998). Friedman and Schwartz (1967), of course, noted the strong correlation between crises and recessions present in the U.S. economy. In some cases, but not all, crises have led to significant, long-lasting reductions in real output (Boyd, Kwak, and Smith 2002). As discussed below, the recent theoretical literature suggests that financial market frictions may play an important role in banking crises.

The early theoretical literature on banking panics did not incorporate monetary economies (Bryant 1980, Diamond and Dybvig 1983). However, many of the empirical facts associated with banking crises involve observations about the behavior of monetary variables, such as currency-deposit and reserve-deposit ratios. This argues for incorporating money into models of banking in order to adequately explain the empirical observations. The Demirguc-Kunt and Detragiache (1998) observations about a possible inflation-crisis link further argue for integrating monetary considerations into models of banking.

Models featuring monetary considerations have often done so by incorporating financial market frictions. One common feature of such models is the propensity for the model economies to exhibit significant volatility. For example, Williamson (1987), Bernanke and Gertler (1989), and Carlstrom and Fuerst (1997, 1998) show that financial market frictions can amplify the magnitude of real exogenous shocks. Furthermore, financial market frictions can also lead to increased endogenous volatility (Azariadis and Smith 1996, 1998 and Boyd and Smith 1998). Models incorporating credit market frictions often imply a critical value of the inflation rate, beyond which the model economies exhibit oscillatory dynamics outside the steady state (Boyd and Smith 1998, Schreft and Smith 1998).

Smith (2002) presents a model in which banks facing stochastic withdrawals insure agents against relocation shocks. When the proportion ($\pi$) of relocating agents exceeds a critical level, bank panics occur in which bank reserves are exhausted. For even higher levels of $\pi$, banks liquidate storage investments and receive a low rate of return on those scrapped investments. Lower output results. In this model, higher rates of inflation are associated with a higher probability of a banking crisis. This model also shows that adherence to the Friedman rule causes banks to hold 100% reserves. This implies that the probability of a banking panic is zero. Nonetheless, setting the nominal interest rate to zero is not optimal in this model. Raising the nominal interest rate above zero induces banks to hold more of the productive storage asset and increases steady state welfare of agents.

Smith (2002) also presents a costly state verification model with credit market frictions. In this model, two steady states arise, one with a low capital stock and one with a high capital stock. Which steady state the economy approaches depends on the economy's initial capital stock. Equilibrium paths that approach the high capital steady state can display indeterminacy, with a multiplicity of equilibrium. Furthermore, the possibility of endogenous volatility arises in the neighborhood of the high capital stock steady state, but only if steady state inflation is sufficiently high. This implies that high inflation may be associated with increased volatility of inflation, an observation made in the empirical literature.

In Choi, Boyd, and Smith (1996), financial intermediaries are faced with an adverse selection problem with the potential for credit rationing. For low rates of inflation, credit market rationing may not occur. In such a case, the model gives rise to a Mundell-Tobin effect. However, with higher rates of inflation, the model gives rise to endogenous rationing of credit. Higher rates of inflation reduce the real rates of returns for savers, and when credit is rationed, informational frictions worsen. In such cases, economic activity suffers. High inflation can also result in development traps. When inflation is sufficiently high, economic volatility results and inflation becomes more variable as do rates of return on savings. Boyd and Smith (1998), in a costly state verification model, yield similar results.

**Summary.** This theoretical literature makes at least three of empirical predictions. One is that inflation that is either "too high" or "too low" can hinder the financial intermediary sector and thus reduce real output. However, we will review no empirical studies that investigate deflationary environments. Sustained deflation has been relatively rare in modern times, and resultantly not much studied. Cross-sectional data we used in this study have few countries with periods of deflation lasting over a year or so. Past periods of deflation, such as the Great Depression or late 1800s in the U.S., suffer from a dearth of adequate data to thoroughly study the impact of inflation on the financial sector.

A second prediction of theoretical models is the existence of thresholds at "sufficiently high" rates of inflation. Depending on the model, economic behavior is different on the high side of the threshold; for example, credit rationing may occur. As we shall see, there has been a good deal of work on the existence of such thresholds, and some work on the possibility of endogenous credit rationing. Finally, a third important prediction of several studies is that asset return volatility will be positively related to the rate of inflation, perhaps with a discrete jump at a threshold. There has been good deal of work on this topic, and we present a few new results in the present study.

# 3 The Stock Market

Most of the theoretical work we have reviewed deals with inflation, banks and the economy. However, the effects of inflation on securities markets are potentially important, too (Levine and Zervos, 1998). Thus, we begin our review of empirical work, with studies of inflation and equity markets. We also will be presenting some new empirical findings of our own on this topic.

## 3.1 Stock Market Size and Performance

Boyd, Levine, and Smith (2001) employ cross-country data to examine the relationship between inflation and four measures of stock market size or performance: total stock market capitalization as a percent of GDP, total value traded as a percent of GDP, the ratio of stock value traded to stock market capitalization, and a measure of return volatility.[1] Their tests are coun-

[1] These stock market variables have been found to be significantly correlated with real economic development (King and Levine, 1993 a, b). Stock market volatility is com-

try cross-sections, employing data averaged over the thirty-six year period, 1970–1995, for 48 countries. The idea of the long time averages is to look at steady-state relationships. They include as control variables initial (1970) real per capital GPD, initial (1970) secondary education, number of coups and revolutions, the black market currency premium, and a measure of the government's fiscal deficit.

They find that inflation is negatively and significantly associated with each of these stock market measures, after controlling for the other variables mentioned. They also report strong evidence of "threshold effects" for all these relationships except the one between inflation and stock market volatility. Specifically, the inflation-stock market performance relationship flattens significantly for high values of inflation (above 15%) so that further increases in inflation are not associated with significant further deterioration in stock market capitalization, total value traded, or turnover.

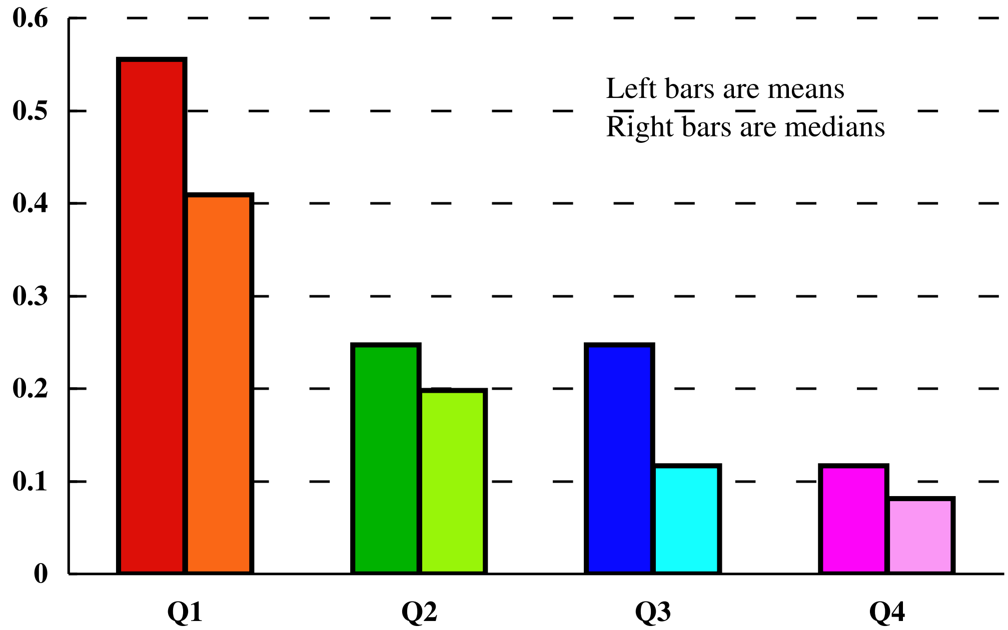
Boyd, Levine, and Smith (2001) find that stock market volatility, on the other hand, is best represented by a simple, positive, linear relationship with inflation, which is highly statistically significant.[2] All these relationships are remarkably strong and statistically significant, however, the authors make no pretense of having established direction(s) of causality.

In Figures 1 and 2 we reproduce some results similar to those of Boyd, Levine, and Smith, using our own data. Figure 1 shows total equity market capitalization as a fraction of GDP (*mcap*), after sorting the data into inflation quartiles. These data are averaged over the period 1970–1995, and there are 23 countries. The figure clearly shows the negative relationship between *mcap* and inflation, as reported by Boyd, Levine and Smith. Figure 2 shows the total value of equity trading as a fraction of GDP (*tvt*) for the same countries and time period, and exhibits the same negative relationship with inflation. In this case we see clear evidence of "flattening" in the two higher inflation quartiles. For quartile three the median value of *tvt* is 0.013 and for quartile four it is hardly different at 0.010. As will be discussed Section 5, there is evidence of a similar inflation threshold in cross-country measures of banking performance.

puted as a 12-month rolling standard deviation, cleansed of 12 months of autocorrelations following the procedure defined by Schwert (1989).

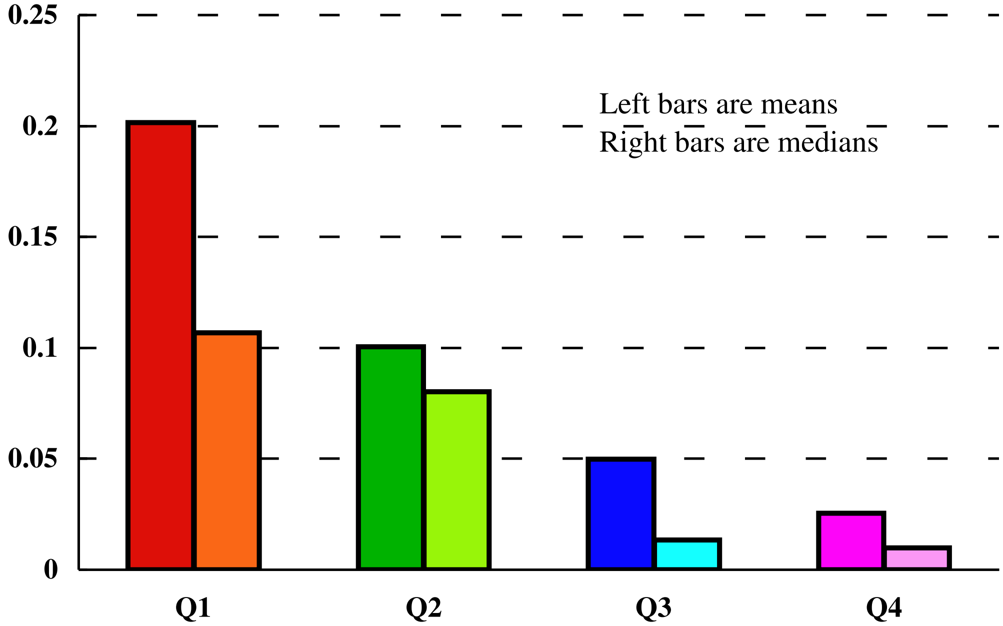
[2] We will return to the inflation-volatility issue in the new work presented in Section 6 of this paper.

**Figure 1: Total Equity Market Capitalization/GDP by Inflation Quartile, 1980–1995**




| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***mcap*** | 0.5551 | 0.4092 | 0.2473 | 0.1977 | 0.2475 | 0.1169 | 0.1165 | 0.0811 |
| ***cpirate*** | 1.0363 | 1.0366 | 1.0664 | 1.0656 | 1.1161 | 1.1140 | 1.3249 | 1.2466 |

**Figure 2: Total Value of Equity Traded/GDP by Inflation Quartile, 1980–1995**




| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***tvt*** | 0.2016 | 0.1067 | 0.1005 | 0.0801 | 0.0497 | 0.0134 | 0.0255 | 0.0098 |
| ***cpirate*** | 1.0363 | 1.0366 | 1.0678 | 1.0666 | 1.1194 | 1.1225 | 1.3249 | 1.2466 |

## 3.2 Inflation and Equity Returns

In this same study, Boyd, Levine, and Smith (2001) examine the relationship between inflation and nominal stock returns for 38 countries, employing the same set of control variables. In simple linear regressions, inflation enters with a positive and highly significant coefficient, and an elasticity a bit greater than one. However, there is also evidence of a threshold effect in the inflation-equity return relationship. For countries with average annual inflation of less than 15 percent, there is no significant relationship between the long run rate of inflation and the nominal return on equity. However, for economies with rates of inflation in excess of 15 percent, marginal increases in inflation are matched by even greater than one-for-one increases in nominal stock returns.[3]

To verify their results, we estimated equations 1 and 2 using a sample of equity returns for 33 countries, averaged over the ten-year period 1989–1998. The dependent variable, *eqrate*, is the gross nominal rate of return on each country's major stock exchange averaged geometrically over the ten years. The inflation measure, *cpirate*, is the geometric average of gross changes in the consumer price index over the same period. Several control variables are also included: *bmp* is the black market currency premium, *initial* is real per capita GDP in 1980, and *revc* is the number of coups and revolutions. We split the sample into low and high inflation halves and equation 1 is estimated with the low inflation countries. Standard errors are robust, and $t$-values are in parentheses. It is clear that there is no significant relationship between equity returns and inflation for this group of low inflation countries. Equation 2 is estimated with the high inflation group and here the inflation coefficient is almost exactly equal to one, and highly statistically significant.[4] Both equations 1 and 2 have negative and significant coefficients on the black market currency premium, *bmp*, suggesting that exchange rate problems are not good for equity investments *ceteris paribus*. *Bmp* is, not surprisingly, correlated with average inflation rates but excluding this variable has little effect on the other coefficients and $t$-values in equations 1 and 2.

$$\underset{}{eqrate} = 1.932 - \underset{(0.36)}{0.855}\,cpirate + \underset{(0.75)}{3.332}\,initial - \underset{(4.78)}{0.504}\,bmp + \underset{(0.46)}{0.038}\,revc \qquad n = 16, \quad R^2 \text{ adj.} = 0.52 \qquad (1)$$

$$eqrate = 0.005 + \underset{(150.43)}{1.026}\,cpirate + \underset{(0.82)}{7.637}\,initial - \underset{(3.07)}{0.003}\,bmp - \underset{(0.43)}{0.144}\,revc \qquad n = 15, \quad R^2 \text{ adj.} = 0.99 \qquad (2)$$

[3]This study did not attempt to search for the "best" threshold in these tests. However, this has been done in Barnes (200?).

[4]In this case, the sample median inflation rate was just less than five percent. We could not split the sample at a 15% inflation rate as did Boyd, Levine, and Smith (2001) for there are too few countries with average inflation exceeding that threshold. Our data come from a later, lower inflation, time period. If these regressions are re-run excluding very high inflation rate countries (inflation exceeding 100% per year), the results change little except that the inflation coefficient is much larger for the high inflation group.

### 3.2.1 Inflation and Equity Returns: Time-series Studies

Some previous studies of equity returns using time-series data have obtained similar results to Boyd, Levine, and Smith (2001) for low inflation countries, in the sense that, when inflation rates are relatively low, nominal equity returns are found to be essentially uncorrelated with inflation (Amihud 1996, Boudoukh and Richardson 1993, Choudry 2001). Kutan and Aksoy (2003) studied the relationship between inflation and equity returns in Turkey, over the period 86.12–2001.3, using monthly data and an asymmetric GARCH model. These authors found that average equity returns on a composite stock index, and an index of industrial stocks, were essentially unrelated to inflation, represented by changes in the CPI lagged by one, two and three months. This is perhaps a surprising result, given that inflation in Turkey averaged about seventy-five percent per year during their sample period.

Kutan and Aksoy (2003) also found that returns on financial sector equities were positively and significantly correlated with inflation in all specifications. As they put it, "In these results, for the financials, anticipated inflation continues to have the most significant impact. All the estimated inflation coefficients are positive, and individually and jointly significant. The sum of the coefficients is 2.08: a 1% increase in the expected inflation rate raises the financial returns by 2.08%, all else constant" (p. 236). This is an unexpected finding because results presented in Section 5 of this paper suggest that bank lending margins are not particularly well-hedged against inflation.

Barnes, Boyd, and Smith (1999) studied a sample of 25 countries employing quarterly time-series regressions for periods as long as 1957.2 through 1996.3, depending on country. Their dependent variable was the nominal rate of return on equity, represented by changes in the country's major stock exchange index. Inflation was represented by the percentage change in the consumer price index, contemporaneous and lagged by one quarter. Sample inflation experience ranged from Switzerland, with a 0.86% average annual rate of inflation, to Peru, with a 54.0% average annual inflation rate. The simple cross-country correlation between the average rate of inflation and average equity returns was 0.84. However, in 15 out of 25 countries the contemporaneous inflation coefficient was negative in the time-series regressions, and for only four countries was this coefficient positive and significantly different from zero. These were the *four highest inflation countries in the sample*: Chile, Israel, Mexico and Peru. On the other hand, the United States, Australia and Japan, three of the lowest inflation countries, had inflation coefficients that were negative and significantly different from zero at usual confidence levels. The one quarter lagged inflation rate was only significant in eight of the twenty-five cases. In four of these cases, the coefficient was negative and of that four, three were low inflation countries (Netherlands, Philippines and Spain).

Obviously, the time-series findings are generally very consistent with the cross-country evidence. With the time-series tests, however, there are a number of cases with a *negative* relationship between inflation and nominal equity returns, always in low inflation countries. This is an advantage to the time-series approach because such cases may be obscured by the time-averaging procedure in the country cross sections. However, the time-series tests themselves suffer from the problem of using relatively high frequency data to estimate what are believed to be steady-state relationships. In addition, in the time-series tests there is the question as to whether, and to what extent, inflation has been fully anticipated by market participants. For present purposes, these issues are irrelevant because both time-series and cross-sectional work lead to largely the same conclusions. We summarize these below.

**Summary.** The response of market equity returns to inflation appears to depend importantly on the level of inflation. In low-inflation environments, cross-country tests find that inflation and nominal equity returns are essentially uncorrelated. Time-series tests suggest that the two are significantly correlated in some countries and not in others. However, when this correlation is statistically significant, it is negative about as frequently as it is positive. In sum, in relatively low inflation environments inflation and real equity returns are negatively associated. In high-inflation environments, the findings are quite different. There, it appears that nominal equity returns increase by at least enough so as to leave real returns unaffected. Time-series tests support this conclusion in the sense that stock returns seem to respond more positively to inflation changes in high inflation environments. In these tests, however, the inflation elasticity of stock returns is almost always less than one. Where, exactly, is the threshold between "low" and "high" inflation environments is not really known at this time.

# 4 Debt Markets: Inflation and Interest Rates

In their study of Turkish financial markets over the period 87.1–2000.12, Kutan and Aksoy (2003) found no evidence of any relationship between inflation, lagged by one, two and three months, and changes in interest rates. As they put it, "...the bond market does not act well as a hedge against anticipated inflation in Turkey" (p. 232).

Barnes, Boyd, and Smith (1999) investigated the relationship between inflation and nominal interest rates for twenty five countries, using quarterly time-series over periods as long as 1957.2–1996.3. They studied two interest rate series—a money market rate and a bank lending rate—and estimated both equations in first differences and ARMA (2,1) processes. When the money market rate was dependent, with either specification, less than half the countries exhibit inflation coefficients that are positive and statistically significant. Similar results were obtained when the bank lending rate was the dependent variable. In all cases and with both interest rates, the inflation coefficient is quite small, and when it is significantly different from zero, it is also significantly less than one. The single largest regression coefficient they found was 0.49 in the money market regression for Israel, a relatively high inflation country.

## 4.1 New Cross-country Inflation & Interest Rate Tests

Our review of the literature found no previous research that looked at the relation between inflation and interest rates employing country cross-sections with long time-averaging. Therefore, we carried out some work of this nature for the present study. We estimated two kinds of regressions: those with nominal rates of interest the dependent variable (Table 1) and those with real rates of interest the dependent variable (Table 2). In Table 1, the dependent variables are, in order, the nominal interest rate on money market securities, Treasury bills, time deposits, bank commercial loans, and medium- to long-term government bonds. Each interest rate is represented by its gross geometric average rate over the time period, 1989–1998, employing annual data. Inflation is measured as the geometric average of gross changes in the consumer price index, averaged over the same period. To control for the level of economic development, which could be associated with the rate of inflation, we include a measure of initial wealth represented by real, per-capita GDP in the year 1980 (*initial*). In many economies, exchange rate risks (or distortions) could be associated with the level of interest rates. Therefore, we include the black market currency premium (*bmp*) as an additional control variable. For obvious reasons, political risk could be associated with interest rates, and the number of coups and revolutions (*revc*) in also included as a control.[5] In the tests with real interest rates reported in Table 2, the dependent variables are these same five geometric average nominal interest rates, divided by the same period geometric average rate of CPI inflation. Identical control variables are employed.

In Table 1 the coefficient of inflation is positive and highly significant for all interest rate measures. In all cases, the interest rate elasticity with respect to inflation (at the sample median values) is less than one; in fact, it is significantly less than one in all cases except for the loan rate and government bond rate.

The real interest rate regressions in Table 2 show generally the same picture. In regressions 1 through 5, the inflation coefficient is negative and highly significant in the equation for the real money market rate, the real Treasury bill rate and the real time deposit rate. However, it is not statistically different from zero for the real loan rate and the real government rate. Two of these relationships, the real Treasury rate and the real loan rate, appear to exhibit non-linearity, according to standard goodness-of-fit criteria, and we have included quadratic specifications for these two cases in regressions 6 and 7 of Table 2. In both instances, the coefficient of the linear term is positive and the coefficient of the squared term negative, implying that real interest rates "worsen" as inflation increases. There is no positive rate of inflation for which the inflation elasticity of the real Treasury bill rate is positive. That is, $\mathrm{d}(rtbillrate)/\mathrm{d}(cpirate) < 0$ for any positive rate of inflation. The inflation elasticity of the real loan rate is positive for inflation rates up to about twenty-two percent, and negative thereafter. Thus, it appears that banks can increase loan rates so as to offset (or more than offset) inflation for low and intermediate rates of inflation, but not for extremely high rates.

Figures 3–7 show means and medians for each of the five real interest rates, sorted into inflation quartiles. The (mean and median) real money market rate shows no obvious pattern, except that the highest quartile is relatively low. The (mean and median) real Treasury bill rate declines with

[5] We experimented with a variety of different control variables. Except as noted, the results were qualitatively little affected.

**Table 1: Nominal Interest Rate Regressions, 1989–1998**

| | Dependent Variable | | | | |
|---|---|---|---|---|---|
| | ***mm*** | ***tbill*** | ***tdep*** | ***loan*** | ***govr*** |
| ***cpirate8998*** | 0.8721<br>(30.75)*** | 0.4825<br>(6.32)*** | 0.5895<br>(4.30)*** | 0.8548<br>(2.70)*** | 0.9376<br>(6.10)*** |
| ***revc*** | 0.0257<br>(0.36) | 0.0148<br>(1.07) | 0.0200<br>(1.13) | -0.0072<br>(0.35) | -0.0372<br>(2.67)** |
| ***bmp*** | -0.0005<br>(1.14) | 0.0001<br>(2.48)** | -0.0002<br>(0.80) | -0.0007<br>(0.97) | -0.0025<br>(2.41)** |
| ***initial*** | -0.3772<br>(0.45) | -2.3370<br>(1.88)* | -1.9550<br>(1.62) | -4.1382<br>(2.34)** | -2.1118<br>(3.12)*** |
| ***constant*** | 0.1792<br>(6.13)*** | 0.6016<br>(6.83)*** | 0.4737<br>(3.07)*** | 0.2717<br>(0.80) | 0.1390<br>(0.85) |
| ***N*** | 34 | 34 | 69 | 69 | 26 |
| **Adjusted $\mathbf{R}^2$** | 0.94 | 0.90 | 0.79 | 0.64 | 0.96 |
| **Elasticity of** ***cpirate8998*** | 0.8326 | 0.4666 | 0.5808 | 0.7973 | 0.8925 |
| **Medians:** | | | | | |
| **Dep. Var.** | 1.0939 | 1.0940 | 1.0977 | 1.1595 | 1.0839 |
| ***cpirate8998*** | 1.0444 | 1.0581 | 1.0815 | 1.0816 | 1.0317 |
| ***revc*** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| ***bmp*** | 0.1839 | 7.4965 | 7.5075 | 7.8157 | 0.0000 |
| ***initial*** | 0.0071 | 0.0041 | 0.0019 | 0.0019 | 0.0093 |

Robust *t*-statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions intentionally exclude observations with average (gross) inflation exceeding 200% per annum.

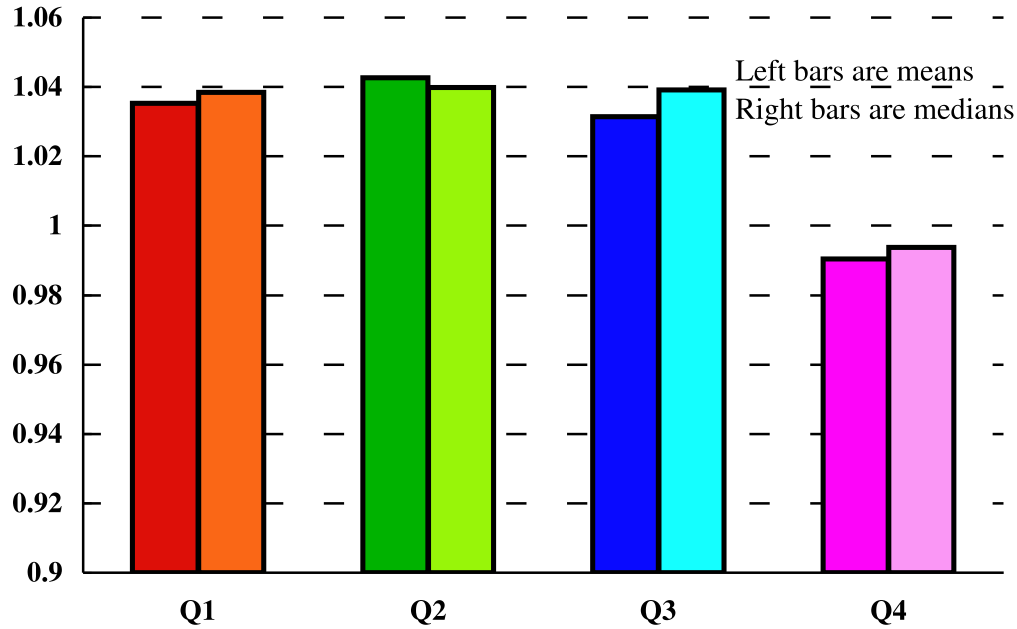
each inflation quartile, as does the real time deposit rate. The mean real loan rate increases between the first and second quartiles, and then declines in the third and fourth quartile. The median real loan rate is basically constant across the first two quartiles and decreases markedly in the third and fourth quartiles. Finally, the (mean and median) real government bond rate is essentially flat for the first three quartiles, and then drops precipitously in the fourth quartile.

## Table 2: Real Interest Rate Regressions, 1989–1998

| | Dependent Variable | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1.** | **2.** | **3.** | **4.** | **5.** | **6.** | **7.** |
| | ***rmmrate*** | ***rtbillrate*** | ***rtdeprate*** | ***rloanrate*** | ***rgovrrate*** | ***rtbillrate*** | ***rloanrate*** |
| ***cpirate8998*** | -0.0920 | -0.2979 | -0.2534 | -0.1214 | 0.0128 | 0.4105 | 1.1203 |
| | (4.11)*** | (9.21)*** | (3.54)*** | (0.62) | (0.09) | (1.38) | (1.61) |
| ***revc*** | 0.0244 | 0.0160 | 0.0138 | -0.0067 | -0.0275 | 0.0172 | -0.0095 |
| | (0.40) | (1.71)* | (1.01) | (0.40) | (1.95)* | (2.12)** | (0.55) |
| ***bmp*** | -0.0005 | 0.00004 | -0.0001 | -0.0004 | -0.0023 | -0.00001 | -0.0005 |
| | (1.44) | (1.25) | (0.94) | (0.94) | (2.52)** | (0.21) | (1.02) |
| ***initial*** | -0.1123 | -0.6342 | -0.8344 | -2.8014 | -1.2440 | 0.6118 | -1.1138 |
| | (0.15) | (0.74) | (1.05) | (2.30)** | (2.01)* | (0.65) | (0.70) |
| ***cpirate8998***$^2$ | | | | | | -0.2467 | -0.4580 |
| | | | | | | (2.48)** | (2.20)** |
| ***constant*** | 1.1375 | 1.3522 | 1.2960 | 1.2273 | 1.0491 | 0.8682 | 0.4127 |
| | (47.67)*** | (34.50)*** | (16.05)*** | (5.86)*** | (7.37)*** | (4.16)*** | (0.80) |
| ***N*** | 34 | 34 | 69 | 69 | 26 | 34 | 69 |
| **Adjusted $R^2$** | 0.26 | 0.83 | 0.63 | 0.16 | 0.88 | 0.86 | 0.22 |
| **Elasticity of** ***cpirate8998*** | -0.0925 | -0.3059 | -0.2698 | -0.1230 | 0.0127 | -0.0851 | 0.2070 |
| **Medians:** | | | | | | | |
| **Dep. Var.** | 1.0390 | 1.0304 | 1.0159 | 1.0668 | 1.0456 | 1.0304 | 1.0668 |
| ***cpirate8998*** | 1.0444 | 1.0581 | 1.0815 | 1.0816 | 1.0317 | 1.0581 | 1.0815 |
| ***revc*** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| ***bmp*** | 0.1839 | 7.4965 | 7.5075 | 7.8157 | 0.0000 | 7.4965 | 7.8157 |
| ***initial*** | 0.0071 | 0.0041 | 0.0019 | 0.0019 | 0.0093 | 0.0041 | 0.0019 |

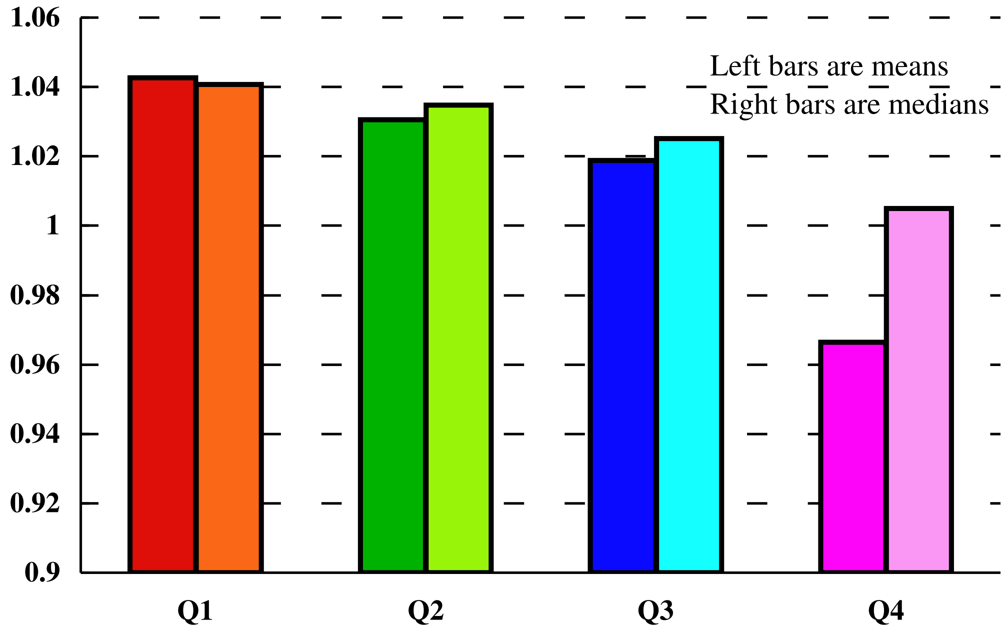
Robust $t$-statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions intentionally exclude observations with average (gross) inflation exceeding 200% per annum.If these data points are included, equation 2 is unaffected. In all other regressions, the inflation coefficient becomes insignificantly different from zero except in equation 1 where it is positive and marginally significant.

**Figure 3: Gross Real Money Market Rate by Inflation Quartile, 1989–1998**



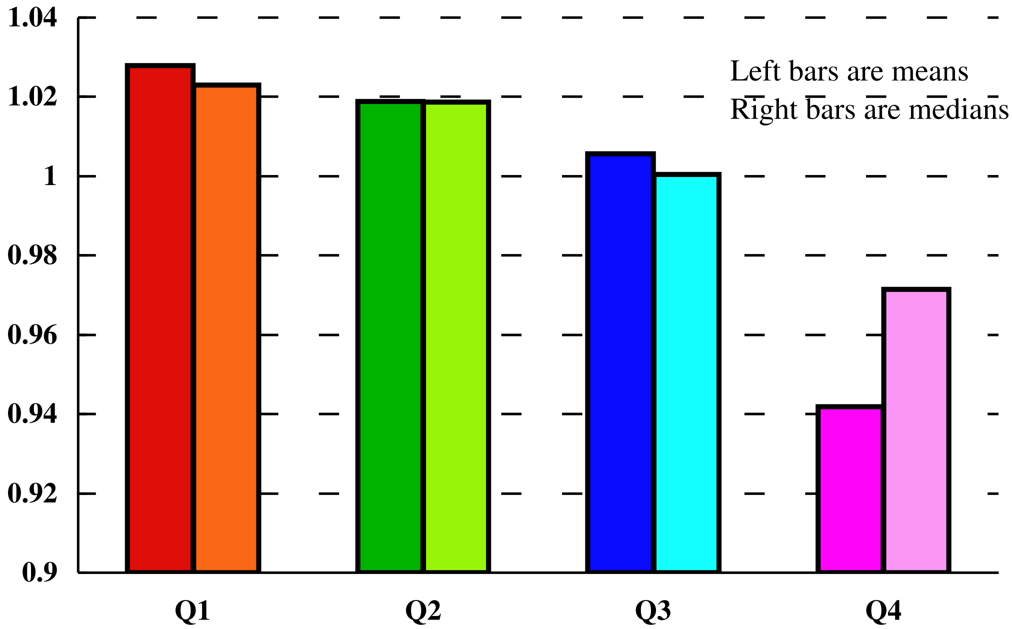

| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rmmrate*** | 1.0353 | 1.0385 | 1.0427 | 1.0399 | 1.0314 | 1.0391 | 0.9904 | 0.9937 |
| ***cpirate*** | 1.0218 | 1.0234 | 1.0329 | 1.0326 | 1.0628 | 1.0583 | 1.2676 | 1.1766 |

**Figure 4: Gross Real Treasury Bill Rate by Inflation Quartile, 1989–1998**



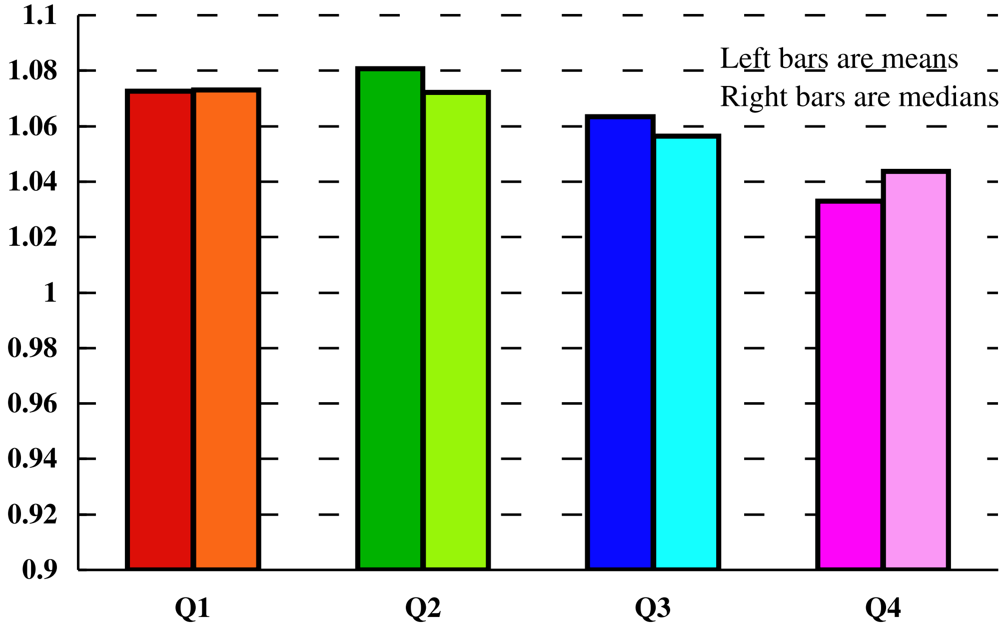

| | **1st Quartile** | | **2nd Quartile** | | **3rd Quartile** | | **4th Quartile** | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rtbillrate*** | 1.0427 | 1.0408 | 1.0306 | 1.0347 | 1.0188 | 1.0252 | 0.9964 | 1.0049 |
| ***cpirate*** | 1.0234 | 1.0253 | 1.0360 | 1.0332 | 1.0892 | 1.0959 | 1.3181 | 1.2377 |

**Figure 5: Gross Real Time Deposit Rate by Inflation Quartile, 1989–1998**



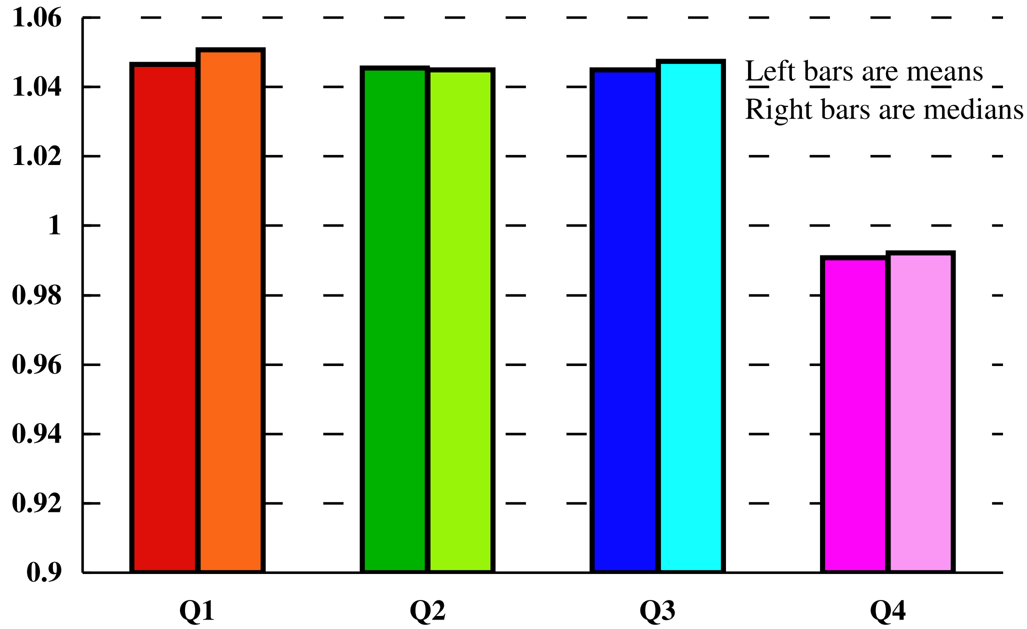

| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rtdeprate*** | 1.0279 | 1.0230 | 1.0189 | 1.0187 | 1.0057 | 1.0004 | 0.9419 | 0.9714 |
| ***cpirate*** | 1.0241 | 1.0254 | 1.0461 | 1.0448 | 1.1043 | 1.1119 | 1.3451 | 1.2613 |

**Figure 6: Gross Real Loan Rate by Inflation Quartile, 1989–1998**




| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rloanrate*** | 1.0726 | 1.0731 | 1.0807 | 1.0722 | 1.0635 | 1.0563 | 1.0330 | 1.0436 |
| ***cpirate*** | 1.0243 | 1.0254 | 1.0461 | 1.0448 | 1.1029 | 1.1096 | 1.3172 | 1.2470 |

**Figure 7: Gross Real Government Bond Rate by Inflation Quartile, 1989–1998**




| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rgovrate*** | 1.0465 | 1.0507 | 1.0455 | 1.0449 | 1.0449 | 1.0473 | 0.9907 | 0.9921 |
| ***cpirate*** | 1.0230 | 1.0234 | 1.0293 | 1.0272 | 1.0563 | 1.0548 | 1.2094 | 1.1533 |

**Summary.** The pattern in these figures is fairly clear, and is consistent with the regression results just presented. Time-averaged real interest rates tend to fall as inflation rises—if not at low to moderate inflation rates—then when inflation enters the fourth quartile. A "representative" high inflation economy, one that had inflation at the fourth quartile sample medians, would have real money market rates and real Treasury bill rates of essentially zero. Its real time deposit rate would be negative three percent, and its real government bond rate about negative one percent. Only its real loan rate would be meaningfully positive at about 4.4%. Frankly, it is hard to imagine how money and capital markets would function in such an environment.

# 5 Inflation and the Banking Industry

## 5.1 Inflation and Banking Development Indicators

Boyd, Levine, and Smith (2001) studied the relationship between inflation and three banking development indicators that have been used widely in the literature:

1. the ratio of liquid liabilities of the financial sector to GDP;
2. the ratio of total assets of "deposit money banks" to GDP; and
3. the ratio of bank lending to the private sector to GDP.

All three variables have been found to be strongly associated with the level and/or rate of change in real, per capita GDP (King and Levine 1993a, b). All variables were averaged over the period 1960–1995 and cross-country regressions were estimated involving 94 countries. The development indicators were regressed against inflation and a set of control variables including initial (1960) real, per capita GDP, initial (1960) secondary school enrollment, number of coups and revolutions, the black market premium and the government deficient. In linear regressions, the inflation coefficient was negative and significant at the 1% confidence level in all cases.

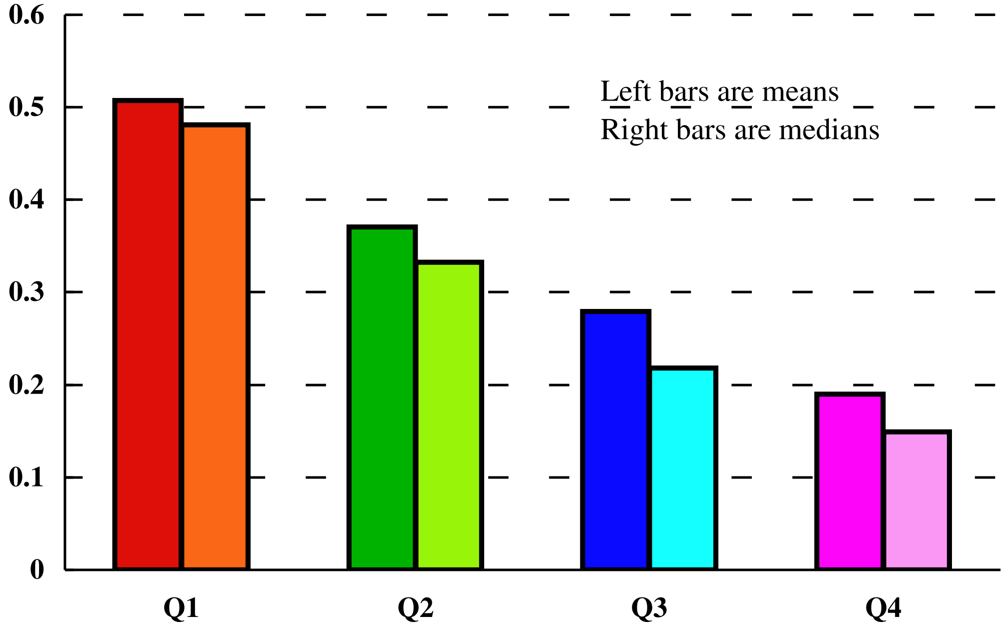
However, there was also evidence of threshold effects. Essentially, inflation was negatively associated with all the financial development indicators in countries with inflation of less than 15 percent. But as inflation exceeded the 15 percent threshold, there was a discrete drop in the development indicator and its relationship with inflation disappeared. This is very similar to the threshold for stock market development measures from the same study that we reported earlier.[6] To summarize in the authors' words, "there appears to be some evidence of a threshold in the empirical relationship between inflation and financial activity. At moderate inflation rates, there is a strong negative association between inflation and financial development. For countries whose inflation is above some critical level, the estimated intercept of the bank development relation is much lower than it is for countries below the threshold. Moreover, in economies with rates of inflation exceeding this threshold, the partial correlation between inflation and financial activity essentially disappears" (p. 237).

[6] This study did not attempt to search for the "best" threshold.

Figure 8 is our own work, and it shows the relationship between bank lending to the private sector as a percent of GDP and inflation, after the data have been sorted into inflation quartiles. For this purpose we have data for 98 countries, averaged over the15-year period 1980–1995.[7] Clearly, bank's private lending is much greater, relative to the size of the economy, in low inflation economies. In the lowest inflation quartile, this ratio averages over 50% and in the highest it averages about19%. Boyd, Levine, and Smith (2001) also report statistical evidence that inflation exerts a causal effect on banking development as represented by *priv*.

[7]This is a much shorter time period and somewhat larger sample of countries than was employed by Boyd, Levine and Smith (2001). However, the results are very similar.

**Figure 8: Commercial Bank Lending to Private Sector/GDP by Inflation Quartile, 1980–1995**




| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rgovrate*** | 1.0465 | 1.0507 | 1.0455 | 1.0449 | 1.0449 | 1.0473 | 0.9907 | 0.9921 |
| ***cpirate*** | 1.0230 | 1.0234 | 1.0293 | 1.0272 | 1.0563 | 1.0548 | 1.2094 | 1.1533 |

**Summary.** These results, along with the results on stock markets, suggest that cross-sectionally, higher inflation goes hand-in-hand with a smaller and arguably less efficient intermediary sector. For banking (but not securities markets), there is evidence of causality running from inflation to financial markets. These combined findings are important given existing work on the importance of financial intermediation in economic development.

## 5.2 Inflation and Credit Availability from Banks: Attitude and Opinion Data

Two recent studies have investigated external financing obstacles in different countries, employing a 1999 survey data set from the World Business Environment Survey. In the survey, almost 5000 firms in 49 countries responded to questions about the obstacles they encountered in obtaining external financing. There were three questions:

1. "How problematic is financing for the operation and growth of your firm?"

2. "Is the need for special connections with banks an obstacle for the operation and growth of your business?"

3. "Is the corruption of bank officials an obstacle for the operation and growth of your business?"

Respondents employed a four-point scale from "1 (no obstacle)" to "4 (major obstacle)." It has been shown that survey responses significantly correlate to actual, measurable outcomes (Hellman *et. al.* 2000) and are especially correlated with firm growth after controlling for many other factors (Beck, Demirguc-Kunt and Maximivic 2002).

Beck, Demirguc-Kunt, and Levine (2003) used this data set to study the effects of banking supervision on the availability of external financing. Beck, Demirguc-Kunt and Maksimovic (2003) used it to study the relationship between banking structure (competition) and availability of external finance. For our purposes, the two studies produce almost identical results and we therefore confine our comments to the first, which provides somewhat more detail. In Beck, Demirguc-Kunt, and Levine (2003) the dependent variables are the survey responses and inflation is included as a control variable along with the ratio of private bank lending to GDP, the growth rate of real GDP per capita, and a variety of legal and institutional variables. When "general financing obstacles" (Question 1) was the dependent variable, the coefficient of inflation was positive and statistically significant at usual confidence levels in almost all specifications. The clear implication is that *ceteris paribus* more inflation is associated with greater difficulty in obtaining external financing.[8] Essentially the same results are obtained when the dependent variable is "Bank Corruption" (Question 3).[9]

[8]The only exception is when a variable representing the liberality of deposit insurance coverage is also included. In that case, the inflation coefficient drops to insignificance. However, adding this variable also results in a very large decline in effective sample size, which could also explain the change.

[9]Surprisingly, when the dependent variable is "Need for a Special Connection" (Question 2), the inflation coefficient becomes negative and statistically significant at the 95%

**Summary.** The findings of this body of research are suggestive that higher inflation is associated with greater impediments to credit access. It would surely be useful to employ this unique data set for a full investigation of the influence of inflation on credit availability. These "soft" attitude and opinion data may be expected to capture non-price credit rationing of the sort modeled by Boyd and Smith (1998), Choi, Boyd, and Smith (2002b) and others.

## 5.3 Banking Crises

Several studies have examined what economic forces are associated with or "cause" banking crises. In at least three cases, inflation, although not the variable of primary interest, was included as a control variable. For example, Demirguc-Kunt, and Detragiache (1998) examine the role of moral hazard due to deposit insurance in causing banking system instability. In their study, the dependent variable was a (0, 1) dummy variable taking on the value 1 if a country experienced a banking crisis, zero otherwise. Banking crisis dates were taken from a data set constructed and updated by the World bank (Caprio and Klingebiel 1999). The study employed a multivariate Logit model with a panel of 61 countries experiencing 40 banking crises over the period 1980–1997. Inflation was included as a control variable, along with the growth rate of real GDP, the terms of trade, the ratio of M2 to foreign exchange reserves, and beginning of sample real GDP per capita.

Under a variety of different specifications, the inflation variable had a positive coefficient that was statistically significant (at high confidence levels) as an explanator of banking crisis probabilities. However, in later revisions of this same study (Demirguc-Kunt and Detragiache 2001), the real interest rate was added as an additional control variable and the sample was expanded. With these changes, the inflation coefficient dropped to insignificance. We believe that adding the real interest rate as an explanatory variable could easily obscure the true effect of inflation on banking crisis probabilities. While inflation is arguably exogenous, the real interest rate is clearly endogenous and (by construction) a function of inflation. In this study, the simple correlation between the rate of inflation and the real interest rate is extremely high

confidence level in most specifications. The study does not discuss this sign difference, which is inconsequential to its research objectives. It is worth noting that responses to the three questions seem to be capturing attitudes about different phenomena, as the simple correlations between the three responses are never larger than 0.42.

at $-0.98$.[10] However, the authors inform us that most of the change in the partial correlation with inflation is due to the change in sample composition. Interestingly, even with the larger sample, the simple correlation between inflation and banking crisis probability (reported by Beck, Demirguc-Kunt, and Levine 2003) is positive and significant at the 1% confidence level.[11]

Another recent study by De Nicolo, Bartholomew, Zaman, and Zephirin (2003) took a different approach to empirically representing the occurrence of banking crises. Instead of trying to date crisis beginnings and endings, they constructed a continuous crisis probability measure for the five largest banks in a country. This "z-score" measure is the probability that the five largest banks experience combined losses great enough to eradicate their consolidated equity capital. The z-score depends on mean profits, the variability of profits, and the equity capital of the five banks. All of these are represented as a percentage of total assets, and measured with annual accounting data over the period 1993–2000. Depending on specification, up to 97 countries are included.

In the reported results, inflation enters as a control variable, along with a set of regional dummy variables, real GDP growth, and a government intervention variable that is intended to capture the effect of government bailouts on banks' profit distributions. In none of the various specifications did inflation enter with a coefficient significantly different from zero. However, the six regional dummy variables, in conjunction with the real growth variable, could be serving as a reasonably good proxy for inflation. So, we asked the authors if they would provide us with a z-score regression with inflation and the government intervention variable as the only explanatory variables. They were gracious enough to do so, and the results are shown in equation 3 below. The dependent variable is the z-score, *cpirate* is the sample average rate of inflation, and crisis is the government intervention variable discussed above. Estimation is by OLS with robust standard errors, and $t$-values are

[10] Another recent study by Beck, Demirguc-Kunt, and Levine (2003) examines the relationship between banking concentration and the probability of banking crises. It employs essentially the same data set as Demirguc-Kunt and Detragiache (2001) and produces, from our perspective, identical results. That is, inflation never enters as a significant explanator of banking crisis probability, but inflation is always entered alongside the real interest rate. All our comments on the previous study apply equally to this one.

[11] It is important to note that for the purposes of the Demirguc-Kunt and Detragiache studies (1998, 2001) such multicollinearity is not at all an issue. They are not interested in separating the effects of inflation and real interest rates, only to control for them.

in parentheses.

$$z\text{-}score = 3.262 - 2.048\,crisis - 3.028\,cpirate \qquad n = 112 \qquad (3)$$
$$(5.87) \qquad (3.029) \qquad R^2 \text{ adj.} = 0.152$$

Inflation enters with a negative coefficient, significant at the 5% confidence level. Since lower z-scores are associated with banking instability, inflation reduces banking stability, ceteris paribus. The coefficient of the government intervention variable, *crisis*, is also negative and significantly different from zero at a high confidence level, reflecting the effect of banking crises.

Boyd, Gomis, Kwak, and Smith (2001) investigated the characteristics of countries that experienced multiple banking crises. A common feature, especially in Latin America, is that such countries often have high rates of inflation during a banking crisis that is going to be preceded by another banking crisis. There are not a sufficient number of multiple crisis countries for formal statistical analysis, but this feature of the data is quite striking.

**Summary.** On the basis of existing work, it is probably premature to conclude that inflation is (not) a major factor associated with banking crises. This is difficult to ascertain empirically, especially given the problems in dating and defining banking crises. Later in this paper we will present some new evidence on this topic that is also suggestive; specifically, higher association is associated with declining real profits margins of banks, and increasing return volatility.[12]

## 5.4 Bank Profits, Borrowing and Lending Spreads, Net Interest Margins, and Value Added: How Are These Associated with Inflation?

A number of studies have looked at the relationship between inflation and bank profits, or between inflation and bank net interest margins represented by (interest income −− interest expense) / total assets. In several of these studies, inflation was included as a "control variable" but was not, itself, the main variable under investigation. One example is Demirguc-Kunt, Laeven, and Levine (2003), which investigates the relationship between bank concentration and net interest margins. These authors employ a large cross-country

[12] It is also difficult to separate the effects of banking and currency crises (Kaminsky and Reinhart, 1999).

panel with data for about 1400 banks and 72 countries over the period 1995–1999. Domestic inflation enters as a control variable along with a number of other controls. These authors report a positive and significant relationship between inflation and bank net interest margins, robust to a variety of specifications. In their regressions the coefficient of inflation is consistently about 0.04, and sample mean inflation is 4.37, and mean net interest margin 3.61. This implies an inflation rate elasticity of bank net interest margins of only about 0.05, which is (undoubtedly) significantly less than one.

A related study by Levine (2002) uses another cross-country panel data set to investigate the effect of entry restrictions on bank net interest margins. This study includes observations on 1165 banks in 47 countries over the same period, 1995–1999, and many of the same control variables are included. The inflation coefficient is again positive and highly significant, with value of about 0.11 depending on specification. The mean net interest margin is 3.46, but sample mean inflation is not reported. However, mean inflation should be close to that reported in Demirguc-Kunt, Laeven and Levine (2003), 4.37%.[13] Assuming mean inflation of 4.37%, the elasticity of bank profit margins with respect to inflation is about 0.14 in this study. That is, again, almost certainly less than one.

**Summary.** Results of both these studies suggest that nominal bank margins are positively and significantly affected by inflation, but that real bank margins are significantly negatively affected.

An interesting study of inflation and bank profitability is by Honohan (2003) who examines country cross-sections for approximately 72 countries. His data are for the years 1988–1999, split into sub-periods 1988–1995 and 1995–1999. For the 1988–1995 sub-sample, Honohan only studies the relationship between inflation and bank profits. For the 1995–1999 subsample, he investigates the relationship between inflation and bank profits, inflation and bank value-added (as a fraction of bank assets),[14] and inflation and bank net interest margins.

In many specifications, Honohan includes banking balance sheet ratios and/or the real interest rate as additional variables. For our purposes, their inclusion is problematic because these right-side variables are arguably endogenous and themselves functions of inflation.[15] Thus, we prefer Honohan's

[13]The two studies cover the same period and use approximately the same data set.

[14]The value-added of banks is, essentially, bank profits before taxes, plus wages, salaries and some other operating expenses.

[15]For example, the simple correlation between inflation and the real interest rate is -0.98,

simplest specification in which inflation is the only right hand side variable. With this specification, he finds that bank profits are positively related to inflation in both sub-periods, and at very high confidence levels. The same is true when net interest margins and bank value-added are the dependent variables. The author indicates that the inflation elasticity of bank profits (1988–1995) is about 0.51, evaluated at the sample median values of both variables. He also reports an inflation elasticity of net interest margins of about 0.29 (p. 393). Again, these results suggest that real profitability is negatively associated with the level of inflation.

### 5.4.1 Legal Reserves and the Inflation Tax on Banks

Perhaps the most interesting results reported by Honohan are those on inflation, bank reserves, and their joint effect on bank profits. It is a hoary notion in monetary economics that governments can effectively tax banks by forcing them to hold non-interest bearing reserves, and inflating. Such a tax, like the inflation tax on non-bank currency holdings, may be an important revenue source in developing or transitional economies where collecting other taxes is problematic. However, Honohan finds no evidence of such a reserve tax on banks. Indeed, he reports, that ".....inflation strongly interacts with reserves—not to reduce profits, but instead to increase them! Rather than the reserve holdings being involuntary, in countries with high reserve holdings and high inflation the banks are likely finding ample remuneration, at least on their marginal reserve holdings. A look at some of the high profit countries in the scatter shows Russia and Romania to be prominent..." (p. 392–393).[16]

### 5.4.2 The Inflation Tax on Bank Reserves: Some New Results

Honohan's results are sufficiently interesting that we decided to re-examine the relationship between inflation, reserves, and bank profits, employing data for up to 84 banks averaged over the period 1991–1995. Two measures of bank reserve holdings are employed, *rrat* = legal reserves/total deposits, and

making it almost impossible to separate the two effects.

[16] This result is obtained with the first sub period, 1988–1995. In the second sub-period a positive interaction between inflation and reserve holdings is also reported, except that here, the dependent variable is net interest margin (Table 13.4, equation 5).

*rrat1* = legal reserves/M2, and both produce very similar results.[17] In Table 3, equation 1, the dependent variable is *rrat* and the explanatory variables are the net *cpirate* (*infl1*) and the same controls we have employed previously. The coefficient of *infl1* is positive and significant, suggesting that, as inflation increases, official reserve holdings increase also. In equation 2, the alternative definition of the reserve ratio is used and produces very similar results. These findings suggest that governments *might* be using a reserve tax on banks. But they are only suggestive because we cannot be sure that reserves are involuntarily held, or are paying below-market rates of interest.

Equations 3 and 4 examine the relationship between the two reserve ratio measures and net interest margins. In both cases the reserve ratio coefficients are positive, with the coefficient on *rrat* statistically significant, which is consistent with what Honohan (2003) reports. However, in equation 5 we regress net interest margin on rrat and our usual control variables and, with this change, the coefficient of rrat becomes statistically insignificant. Next, in equation 6 of Table 3, we include the variable $inter = rrat \cdot cpirate$, to represent the interaction between reserve holdings and inflation. In this case, the coefficient of *rrat* is positive and highly significant, while the coefficient of the interaction term is negative and highly significant also. This suggests that reserve holdings could have a positive association with bank profits, as reported by Honohan (2003), but only when inflation is below some threshold. Once inflation exceeds that threshold, higher reserve holdings may be associated with lower bank returns. According to these estimates that threshold occurs at an inflation rate of about 13 percent, which is close to the sample mean inflation rate, or the $60^{\text{th}}$ sample inflation percentile. Thus, with this specification there are plenty of sample data points both above and below the threshold.

In equations 7, 8, and 9, we deflate bank net interest margins by the rate of inflation, creating a "real net interest margin" measure, $rnet = net/cpirate$. In equation 7, with no control variables, the coefficient of *rrat* is negative and highly significant. However, when the control variables are added in equation 8, the coefficient of *rrat* drops to only marginal significance. Finally, in equation 9, there is no evidence of a significant interaction effect between

[17] We only have data on bank reserve holdings, not reserve requirements, and thus cannot distinguish reserves that are voluntarily held from those that are not. Honohan's empirical investigation is confronted with exactly the same problem. Also, these tests would be greatly improved if we had the data to control for other bank regulatory policies, for example entry restrictions.

the reserve ratio and inflation.

**Summary.** We conclude from Honohan's work and our own, that if there is an inflation tax operating via bank reserves, it is either not large and/or is not commonly employed. The empirical evidence seems somewhat mixed and dependent on specification. Moreover, as Honohan (2003) notes, the results could be importantly affected by special reserve subsidies in a few sample countries. This is not, however, to suggest that bank profits are unaffected by inflation. We will see momentarily that is surely incorrect. What we are saying is that we find little evidence of a tax imposed on banks by forcing them to hold non-interest-bearing reserves and then inflating.

**Table 3: Reserve Holdings, Inflation, and Bank Net Interest Margins, 1991–1995**

| | Dependent Variable | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **1.** *rrat* | **2.** *rrat1* | **3.** *net* | **4.** *net* | **5.** *net* | **6.** *net* | **7.** *rnet* | **8.** *rnet* | **9.** *rnet* |
| ***infl1*** | 0.1892<br>(3.53)** | 0.6236<br>(2.33)* | | | | | | | |
| ***revc*** | 0.0611<br>(1.39) | 0.1289<br>(1.17) | | | -0.0059<br>(0.88) | -0.0047<br>(0.84) | | -0.0094<br>(1.17) | -0.0096<br>(1.18) |
| ***bmp*** | -0.00006<br>(0.60) | -0.0009<br>(2.89)** | | | 0.00002<br>(0.97) | 0.00000005<br>(0.00) | | -0.00003<br>(1.77) | -0.00003<br>(1.51) |
| ***initial*** | -8.9773<br>(4.76)** | -7.2112<br>(0.98) | | | -0.9221<br>(2.02)* | -0.2750<br>(0.55) | | 0.8927<br>(1.99) | 0.7981<br>(1.37) |
| ***rrat*** | | | 0.0810<br>(3.08)** | | -0.0106<br>(0.52) | 0.5040<br>(3.06)** | -0.4846<br>(4.21)** | -0.0555<br>(1.99) | -0.1308<br>(0.47) |
| ***cpirate9195*** | | | | | 0.0786<br>(7.01)** | 0.1911<br>(5.49)** | | -0.4990<br>(16.75)** | -0.5154<br>(6.18)** |
| ***rrat1*** | | | | 0.0123<br>(1.77) | | | | | |
| ***inter*** | | | | | | -0.4536<br>(3.18)** | | | 0.0663<br>(0.26) |
| ***constant*** | 0.1552<br>(6.47)** | 0.3090<br>(4.85)** | 1.0303<br>(283.27)** | 1.0397<br>(264.22)** | 0.9579<br>(68.12)** | 0.8314<br>(20.89)** | 0.9871<br>(84.37)** | 1.5013<br>(46.91)** | 1.5198<br>(16.59)** |
| ***N*** | 84 | 74 | 77 | 67 | 73 | 73 | 77 | 73 | 73 |
| **Adjusted $R^2$** | 0.35 | 0.15 | 0.16 | 0.03 | 0.55 | 0.61 | 0.30 | 0.97 | 0.97 |
| **Elasticities of:** | | | | | | | | | |
| ***infl1*** | 0.1363 | 0.2463 | | | | | | | |
| ***cpirate9195*** | | | | | 0.0835 | 0.2033 | | -0.5839 | -0.6032 |
| **Medians:** | | | | | | | | | |
| **Dep. Var.** | 0.1437 | 0.2842 | 1.0374 | 1.0409 | 1.0388 | 1.0388 | 0.9530 | 0.9439 | 0.9439 |
| ***infl1*** | 0.1035 | 0.1123 | | | | | | | |
| ***revc*** | 0.0500 | 0.1000 | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 |
| ***bmp*** | 9.0407 | 12.3059 | | | 9.5628 | 9.5628 | | 9.5628 | 9.5628 |
| ***initial*** | 0.0014 | 0.0012 | | | 0.0017 | 0.0017 | | 0.0017 | 0.0017 |
| ***rrat*** | | | 0.1237 | | 0.1332 | 0.1332 | 0.1237 | 0.1332 | 0.1332 |
| ***cpirate9195*** | | | | | 1.1046 | 1.1046 | | 1.1046 | 1.1046 |
| ***rrat1*** | | | | 0.2823 | | | | | |
| ***inter*** | | | | | | 0.1490 | | | 0.1490 |

Robust $t$-statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions intentionally exclude observations with gross average inflation exceeding 200% per annum. When the high inflation data points are included, the inflation coefficient becomes negative in equations 1 and 2, and is statistically significant in equation 1. If the high inflation observations are included, the coefficient of inflation becomes insignificant in equation 6. In equation 9. the coefficient of inflation changes sign and remains significant at a high confidence level.

## 5.5 Some New Results on Inflation and Bank Profitability

Given the importance of banking in most economies, and given the finding that inflation tends to shrink the relative size of the banking sector according to previous empirical work, we decided to carry out some additional tests of our own. Specifically, we investigate the effect of inflation on bank profitability. Table 4 shows the results of regressions in which the dependent variables are bank lending – borrowing spreads, net interest margins, profits before taxes, and value-added to GDP. All these dependent variables are regressed against inflation and the usual set of control variables. The dependent variable in the first regression is *spread*, defined as the difference between commercial loan rates and time deposit rates ($spread = 1 + loanrate - tdeprate$).[18] In this specification the inflation coefficient is positive, but not significant at usual confidence levels. The elasticity of spread with respect to the inflation rate, at the sample medians is only about 0.34.[19]

In equation 2, *rspread* is the spread variable deflated by the average rate of inflation ($rspread = spread/cpirate$). In this specification, the inflation coefficient is negative and significant at the one percent confidence level. In essence, this result suggests that, although bank lending – borrowing spreads increase with the rate of inflation, they don't increase fast enough to remain unaffected in real terms.

In equations 3 and 4, the dependent variables are bank profits before taxes and net interest margins, both deflated by the average rate of inflation. These are related and correlated measures, and they produce very similar results. The coefficient of inflation is negative and highly significant in both cases, with the implication that inflation hurts real bank returns according to either measure.

The dependent variable in equation 5 is the value-added of the banking industry, again deflated by inflation.[20] Note that this is quite different from a return or profitability measure since it is the sum of operating profits and

[18]These are averages of annual commercial loan and time deposit interest rates as reported in the IFS data set. Definitions and averaging methods may vary from country to country.

[19]Due to the large standard error, the coefficient of 0.33 is not significantly less than 1.0 at usual confidence levels.

[20]Our measure of value-added is bank profits before taxes plus overhead costs, primarily in the form of wages and salaries.

operating expenses. Rather, it roughly represents "output" of the banking industry, divided by bank assets. This variable, too, is negatively and very significantly related to average inflation during the sample period. Equations 6 and 7 are identical to equations 4 and 5, except that they employ data over the period 1991–1995 instead of 1995–1999. They produce very similar results, suggesting robustness.

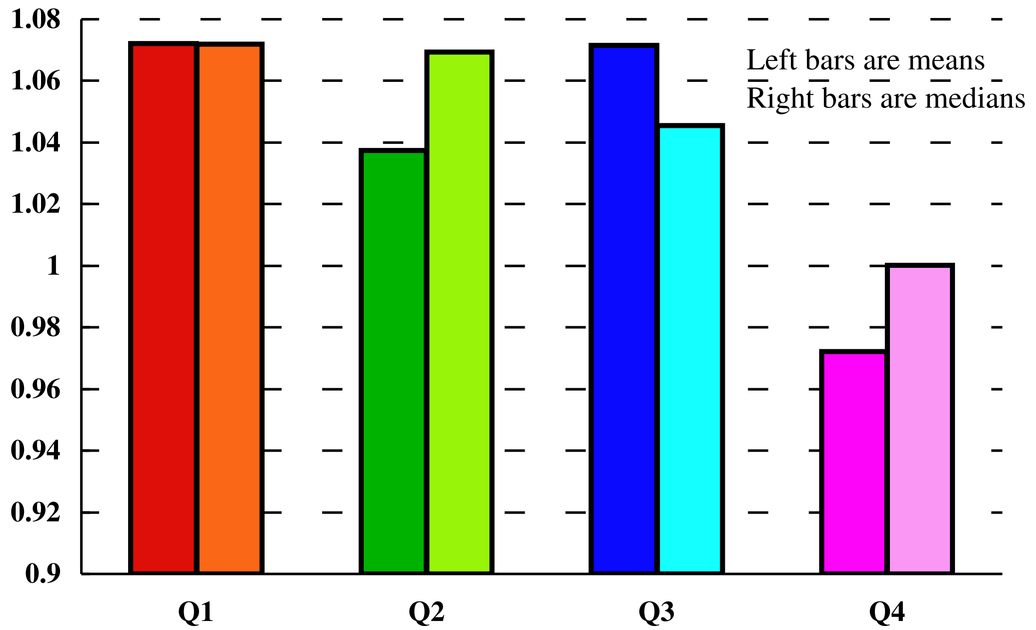
Figure 9 portrays the inflation-bank profitability relationship in yet another way. It shows average real rate of return on accounting equity (that is, profits before taxes / shareholders' equity) after the data have been sorted into inflation quartiles. Both the mean and median statistics decline monotonically as inflation rises. Between the first and fourth inflation quartile, the mean real rate of return on bank equity falls by about 55% and the median by about 62%.

## Table 4: Inflation's Association with Bank Interest Rate Spreads, Net Interest Margins, Profits, and Value Added

| | Dependent Variable | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1.** *spread* | **2.** *rspread* | **3.** *rroa* | **4.** *rnet* | **5.** *rvalad* | **6.** *rnet* | **7.** *rvalad* |
| ***cpirate8998*** | 0.3309 | -0.4163 | | | | | |
| | (1.45) | (2.84)** | | | | | |
| ***revc*** | -0.0186 | -0.0207 | -0.0044 | -0.0012 | 0.0023 | -0.0134 | -0.0052 |
| | (1.18) | (1.50) | (1.23) | (0.19) | (0.41) | (1.41) | (0.41) |
| ***bmp*** | -0.0003 | -0.0002 | 0.0001 | 0.00004 | 0.0001 | -0.00003 | -0.000008 |
| | (0.59) | (0.47) | (7.23)** | (1.14) | (3.39)** | (1.47) | (0.32) |
| ***initial*** | -1.2479 | 0.3694 | 0.2424 | -0.1214 | 0.4472 | 1.2224 | 1.2083 |
| | (1.04) | (0.37) | (0.90) | (0.28) | (1.15) | (2.89)** | (2.15)* |
| ***cpirate9195*** | | | | | | -0.5119 | -0.4728 |
| | | | | | | (17.86)** | (17.23)** |
| ***cpirate9599*** | | | -0.7880 | -0.6190 | -0.6609 | | |
| | | | (31.14)** | (10.14)** | (13.59)** | | |
| ***constant*** | 0.7185 | 1.4372 | 1.7882 | 1.6416 | 1.6816 | 1.5073 | 1.4959 |
| | (2.98)** | (9.24)** | (63.17)** | (25.10)** | (32.05)** | (45.32)** | (46.06)** |
| ***N*** | 64 | 64 | 51 | 51 | 51 | 76 | 76 |
| **Adjusted $R^2$** | 0.31 | 0.64 | 0.98 | 0.90 | 0.92 | 0.97 | 0.93 |
| **Elasticities:** | | | | | | | |
| ***cpirate8998*** | 0.3359 | -0.4557 | | | | | |
| ***cpirate9195*** | | | | | | -0.5920 | -0.5291 |
| ***cpirate9599*** | | | -0.8588 | -0.6490 | -0.6925 | | |
| **Medians:** | | | | | | | |
| **Dep. Var.** | 1.0571 | 0.9805 | 0.9581 | 0.9960 | 0.9966 | 0.9540 | 0.9860 |
| ***revc*** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| ***bmp*** | 7.4965 | 7.4965 | 4.4806 | 4.4806 | 4.4806 | 9.0407 | 9.0407 |
| ***initial*** | 0.0019 | 0.0019 | 0.0026 | 0.0026 | 0.0026 | 0.0018 | 0.0018 |
| ***cpirate9195*** | | | | | | 1.1033 | 1.1033 |
| ***cpirate9599*** | | | 1.0442 | 1.0442 | 1.0442 | | |

Robust *t*-statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions intentionally exclude observations with average inflation exceeding 200% per annum.

**Figure 9: Gross Real Rate of Retun on Bank Equity by Inflation Quartile, 1995–1999**




| | 1st Quartile | | 2nd Quartile | | 3rd Quartile | | 4th Quartile | |
|---|---|---|---|---|---|---|---|---|
| $N = 68$ | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| ***rgovrate*** | 1.0465 | 1.0507 | 1.0455 | 1.0449 | 1.0449 | 1.0473 | 0.9907 | 0.9921 |
| ***cpirate*** | 1.0230 | 1.0234 | 1.0293 | 1.0272 | 1.0563 | 1.0548 | 1.2094 | 1.1533 |

**Summary.** The main conclusion to take away from the results in Table 4 and Figure 9 is that banks appear to be harmed by inflation. Their net interest margins, net profits, rate of return on equity and value-added all appear to decline in real terms as inflation rises. All this seems quite consistent with the finding, reported earlier, that the relative size of the banking industry declines also.

# 6 Inflation and Asset Return Volatility

Several of the theoretical models discussed earlier (for examples, Boyd and Smith 200?, Choi, Boyd, and Smith 1996) predict a positive relationship between steady-state inflation and asset return volatility, at least when the rate of inflation is above some threshold. It is clear that the volatility of inflation, itself, is very closely associated with average inflation. For example, in the cross-sectional tests of Boyd, Levine and Smith (2001), the simple correlation between mean inflation and inflation volatility is 0.98 based on a sample of 48 countries and 36 years of data. Barnes, Boyd and Smith (1999) estimated the correlation between mean inflation and the standard deviation of inflation to be 0.99, based on data for 25 countries and twenty or so years of data (depending on country.) As both studies note, these correlations are so high that it would be almost impossible to empirically separate the effects of mean inflation and inflation volatility.

Both studies also reported high correlations between the average rate of inflation and the volatility of equity returns. In the Barnes, Boyd and Smith (1999) study, the simple correlation between the mean rate of inflation and the standard deviation of equity returns is 0.74. Boyd, Levine and Smith (2001) use a more complicated measure of equity return volatility (see p. 230) and find that this measure exhibits a simple correlation of 0.84 with average inflation. They also examine the partial correlation of equity return volatility and inflation, after controlling for a number of other factors. This partial correlation is positive and significant at the 1% level.

From all this work, there is ample evidence that, across countries, inflation volatility and equity return volatility are strongly, positively associated with mean inflation. What has not been done before, to our knowledge, is to examine the relationship between mean inflation and interest rate volatility. Therefore, some tests of this kind are presented in Tables 6.1 and 6.2.

We find that inflation and interest rate volatility are positively associated. In regressions 1 through 10, the dependent variable is the sample standard deviation of a nominal interest rate calculated over the period 1989–1998. The explanatory variables are either average inflation by itself, or average inflation and our usual set of control variables. The interest rates examined are a Treasury bill rate, money market rate, time deposit rate, bank loan rate. and a government bond rate. In all ten regressions, the inflation coefficient is positive. In eight cases it is significant at the 1% level and in two cases significant at the 5% level. The largest effect is on the bank loan rate, and the smallest on the government bond rate.

In equations 11 and 12, the dependent variable is the standard deviation of the spread between bank loan rates and bank deposit rates. We employ this interest rate spread as a proxy variable for bank profitability, since avail-

**Table 5.1: Inflation and Asset Return Volatility, 1989–1998**

| | Dependent Variable | | | | | |
|---|---|---|---|---|---|---|
| | **1.** ***stbill*** | **2.** ***stbill*** | **3.** ***smm*** | **4.** ***smm*** | **5.** ***stdep*** | **6.** ***stdep*** |
| ***cpirate8998*** | 0.3171 (3.99)** | 0.4401 (21.27)** | 0.2584 (3.48)** | 0.3316 (12.40)** | 0.3801 (2.46)* | 0.2269 (4.05)** |
| ***revc*** | | -0.0089 (0.70) | | -0.0537 (0.98) | | -0.0036 (0.37) |
| ***bmp*** | | -0.0001 (1.45) | | 0.0003 (1.47) | | -0.0000009 (0.02) |
| ***initial*** | | 1.5227 (2.51)* | | 0.1625 (0.12) | | 0.8853 (1.90) |
| ***constant*** | -0.3093 (3.63)** | -0.4468 (19.11)** | -0.2354 (3.02)** | -0.3104 (9.16)** | -0.3709 (2.41)* | -0.2229 (3.64)** |
| ***N*** | 52 | 34 | 44 | 34 | 103 | 69 |
| **Adjusted $R^2$** | 0.72 | 0.92 | 0.56 | 0.76 | 0.07 | 0.63 |
| **Elasticity of** ***cpirate8998*** | 13.0616 | 16.1249 | 9.4985 | 11.6766 | 19.5107 | 10.2050 |
| **Medians:** | | | | | | |
| **Dep. Var.** | 0.0254 | 0.0289 | 0.0284 | 0.0297 | 0.0208 | 0.0240 |
| ***cpirate8998*** | 1.0461 | 1.0581 | 1.0443 | 1.0444 | 1.0694 | 1.0694 |
| ***revc*** | | 0.0000 | | 0.0000 | | 0.0000 |
| ***bmp*** | | 7.4965 | | 0.1839 | | 7.5075 |
| ***initial*** | | 0.0041 | | 0.0071 | | 0.0019 |

Robust $t$-statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions intentionally exclude observations with average gross inflation exceeding 200% per annum. If these data points are included, the coefficient of inflation in equations 3 and 4 becomes an order of magnitude larger, but statistically insignificant. In equations 5 and 6 the inflation coefficient becomes an order of magnitude larger but remains positive and significant at high confidence levels.

able data do not allow us to compute the volatility of bank profits. In any case, this return volatility measure is positively associated with average inflation. The coefficient is not quite statistically significant at usual confidence levels in the simple regression, but when the control variables are added it is significant at the 1% confidence level. This finding may suggest that as inflation increases, *ceteris paribus*, bank profitability becomes more variable. It is even more certain that, as inflation rises, the rates at which banks lend and borrow become more variable.

**Table 5.2: Inflation and Asset Return Volatility, 1989–1998**

| | Dependent Variable | | | | | |
|---|---|---|---|---|---|---|
| | **7.** ***sloan*** | **8.** ***sloan*** | **9.** ***sgov*** | **10.** ***sgov*** | **11.** ***sspread*** | **12.** ***sspread*** |
| ***cpirate8998*** | 0.8408 | 0.3858 | 0.2667 | 0.2368 | 0.5121 | 0.1174 |
| | (2.34)* | (4.28)** | (5.14)** | (6.30)** | (1.51) | (3.01)** |
| ***revc*** | | -0.0046 | | -0.0566 | | -0.0047 |
| | | (0.69) | | (1.76) | | (0.77) |
| ***bmp*** | | -0.0003 | | | | -0.00007 |
| | | (1.19) | | | | (0.74) |
| ***initial*** | | 1.4808 | | -0.9289 | | -0.4406 |
| | | (3.22)** | | (1.23) | | (1.17) |
| ***constant*** | -0.8662 | -0.3906 | -0.2595 | -0.2130 | -0.5342 | -0.1040 |
| | (2,28)* | (4.10)** | (4.88)** | (6.05)** | (1.45) | (2.43)* |
| ***N*** | 103 | 69 | 34 | 28 | 98 | 64 |
| **Adjusted $R^2$** | 0.16 | 0.75 | 0.63 | 0.71 | 0.25 | 0.50 |
| **Elasticity of** ***cpirate8998*** | 35.8435 | 15.4524 | 16.9427 | 13.8939 | 37.4289 | 8.3843 |
| **Medians:** | | | | | | |
| **Dep. Var.** | 0.0251 | 0.0270 | 0.0164 | 0.0176 | 0.0145 | 0.0150 |
| ***cpirate8998*** | 1.0694 | 1.0815 | 1.0408 | 1.0317 | 1.0631 | 1.0731 |
| ***revc*** | | 0.0000 | | 0.0000 | | 0.0000 |
| ***bmp*** | | 7.8157 | | | | 7.4965 |
| ***initial*** | | 0.0019 | | 0.0101 | | 0.0019 |

Robust *t*-statistics in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All regressions intentionally exclude observations with average gross inflation exceeding 200% per annum. If these high inflation data points are included, the coefficient of inflation becomes much larger in all regressions except 9 and 10. All coefficients remain positive. Statistical significance increases in equations 8, 11 and 12, but is unchanged or decreases in equations 7, 9, and 10.

# 7 Conclusion

*High inflation is not a "good sign" for equity markets or banks.* Stock market capitalization and trading have been found to be smaller—relative to the size of the overall economy—in high inflation countries. No work has been done to determine direction of causality (which is not obvious in this instance), and that remains on the agenda of work to be done. Similarly, the size of the banking industry—relative to the size of the overall economy—has been found to be lower in high inflation environments. Here formal tests of endogeneity have been done, with the conclusion that there is causality running from inflation to banking sector size. Relatedly, we have reported results suggesting that the real value-added of banks is negatively and significantly associated with average inflation levels across countries.

*For both stock market and banking industry size, there is evidence of inflation threshold effects.* In essence, for sufficiently high rates of inflation, the negative association between inflation and intermediary sector size essentially disappears (after a discrete drop). Little previous work has been done to explain why this may occur. Equity returns also exhibit a threshold that is almost the exact reflection of intermediary sector size. That is, equity returns are essentially uncorrelated with inflation up to a threshold and then (after a discrete drop) move essentially one-for-one with inflation.

*Based on a variety of tests in a variety of countries, asset returns do not generally seem to conform to the predictions of monetary neutrality.* In both cross-sectional and time-series work, asset returns do not seem to adjust fully for inflation, even after extended periods of time. The only exception to this statement is equity returns in relatively high inflation environments. In time-series tests, equity returns are often unrelated to inflation changes, and not infrequently are *negatively* related to inflation changes in low inflation environments. The new cross-country tests in this study found that, of five different interest rates studied, none is fully indexed to inflation even when averaged over ten year periods. All this work on inflation and asset returns is consistent with the theoretical possibility discussed earlier—that inflation results in real rates of interest that are "too low." This could exacerbate credit market frictions, lead to credit rationing, and so on.

*It does not appear that, on average, banks are well able to hedge their real profits against inflation, especially when inflation is relatively high.* We have seen that across countries nominal bank profits increase with inflation, but not at a fast enough rate so as to leave real profits unaffected. Indeed bank profits, net interest margins, and lending $--$ borrowing rate spreads, were found to decline in real terms as inflation rises across countries. These findings are consistent with the evidence that the size of the banking industry, and its value-added, are negatively associated with the average rate of inflation.

*What is less clear, however, is why inflation, especially high inflation, seems to be so harmful to banks.* Banks are financial institutions, and, in principle, they can set loan and deposit rates as appropriate for given market conditions. One would think they are relatively sophisticated and not subject to money illusion. We found little evidence of the most obvious and "talked about" mechanism whereby inflation harms banks—that is, a combination of binding reserve requirements and non-interest bearing reserves. Indeed, there is even evidence of a "bank reserve subsidy" in some countries.

One possible explanation is that our time-averaging is not long enough in the cross country tests, and resultantly that the data reflect transitional effects of inflation (capital losses) that would disappear in the long run. Frankly, we are skeptical of this explanation. As a general rule, banks borrow shorter-term and lend longer-term so that they are temporarily hurt by *rising* interest rates. We doubt that this is an pervasive phenomenon that could drive our results simply because, on average, interest rates have been declining over the period examined. But it is still a possibility.

A second possibility is that interest rate regulation hinders banks' ability to adjust their interest rates upward in response to inflation. This could be due to ceilings on loan rates, ceilings on deposit rates that result in disintermediation out of banking. What is clear from our results is that loan rates are much more responsive to inflation than are deposit rates. In Table 1, the inflation elasticity of time deposit rates is 0.58 and the inflation elasticity of commercial loan rates is 0.80. In Table 2, the inflation elasticity of real time deposit rates is −0.27 and the inflation elasticity of real commercial loan rates is −0.12. This suggests that, relatively speaking, if regulation is affecting rate setting, it is having greater effect on deposit than on loan markets. This is not necessarily good for banks if deposit rate regulation results in disintermediation. The negative real deposit rate in the high inflation quartile of −2.9% (Figure 5) suggests that disintermediaton out could be significant in the higher inflation countries.

A third possibility is credit rationing in bank loan markets. Empirical results with attitude and opinion data suggest that credit may be more subject to rationing in high inflation environments. (As noted earlier, much more work is needed on this issue). And the evidence clearly supports the notion that inflation drives down real interest rates, and thus creates an environment in which credit rationing may occur as discussed in a number of theoretical models (for example, Boyd and Smith 1998). However, of all the interest rates examined in our own work, bank loan rates are the most responsive to inflation, as indicated by Figures 5 and 6, and the elasticities in Table 4.

A third possibility is credit rationing in bank loan markets. Here, the evidence is mixed. Empirical results with attitude and opinion data suggest that credit may be more subject to rationing in high inflation environments.

(As noted earlier, much more work is needed on this issue). And the evidence clearly supports the notion that inflation drives down real interest rates, and thus creates an environment in which credit rationing may occur as discussed in a number of theoretical models (for example, Boyd and Smith 1998). However, of all the interest rates examined in our own work, bank loan rates are the most responsive to inflation, as indicated by Figures 5 and 6, and the elasticities in Table 2.

*Asset return volatility is positively associated with inflation across countries.* Based on our own work and that of others, there is considerable evidence that higher inflation is associated with more volatile equity returns, nominal interest rates and bank returns. This finding is consistent with the predictions of a number of theoretical studies discussed earlier. Of course, it is also consistent with the idea that inflation may "noise up" the prices of financial claims and intere with their effectiveness in allocating real capital.

This finding is also potentially relevant to the observed negative relationship between inflation and real bank profitability measures. That is, banks solve a portfolio problem in which they trade off risk versus expected profitability. As conditions in bank asset and liability markets become more volatile (as we have found they do in high inflation environments), the risk-return frontier confronting banks has shifted inward (e.g., worsened). Under quite general conditions, banks would be expected to respond by reducing both their risk exposure and their expected profits. This conclusion would also be consistent with the (admittedly tentative) empirical evidence that the risk of bank crises is *ceteris paribus* higher in high inflation environments.

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