Financial Development and Monetary Policy Efficiency

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Abstract

We study how financial development is related to short run stabilization. Specifically, our objective is to derive monetary policy efficiency measures (PEMs) for 37 industrialized and developing countries and analyze the impact that the size and depth of the banking sector and the capital sector have on policy performance. It is our contention that a more developed financial sector increases the scope of action of policy resulting in improved policy performance.

In our empirical analysis we use three financial development measures: *private credit*, *liquid liabilities*, and a *financial aggregate* index that comprises banking and stock market measures. Our findings suggest that more developed financial markets, controlling for central bank independence, inflation targeting and membership to the European Monetary Union, significantly contribute to explaining a more efficient monetary policy implementation.

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1 Introduction

The latter part of the 1990s and these first few years of the new millennium have evidenced a general improvement in macroeconomic performance in industrialized and developing countries alike. Both the level and variability of inflation were lower in the latter half of the 1990s than they were in the preceding ten years. Cecchetti, Flores-Lagunes and Krause (2006) document that for a broad cross-section of 102 countries, median inflation fell from an average annual rate of 7.6 percent in the period 1983:I-1990:IV to 4.9 percent in the period 1991:I-1998:IV. The reduction in average inflation was even sharper between these two sub periods, as the annualized level went from 102 percent to just 16 percent. Output volatility has also been on the decline since the mid-1980s. Kent, Smith, and Holloway (2005) document that for 20 OECD countries, the standard deviation of GDP growth has fallen, on average, from 1.9 percent in 1983 to 1.4 percent in 2003.

There are many reasons for this generalized improvement in macroeconomic outcomes. Several authors have reported a link between the degree of central bank independence (*CBI*) and both the level and variability of inflation. Berger, de Haan and Eijffinger (2001), provide an exhaustive survey on central bank independence theoretical and empirical literature. Others have analyzed similar findings regarding the effects of specific elements within the monetary policy framework.[1] These elements include, but are not limited to, the role of inflation targeting (*IT*) regimes, legal and political environment, the adoption of specific exchange rate regimes, and the effects of joining a monetary union. As for changes in output volatility, Clarida, Galí and Gertler (2000) attribute much of its persistent decline to changes in the monetary policy regime. Similarly, Romer (1999) attributes the moderation of the US business cycle since the mid-to-late 1980s to the success of monetary policy and automatic fiscal stabilizers in reducing the effect and frequency of recessions and to smaller "mistakes" in policy (relative to the 1960s and 1970s) in over-expanding/contracting the economy.

There clearly are other elements, which are not under the direct control of policy makers

[1] Truman (2003) provides an extensive literature review.

(at least not in the short run) that can influence such outcomes. These include the reduction in the size and frequency of external shocks and advances in information technology that have increased manufacturers' flexibility in responding to changes in demand. (McConnell and Pérez-Quirós, 2000; Kahn, McConnell and Pérez-Quirós, 2002; Stock and Watson, 2002; and Herrera and Pesavento, 2005).

A few studies have looked at the role of financial development and institutions in assisting to a successful macroeconomic policy. Posen (1995) argues for the importance of establishing which societal forces support the objective of price stability and claims that effective financial opposition to inflation is relevant in order for monetary policy institutions to successfully achieve stabilization objectives. His argument is that central bank decisions not only reflect its institutional capabilities and legal constraints, but that such determinations also respond to the political environment. Therefore, the central bank can guarantee price stability only as long as the financial sector is ready to support policies associated with reducing inflation: the more developed the financial sector, the more successful will be stabilization policies.[2] Cecchetti and Krause (2001) find evidence suggesting that an improvement in the depth of the financial sector and the intermediation process, measured by a less centrally controlled banking system, has contributed to the reduction in inflation and output variability.

Lastrapes and McMillin (2004) estimate the magnitude of the liquidity effect for a group of 21 countries. They find that financial markets are an important determinant of the size of the liquidity effect in a sample of 21 countries. Specifically, they find that the liquidity effect is weaker in countries where individuals can more easily rebalance their portfolio in reaction to monetary policy changes, which provides support to "limited participation" models. Finally, Dynan, Elmendorf, and Sichel (2006) emphasize the role of deeper financial markets in allowing private agents (consumers and firms) to smooth expenditures, thereby reducing fluctuations in economic activity.

[2] It is well known that the financial sector plays a key role in the channels of monetary transmission like the *traditional interest rate channel* or the newer *credit channels* where lending is a key component (Mishkin, 1996).

A well functioning financial system is of great importance, so factors that perversely affect the intermediation process will have negative outcomes on the economy. Bernanke and Gertler (1990, 1995) argue that a reduction in the supply of bank credit is likely to increase the external finance premium and therefore reduce real economic activity. Turning to the empirical evidence, Roubini and Sala-i Martin (1991) show that, after controlling for other determinants of economic development, various measures of financial repression affect growth negatively. More recently, Beck, Levine, and Loayza (2000), and Levine, Loayza, and Beck (2000) find strong statistical evidence that a larger participation of financial intermediaries causes an increase in economic growth, at least in the long-run. Finally, Rioja and Valev (2004) observe that the effect of additional improvements in financial development on output growth will be contingent upon the initial level of financial development.[3]

Rather than focusing on the effects of the development of financial markets on output growth, in this paper we follow the spirit of Posen (1995) and study how financial development is related to short run stabilization. It is our contention that a more developed financial sector increases the scope of action of policy, resulting in improved policy performance. Therefore, our objective is to derive monetary *policy efficiency measures* (PEMs), and employ them to analyze the impact that the size and depth of the banking sector and the capital sector have on policy performance. The advantage of using PEMs instead of other measures of volatility is twofold: First, the PEMs allow us to have a measure of macroeconomic performance that includes both inflation and output gap volatility; and, second, we can factor out the contribution of aggregate disturbances to the observed changes in economic fluctuations.

The remainder of the paper is organized as follows: Section 2 discusses how we compute the PEMs, and how we control for the effect of changes in the volatility of aggregate shocks to obtain an *adjusted PEM*. The relevant financial development variables and other institutions are described in Section 3. In Section 4 we detail our estimation method and state our

[3] Levine (2004) provides an updated survey of the literature and issues of finance and growth.

hypotheses, while in Section 5 we present our main results from studying the impact of three alternative financial development measures on the effectiveness of monetary policy in achieving macroeconomic stability for a panel of 37 countries. Our findings suggest that more developed financial markets, controlling for central bank independence, inflation targeting and membership to the European Monetary Union, significantly contributes to explaining a more efficient monetary policy implementation. Finally, in Section 6 we conclude and discuss some extensions.

2 Measure of Monetary Policy Performance

2.1 Theoretical Derivation of the *PEM*

Our starting point for obtaining the policy efficiency measures (PEMs) requires knowledge of how disturbances in the economy affect the deviations of inflation from its target level (π) and the (log) of the output gap (x). Following Cecchetti (1998) and others, we assume that a positive *aggregate demand disturbance* (d) increases both π and x, while a positive *aggregate supply disturbance* (s) increases π and reduces x. We further impose the condition that d and s are uncorrelated ($Cov(d,s)=0$). These relationships are summarized by:

$$\pi_t = \alpha_{\pi d} d + \alpha_{\pi s} s \ , \tag{1}$$

$$x_t = \alpha_{xd} d - \alpha_{xs} s \ , \tag{2}$$

where $\alpha_{\pi d}$, $\alpha_{\pi s}$, α_{xd}, and $\alpha_{xs} > 0$ will generally depend on the policy response to aggregate disturbances and the structure of the economy.[4]

Equations (1) and (2), in addition to the condition $Cov(d,s)=0$, allow us to obtain

[4] Using an aggregate demand - aggregate supply framework, Krause (2006) derives explicit representations for these coefficients as functions of policy and structural parameters.

the *actual* variances of inflation and the output gap, and its covariance:

$$var(\pi_t) \equiv \sigma_\pi^2 = \alpha_{\pi d}^2 \sigma_d^2 + \alpha_{\pi s}^2 \sigma_s^2 \ , \tag{3}$$

$$var(x_t) \equiv \sigma_x^2 = \alpha_{xd}^2 \sigma_d^2 + \alpha_{xs}^2 \sigma_s^2 \ , \tag{4}$$

$$cov(\pi_t, x_t) \equiv \sigma_{\pi x} = \alpha_{\pi d}\alpha_{xd}\sigma_d^2 - \alpha_{\pi s}\alpha_{xs}\sigma_s^2 \ . \tag{5}$$

Consistent with Cecchetti and Krause (2001) we employ equations (3)-(5) to define the following measure:

$$H \equiv \sigma_\pi^2 \sigma_x^2 - (\sigma_{\pi x})^2 = (\alpha_{\pi d}\alpha_{xs} + \alpha_{\pi s}\alpha_{xd})^2 \sigma_d^2 \sigma_s^2 > 0 \ . \tag{6}$$

Clarida, Galí and Gertler (1999) show that under *optimal monetary policy*, inflation and the output gap depend exclusively on the magnitude of the supply disturbance; i.e., policy completely neutralizes the effect of aggregate demand shocks. Using our notation, this would be equivalent to setting $\alpha_{\pi d} = \alpha_{xd} = 0$ in equations (1) and (2). Therefore, optimal policy implies:

$$H(optimal) = 0 \ . \tag{7}$$

As a result, a more efficient monetary policy can be characterized by a smaller value for H in equation (6), controlling for changes in the variance of aggregate demand and aggregate supply disturbances to the economy.

For estimation purposes, it is more convenient to use the log transformation of equation (6), which is given by:

$$\ln H \equiv h = 2\ln(\alpha_{\pi d}\alpha_{xs} + \alpha_{\pi s}\alpha_{xd}) + \ln \sigma_d^2 + \ln \sigma_s^2 \tag{8}$$

Thus, the right-hand side of equation (8) can be divided into a systematic part, which is a function of policy $(2\ln(\alpha_{\pi d}\alpha_{xs} + \alpha_{\pi s}\alpha_{xd}))$, and the contribution due to aggregate disturbances $(\ln \sigma_d^2 + \ln \sigma_s^2)$.

Rather than directly measuring these disturbances and their variance, a quite controversial exercise in macroeconomics, we opt for an alternative approach. We assume that, for each country i and each period t, the aggregate disturbances d and s can each be defined as the product of a country-specific effect (Γ), a common (time varying) disturbance (Φ) and a residual shock (ξ), i.e.:

$$\begin{aligned} d_{it} &= \Gamma_{d,i} * \Phi_{d,t} * \xi_{d,it} \\ s_{it} &= \Gamma_{s,i} * \Phi_{s,t} * \xi_{s,it} \end{aligned}$$

By construction, μ, ν, and ξ will be orthogonal, which implies:

$$\begin{aligned} \ln \sigma_d^2 &\equiv \ln Var(d_{it}) = \ln Var(\Gamma_{d,i}) + \ln Var(\Phi_{d,t}) + \ln Var(\xi_{d,it}) \\ \ln \sigma_s^2 &\equiv \ln Var(s_{it}) = \ln Var(\Gamma_{s,i}) + \ln Var(\Phi_{s,t}) + \ln Var(\xi_{s,it}) \end{aligned}$$

Defining $\gamma_i \equiv \ln Var(\Gamma_{d,i}) + \ln Var(\Gamma_{s,i})$; $\phi_t \equiv \ln Var(\Phi_{d,t}) + \ln Var(\Phi_{s,t})$ and $\varepsilon_{it} \equiv \ln Var(\xi_{d,it}) + \ln Var(\xi_{s,it})$ we can rewrite (8) as:

$$h_{it} = PEM_{it} + \gamma_i + \phi_t + \varepsilon_{it} \tag{9}$$

where: γ_i is a country-specific effect; ϕ_t a (time-varying) common component; and ε_{it} is the residual. Since PEM_{it} ($\equiv 2 \ln [\alpha_{ys}(i,t)\alpha_{\pi d}(i,t) + \alpha_{yd}(i,t)\alpha_{\pi s}(i,t)]$) implicitly includes the policy reaction (net of shocks) for each country i and time period t, we identify PEM_{it} as our *adjusted* policy efficiency measure; all other things equal, a lower PEM results in a smaller value for h (and subsequently H), which indicates more efficient monetary policy.

2.2 Estimation and Interpretation of the PEM

For our empirical analysis, we take the following steps to obtain estimates for the PEMs:

- First, we compute σ_π^2, σ_x^2, and $\sigma_{\pi x}$ for the 37 countries in our sample, using rolling averages of 20 quarters. We measure inflation π as the deviation of CPI inflation from its linear trend, while output gap x is measured as the deviation of real GDP from the trend obtained by applying the Hodrick-Prescott filter.[5]

- Next, we substitute the estimates for σ_π^2, σ_x^2, and $\sigma_{\pi x}$ into equation (6) to derive an estimate for H, $\widehat{H}$. Consequently, the log of $\widehat{H}$ will yield an estimate of the *unadjusted* PEM, $\widehat{h}$.

- Finally, in our regressions we control for the country-specific, time-specific and residual error terms (γ_i, ϕ_t, and ε_{it}, respectively) in order to isolate the *adjusted* estimate for the PEM.

It is useful to provide a brief discussion on how to interpret changes in the PEMs in terms of output gap volatility and deviations of inflation from its target. Assuming $\sigma_{\pi x} = 0$ in equation (6), it is straightforward to verify that a decrease of one unit in the PEM in equation (9) is equivalent, after applying the exponential function, to a reduction of $1 - e^{-1} \simeq \mathbf{63.2}\%$ in the variance of the output gap, controlling for changes in σ_π^2, σ_d^2 , and σ_s^2. For example, a decrease of the standard deviation of GDP from 4.0 % to 2.4% translates to a 1 unit decrease in the PEM. Alternatively, assuming again $\sigma_{\pi x} = 0$ and no changes in σ_x^2, σ_d^2 , and σ_s^2, for an (initial) average inflation rate of 5%, the reduction of one unit in the PEM would be equivalent to a fall in inflation to 3%.

Our estimates suggest that the 20 industrialized countries in our sample have experienced, on average, a reduction of 3.6 units in the unadjusted PEM between 1985 and 1998, while for our 17 developing economies this average decline has been about 2.8. Therefore, even if we should ascribe one-half of this decrease to a lower volatility of aggregate shocks,[6] we can conclude that more efficient policy has been quite important in explaining

[5] See Data Appendix for more details.

[6] Cecchetti, Flores-Lagunes and Krause (2006) find that the relative contribution of more moderate shocks to the reduction of inflation and output volatility is substantially less than one half.

the across-the-board reduction in inflation and output fluctuations. In the next section we detail how financial development and innovations in monetary institutions can explain these improvements in monetary policy, which will later lead to our hypothesis testing and results.

3 Explanatory Variables

3.1 Financial Development

The role of the financial environment in the monetary transmission mechanism (i.e., the *lending view*) has been extensively discussed in the literature over the last 20 years.[7] The lending view looks at how monetary policy affects prices and output through the economic agents' net worth (Bernanke and Gertler, 1989) and through bank lending practices directly (Kashyap and Stein, 1995). Under both transmission mechanisms, an increase (say) in the nominal interest rate will have a greater impact on the economy, the larger the degree of dependence on bank financing agents exhibit in an economy.

One should therefore expect that a higher participation of the financial intermediation sector as a source of funds for production will signify a broader scope of action for monetary policy. All other things equal, a larger share of credit extended to the private sector should be associated with more efficient policy (Cecchetti and Krause, 2001).

The preferred measure of financial development in the recent literature (Levine, Loayza, and Beck, 2000; Levine, 2004) has been *PRIVATE CREDIT*, which is the value of all credit that financial intermediaries issue to the private sector as a share of GDP. It is the preferred measure since it excludes credit to public enterprises and other government agencies which may not be allocated by expected return. *PRIVATE CREDIT* includes credit issued by all financial intermediaries (including non-deposit money banks) in a country, but excludes credit issued by central banks. According to Levine, Loayza, and Beck (2000), higher levels

[7] See, for example, Bernanke and Blinder (1992), Bernanke and Gertler (1989, 1995) and Kashyap and Stein (1995).

of *PRIVATE CREDIT* indicate "higher levels of financial services and therefore greater financial intermediary development."

A second measure of financial development that we use is liquid liabilities (*LIQUID)* which is currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries as percent of GDP. This is a size or financial depth measure that has been used in the literature by Goldsmith (1969) and King and Levine(1993b) among others.

Our third measure of financial development attempts to not only include bank based measures as above, but also stock market variables. This measure is denoted *FINANCIAL AGGREGATE* and its construction is described below. Since *FINANCIAL AGGREGATE* includes stock market related measures, it is first useful to describe the rationale for their inclusion. On the one hand, stocks represent an alternative source of funds and, hence, a substitute of bank loans as a means of financing for entrepreneurs. Since the interest rates set by the central bank do not *directly* affect equity trading, a larger size of the stock market may reduce the scope for policy action. On the other hand, in many countries the behavior of asset prices is *in sync* with changes in monetary policy: a sharp increase in interest rates is commonly followed by a reduction in both the trading and the value of equity shares. If this latter effect is stronger than the substitution of sources of funds, then a more developed stock market will also be associated with a wider impact of changes in policy conduct on economic activity and the rate of inflation.

Three stock market measures are useful in constructing *FINANCIAL AGGREGATE.* First, *CAPITALIZATION* will denote the stock market capitalization which is the value of all domestic shares listed on the domestic markets as a share of GDP. This measure has been widely used in the literature in Levine and Zervos (1998) and Rousseau and Wachtel (2000) among others. Levine (2004) cautions, however, that stock market capitalization may just measure listings on a national stock market, but not truly measure the activity of the stock market. The activity in stock markets is measured by the *TURNOVER RATIO* and the *VALUE TRADED. TURNOVER RATIO* is defined as the value of trades in domestic shares in the market relative to the total value of shares listed. Hence, it is a measure of liquidity of the stock market relative to its size. Furthermore, it is also an indicator of transactions costs in the stock market: high turnover ratios would indicate low transaction costs and vice-versa. *VALUE TRADED* measures the total shares traded in the domestic stock market divided by GDP.

The overall measure of financial markets, *FINANCIAL AGGREGATE* is computed as follows. Let *FINANCIAL SIZE = PRIVATE CREDIT + CAPITALIZATION* be a measure of the overall size of the market. Let *FINANCIAL ACTIVITY = PRIVATE CREDIT + VALUE TRADED + TURNOVER RATIO* be a measure of the overall activity in the financial markets. Then we define *FINANCIAL AGGREGATE* as the first principal component of (*FINANCIAL SIZE, FINANCIAL ACTIVITY*).[8] Hence, we combine two different characteristics of the financial market into one variable which we describes the overall financial development in the country. This type of aggregate measure has been used in the literature by Beck and Levine (2002).

3.2 Monetary Institutions

Among monetary institutions and arrangements, substantial attention has been paid as to how the degree of central bank independence (*CBI*) is associated with both the average level and variability of inflation. There exists generalized agreement that a higher level of *CBI* results in a lower level and variance of inflation (see Alesina, 1988; Grilli, Masciandaro and Tabellini, 1991; Cukierman, 1992; Alesina and Summers, 1993; and Eijffinger, van Rooij and Schaling, 1996, for evidence in industrialized countries; and Loungani and Sheets, 1997; and de Haan and Kooi, 2000, for the case of transition and developing economies).

More recently, attention has shifted to analyzing how countries can benefit from adopting an explicit inflation target regime. Bernanke and Mishkin (1997) argue that inflation target-

[8] A principal component is a linear combination of two or more variables into one variable called "factor." Technically, extracting a first principal component involves variance maximizing rotation of the variable space. The first principal component extracts as much variance as possible from each variable (see Cooley and Lohnes, 1971).

ing (*IT*) makes price stability the main goal of policy. The empirical evidence suggests that most *IT* experiences have been successful in reducing inflation (Bernanke, Laubach, Mishkin and Posen, 1999; Corbo and Schmidt-Hebbel, 2001; and Mishkin and Schmidt-Hebbel, 2002). Finally, as documented by Issing (2002), countries that have joined the European Monetary Union have been quite effective in achieving lower inflation rates.

Therefore, when analyzing monetary policy performance over time and across countries, we need to account for changes in the above mentioned institutions and arrangements. Krause and Méndez (2006) find evidence that particular institutional designs will have different outcomes on preferences for inflation stability, once a distinction is made between high and low inflation countries. Their general results suggest however that *CBI*, *IT* and membership to the EMU are the main variables that can account for explaining stabilization policies. Therefore, we will employ them as controls when analyzing the role of financial development on monetary policy efficiency.

The first two columns of Table 1 contain the information on the operating measure for central bank independence (*CBI*) we will employ for our empirical analyses; namely, the central bank governor's average turn-over ratio (*TOR*). We use the indices constructed by Krause and Méndez (2006), whose computation of the *TOR* involves dividing the number of changes in the Central Bank Governor/Chairman by 20 (the length of the period). This procedure yields estimates of the *TOR* for the 37 countries in our sample for two (overlapping) periods: 1975:I-1994:IV and 1985:I-2004:IV.

The last column of Table 1 summarizes the particulars of whether or not a country has adopted an *IT* regime; which scheme it has chosen (strict vis-a-vis flexible) and the date of implementation, based on the information reported by Mishkin and Schmidt-Hebbel (2002), and Abigail and Schmidt-Hebbel (2004).[9] For our empirical analysis, we construct a dummy variable for the full *IT* regime (that takes a value of one starting the date that the *IT* policy

[9] In a strict IT regime, the target for inflation is usually specified as a range. For countries employing flexible IT, there is an initial stage with a moderate disinflation process, which is followed eventually by the implementation of a full IT policy.

is implemented and zero otherwise) and another dummy variable for the flexible *IT* regime (with an analogous definition).

Finally, we define a dummy variable representing membership to the EMU, which takes a value of one for all of its current members starting 1992, except for Greece,[10] and zero otherwise.

4 Data and Empirical Methodology

4.1 Data description

We use data from 37 countries over the period 1985 to 1998. The choice of the time period is dictated by the availability of data which can generate a balanced panel over that 14 year period.[11] The countries are listed in the Appendix and some of the key variables are shown by country for the first and the last year of our sample. Given that the *PEM* is computed in five-year rolling averages, it is also appropriate to use five-year rolling averages for the following explanatory variables: *PRIVATE CREDIT*, *LIQUID*, *FINANCIAL AGGREGATE* (and its components).

Table 2 presents descriptive statistics of the data. The mean *PEM* is 3.82. As we mentioned in Section 2, a lower (decreasing) value of the *PEM* measure will be associated with more efficient policy. The average *PRIVATE CREDIT* is about 64 % of GDP, with the maximum of 1.78 in Japan in 1997. As Table 2 shows, *PEM* and *PRIVATE CREDIT* show a strong negative correlation (as expected) of -0.54. In general the *PEM* is negatively correlated with all the financial market variables in Table 2. Of course, the proper relationship must be established using formal econometric procedures as follows.

[10] We consider 1992 as the starting date, since on February of that year the countries signed the Maastricht Treaty, signaling from that point forward joint objectives of policy coordination, fiscal discipline and low inflation. Greece is not included since it didn't join the EMU until 2001, so its convergence process was different from the other ten countries. Including Greece as a member of the EMU does not affect our main results, however.

[11] We do not consider the case of an unbalanced panel, due to overfitting problems that arise in the GMM estimation.

4.2 GMM Estimators

We are interested in analyzing the likely effect of financial development on monetary policy performance. In order to do so, we employ a panel data approach and study the behavior of the *PEM* measures as a function of the private credit and stock market capitalization ratios to GDP controlling for the above described monetary institutions and arrangements. One of the components of the dependent variable (*PEM*) is the variability of inflation over a five-year period. Boyd, Levine, and Smith (2001) and others have found that inflation has an adverse effect on financial development. According to Huybens and Smith (1998, 1999), higher inflation reduces the real return on money and other assets. This lower real return aggravates credit market frictions: the incentive to lend falls so less credit is available, while the incentive to borrow increases and lower quality borrowers enter the market. This leads to more credit rationing, fewer loans, so financial market activities are reduced.[12] For our study, those findings imply that a potential endogeneity problem may exist.[13] We confront this potential problem by using instruments for the potentially endogenous variables and employing generalized method of moments (GMM) systems estimators. This approach is described below. It has been used in the finance and growth literature in papers by Beck, Levine, and Loayza (2000); Levine, Loayza, and Beck (2000); and Rioja and Valev (2004), among others.

It is appropriate to discuss the basic framework of GMM systems estimators. Consider the model:

$$z_{it} = \beta' X_{it} + \mu_i + \delta_t + \eta_{i,t}, \tag{10}$$

where X_{it} is the vector of explanatory variables some of which are predetermined or endogenous.[14] The unobserved country-specific effect is μ_i, while δ_t and $\eta_{i,t}$ represent the time

[12] Boyd, Levine, and Smith (2001) empirically find that this effect is non-linear and that the effect is larger once inflation passes a threshold of 15%.

[13] We must also consider that a similar problem may arise from the other basic component of PEM, GDP variability. Both of these potential problems can be addressed with the methodology in this section.

[14] The vector X can also include lagged dependent variables.

specific effect and the residual. Taking first differences to eliminate the country specific effect, we obtain,

$$z_{it} - z_{it-1} = \beta'(X_{it} - X_{it-1}) + (\delta_t - \delta_{t-1}) + (\eta_{i,t} - \eta_{i,t-1}). \tag{11}$$

Since $\Delta X_{it} = X_{it} - X_{it-1}$ contains endogenous variables which by design are correlated with the residual, obtaining unbiased and consistent estimates requires the use of instruments. Arellano and Bond (1991) developed a GMM difference estimator which uses lagged levels of X_{it} as instruments for ΔX_{it} under two conditions. The first condition is that the lagged levels of X_{it} are uncorrelated with future errors (i.e., weakly exogenous). This would mean, for instance, that the financial development variables can be affected by past and present inflation, but that they must be uncorrelated with future inflation *innovations*. The second condition is that the error term is not serially correlated. The following moment conditions can be then be used to obtain a GMM difference estimator:

$$E[X_{i,t-s}(\eta_{i,t} - \eta_{i,t-1})] = 0 \text{ for } s \geq 2;\ t = 3, 4, ...T \tag{12}$$

The GMM difference estimator has, however, a drawback that lagged levels may often not be good instruments for first differences especially when there is persistence in the explanatory variables. Weak instruments may yield imprecise estimates and finite sample biases according to simulation studies by Alonso-Borrego and Arellano (1996) and Blundell and Bond (1997). Another concern with the GMM difference estimator is that it eliminates the cross country effects. To address these concerns, Arrellano and Bover (1995) and Blundell and Bond (1995) proposed to stack the difference equations with the original equations in levels and estimate the system as a whole. Adding the level equations in this fashion would preserve the cross country effects. The level equations, however, include the country-specific effect which is potentially correlated with some of the explanatory variables. Therefore, the explanatory variables in the levels equations are instrumented using their own lagged differences. The lagged differences are valid instruments under the additional assumption that the correlation between the country-specific effect and the levels of the explanatory variables is constant over time as follows:

$$E[X_{i,t+p}\mu_i] = E[X_{i,t+q}\mu_i] \qquad \text{for all } p \text{ and } q. \tag{13}$$

This implies no correlation between the difference in the explanatory variables and the country-specific errors. For example, private credit may be correlated with the country specific effect, but this correlation does not change over time. Then, the lagged differences can be used as valid instruments in the levels equation. The moment conditions for the levels equations are:

$$E[(X_{i,t-s} - X_{i,t-s-1})(\mu_i + \eta_{i,t})] = 0 \qquad \text{for } s = 1; t = 3, ..., T. \tag{14}$$

In summary, the GMM systems estimator comes from two stacked regressions: the regression in differences (applying the moment conditions of equation (12)) and the regressions in levels (applying the moment conditions of equation (14)). Compared with its difference counterpart, the GMM systems estimator has been shown to improve precision and reduce the potential biases in finite samples by Blundell and Bond (1995) using Monte Carlo simulations. We compute one-step and two-step GMM systems estimators. The error terms are assumed independent and homoskedastic over time and across countries in the first step estimation. In the second step, a consistent estimate of the variance-covariance matrix is constructed from the residuals in the first step. The second step estimates then relax the assumptions of independence and homoskedasticity. As standard in this literature, we employ two specification tests. First, a serial correlation test for the error term of the difference equation. The null hypothesis is that the differenced error has no second-order serial correlation. Second, the Hansen J test is a test which tests the validity of the instruments (i.e., their exogeneity). The null hypothesis is that the instruments are not correlated with the residuals. Both of these tests have implications for the consistency of the GMM systems estimator.

4.3 Hypotheses

We can state our hypothesis more specifically by rewriting the general equation (10):

$$h_{i,t} = \beta_1 FD_{i,t} + \beta_2 CBI_{i,t} + \beta_3 SIT_{i,t} + \beta_4 FIT_{i,t} + \beta_5 EMU_{i,t} + \mu_i + \delta_t + \eta_{i,t}, \tag{15}$$

where: $t = 1985, .., 1998$ represents the time period; h is the *unadjusted policy efficiency measure (PEM)*, as defined in equation (9); FD represents financial development (which we measure in several alternative ways as described); CBI is the index for central bank independence; SIT represents a strict inflation targeting scheme; FIT represents flexible or partial inflation targeting; EMU denotes membership in the European Monetary Union. Finally, μ_i, δ_t, and $\eta_{i,t}$, which are defined in equation (10), are used to isolate the *adjusted* estimate for the PEM.

Consistent with our discussion in section 3, our hypothesis is that a larger participation of financial intermediaries improves the scope of action of monetary policy and makes it more efficient, thereby resulting in a lower PEM ($\beta_1 < 0$). Regarding the control variables, our conjecture is that $\beta_2 > 0$ (a larger value for CBI is associated with higher inflation level and variance and, therefore, a larger PEM); and we expect β_3, β_4 and $\beta_5 < 0$ (an IT regime or joining the EMU is associated with more stable inflation and a lower value for PEM).

5 Results

The results from various specifications are presented in Table 3. One- and two-step GMM systems estimates are shown under each specification. Consider the baseline specification 1. *PRIVATE CREDIT* has a statistical significant coefficient estimate of -3.56 using the two-step procedure (the one-step estimate is very similar). First, the negative sign of the coefficient is as hypothesized: countries with larger credit markets appear to have a more effective monetary policy. It is also important to interpret the economic size of this coefficient. For example, an increase in *PRIVATE CREDIT* of 0.10 (10 percent), would be associated with a reduction in the *PEM* of 0.356 (-3.56x0.10). The average PEM over all countries equals 3.82 according to Table 2. Hence in percent terms, the 10% increase in *PRIVATE CREDIT* would be associated with a reduction in the *PEM* of about 9.3%. In other words, "the efficiency of monetary policy" improves by about 9.3%. Another way to interpret this coefficient is looking at the median *PRIVATE CREDIT* in 1997, 0.70, which corresponds to Israel. A one standard deviation increase (0.43) in *PRIVATE CREDIT* in Israel would yield a reduction in the *PEM* of 1.53, cutting by about half its *PEM* and making it comparable to Portugal's. For comparison, Israel ranked 24th and Portugal ranked 18th out of the 37 countries in terms *PEM* in 1997.

Regarding the control variables in specification 1, *CBI* and *EMU* membership are statistically significant and have the expected signs. Higher central bank turnover rates imply a higher *PEM*, that is, less effective monetary policy. *EMU* membership has made monetary policy more effective as membership requires keeping inflation, as well as some other macro variables within specified thresholds.

Given that our group of countries includes 20 developing countries and 17 developed countries, one natural question is whether the effects of *PRIVATE CREDIT* differ between these two groups of countries. Specification 2 tries to address this question by adding an interaction term *LDC*PRIVATE CREDIT*, where *LDC* is a dummy variable that equals 1 for developing countries.[15] Results for specification 2 show that coefficient estimates for this interaction term are not statistically significant as the p-values are around 15%. This means that there is no evidence that the effects differ for industrial and developing countries. As a

[15] Another option would be to separately estimate our specification for industrialized countries and developing countries. Splitting the sample, however, reduces the number of observations such that overfitting problems in the GMM estimation arise.

first robustness test, results using the *LIQUID* measure are also reported on Table 3 under specifications 3 and 4. They are very similar to those using *PRIVATE CREDIT* described above.

As another robustness test, we use our overall measure of the financial market's scope, *FINANCIAL AGGREGATE.* Results are presented on Table 4. Coefficient estimates for this variable are negative and statistically significant like for the previous two financial market measures. The two-step coefficient estimate under specification 1 is -1.91 which can be interpreted as follows. Consider the case of Mexico which from 1990 to 1998 experienced increases in *PRIVATE CREDIT* from 0.15 to 0.18; *CAPITALIZATION* from 0.11 to 0.16, *VALUE TRADED* 0.05 to 0.08 and *TURNOVER* from 0.44 to 0.49. Clearly both bank and stock market based financial markets expanded during that eight-year period. In *FINANCIAL AGGREGATE* terms, this is an increase of 0.6 (from -0.96 in 1990 to -0.36 in 1998), which would yield a *PEM* reduction of -1.91 x 0.6 = 1.146. The actual reduction in *PEM* in Mexico was 2.07, hence the expansion in financial markets appears to "explain" about half on the improvement in monetary policy efficiency.[16]

Finally, specification 2 in Table 4 shows that a differential effect for developing countries is again not statistically significant. The coefficient estimates for the industrial countries are once again higher than those for the LDC countries (the latter are the sum of the interacted and un-interacted term).

6 Conclusions

Macroeconomic performance has improved in many countries in the world in the last fifteen years or so. Much of the literature has concentrated on how central bank independence, inflation targeting regimes, and currency unions have contributed to improving the

[16] We also ran several specification with *PRIVATE CREDIT* and the stock market variables individually. Coefficient estimates for the former are significant, but generally not for the latter variables. These results are available on request.

effectiveness of monetary policy and hence macroeconomic performance. Since the financial system is a key component of the monetary transmission mechanism, we study how a country's financial development affects monetary policy efficiency. Using panel data for 37 countries, we find that higher financial development is associated with increased monetary policy efficiency. This result is obtained controlling for many other factors, and it does not make a difference whether the country is industrialized or developing.

While there is a large literature on the contribution of finance to long-run economic growth, it appears from our results that the contribution of larger, more developed and efficient financial markets also extends to short-run stabilization. This is an area that has not received much attention and may be deserving of further study.

7 Appendix: Data Sources

CPI Inflation and *GDP* data, used to compute the Policy Efficiency Measure (*PEM*), come from the *International Financial Statistics CD_ROM* (December 2004). Data on fiscal deficit and government consumption was obtained from the World Bank's *World Development Indicators* (2004). *Private credit by deposit money banks to GDP* was calculated using the following deflation method: {(0.5)*[Ft/P_et + Ft-1/P_et-1]}/[GDPt/P_at], where F is credit to the private sector, P_e is end-of period CPI, and P_a is average annual CPI. *Value of listed shares to GDP* was calculated using the following deflation method: {(0.5)*[Ft/P_et + Ft-1/P_et-1]}/[GDPt/P_at], where F is stock market capitalization, P_e is end-of period CPI, and P_a is average annual CPI.

The information used to compute the turnover ratio of central bank governors (*TOR*) was obtained directly from individual Central Banks' websites and direct inquiries to staff members. For the information on the dates that inflation targeting was introduced, we employed the data from Mishkin and Schmidt-Hebbel (2002) and include Hungary.

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Table 1: Central Bank Independence and Inflation Targeting

Country	CBI [a] 75-94	CBI [a] 85-04	Inflation Targeting Regime [b]
Australia	0.15	0.10	Strict since Sep. 1994
Austria	0.15	0.25	None
Belgium	0.15	0.10	None
Canada	0.10	0.10	Strict since Feb. 1991
Chile	0.55	0.30	Flexible since Jun. 1991, Strict since Jan. 1999
Colombia	0.20	0.10	Flexible since Sep. 1999
Costa Rica	0.55	0.35	None
Cyprus	0.00	0.05	None
Denmark	0.05	0.05	None
Finland	0.15	0.15	Strict since Feb. 1993
France	0.20	0.15	None
Germany	0.20	0.20	None
Greece	0.25	0.20	None
Hungary	0.20	0.25	Strict since Oct. 2001
India	0.45	0.30	None
Ireland	0.20	0.15	None
Israel	0.20	0.15	Flexible since Jan. 1992, Strict since Mar. 2001
Italy	0.15	0.05	None
Japan	0.20	0.20	None
Korea, South	0.40	0.35	Strict since Jan. 1998
Malawi	0.20	0.25	None
Malaysia	0.15	0.20	None
Mexico	0.20	0.05	Flexible since Jan. 1999
Netherlands	0.05	0.05	None
New Zealand	0.20	0.10	Strict since Mar. 1990
Norway	0.10	0.15	Strict since Mar. 2001
Peru	0.45	0.35	Flexible since Jan. 1994
Phillipines	0.20	0.15	Flexible since Oct. 1998
Portugal	0.35	0.25	None
South Africa	0.25	0.20	Strict since Feb. 2000
Spain	0.20	0.10	Strict since Nov. 1994
Sweden	0.20	0.10	Strict since Jan. 1993
Switzerland	0.10	0.20	Strict since Jan. 2000
Trinidad & Tobago	0.15	0.20	None
United Kingdom	0.10	0.10	Strict since Dec. 1991
United States	0.15	0.05	None
Uruguay	0.25	0.35	None

/a: Own computations using the average turn-over ratio (TOR) of the central bank governor.

/b: For the information on the dates that an IT regime was introduced we employ the data from Appendix A in Mishkin and Schmidt-Hebbel (2002), and Table 1 in Abigail and Schmidt-Hebbel (2004); and include Hungary, where the strict IT regime began in October 2001.

Table 2: Descriptive Statistics

Variable	PEM	Priv.. Credit	Liq.	Capit.	Turn.	CBI	SIT	FIT	EMU
Mean	3.82	0.64	0.59	0.36	0.39	0.19	0.09	0.04	0.13
Std. Dev.	3.64	0.30	0.33	0.37	0.41	0.11	0.28	0.19	0.34
Min.	-2.56	0.06	0.11	0.003	0.001	0	0	0	0
Max.	20.2	1.78	1.89	2.46	3.35	0.55	1	1	1
PEM	1								
Private Credit	-0.5442	1							
Liquid	-0.4190	0.8404	1						
Capitalization	-0.3284	0.4937	0.4217	1					
Stock Turnover	-0.2236	0.4119	0.3387	0.1459	1				
CB Indep.	0.5177	-0.3464	-0.2838	-0.1896	-0.1286	1			
Strict IT	-0.1636	0.1986	0.0546	0.1580	0.0175	-0.2135	1		
Flexible IT	0.1787	-0.1217	-0.1235	0.0327	-0.0141	0.1464	-0.0773	1	
EMU member	-0.2784	0.1825	0.0589	-0.0537	0.1340	-0.1754	0.0729	-0.0691	1

Table 3: Bank-Based Financial Development GMM Systems Estimators, 1985-1998
Dependent variable: Policy Efficiency Measure (PEM)

Explanatory Variable	Specification 1		Specification 2		Specification 3		Specification 4	
	One-step	Two-step	One-step	Two-step	One-step	Two-step	One-step	Two-step
PRIVATE CREDIT	-3.51 (0.041)	-3.56 (0.029)	-5.27 (0.055)	-5.89 (0.053)				
*LDC*PRIVATE CREDIT*			4.34 (0.159)	3.74 (0.155)				
LIQUID					-4.56 (0.022)	-5.01 (0.039)	-7.81 (0.088)	-7.08 (0.148)
*LDC*LIQUID*							6.74 (0.105)	7.40 (0.269)
CB INDEPENDENCE	11.1 (0.028)	12.1 (0.023)	9.09 (0.054)	7.66 (0.063)	10.6 (0.052)	12.4 (0.189)	6.48 (0.304)	8.95 (0.181)
STRICT IT	2.69 (0.222)	1.53 (0.424)	4.52 (0.128)	3.66 (0.174)	-1.03 (0.583)	-0.66 (0.807)	2.42 (0.417)	0.58 (0.853)
FLEXIBLE IT	6.82 (0.434)	3.27 (0.638)	2.19 (0.766)	0.06 (0.991)	0.63 (0.920)	-0.34 (0.958)	-0.98 (0.884)	-0.68 (0.927)
MEMBERSHIP EMU	-1.53 (0.081)	-1.72 (0.021)	-0.72 (0.508)	-0.95 (0.385)	-2.42 (0.004)	-2.01 (0.029)	-0.92 (0.484)	-0.64 (0.643)
Hansen test overid. restrictions (p-value)[a]	0.65	0.65	0.59	0.59	0.40	0.40	0.57	0.57
Arellano-Bond AR(2) test (p-value)[b]	0.19	0.40	0.44	0.64	0.32	0.57	0.68	0.59
Number Observations	515	515	515	515	444	444	444	444

Note: p-values are in parenthesis
[a] The null hypothesis is that the instruments used are not correlated with the residuals.
[b] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

Table 4: Financial System Aggregate, GMM Systems Estimators, 1985-1998
Dependent variable: Policy Efficiency Measure (PEM)

Explanatory Variable	Specification 1		Specification 2	
	One-step	Two-step	One-step	Two-step
FINANCIAL AGGREGATE	-1.70 (0.036)	-1.91 (0.030)	-3.30 (0.054)	-4.00 (0.055)
*LDC*FIN. AGGREGATE*			2.22 (0.334)	2.57 (0.237)
CB INDEPENDENCE	8.65 (0.041)	7.61 (0.014)	9.51 (0.031)	7.64 (0.029)
STRICT IT	-1.01 (0.669)	-1.1 (0.508)	-0.57 (0.756)	-0.42 (0.810)
FLEXIBLE IT	2.01 (0.236)	1.77 (0.265)	0.24 (0.917)	0.01 (0.998)
MEMBERSHIP EMU	-2.00 (0.001)	-1.86 (0.002)	-2.11 (0.001)	-1.88 (0.009)
Hansen test overid. restrictions (p-value)[a]	0.85	0.85	0.95	0.95
Arellano-Bond AR(2) test (p-value)[b]	0.28	0.40	0.31	0.36
Number Observations	474	474	474	474

Note: p-values are in parenthesis
[a] The null hypothesis is that the instruments used are not correlated with the residuals.
[b] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation.

Appendix
Country List and Key Variables in 1985 and 1998

	PEM		*PRIV. CREDIT*		*FIN. AGG.*		*CBI*		*SIT*		*FIT*	
	1985	1998	1985	1998	1985	1998	1985	1998	1985	1998	1985	1998
Australia	3.2699	0.569	0.4045	0.5184	-0.65649	0.691778	0.15	0.1	0	1	0	0
Austria	6.146	-0.3835	0.4909	0.5089	-0.10142	0.540027	0.15	0.25	0	0	0	0
Belgium	2.0791	1.2673	0.4476	0.478	-1.07463	0.340398	0.15	0.1	0	0	0	0
Canada	3.4436	-0.9134	0.4827	0.6312	0.182012	0.828716	0.1	0.1	0	1	0	0
Denmark	3.669	-2.0199	0.4871	0.6575	-0.91362	0.021914	0.05	0.05	0	0	0	0
Finland	1.85	-0.3929	0.5347	0.5645	-0.56194	0.406476	0.15	0.15	0	1	0	0
France	1.7686	-1.1713	0.5267	0.5645	0.283191	0.70069	0.15	0.15	0	0	0	0
Germany	2.5414	-0.5354	0.658	0.7094	0.341935	0.926522	0.2	0.2	0	0	0	0
Ireland	5.4236	0.8307	0.6531	0.7022		0.55616	0.2	0.15	0	0	0	0
Italy	0.063	-0.0252	0.6694	0.7611	-0.42395	0.241122	0.15	0.05	0	0	0	0
Japan	1.181	2.2441	0.8234	0.9162	0.952789	1.270804	0.2	0.2	0	0	0	0
Netherlands	2.5016	-2.16	0.8727	0.8737	0.472172	1.474199	0.05	0.05	0	0	0	0
New Zealand	4.98	0.9521	0.7485	0.8618	-0.75678	0.627903	0.2	0.1	0	1	0	0
Norway	4.2866	0.8316	0.7637	0.8678	-0.09724	0.548745	0.1	0.15	0	0	0	0
Portugal	8.7715	1.1199	0.8267	0.9297	-0.06469	0.365604	0.35	0.25	0	0	0	0
Spain	1.7686	-1.1713	0.7013	0.8659		0.853923	0.2	0.1	0	1	0	0
Sweden	3.4	1.4018	0.6819	0.9585	0.391303	1.208004	0.2	0.1	0	1	0	0
Switzerland	3.8467	0.109	0.9442	1.074	1.666549	1.888122	0.1	0.2	0	0	0	0
UK	3.1066	-2.5618	0.879	1.1349	-0.22142	1.349653	0.1	0.1	0	1	0	0
US	3.6632	-2.3134	0.8783	1.2058	0.489724	1.37336	0.15	0.05	0	0	0	0

Appendix-continued

	PEM		*PRIV. CREDIT*		*FIN. AGG.*		*CBI*		*SIT*		*FIT*	
	1985	1998	1985	1998	1985	1998	1985	1998	1985	1998	1985	1998
Chile	8.0899	3.1099	0.809	1.1755	-0.43413	0.33874	0.55	0.3	0	0	0	1
Colombia	6.577	3.4923	0.6543	1.0135	-1.29795	-0.85418	0.2	0.1	0	0	0	0
Costa Rica	9.252	5.0128	0.4186	0.7116	-1.9412	-1.65331	0.55	0.35	0	0	0	0
Cyprus	3.9334	3.1253	0.4405	0.7640		0.692562	0	0.05	0	0	0	0
Greece	3.7146	0.0915	0.3741	0.5894	-0.73474	-0.21305	0.25	0.2	0	0	0	0
Hungary	3.3311	6.2968	0.3059	0.504		-0.53557	0.2	0.25	0	0	0	0
India	5.8809		0.3367	0.4782	-0.6663	-0.62698	0.45	0.3	0	0	0	0
Israel	10.265	3.1057	0.3951	0.5889	0.106209	0.284797	0.2	0.15	0	0	0	1
Korea, S.	6.2951	3.108	0.4121	0.5964	0.048602	1.16821	0.4	0.35	0	1	0	0
Malawi	10.0328	11.573	0.3457	0.5339			0.2	0.25	0	0	0	0
Malaysia	5.7356	2.3141	0.4758	0.7986	0.152059	1.732501	0.15	0.2	0	0	0	0
Mexico	9.441	7.3829	0.4393	0.7891	-1.38737	-0.3598	0.2	0.05	0	0	0	0
Peru	14.117	5.6327	0.3704	0.6998	-2.14575	-0.83702	0.45	0.35	0	0	0	1
Philippines	2.7863	3.7862	0.2979	0.5192	-0.83653	0.256134	0.2	0.15	0	0	0	0
S. Africa	4.954	3.4419	0.373	0.6379	0.001085	0.659011	0.25	0.2	0	0	0	0
Trinidad	5.5164	5.4838	0.3081	0.4156		-0.52166	0.15	0.2	0	0	0	0
Uruguay	10.4053	5.9016	0.3543	0.4502	-0.89178	-1.58787	0.25	0.35	0	0	0	0