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Antonio Fatás
Ilian Mihov
Andrew K. Rose

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1050 Massachusetts Avenue
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Fatás is Professor of Economics and Area Coordinator, and CEPR Research Fellow. Mihov is Associate Professor of Economics, and CEPR Research Associate. Rose is Rocca Professor of International Business, NBER Research Associate and CEPR Research Fellow. Rose thanks INSEAD, the Reserve Bank of Australia, and the Monetary Authority of Singapore for hospitality while this paper was written. A current version of this paper and the data set are available at Rose's website. The views expressed herein are those of the author(s) and not necessarily those of the National Bureau of Economic Research.

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ABSTRACT

We study empirically the macroeconomic effects of an explicit de jure quantitative goal for monetary policy. Quantitative goals take three forms: exchange rates, money growth rates, and inflation targets. We analyze the effects on inflation of both having a quantitative target, and of hitting a declared target; we also consider effects on output volatility. Our empirical work uses an annual data set covering 42 countries between 1960 and 2000, and takes account of other determinants of inflation (such as fiscal policy, the business cycle, and openness to international trade), and the endogeneity of the monetary policy regime. We find that both having and hitting quantitative targets for monetary policy is systematically and robustly associated with lower inflation. The exact form of the monetary target matters somewhat, but is less important than having some quantitative target. Successfully achieving a quantitative monetary goal is also associated with less volatile output.

Antonio Fatás
INSEAD
Boulevard de Constance
77305 Fontainebleau, France
fatas@econ.insead.edu

Ilian Mihov
INSEAD
1 Ayer Rajah Ave
Singapore 138678
mihov@econ.insead.edu

Andrew K. Rose
Haas School of Business
University of California
Berkeley, CA 94720-1900
and NBER
arose@haas.berkeley.edu

1. Introduction and Motivation

The economics profession has gradually moved to the view that transparency in monetary (and other) policies is desirable. For instance, the IMF believes that transparent policies are both more effective and enhance accountability. Accordingly, the Fund encourages countries "... to state clearly the role, responsibility and objectives of the central bank. The objectives of the central bank should be clearly defined, publicly disclosed and written into law."¹ But while the theoretical advantages of transparency have been much analyzed, there is less in the way of empirical support. One objective of this paper is to help fill that gap.

We find that in practice, countries with transparent targets for monetary policy achieve lower inflation. We identify "transparent" targets for monetary policy with "quantitative" targets. Quantitative targets are easily measured, allowing the monetary authority's successes (or lack thereof) to be determined mechanistically. That is, quantitative targets are transparent since they can be assessed without (much) debatable personal judgment.

In practice, central banks have used three types of quantitative monetary targets (with varying degrees of success): exchange rates, money growth rates, and inflation targets. A number of economists in the past have analyzed the effects of one of these regimes. For instance, there is a large and growing literature on countries with inflation targets. There is an even larger literature which compares the merits of fixed and floating exchange rate regimes. Rather than focusing on any one of these targets, we use all three. In part this is because we are interested in estimating the effect of transparency in monetary policy, and transparency can take different forms. Indeed, when we compare the inflationary effects of different quantitative targets for monetary policy (exchange rate/money growth/inflation), we find differences, but they are small compared to the presence of *any* transparent target.

¹ <http://www.imf.org/external/np/exr/facts/mtransp.htm>

Still, we combine together different types of targets for monetary policy for a more important reason, which is best explained with an example. Fixed exchange rates are well-defined monetary policies, and are often compared with floating exchange rate regimes. But a float is not a well-defined monetary policy! Similarly, central banks that do not target inflation have to do something else. By using data for *all* quantitative monetary regimes, we can reasonably compare the merits of having a transparent monetary policy to the alternative, which we consider to be “opaque monetary objective(s).”

In section 2, we review the extensive literature of relevance; our methodology and data set are presented afterwards. The core of our paper is in section 4 which presents our results for inflation, along with sensitivity analysis. We then analyze the effects of quantitative targets on the short run/business cycle volatility of output. A brief conclusion closes.

2. Literature Review

Our work is related to a number of other classic problems in economics. One is the choice of monetary instrument. Different instruments have different degrees of transparency (as well as other attributes); accordingly, the question of whether central banks should use the exchange rate, the money growth rate, or something else has been addressed by many scholars.² Most of this literature is concerned with exchange rate regimes. There is an enormous literature that compares the attributes of fixed and floating exchange rate regimes, both theoretically and empirically. Still, to repeat a standard but important criticism of this area, a fixed exchange rate is a well-defined monetary policy, but a floating exchange rate regime is not. If the monetary authorities are not pegging the exchange rate, they must be doing something else. Because of the recent increase in the adoption of inflation targets, we have seen a shift in the literature towards

² See e.g., Atkeson and Kehoe (2001) NBER WP 8681.

the study of inflation targeting regimes. Another related literature is that of the optimal degree of transparency in monetary policy.³

There is also a literature that has focused on the role of domestic institutions in the conduct of monetary policy, most of which is centred on the effects of independence of central banks, and/or, more recently, on inflation targets. Although these areas of the literature are ultimately addressing the same issue (how monetary policy regimes affect macroeconomic outcomes), it is fair to say that, to a large extent, they have been developed separately. We now review some of the key papers in each of these strands of literature, summarizing their main insights.

Exchange Rate Regimes

The macroeconomic effect of the exchange rate regime is still an open question, one that is associated with many controversies in both the international and monetary economics literatures. There is a broad literature that deals with the theoretical analysis on the costs and benefits of different exchange rate arrangements and there is a consensus on the main factors that shape these costs and benefits. However, there are still many disagreements on the relative empirical importance of these factors. As a result, when it comes to the best monetary policy regime for a given country, most of the predictions are inconclusive as they depend on a variety of assumptions that can only be validated empirically. Relative to the theoretical literature, there have been fewer papers that have taken these assumptions to a test or that, more generally, have empirically estimated the implications of monetary policy regimes.

One of the first papers to provide a comprehensive empirical study of the effects of different exchange rate regimes on macroeconomic outcomes is Baxter and Stockman (1989).

³ See e.g., Faust and Svensson (2002), and Cukierman and Meltzer (1986).

Using a cross-section of countries with different exchange rate regime, they looked at the association between the exchange rate regime and variables such as output, consumption, trade flows, government consumption and the real exchange rate. Their conclusion was that the exchange rate regime did not matter for most of the macroeconomic variables, with the exception of the real exchange rate (that was more volatile under flexible exchange rate systems).

Most of the studies that have followed Baxter and Stockman (1989) have had a narrower focus; they look mainly into the consequences on inflation and output volatility. Recent studies by Ghosh et al. (1997, 2002) and Levy-Yeyati and Sturzenegger (2003) provide detailed analyses of the effects of exchange rate regimes on inflation. The approach is to look initially at the marginal effect of the exchange rate regime, after controlling for the effect of money growth. The hypothesis is that the exchange rate regime has a direct effect on the relationship between money and inflation, beyond any potential indirect effect through the conduct of monetary policy (i.e. on money growth rates). There is evidence that inflation is lower under fixed rate regimes.⁴

Both Levy-Yeyati and Sturzenegger (2003) and Ghosh et al. (1997) also study the effects on business cycle volatility and growth. Regarding business cycle volatility, their results are consistent: fixed exchange rate regimes are associated to greater output volatility. Regarding growth effects, the papers reach different conclusions. While Ghosh et al. (1997) do not find strong evidence in any direction Levy-Yeyati and Sturzenegger (2003) conclude that growth is higher for floaters.

Domestic Institutions

⁴ In the case of Levy-Yeyati and Sturzenegger (2003) there is also a test of the indirect effect of the regime on inflation via money growth. Money growth is regressed on GDP growth (lagged), money growth lagged, openness, budget balance, a set of regional dummies and the exchange rate dummies. Once again long pegs are the only cases where there seems to be a significant negative effect on inflation, in this case through lower money growth.

Even for countries where the discussion on exchange rate regimes is not important (in most cases because of the adoption of floating exchange rates), there has been an active recent debate on optimal monetary policy. The two key issues are typically whether the central bank should have instrument-independence, and whether it should have an explicit inflation target.

Regarding the independence of central banks, the literature has focused on the observed negative correlation between inflation and central bank independence as documented in Alesina and Summers (1993), Cukierman (1992) or Grilli et al. (1991).

The other main features of monetary policy that have been studied in this literature are the effects of explicit targets and transparency. Initially the analysis was centred on money targets, but as countries moved away from these targets into inflation ones, the focus of the literature has moved accordingly. Because of the lack of a large number of observations, the literature tends to be descriptive, based on case studies rather than cross-country regressions. Mishkin (1999) and the books by Bernanke, Laubach, Mishkin and Posen (1999) and Loayza and Soto (2002) present good surveys and case studies of money and inflation targeting. Overall the evidence is mixed. While there is evidence that inflation targets have helped countries reduce their inflation rates (Mishkin and Schmidt-Hebbel, 2002), others argue that this effect is the result of factors other than the monetary regime (Ball and Sheridan (2003)).

Regimes

In all the literature reviewed above, two issues appear repeatedly: the characterization of monetary policy regimes (especially when it comes to exchange rate regimes) and the problem of endogeneity.

Classification of regimes: words or actions? When it comes to the classification of exchange rate regimes, there are two possible approaches. The first is to look at the officially declared *de jure* regime. The problem with this approach is that we often observe in practice that countries sometimes peg their exchange rate without a clear *de jure* commitment (or intervene frequently despite having declared a floating exchange rate, the “fear of floating” as defined by Calvo and Reinhart, 2000). As an alternative one can look at actions and classify regimes but looking at the actual behaviour of exchange rates (or the target set by monetary policy), i.e. the *de facto* regime. This is the approach of Reinhart and Rogoff (2004) and Levy Yeyati, Eduardo and Federico Sturzenegger (2003). Their results show that looking at a *de facto* classification might provide very different results. The distinction between words and actions also matters for other monetary policy targets such as money and inflation targets. For example, there is plenty of evidence that central banks that declared themselves to be money targetters were not behaving as such (see, for example, Bernanke and Mihov (1997) for the case of the Bundesbank).

Rather than attempt to resolve this issue on a conceptual level, we simply look at both the *de facto* regime and whether or not it is actually hit in practice.

Dealing with endogeneity. The interpretation of the existence of a correlation between inflation (or output volatility) and the exchange rate regime is problematic because of endogeneity. Is inflation lower because of the fixed exchange rate regime? Or are countries with low inflation (or more distaste of inflation) more likely to adopt fixed exchange rate regimes? The literature has dealt with the issue of endogeneity by using a set of instrumental variables based on either economic or political arguments.⁵ Levy-Yeyati, Sturzenegger and Reggio (2002) or von Hagen and Jizhong Zhou (2004) provide a comprehensive study of the endogeneity of

⁵ A separate but related issue is the need to control for variables other than the monetary policy regime in the determination of inflation. Romer (1993) or Lane (1997) are examples of papers that have studied how the determinants of the incentives of governments to inflate their economies.

exchange rate regimes. Frieden, Ghezzi and Stein (2000), within the context of Latin America, use a similar framework. Alesina and Wagner (2003) provide an analysis of how institutions affect decisions by countries to abandon fixed exchange rate regimes and to dissemble why such regimes are in place.

The arguments about what determines the choice of an exchange rate regime are based on theories that highlight the economic costs and benefits of the regimes, as well as the political institutional environment in which different regimes might be preferable. The economic variables are related to the optimum currency area debate. What makes a country a better candidate to adopt the currency of a different country? Openness, size, geographical concentration of country's trade, the type of shocks (volatility of terms of trade, volatility of other nominal versus real shocks), financial dollarization all matter to assess these costs and benefits and have been used as instrumental variables in the literature.

The political arguments are more institutional, and concern the benefits of committing to a certain monetary policy. From a theoretical point of view, fragmentation of power (measured by e.g., the fraction of seats in congress held by government, years in office, or a Herfindahl index of political parties) or political instability shape the benefits and costs of commitment when it comes to monetary policy or the exchange rate regime. There is evidence that these variables matter (Frieden, Ghezzi and Stein (2000) or Edwards (1996)).

The issue of endogeneity has rarely been studied in the case of money or inflation targets. One of the few exceptions is Gerlach (1999) in the context of inflation targets. His results show that the adoption of inflation targets is more likely with low degree of central bank independence, less openness, countries that export a low number of goods and among members of the EU.

3. Methodology

3.a Benchmark model

Our benchmark model is the following:

$$\begin{aligned}\Pi_{it} = & \beta_1 DJTarget_{it} + \beta_2 Success_{it} \\ & + \gamma_1 Open_{it} + \gamma_2 Budget_{it} + \gamma_3 BusCycle_{it} + \gamma_4 GDPpc_{it} + \gamma_5 GDP_{it} + \varepsilon_{it}\end{aligned}$$

where i denotes a country, t denotes a year, and

- Π denotes the annual inflation rate in percentage points
- $DJTarget_t$ is a dummy variable that is one if the country had a quantitative monetary policy target during period t , and zero otherwise,
- γ_i is a set of nuisance coefficients,
- $Success$ is a dummy variable that is one if the country hit its *de jure* quantitative target during t , and zero otherwise,
- $Open$ is trade (exports plus imports) as a percentage of GDP,
- $Budget$ is the government budget surplus (+) or deficit (-), as a percentage of GDP,
- $BusCycle$ is the difference between real GDP growth and average GDP growth, measured in percentage points,
- $GDPpc$ is the natural logarithm of real GDP per capita,
- GDP is the natural logarithm of real GDP, and
- ε is a well-behaved residual term for all other inflation determinants.

The coefficients of interest to us are β_1 and β_2 . The first coefficient is of greatest interest; it represents the effect of having a formally declared *de jure* quantitative monetary target on inflations, *ceteris paribus*. Of slightly less interest to us is β_2 which shows the effect on inflation of successfully hitting a quantitative monetary target.

The other regressors control for “nuisance” factors that affect inflation and might be correlated with the monetary policy regime, but are not of direct interest to us. Romer (1993) argues that more open economies have lower inflation because the costs of monetary expansion are high when the country has high trade-to-GDP ratio. More open economies might also opt for a fixed exchange rate relative to their trading partners as argued by the literature on the optimal currency areas. This argument prompts us to include *Open* as a regressor. The budget balance (*Budget*) can affect inflation by imposing requirements for money-financed deficits or through aggregate demand. At the same time the success in hitting a monetary target can be affected by fiscal policy outcomes. We also include the state of the business cycle (*BusCycle*) as a measure of aggregate demand pressures on the price level and as a covariate which might be correlated with the success of the monetary regime. GDP per capita (*GDPpc*) enters the regression to account for the fact that rich countries have more sophisticated financial sectors, which implies higher opposition to inflation (as in Posen, 1995) and lower optimal inflation tax because of better developed standard tax instruments. Posen’s argument also suggests that rich countries have low incentives to adopt an explicit target given that there is already pressure to achieve low inflation. Finally, the level of GDP is included to account for the market size. Since market size can affect productivity as in the models of Romer (1986) or Lucas (1988), a larger country may have lower inflation *ceteris paribus*. On the correlation between country size and explicit targets, one might argue that larger countries are less likely to adopt an exchange rate target.

Our benchmark regression is similar to those used by Levi-Yeyati and Sturzenegger (2003), and Ghosh et al. (2002). The theoretical motivation for their econometric specification is quite similar to ours, except that these studies focus only on the exchange rate regime. Campillo and Miron (1996) provide also a cross-sectional investigation of determinants of

inflation and the regressors are almost identical to the ones we use, but they do not include any variable that captures the nature of the monetary regime.

We estimate the model with least squares, and use robust standard errors. Still, we are cognizant of a number of potential econometric pitfalls associated with this strategy (e.g., simultaneity). Accordingly, we do perform extensive sensitivity analysis to take into account a variety of different issues.

3.b Data Description

A data appendix describes in detail the sources and the list of variables used in our empirical analysis. Our annual data set spans 1960 through 2000, and includes all countries with 1960 GDP per capita of at least \$1000 dollars in the Penn World Table database for which comprehensive data are available. There is significant variation in monetary policy practices both over time and across countries in the data set. Exchange rate pegs are more common in the 1960s, money targets disappear from many countries during the 1980s, inflation targeting only appears in the 90s. For most of our analysis we use annual frequency (given that we are not interested in high-frequency properties of the data), but we provide sensitivity analysis by replicating our results using five-year averages.

We use two variables to characterize the monetary policy regime: whether or not there was an announced *de jure* target and whether or not the target was hit *de facto*. Our approach is complementary to that of the previous literature. As mentioned in our literature review, previous papers have struggled with the issue of “words versus actions”. Central banks often claim to have adopted strict monetary policy targets, whether they are monetary aggregates, exchange rates, or inflation targets. In many cases these claims are not validated by their actions or the

data. Some obvious examples of this behavior include: countries that intervene on foreign exchange markets extensively despite having a floating exchange rate policy; missed targets for monetary aggregates; and missed inflation targets. Our strategy is to capture with our *de jure* classification of monetary regimes the stated announcements of central banks, and then also to look separately at whether or not the target was hit in practice.

Establishing a *de jure* classification for exchange rate and inflation targets is not conceptually complicated, though there is much debatable minutiae.⁶ In the case of targets for monetary aggregates, there are several cases where a judgment call needs to be made; many central banks use monetary aggregates as *reference indicators* for their monetary policy without formally *targeting* money growth. We try not to take this logic too far, because we are still interested in words (not actions) for our *de jure* classification. For example, the Bundesbank is classified as having a target for money even though we know that in practice the commitment to the target was weaker than the Buba's words.

There is one complication that we have to address before we proceed with the estimation of our benchmark model. Sometimes countries change their monetary regimes in mid-year. This presents a problem for our estimation because for the year when there is a change we will use data for the dependent variable and the controls that correspond to two regimes at the same time. Had we known the exact date of the regime change, we could remove that year. Unfortunately we do not have this information for a good number of observations.⁷ In our benchmark results we proceed conservatively and delete adjacent years with different regimes (so that each regime shift entails two dropped observations).

⁶ Our classification is consistent with several recent papers.

⁷ When we know the date of a regime shift, we follow the convention of dating it to the year when it was first in place for at least six months.

Our *de facto* classification of monetary policy regimes provides a measure of whether or not the announced targets were met. In the case of the exchange rate targets we make use of the Reinhardt and Rogoff classification that characterizes exchange rate regimes by their actions (not their words). In the case of inflation and money targets we simply compare the outcome (inflation or money growth) with the announced range for the target. Still, we face several difficulties in making this comparison. First, targets are sometimes expressed as a single number, while for others a range is provided. When an explicit range is provided we simply assess whether or not the outcome is within the range. If there is no band around the announced target, we either consider the target as a maximum (by establishing a range from 0 to the announced value) or we build a range around the target. We consider the value as a maximum when the central bank is clearly trying to bring inflation down and establishes a series of decreasing targets for the years ahead. We add a range to the target when this is consistent with previous or future behavior of that central bank. For example, there are also instances where central banks switch from an explicit range to a single point. In those cases we add a band of around the announced target of the same size as the band that was in place in previous years.⁸

The second difficulty associated with determining whether or not a target was hit is measuring the outcome. Money and inflation targets are established for a specific measure of inflation or a monetary aggregate. In some cases, the information about the precise measure being used is unavailable. In others, we know the variable used, but have not been able to find the data. As a result, we are missing some observations. In the case of inflation, we use the CPI

⁸ In the very few cases where we cannot find information or a historical reference to establish a band, we use the convention of adding one percentage points to each side of the target. Details are provided in the data appendix.

as our measure of the price index. In the case of monetary aggregates, we normally use information on both target and outcome that originate from the same source.⁹

4. Empirics

4.a Benchmark Results

OLS estimation of our model results in the benchmark estimates presented in Table 1. The coefficient of greatest interest to us is β_1 , the effect on inflation of a country's having a quantitative target for monetary policy of any type (whether an inflation target, a money growth target, or an exchange rate target). The effect is both economically and statistically significant; the existence of a *de jure* target is estimated to lower annual inflation by about sixteen percentage points, with a t-statistic greater than five in absolute value (and hence different from zero at all conventional significance levels). This effect is enhanced if the quantitative target is actually hit. A monetary target that is successfully achieved reduces inflation by another five percentage points, a result that is again highly statistically and economically significant.

Our basic framework is perturbed in three ways in Table 1. First, we drop the dummy variable for successful implementation of a quantitative monetary target. Second and symmetrically, we also drop the dummy representing the existence of a quantitative target. Each of the coefficients remains economically and statistically significant if the other is set to zero. Finally, we drop all the conditioning variables (that is, we set $\gamma_1=\gamma_2=\dots=\gamma_5=0$).

At first blush it seems that countries with transparent (quantitative) *de jure* monetary targets experience lower inflation. Actually hitting the target lowers inflation further. While the preliminary findings are positive, caveats certainly exist. For one thing, the model fits the data

⁹ If this is not the case and the information on the specific monetary target being used is not available, then we leave the observation as missing.

poorly. While many of the auxiliary regressors are correctly signed (more open economies have lower inflation; tight fiscal policy lowers inflation; richer economies have lower inflation), some are not (observations with higher-than-average growth display lower inflation). Furthermore, a number of potentially important omitted variables and econometric complications come to mind quickly. Accordingly, we now engage in sensitivity analysis.

4.b Sensitivity Analysis

Table 2 checks the sensitivity of the results with respect to the precise sample used for estimation. First we drop observations before 1975. Next we drop all observations where the (country x year) observation is for a country with real GDP per capita below \$5,000. Next we drop outlier observations.¹⁰ Our last two changes are to add in Argentina and Brazil, two high inflation countries, and then to drop all high inflation countries, defined as a country which experienced inflation exceeding 100% annually at any point in our sample (Chile, Israel, Mexico, Turkey and Uruguay). It is striking that our key coefficient of interest – β_1 – remains economically large and statistically significant in all of these perturbations. (The size of the effect of course varies with the sample; excluding high-inflation countries reduces considerably the potential and actual influence of a quantitative monetary target.) Further, β_2 is also significantly negative (in both the economic and statistical senses) in all cases except when Argentina and Brazil are included in the sample.

In Table 3 we check the robustness of our results with respect to unobserved country- and time-specific factors. We do this by adding successively: a) country-specific intercepts; b) year-specific intercepts; and c) country- and year-specific intercepts simultaneously. The last column

¹⁰ The latter are defined as observations with a residual estimated to lie more than 1.5 standard deviations from the mean of zero.

of the table adds dynamics to the perturbation with both sets of fixed effects by modeling the error term as an AR(1) disturbance rather than serially uncorrelated. Again, our key coefficient remains negative and significant throughout (though adding country effects eliminates the significance of the effect of achieving a monetary target).

Table 4 explores whether the three types of quantitative monetary policy targets – inflation, money growth, and exchange rate – have similar effects on inflation. When the three different regimes are allowed to take on different coefficients, the inflation targeting regime seems to have more of a dampening effect on inflation than the (similar) effects of either exchange rate or money growth targets. The differences between the three targets are significant at conventional confidence level. The effect of a successfully-hit monetary target on inflation also varies by the type of target; surprisingly, the effect of successfully hitting an inflation target has a positive coefficient. A closer inspection of the data reveals that several countries have indeed missed the target by having inflation that is below the target range. For example, Sweden in the 1990s had a range between 1% and 3% inflation, but in four years inflation was below 1%.

Table 5 shows that the effects of political instability on inflation are of negligible importance. Neither revolutions nor coups (the variables used by Campillo and Miron, 1996) much affects inflation.

Table 6 uses instrumental variables estimation to account for possible simultaneity in the equation. We are particularly concerned with the possibility that high inflation induces the authorities to introduce or use quantitative targets. There is also the possibility that a low inflation environment may encourage the authorities to lock in stability with a transparent monetary policy.

As instrumental variables for both our *de jure* monetary dummy, and the dummy variable for *de facto* success in hitting this target, we use three political variables and two variables capturing social characteristics. They are: a) political constraints (used by Henisz, (2000)); b) a dummy for (country x year) observations with a presidential electoral system (taken from Persson-Tabellini (2001)); c) a comparable dummy for observations with majoritarian electoral systems (again taken from Persson-Tabellini, (2001)) d) the percentage of males over 25 years old with completed primary education; and e) the percentage of males over 25 years with completed secondary education. We use these variables for a number of reasons. The presence of political constraints in the country reveals an overall preference for rules. In addition, countries with more political constraints have more disciplined fiscal policy. With more discipline on the fiscal side it is more likely that that a monetary regime is sustainable. A somewhat different argument is that if political constraints restrict fiscal policy, then society might prefer to leave monetary policy unconstrained and assign to it a bigger role in smoothing business cycle fluctuations. The nature of the political system (presidential vs. parliamentary) affects regime choice in a similar way. Presidential regimes are often characterized by better separation of powers than parliamentary ones, because the president cannot be subjected to a no-confidence vote by the parliament (except under rare circumstances of impeachment). The executive in a parliamentary system, on the other hand, can be more easily removed. The separation of powers in a presidential system again makes fiscal policy rather constrained, which boosts the case for having flexible monetary policy. The electoral system matters because countries with majoritarian systems are associated with stronger governments relative to those with proportional representation. Proportional systems often lead to the need for coalitions to form a government; Levy-Yeyati, Sturzenegger and Reggio (2002) argue coalition governments

are more prone to be influenced by special interests. To avoid a situation where special interests affect monetary policy, the society might opt for a regime with an explicit target. Hence majoritarian systems should be linked with a more flexible regime. Finally the two education variables are used since more educated societies may insist on having institutions for low inflation, while education has no direct effect on inflation.

We provide four different perturbations of our IV results: benchmark; with country-fixed effects; with year intercepts; and with both. The standard errors for the coefficients of interest are considerably higher, indicating that the first-stage regressions do not fit well. That is, our instrumental variables do not work particularly well. This is even more obvious from the dramatic increase in the size of the effects; the IV estimates of β_1 are approximately three times the magnitude of the OLS estimates. Once we control for unobserved country fixed effects, the coefficient on monetary success in hitting a quantitative target becomes positive and significant. It is difficult to provide a reasonable interpretation of this reversal. The effect of *de jure* regime on inflation is, however, consistently negative and highly significant. The final four columns add as instrumental variables lags of *de jure* and *de facto* regimes. These instruments help with addressing issues of omitted variables (e.g. a beneficial supply shock that leads to lower inflation and also helps the central bank hit the target). The results are highly significant and consistent with the findings of our benchmark model.

Our final set of experiments moves away from the annual domain to consider data averaged over mutually exclusive and jointly exhaustive five-year intervals between 1960 and 1999 (1960-64, 1965-69, and so forth). These are contained in Table 7, which tabulates our key coefficients estimated twelve different ways. For convenience, the auxiliary regressors (openness, the budget deficit, and so forth) are included in the regressions but not explicitly

tabulated. The benchmark equation is presented in the top row. The other eleven perturbations we consider include: a) dropping observations before 1975; b) dropping all (time period x country) observations with real GDP per capita below \$5,000; c) dropping all controls (i.e., setting $\gamma_1=\gamma_2=\dots=\gamma_5=0$); d) adding Argentina and Brazil; e) dropping our five high inflation countries (Chile, Israel, Mexico, Turkey and Uruguay); f) adding country intercepts; g) adding time-period effects; h) adding both country- and time-period fixed effects; i) adding an AR(1) residual to the country- and time-period intercepts; j) using IV on the benchmark equation; and k) using IV with country and time-period intercepts. Our key coefficient, β_1 , remains negative, economically large and statistically significant except when we exclude our high inflation countries and when we estimate the model by IV with time and country effects. Also when we include AR(1) errors into panel estimation the significance drops to about 10% level. This is grounds for some caution, but not perhaps too much. Smoothing the data and excluding countries that have ever experienced high inflation may simply reduce the variation in inflation too much to allow the effects of a quantitative target to be detectable.

4.c Output Volatility

Our benchmark model for the volatility regression is analogous to that for inflation:

$$\sigma_{it} = \beta_1 \text{DJTarget}_{it} + \beta_2 \text{Success}_{it} + \gamma_1 \text{Open}_{it} + \gamma_2 \text{Budget}_{it} + \gamma_3 \text{GDPpc}_{it} + \gamma_4 \text{GDP}_{it} + \varepsilon_{it}$$

where i denotes a country, t denotes a 5-year period, and

- σ denotes output volatility (defined carefully below), and
- other variables are as defined above.

For output volatility, we initially use the five-year average absolute deviation of output growth from mean growth (calculated from annual data). That is, we first compute the country-specific mean growth rate using the entire span of annual data, denoted $\overline{\Delta GDP_i} \equiv (1/T)\sum_t GDP_{it}$, then compute our regressand as $\sigma_{it} \equiv (1/5)\sum_\tau |GDP_{it} - \overline{\Delta GDP_i}|$ for non-overlapping, mutually exclusive five-year periods, where GDP denotes the natural logarithm of GDP.

We start directly with five-year averages in order to provide a better estimate of business cycle volatility. The coefficients of interest again are β_1 and β_2 . The benchmark results for the volatility equation are reported in Table 8. From the first column we conclude, that the coefficients on both *de jure* and *de facto* regimes are not statistically significant at the 5% level of significance. This implies that having an explicit target does not affect output volatility – that is, average absolute deviation of output growth from its mean. If the target is successfully achieved, however, then the volatility is reduced by about half of a percentage point. This result should not be over-interpreted as it is significant only at the 10% level.

The rest of Table 8 reports several sensitivity checks. In column 2 we drop the dummy for “Success in achieving the target” and in column 3 we drop the *de jure* variable. In both cases the estimates of the regime remain insignificant. Adding a lag of our volatility measure does not change the main conclusion that explicit targets do not affect significantly volatility of output.

In Table 9 we explore the sensitivity of these results in several dimensions. We start by including Argentina and Brazil in column (1) and by removing all of the high inflators in column (2). Again, hitting the target has a negative effect on volatility but statistically this result is significant at the 10% level at best. Adding unobserved time effects increases the significance of the success variable, but overall we find that there is little evidence to support any claim on the effect of policy regimes on output volatility.

Table 10 dis-aggregates the effects of monetary regimes on output volatility into those due to inflation, money growth, and exchange rate targets. There are no significant results that one can interpret here. Table 11 pursues instrumental variable estimation so as to account for endogeneity. When we use our political and education variables as instrumental variables, and also when we add lagged regimes, the effects of *de jure* and *de facto* regimes remain statistically insignificant, which could be again a signal that these are poor instruments or that volatility is indeed unrelated to the monetary policy regime. Finally, in Table 12 we provide analogues to OLS and IV estimation of our default model, but measuring output volatility in three different ways: a) the average absolute value of the deviation of real GDP from *HP-filtered* real GDP (in logs), b) the average absolute value of deviation of output growth from a ten-year average growth rate, or c) the standard deviation of output growth computed over (mutually exclusive) decades of annual data.¹¹ The estimates of having a *de jure* quantitative monetary target are insignificant, but the estimates for successfully hitting this target are typically but not overwhelmingly statistically significant.

The conclusion from the volatility regressions is that, at a minimum, having an explicit monetary target does not increase the volatility of the economy. On the contrary, our evidence suggests that the coefficients on successfully hitting a target are negatively and significantly (in the economic sense) associated with lower volatility. Under several perturbations of our model these coefficients are statistically significant at the 10% level.

5. Conclusions

In this paper we investigate the effect of quantitative targets for monetary policy on inflation and business cycle volatility. We combine data for three types of targets for monetary

¹¹ We use a smoothing parameter of $\lambda=100$.

policy (exchange rate targets, money growth targets, and inflation targets), so as to be able to compare the effects of both having and hitting transparent objectives for monetary policy against the alternative of having unclear or qualitative goals. Using a panel of macroeconomic data covering over forty years of annual data and countries, we find that having a quantitative *de jure* target for the monetary authority tends to lower inflation and smooth business cycles; hitting that target *de facto* has further positive effects. These effects are economically large, typically statistically significant and reasonably insensitive to perturbations in our econometric methodology.

During the past decade, there has been much emphasis placed on the importance of transparent goals for monetary authorities; the current consensus is that central banks should independently pursue well-defined goals in a transparent fashion. Our results lead us to conclude that this emphasis seems justified.

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Table 1: Benchmark OLS Inflation Results

De Jure Quant. Monetary Target	-16.5 (3.16)	-20.8 (3.02)		-16.8 (3.07)
Quant. Monetary Success	-5.52 (1.05)		-14.8 (1.79)	-4.88 (.90)
Openness (% GDP)	-.024 (.009)	-.027 (.009)	-.022 (.008)	
Budget Deficit (% GDP)	-.46 (.17)	-.49 (.17)	-.46 (.18)	
BusCycle (Growth – Avg. Growth)	-1.01 (.53)	-1.08 (.52)	-1.00 (.54)	
Log Real GDP p/c	-4.63 (1.10)	-4.54 (1.11)	-5.83 (1.27)	
Log Real GDP	-1.31 (.44)	-0.98 (.42)	-1.53 (.46)	
Observations	1200	1340	1200	1408
R²	.19	.19	.16	.13

Regressand is inflation. Annual data, 1960-2000 for 42 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

Table 2: Sample Sensitivity

	Without pre-1975	GDP p/c at least \$5,000	Without outliers	With Argentina, Brazil	Without High Inflators
De Jure Quant. Monetary Target	-15.1 (2.6)	-12.1 (2.24)	-13.2 (2.14)	-77.2 (21.2)	-3.11 (.98)
Quant. Monetary Success	-4.14 (.99)	-4.88 (1.02)	-5.69 (1.01)	11.2 (6.78)	-3.57 (.53)
Openness (% GDP)	-.017 (.009)	-.013 (.008)	-.019 (.007)	-.037 (.04)	-.015 (.004)
Budget Deficit (% GDP)	-.61 (.25)	-.65 (.17)	-.52 (.15)	-1.27 (.99)	-.13 (.04)
BusCycle (Growth – Avg. Growth)	-.99 (.75)	-.53 (.20)	-.45 (.18)	-5.69 (3.31)	-.45 (.14)
Log Real GDP p/c	-7.29 (1.52)	-7.17 (1.33)	-3.61 (.82)	-30.4 (9.73)	-2.17 (.42)
Log Real GDP	-.97 (.56)	-1.11 (.50)	-1.16 (.42)	12.3 (5.09)	-.74 (.18)
Observations	817	989	1198	1232	1067
R²	.25	.31	.27	.08	.24

Regressand is inflation. Annual data, 1960-2000 for 40 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

High Inflation countries are: Chile, Israel, Mexico, Turkey, and Uruguay.

Table 3: Robustness Checks

	Country Fixed Effects	Year Fixed Effects	Country, Year Effects	Country, Year Effects
De Jure Quant. Monetary Target	-12.7 (2.5)	-16.2 (2.2)	-12.6 (2.5)	-15.8 (3.5)
Quant. Monetary Success	-2.4 (2.1)	-6.8 (2.0)	-3.2 (2.1)	.97 (1.85)
Openness (% GDP)	.16 (.04)	-.025 (.014)	.12 (.04)	.07 (.06)
Budget Deficit (% GDP)	-.55 (.15)	-.29 (.14)	-.41 (.16)	-.12 (.17)
BusCycle (Growth – Avg Growth)	-1.26 (.20)	-.93 (.23)	-1.19 (.21)	-.41 (.13)
Log Real GDP p/c	-17.1 (7.5)	-3.74 (1.33)	-21.6 (7.4)	5.38 (16.8)
Log Real GDP	3.1 (5.4)	-1.22 (.57)	13.8 (6.4)	-24.1 (13.0)
AR(1) Coefficient				.87
Observations	1200	1200	1200	1161
R²	.09	.19	.06	.01

Regressand is inflation. Annual data, 1960-2000 for 40 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

Table 4: Dis-Aggregating Monetary Regimes

De Jure Inflation Target	-20.2 (2.5)	-13.2 (1.83)
Inflation Target Success	4.1 (1.9)	
De Jure Money Growth Target	-11.2 (2.7)	-7.6 (1.9)
Money Growth Target Success	-2.43 (3.23)	
De Jure Exchange Rate Target	-10.9 (4.0)	-16.7 (2.3)
Exchange Rate Target Success	-10.2 (2.7)	
Openness (% GDP)	-.021 (.009)	-.027 (.009)
Budget Deficit (% GDP)	-.47 (.19)	-.51 (.18)
BusCycle (Growth – Avg Growth)	-1.05 (.58)	-1.08 (.54)
Log Real GDP p/c	-4.59 (1.26)	-4.89 (1.19)
Log Real GDP	-1.11 (.51)	-1.09 (.47)
Observations	1023	1200
R²	.18	.17

Regressand is inflation. Annual data, 1960-2000 for 40 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

Table 5: The Role of Political Stability

De Jure Quant. Monetary Target	-16.4 (3.2)	-16.5 (3.1)
Quant. Monetary Success	-5.42 (1.05)	-5.45 (1.05)
Openness (% GDP)	-.024 (.009)	-.024 (.009)
Budget Deficit (% GDP)	-.46 (.17)	-.46 (.17)
BusCycle (Growth – Avg Growth)	-1.03 (.54)	-1.04 (.53)
Log Real GDP p/c	-4.43 (1.18)	-4.80 (1.13)
Log Real GDP	-1.45 (.43)	-1.34 (.44)
Revolutions	1.86 (1.89)	
Coups		-6.23 (2.65)
Observations	1195	1197
R²	.19	.19

Regressand is inflation. Annual data, 1960-2000 for 40 countries unless noted.
OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

Table 6: Instrumental Variable Results

Instrumental variables	Political				Political and lagged regime			
	Benchmark	Country Fixed Effects	Year Fixed Effects	Country, Year Effects	Benchmark	Country Fixed Effects	Year Fixed Effects	Country, Year Effects
De Jure Quant. Monetary Target	-41.2 (16.9)	-33.4 (11.3)	-34.6 (16.3)	-29.4 (11.8)	-13.6 (3.2)	-11.2 (2.9)	-12.9 (2.6)	-10.5 (2.9)
Quant. Monetary Success	-1.31 (11.2)	29.1 (12.3)	-13.5 (10.2)	33.8 (19.8)	-9.3 (1.7)	-5.6 (3.1)	-11.7 (2.6)	-7.0 (3.2)
Openness (% GDP)	-.02 (.009)	.14 (.06)	.002 (.02)	.10 (.06)	-.022 (.008)	.17 (.05)	-.019 (.014)	.13 (.05)
Budget Deficit (% GDP)	-.393 (.161)	-.80 (.21)	-.20 (.16)	-.54 (.21)	-.47 (.17)	-.51 (.16)	-.31 (.14)	-.40 (.16)
BusCycle (Growth – Avg Growth)	-.86 (.53)	-1.56 (.25)	-.95 (.26)	-1.47 (.27)	-.99 (.55)	-1.29 (.21)	-.96 (.24)	-1.23 (.22)
Log Real GDP p/c	-2.64 (2.11)	-35.7 (15.5)	-.41 (2.11)	-49.7 (20.2)	-5.29 (1.17)	-15.7 (8.2)	-4.15 (1.38)	-21.6 (8.2)
Log Real GDP	-1.97 (0.74)	22.6 (13.6)	-2.18 (.74)	32.9 (15.5)	-1.78 (.49)	.46 (6.2)	-1.67 (.60)	13.0 (7.0)
Observations	1149	1149	1149	1149	1149	1149	1149	1149
R²	0.09	.01	.17	.01	.20	.09	.19	.06

Regressand is inflation. Annual data, 1960-2000 for 40 countries.
IV with robust standard errors in parentheses. Intercepts included but not tabulated.
Political instrumental variables for *de jure* quantitative monetary target and quantitative monetary success are: a) political constraints (Henisz); b) Presidential Electoral System (Persson-Tabellini); c) Majoritarian electoral system (Persson-Tabellini); d) Percentage of males over 25 years old with primary education (Barro-Lee); and e) Percentage of males over 25 years old with secondary education (Barro-Lee);

Table 7: Using Five-Year Averaged Data

	<i>De Jure</i> Quantitative Monetary Target (β_1)	Quantitative Monetary Target Hit (β_2)
Benchmark	-11.8 (4.4)	-3.5 (1.5)
Without pre-1975	-10.8 (4.2)	-3.12 (1.62)
GDP p/c at least \$5,000	-11.4 (4.7)	-2.9 (1.7)
Without Controls	-12.3 (4.0)	-3.5 (1.3)
With Argentina, Brazil	-87.4 (56.2)	19.7 (19.3)
Without High Inflators	-1.6 (1.9)	-4.24 (1.15)
With Country Effects	-7.8 (2.7)	-2.5 (2.1)
With Time Effects	-11.9 (2.4)	-3.8 (2.2)
With Time and Country Effects	-7.9 (2.6)	-3.3 (2.1)
With Year and Country Effects, AR(1) Residual	-5.5 (3.3)	-2.4 (2.6)
IV, Benchmark	-40.6 (13.8)	5.3 (9.0)
IV, Time and Country Effects	-1.31 (7.7)	-5.0 (12.8)

Regressand is inflation. Data in 5-yr averages, derived from annual observations 1960-1999 for 40 countries. Controls added but not recorded: openness; budget deficit; business cycle growth deviation from mean; and logs of real GDP and real GDP per capita.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

High Inflation countries are: Chile, Israel, Mexico, Turkey, and Uruguay.

Instrumental variables for *de jure* quantitative monetary target and quantitative monetary success the following political variables: a) political constraints (Henisz); b) Presidential Electoral System (Persson-Tabellini); and c) Majoritarian electoral system (Persson-Tabellini). d) Percentage of males over 25 years old with primary education (Barro-Lee); and e) Percentage of males over 25 years old with secondary education (Barro-Lee);

Table 8: Effects of Regimes on Output Volatility: Benchmark Results.

De Jure Quant. Monetary Target	.17 (.35)	-.18 (.29)		.13 (.51)	-.56 (.33)
Quant. Monetary Success	-.43 (.24)		-.33 (.22)	-.55 (.31)	.33 (.26)
Openness (% GDP)	-.002 (.002)	-.002 (.002)	-.002 (.002)	-.001 (.002)	
Budget Deficit (% GDP)	-.03 (.02)	-.03 (.02)	-.03 (.02)	-.03 (.02)	
Log Real GDP p/c	-.32 (.18)	-.31 (.18)	-.31 (.17)	-.24 (.19)	
Log Real GDP	-.30 (.08)	-.27 (.08)	-.29 (.08)	-.37 (.10)	
Lag of volatility				.11 (.08)	
Observations	211	211	211	153	237
R²	.21	.20	.21	.31	.01

Regressand is the average absolute value of the deviation of output growth from the mean growth rate.

Data in 5-year averages derived from annual observations 1960-1999 for 40 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

Table 9: Output Volatility; Robustness Checks.

	With Argentina, Brazil	Without High Inflators	With time effects	With country effects	With time and country effects
De Jure Quant. Monetary Target	-.07 (.33)	.61 (.37)	.14 (.34)	-.15 (.48)	.04 (.48)
Quant. Monetary Success	-.26 (.23)	-.46 (.25)	-.52 (.25)	.21 (.38)	.07 (.40)
Openness (% GDP)	-.002 (.002)	-.001 (.002)	-.001 (.002)	-.012 (.007)	-.015 (.008)
Budget Deficit (% GDP)	-.03 (.02)	-.02 (.02)	-.03 (.02)	-.05 (.02)	-.07 (.02)
Log Real GDP p/c	-.45 (.18)	-.33 (.18)	-.24 (.19)	-.97 (1.11)	-.78 (1.12)
Log Real GDP	-.23 (.09)	-.27 (.08)	-.31 (.08)	.47 (.78)	1.33 (.87)
Observations	219	196	211	211	211
R²	.18	.21	.24	.001	.05

Regressand is the average absolute value of the deviation of output growth from the mean growth rate.

Data in 5-year averages derived from annual observations 1960-1999 for 40 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated

Table 10: Output Volatility and Dis-Aggregated Monetary Regimes

De Jure Inflation Target	-1.06 (.57)	-.40 (.34)
Inflation Target Success	.72 (.83)	
De Jure Money Growth Target	-.004 (.65)	.15 (.25)
Money Growth Target Success	-.48 (1.15)	
De Jure Exchange Rate Target	.93 (.81)	-.26 (.23)
Exchange Rate Target Success	-1.28 (.81)	
Openness (% GDP)	-.002 (.002)	-.002 (.002)
Budget Deficit (% GDP)	-.03 (.02)	-.03 (.02)
Log Real GDP p/c	-.23 (.19)	-.29 (.18)
Log Real GDP	-.31 (.09)	-.30 (.09)
Observations	182	211
R²	.21	.21

Regressand is the average absolute value of the deviation of output growth from the mean growth rate.

Data in 5-year averages derived from annual observations 1960-1999 for 40 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated

Table 11: Effects of policy regime on output volatility. Instrumental Variable Results

Instrumental Variables	Political	Political	Political, Lags	Political, Lags
		Country, Year Effects		Country, Year Effects
De Jure Quant. Monetary Target	.56 (1.85)	-1.8 (1.5)	.19 (.54)	.82 (1.3)
Quant. Monetary Success	-1.24 (1.85)	-.58 (2.5)	-.67 (.43)	-.10 (1.1)
Openness (% GDP)	-.001 (.002)	-.01 (.01)	-.001 (.002)	-.005 (.01)
Budget Deficit (% GDP)	-.02 (.02)	-.06 (.03)	-.03 (.02)	-.08 (.03)
Log Real GDP p/c	-.30 (.22)	1.17 (2.41)	-.22 (.19)	-2.94 (2.12)
Log Real GDP	-.36 (.11)	-.10 (1.75)	-.43 (.10)	2.40 (1.55)
Observations	202	202	147	147
R²	.17	.00	.30	.11

Regressand is the average absolute value of the deviation of output growth from the mean growth rate.

Data in 5-year averages derived from annual observations 1960-1999 for 40 countries. IV with robust standard errors in parentheses. Intercepts included but not tabulated. Instrumental variables for *de jure* quantitative monetary target and quantitative monetary success are: a) political constraints (Henisz); b) Presidential Electoral System (Persson-Tabellini); c) Majoritarian electoral system (Persson-Tabellini) d) Percentage of males over 25 years old with primary education (Barro-Lee); and e) Percentage of males over 25 years old with secondary education (Barro-Lee); "Lags" adds: d) lag of *de jure* quantitative monetary target; and e) lag of quantitative monetary success.

Table 12: Volatility from Different Trend Models

	HP-Filtered	HP-Filtered	Decadal Deviations	Decadal Deviations	Decadal Std. Dev.	Decadal Std. Dev.
	OLS	IV	OLS	IV	OLS	IV
De Jure Quant. Monetary Target	.23 (.43)	2.95 (2.19)	.33 (.46)	3.54 (1.64)	.65 (.70)	5.80 (2.47)
Quant. Monetary Success	-.72 (.31)	-3.33 (1.32)	-.57 (.34)	-2.36 (1.16)	-.94 (.56)	-3.74 (1.81)
Openness (% GDP)	.003 (.002)	.004 (.002)	.001 (.002)	.001 (.002)	.002 (.002)	.002 (.003)
Budget Deficit (% GDP)	-.05 (.02)	-.04 (.03)	-.04 (.02)	-.04 (.03)	-.06 (.02)	-.06 (.04)
Log Real GDP p/c	-.35 (.18)	-.49 (.27)	-.13 (.19)	-.30 (.26)	-.17 (.24)	-.43 (.37)
Log Real GDP	-.24 (.11)	-.42 (.15)	-.32 (.11)	-.40 (.14)	-.43 (.15)	-.53 (.21)
Observations	211	147	90	86	90	86
R²	.17	-	.32	-	.30	-

Regressand is: a) average absolute value of the deviation of real GDP from HP-filtered real GDP (in logs), b) average absolute value of deviation of output growth from a ten-year average growth rate, or c) decadal standard deviation of output growth.

Data derived from annual observations 1960-1999 for 40 countries.

OLS/IV with robust standard errors in parentheses. Intercepts included but not tabulated.

Instrumental variables for *de jure* quantitative monetary target and quantitative monetary success are: a) political constraints (Henisz); b) Presidential Electoral System (Persson-Tabellini); c) Majoritarian electoral system (Persson-Tabellini); d) Percentage of males over 25 years old with primary education (Barro-Lee); and e) Percentage of males over 25 years old with secondary education (Barro-Lee);

Appendix: Growth

We briefly turn in passing to the effects of the monetary policy regime on economic growth. This question has been an issue of heated debate. The most recent evidence on the issue comes from the paper of Levi-Yeyati and Sturzenegger (2003) who document that in a large set of countries a fixed exchange rate regime leads to lower economic growth. To address this question in our data set we use as a benchmark model following specification:

$$\Delta y_{it} = \beta_1 DJTarget_{it} + \beta_2 Success_{it} \\ + \gamma_1 Open_{it} + \gamma_2 GovSpend_{it-1} + \gamma_3 GDPpc_{it-1} + \gamma_4 PopGR_{it-1} + \gamma_5 Secondary_{it-1} + \varepsilon_{it}$$

where i denotes a country, t denotes a five-year period, and $t-1$ denotes the average over the previous (non-overlapping) five-year period. The other variables are:

- Δy denotes the five-year average growth rate of country i calculated from annual data
- $DJTarget_t$ is a dummy variable that is one if the country had a quantitative monetary policy target during period t , and zero otherwise,
- γ_i is a set of nuisance coefficients,
- $Success$ is a dummy variable that is one if the country hit its *de jure* quantitative target during t , and zero otherwise,
- $Open$ is trade (exports plus imports) as a percentage of GDP,
- $GovSpend$ is government spending as a percentage of GDP,
- $GDPpc$ is the natural logarithm of real GDP per capita from the previous five-year period,
- $PopGR$ is the growth rate of population
- $Secondary$ is the percentage of males over 25 years old with completed secondary degree of education
- ε is a well-behaved residual term for all other growth determinants.

The specification of the controls in the growth regression is standard. The initial GDP per capita is expected to have a negative sign under the conditional convergence hypothesis, openness should enter with a positive sign as more open economies are expected to grow faster (Frankel and Romer, 1999), higher government spending will slow down economic growth, which implies a negative sign for γ_2 ; population growth can be positively correlated with real growth and negatively with the growth rate of real GDP per capita; and, education is expected to be positively correlated with output growth. We have decided to use again five-year averages because most of the theories cited above refer to long-term growth rates and the five-year average seems to be the shortest period for which one can reasonably argue that the variables capture long-term growth rates.

Table A1 starts with the benchmark results in the first column. The first coefficient of interest, which captures the effect of an explicit target on growth, is insignificant statistically and it implies that the economic impact of an explicit target is negligible. The success in implementing the target is negative, but again insignificant. Although the fit of the regression is relatively good with an R^2 of 50%, it seems that neither having, not hitting the target affects economic growth in our sample of countries.

In Table A2, we report some standard robustness checks. In general we do not find much evidence to support a claim that monetary targets affect growth positively or negatively. Only when time effects are included in the regression, there is some evidence that having a target is significant the 5% level.

Overall we find some evidence that the having an explicit target leads to faster economic growth, but we quickly point out that this evidence is quite fragile and most of the time insignificant at conventional levels.

Table A1: Policy Regime and Growth: Benchmark Results.

De Jure Quant. Monetary Target	1.28 (.81)	1.01 (.72)		-1.13 (.62)
Quant. Monetary Success	-.40 (.52)		.20 (.50)	2.33 (.55)
Log Real GDP p/c (lagged)	-2.24 (.61)	-2.18 (.61)	-2.28 (.61)	
Openness (% GDP)	.01 (.003)	.01 (.003)	.01 (.002)	
Government spending (% GDP, lagged)	-.03 (.02)	-.038 (.020)	-.03 (.02)	
Population growth	.06 (.40)	.05 (.40)	.09 (.40)	
Percentage of males with secondary school (lagged)	.01 (.02)	.01 (.02)	.02 (.02)	
Observations	106	106	106	237
R²	.50	.50	.48	.08

Regressand is the average growth rate of output over five-year periods.

Data in 5-year averages derived from annual observations 1960-1999 for 42 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated.

Table A2: Policy Regime and Growth: Robustness Checks.

	With Argentina, Brazil	Without High Inflators	With time effects	With country effects	With time and country effects
De Jure Quant. Monetary Target	1.27 (.77)	.73 (.73)	1.51 (.74)	-.003 (.85)	.04 (.78)
Quant. Monetary Success	-.39 (.52)	.42 (.51)	-.29 (.54)	.52 (.73)	.38 (.69)
Log Real GDP p/c (lagged)	-2.23 (.61)	-2.37 (.59)	-2.51 (.52)	-2.80 (1.06)	-3.54 (1.32)
Openness (% GDP)	.014 (.003)	.014 (.003)	.014 (.003)	.05 (.02)	.05 (.02)
Government spending (% GDP, lagged)	-.03 (.02)	-.03 (.02)	-.05 (.02)	.02 (.04)	-.02 (.05)
Population growth	.07 (.40)	-.06 (.39)	-.09 (.37)	1.0 (.52)	1.18 (.48)
Percentage of males with secondary school (lagged)	.01 (.01)	.01 (.01)	.009 (.012)	.03 (.04)	.01 (.03)
Observations	108	103	106	137	137
R²	.50	.53	.58	.37	.45

Regressand is the average growth rate of output over five-year (non-overlapping) periods.

Data in 5-year averages derived from annual observations 1960-1999 for 42 countries.

OLS with robust standard errors in parentheses. Intercepts included but not tabulated

Appendix: Classification of Monetary Policy Regimes

Data on exchange rate regimes comes from Reinhart and Rogoff (2004). The *de jure* classification (downloaded from Carmen Reinhart's web site) is based on the official IMF classification. We label all observations as having an exchange rate target with the exception of those in the category freely floating. As a *de facto* classification we use their *natural* classification (see the appendix of their paper and additional materials available at Carmen Reinhart's web site for detailed analysis of each of the countries in our sample).

The data on inflation and money targets comes from different sources. We will refer to several references below. For recent years, web sites of the corresponding central bank have also been used as confirmation. In some cases, there were disagreements about the sources on the starting year. Our main references are Cottarelli and Gianoni (1997) (CG) for all regimes and Mishkin and Schmidt-Hebbel (2002) (MS) for inflation targets. In addition, for developed countries, we also use Agenor (2002). Other general references for inflation and money targets are Sterne (2002), Siklos (1999) and Bernanke, Laubach, Mishkin and Posen (1999).

Inflation targets

When it comes to the classification of inflation targets, there are very few cases of disagreement on the years were inflation targets were present. There are some minor disagreements on the exact month were the policy was started (and in those cases we make a judgement call). Same is true for the ranges set for the inflation target that we use to assess whether the target was hit or not. The biggest complication is to define a range when a single point is used as a target. In some cases we take the single number as maximum and set a range for 0% to that number. We do this when there is clear evidence that the central bank is trying to reduce inflation. In some other cases we set a band around this central point. We look for a historical reference within the same central bank to establish the size of the band (for example, a band set in previous years or in the years that follow). In the absence of any historical reference, we use $\pm 1\%$.

Money Targets

The classification of money targeters is a much more difficult one. The reason is that there are a large number of central banks that use money aggregates as references but cannot be properly considered as having a target for money (for the same reason that most central banks use inflation forecasts but we have not included them as targeting inflation). At the same time, we do not want to be too strict because we want to base our classification as much as possible on the words they use and not on their actions given that we will be checking later whether they met their targets or not. What we have done is to collect as much information as possible on each of the central banks and make a judgement call on whether or not the central bank had a target for a monetary aggregate that was meaningful.

***De jure* Classification of Monetary Policy Regimes**

Argentina		Exchange Rate	Inflation	Money
	1960-1978	Yes	No	No
	1979	Yes	No	Yes
	1979-1988	Yes	No	No
	1989-1990	No	No	No
	1990-2000	Yes	No	No

Comments: Money target was in place in 1979 according to CG who claims “the central bank announced the commitment to monitor the attainment of the announced (credit) targets”.

Australia		Exchange Rate	Inflation	Money
	1960-1975	Yes	No	No
	1976-1983	Yes	No	Yes
	1984	No	No	Yes
	1985-1992	No	No	No
	1993-2000	No	Yes	No

Comments: Monetary targeting starts in March 1976 and finishes in January 1985. Source: CG, Edey (1997) and Reserve Bank of Australia Bulletin (October 1997). Inflation targeting starts in January 1993. Range for inflation is 2-3%.

Austria		Exchange Rate	Inflation	Money
	1960-1998	Yes	No	No
	1999-2000	No	Yes	Yes

Comments: After 1999, Austria becomes part of EMU so policies are ECB policies.

Belgium		Exchange Rate	Inflation	Money
	1960-1998	Yes	No	No
	1999-2000	No	Yes	Yes

Comments: After 1999, Belgium becomes part of EMU so policies are ECB policies.

Botswana		Exchange Rate	Inflation	Money
	1960-1969	Yes	No	No

Brazil		Exchange Rate	Inflation	Money
	1960-1976	Yes	No	No
	1977	Yes	No	Yes
	1978-1989	Yes	No	No
	1990-1993	No	No	No
	1994-1998	Yes	No	No
	1999-2000	No	Yes	No

Comments: In 1997 Brazil adopts a money target on top of the exchange rate target (source: CG). Inflation targeting starts in June 1999. Source for inflation target and range: MS.

Canada		Exchange Rate	Inflation	Money
	1960-1969	Yes	No	No
	1970-1975	No	No	No

	1976-1982	No	No	Yes
	1983-1990	No	No	No
	1991-2000	No	Yes	No

Comments: Money target First announced in November 1975 and dropped in November 1982. Sources: CG, Reserve Bank of Australia Bulletin (October 1997). Inflation targeting starts in February 1991. Source for inflation target and range: MS.

Chile		Exchange Rate	Inflation	Money
	1960-1961	Yes	No	No
	1962-1964	No	No	No
	1965-1990	Yes	No	No
	1991-1999	Yes	Yes	No
	2000	No	Yes	No

Comments: Inflation targeting starts in January 1991 (Source: MS). Range for inflation is replaced by single point ranges in the period 1995-2000. We add a range of +/- 1% to those years, which is consistent with the range that existed prior to 1994 (and also the range in place for 2001).

Colombia		Exchange Rate	Inflation	Money
	1960-1992	Yes	No	No
	1993-1998	Yes	No	Yes
	1999	No	No	Yes
	2000	No	Yes	Yes

Comments: Years for money targeting from: CG (Target announced in November 1992) and Informe de Inflacion, Central Bank of Colombia (recent years). Inflation target adopted in September 1999. We interpret the target of 10% as a maximum (consistent with inflation reports by central bank).

Costa Rica		Exchange Rate	Inflation	Money
	1960-1991	Yes	No	No
	1992-1994	No	No	No
	1995-2000	Yes	No	No

Denmark		Exchange Rate	Inflation	Money
	1960-2000	Yes	No	No

Finland		Exchange Rate	Inflation	Money
	1960-1991	Yes	No	No
	1992	No	No	No
	1993-1995	No	Yes	No
	1996-1998	Yes	Yes	No
	1999-2000	No	Yes	Yes

Comments: Starting date for inflation targeting is February 1993 (source: MS). After 1999, Finland becomes part of EMU so policies are ECB policies. For the targets before 1999 we interpret 2% as a maximum, which is consistent with the way we interpret ECB policies after 1999.

France		Exchange Rate	Inflation	Money
	1960-1976	Yes	No	No
	1977-1998	Yes	No	Yes

	1999-2000	No	Yes	Yes
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Comments: Sources for money target years: CG and Bank of France. After 1999, France becomes part of EMU so policies are ECB policies.

Germany		Exchange Rate	Inflation	Money
	1960-1970	Yes	No	No
	1971	No	No	No
	1972-1974	Yes	No	No
	1975-1998	Yes	No	Yes
	1999-2000	No	Yes	Yes

Comments: After 1999, Germany becomes part of EMU so policies are ECB policies.

Greece		Exchange Rate	Inflation	Money
	1960-1969	Yes	No	No
	1970-1994	Yes	No	Yes
	1995-1999	Yes	No	No
	1999-2000	No	Yes	Yes

Comments: Source for Money target years: CG. After 1999, Greece becomes part of EMU so policies are ECB policies.

Hong Kong		Exchange Rate	Inflation	Money
	1960-2000	Yes	No	No

Ireland		Exchange Rate	Inflation	Money
	1960-1998	Yes	No	No
	1999-2000	No	Yes	Yes

Comments: After 1999, Ireland becomes part of EMU so policies are ECB policies.

Israel		Exchange Rate	Inflation	Money
	1960-1976	Yes	No	No
	1977-1984	No	No	No
	1985-1991	Yes	No	No
	1992-2000	Yes	Yes	No

Comments: Inflation target adopted in January 1992 (source: MS). We add a range of +/- 1% added in years where single point range is announced, which is consistent with the years where the band was explicit.

Italy		Exchange Rate	Inflation	Money
	1960-1971	Yes	No	No
	1972-1973	No	No	No
	1974-1978	No	No	Yes
	1979-1991	Yes	No	Yes
	1992-1995	No	No	Yes
	1996-1998	Yes	No	Yes
	1999-2000	No	Yes	Yes

Comments: Source for Money target years: CG and annual reports Bank of Italy. After 1999, Italy becomes part of EMU so policies are ECB policies.

Japan		Exchange Rate	Inflation	Money
	1960-1972	Yes	No	No
	1973-2000	No	No	No

Korea		Exchange Rate	Inflation	Money
	1960-1978	Yes	No	No
	1979-1996	Yes	No	Yes
	1997	No	No	Yes
	1998-2000	No	Yes	Yes

Comments: Source: CG (until 1994) and document "Monetary Policy in Korea" (Bank of Korea). Money stopped being a target in 2001. Notice that from 1997 onwards the monetary aggregate that was targeted was changed and that there was a double domestic target (inflation and money) "based on the ECB". Range for inflation target from MS and confirmed by web site of Bank of Korea.

Malaysia		Exchange Rate	Inflation	Money
	1960-1997	Yes	No	No
	1998	No	No	No
	1999-2000	Yes	No	No

Mauritius		Exchange Rate	Inflation	Money
	1960-1997	Yes	No	No
	1998-2000	No	No	No

Mexico		Exchange Rate	Inflation	Money
	1960-1993	Yes	No	No
	1994-1998	No	No	No
	1999-2000	No	Yes	No

Comments: Date of adoption of inflation target is January 1999 (source: MS). Point targets interpreted as maximum.

Netherlands		Exchange Rate	Inflation	Money
	1960-1998	Yes	No	No
	1999-2000	No	Yes	Yes

Comments: After 1999, the Netherlands becomes part of EMU so policies are ECB policies.

New Zealand		Exchange Rate	Inflation	Money
	1960-1983	Yes	No	No
	1984-1989	No	No	No
	1990-2000	No	Yes	No

Comments: Date of adoption inflation target is March 1990 (source: MS).

Norway		Exchange Rate	Inflation	Money
	1960-1991	Yes	No	No
	1992-1994	No	No	No
	1995-2000	Yes	No	No

Panama		Exchange Rate	Inflation	Money
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	1960-2000	Yes	No	No
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Paraguay		Exchange Rate	Inflation	Money
	1960-1989	Yes	No	No
	1990-1997	No	No	No
	1998-2000	No	No	Yes

Portugal		Exchange Rate	Inflation	Money
	1960-1998	Yes	No	No
	1999-2000	No	No	No

Comments: After 1999, Portugal becomes part of EMU so policies are ECB policies.

Singapore		Exchange Rate	Inflation	Money
	1960-1962	No	No	No
	1963-2000	Yes	No	No

South Africa		Exchange Rate	Inflation	Money
	1960-1982	Yes	No	No
	1983-1985	No	No	No
	1986-1999	No	No	Yes
	2000	No	Yes	No

Comments: Money targets replaced by Inflation targeting in February 2000 (Source: CG until 1994 complemented for recent years with document named "Monetary Policy in South Africa" downloaded from the web site of the SA Central Bank).

Spain		Exchange Rate	Inflation	Money
	1960-1973	Yes	No	No
	1974-1975	No	No	No
	1976-1977	Yes	No	No
	1978-1983	Yes	No	Yes
	1984-1988	No	No	Yes
	1989-1994	Yes	No	Yes
	1995-1998	Yes	Yes	No
	1999-2000	No	Yes	Yes

Comments: Source for money target years is CG and Sterne (Bank of England, 2000) who confirm that the Bank of Spain dropped money targets in 1994 and adopted inflation targets in 1995 ("a new framework based on inflation targeting was announced in January 1995"). After 1999, Spain becomes part of EMU so policies are ECB policies. Source for inflation target and range: MS.

Sweden		Exchange Rate	Inflation	Money
	1960-1992	Yes	No	No
	1993-2000	Yes	Yes	No

Comments: Date of adoption inflation target is January 1993 (source: MS).

Switzerland		Exchange Rate	Inflation	Money
	1960-1972	Yes	No	No
	1973-1974	No	No	No

	1975-1977	No	No	Yes
	1978	Yes	No	Yes
	1979	Yes	No	No
	1980-1981	Yes	No	Yes
	1982-1999	No	No	Yes
	2000	No	Yes	No

Comments: Source for Money target years: CG, Rich (JME 1997) and Annual reports Bank of Switzerland. Annual target was put in place in 1975 and abandoned in the Fall of 1978. Reinstated later in 1980 and replaced in 1990 by medium-term targets for 5 year periods. Inflation target starts in January 2000. Source for inflation target and range: MS and confirmed by Central Bank web site.

Thailand		Exchange Rate	Inflation	Money
	1960-1996	Yes	No	No
	1997-1999	No	No	No
	2000	No	Yes	No

Comments: Inflation target adopted in April 2000. Source for inflation target and range: MS.

Trin&Tob.		Exchange Rate	Inflation	Money
	1960-1969	No	No	No

Tunisia		Exchange Rate	Inflation	Money
	1960-2000	Yes	No	No

Turkey		Exchange Rate	Inflation	Money
	1960-1989	Yes	No	No
	1990-1992	Yes	No	Yes
	1993-2000	Yes	No	No

Comments: Source for Money target years: CG and Sterne, who confirms that it was abandoned during 1992.

Uruguay		Exchange Rate	Inflation	Money
	1960	No	No	No
	1961	Yes	No	No
	1962-1963	No	No	No
	1964	Yes	No	No
	1965	No	No	No
	1966-1969	Yes	No	No
	1970-1973	Yes	No	Yes
	1974-1981	Yes	No	No
	1982-1985	No	No	No
	1986-1989	No	No	Yes
	1990-1992	No	No	No
	1993-2000	Yes	No	No

Comments: Source for Money target years: CG.

UK		Exchange Rate	Inflation	Money
	1960-1971	Yes	No	No

	1972-1976	No	No	No
	1977-1990	No	No	Yes
	1991-1992	Yes	No	Yes
	1993-1996	No	Yes	Yes
	1997-2000	No	Yes	No

Comments: Source for money target years Edey, Reserve Bank of Australia Bulletin, October 1996 and Sterne, Band of England. Inflation target starting in October 1992 (source: MS). We use a range of +/- 1% around central inflation target.

USA		Exchange Rate	Inflation	Money
	1960-1972	Yes	No	No
	1973-1974	No	No	No
	1975-1995	No	No	Yes
	1996-2000	No	No	No

Comments: Source for Money target years: CG and annual reports Federal Reserve. After reading annual reports, the word "Target" stops appearing in the 1996 report so we pick 1995 as a .

Venezuela		Exchange Rate	Inflation	Money
	1960-1988	Yes	No	No
	1989-1993	No	No	No
	1994-2000	Yes	No	No