

# Central Bank Structure, Policy Efficiency and Macroeconomic Performance: Exploring Empirical Relationships

Stephen G. Cecchetti and Stefan Krause\*

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## Abstract

There is a broad consensus that the substantial changes in the operational framework of central banks over the past few decades have produced better overall policy outcomes. We examine this view by looking at the relationship between macroeconomic outcomes and monetary policy efficiency on the one hand, and central bank independence, accountability, transparency and credibility on the other. Our first task is to develop empirical counterparts to each of these theoretical concepts, and then proceed to look at their relationship. Using cross-sectional data on a broad range of countries we find that more credible central banks deliver superior macroeconomic performance and more efficient policy.

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# 1 Introduction

All economists agree that more information is better than less. When people are better informed, they make better decisions, enhancing the efficiency of the economy in allocating resources and improving overall welfare. It would be difficult to find an area of economic life where this line of argument has carried more weight than it has in central banking circles in recent years.

The job of central bankers is to conduct monetary policy in order to promote price stability, stable growth, and a stable financial system. They do this in an environment fraught with unavoidable uncertainties. But in conducting policy, there is one uncertainty that policy makers can reduce: the uncertainty they themselves create. Everyone agrees that monetary policy makers should do their best to minimize the noise their actions add to the environment. The essence of good, transparent policy is that the economy and the markets respond to the data, not to the policy makers.

The result of this is that today we have the nearly universal and immediate public broadcast of all interest rate changes. As everyone in financial markets around the world knows, the Federal Reserve's Federal Open Market Committee now makes a public statement at 2:15pm Eastern U.S. time following each meeting. But the first public announcement of a move in the Federal Funds rate target was on February 4, 1994, and the regular issuance of a statement became an official feature of the FOMC's procedures on January 19, 2000. Before that, it was customary for FOMC policy changes to be communicated to market participants through actions rather than words.

There are still people who argue for the efficacy of central bank secrecy in various forms, claiming that surprises are more effective and that even accurate information can be misinterpreted resulting in undesirable financial market volatility. We think that it is fair to say that these arguments have not been persuasive, and that the advocates of policy transparency have won the day. We have been reduced to arguments about the mechanics and

exact timing of information release. Should the minutes of a meeting be released as soon as physically possible following the meeting, as done by the Bank of England's Monetary Policy Committee, or should there be a modest delay until just after the following meeting, the FOMC's practice, or is it acceptable to wait for years, as the European Central Bank is planning to do? Is it necessary or advisable for the head of the interest rate setting body to hold regularly scheduled news conferences? Should the policymakers be required to appear before legislative bodies to provide descriptions of their decision-making processes and justifications for their actions? How public should the inputs - forecasts, models, and anecdotes - into interest rate decisions be? All of these questions concern minor issues about the availability of information.

As for general principles, we have now progressed to the point where on September 26, 1999 the Interim Committee of the Board of Governors of the International Monetary Fund issued a Code of Good Practices on Transparency in Monetary and Financial Policies: Declaration and Principles (which we will refer to as the IMF Code). As in the case of other standards and codes promulgated under the auspices of the IMF,<sup>1</sup> the expectation is that they will be adhered to by all of the countries in the world.

We take the statements in the IMF Code to represent a rough version of the consensus on the value of monetary policy transparency. Paragraph 4 of the IMF Code states:

“The case for transparency of monetary and financial policies is based on two main premises. First, the effectiveness of monetary and financial policies can be strengthened if the goals and instruments of policy are known to the public and if the authorities can make a credible commitment to meeting them. In making available more information about monetary and financial policies, good transparency practices promote the potential efficiency of markets. Second, good governance calls for central banks and financial agencies to be accountable,

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<sup>1</sup>The IMF monitors compliance with codes and standards on data dissemination, fiscal transparency, banking supervision, accounting and auditing that are issued by a variety of international agencies.

particularly where the monetary and financial authorities are granted a high degree of autonomy.”<sup>2</sup>

This is a concise statement of the view that the key ingredients leading to an effective central bank are independence, credibility, transparency and accountability. Going one step further, there is general agreement that independent, transparent, accountable and credible central banks are able to deliver better overall policy outcomes.<sup>3</sup>

Many people have concluded that the substantial changes undertaken in the operational framework of central banks over the past decade or more have produced better overall policy outcomes. And there is substantial prima facie evidence to support the case. Looking at a broad array of industrialized, transition and emerging market economies we see institutional reforms that have increased both the independence and accountability of central banks, as well as making monetary policy more transparent through clear public statement of instruments, methods and objectives. Not only this, but over the same decade or so, many central banks have succeeded in establishing significant reputations for competence, acquiring considerable credibility in the process.

The data that we study here bear out that, as the institutional framework was evolving, macroeconomic performance was improving. Both the level and variability of inflation were lower over the past five years than they were in the previous ten. Looking at a broad cross-section of 63 countries we see that median inflation has dropped from 7.04% in 1985:I-1994:IV to 2.97% in 1995:I-1999:IV. The decrease in average inflation has been even sharper, going

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<sup>2</sup>The Code of Good Practices on Transparency in Monetary and Financial Policies: Declaration and Principles is available in its entirety at <http://www.imf.org/external/np/mae/mft/code/index.htm>.

<sup>3</sup>Empirical studies by Alesina (1988), Grilli, Masciandaro and Tabellini (1991), Cukierman (1992) Cukierman, Webb and Neyapti (1992) and Alesina and Summers (1993), among others, find evidence of a negative correlation of central bank independence with lower and more stable inflation, within industrialized countries.

Also, Chortareas, Stasavage and Sterne (2001) examine the association between the cross-country differences in macroeconomic outcomes and the degree of transparency exhibited by monetary policy, measured by the detail with which central banks publish economic forecasts. Their results suggest that a high degree of transparency in economic forecasts is associated with a lower inflation for all countries (with the exception of the ones that target the exchange rate, for which the publication of forecasts has no significant impact on inflation).

from 83.19% to 8.59%. Inflation rose in only 10 of the 63 countries, and in the bulk of those the increase was small - only in Ghana, Indonesia and Turkey did average inflation rise by more than 2 percentage points.

Successful policymaking usually means more than just reducing inflation. It means stabilizing inflation and output as well. Looking at a somewhat narrower sample of 23 countries we see that 21 experienced lower inflation variability while output variability was lower in 15.<sup>4</sup> Again, this occurred as the institutional framework for policymaking was changing, suggesting at least the possibility of a relationship.

The remainder of the paper explores the empirical relationship between economic performance and the monetary policy framework. For reasons that will become clear later, the data on transparency, accountability, credibility and independence force us to study a cross-section of countries. That is, we examine the extent to which contemporaneous differences in institutional design are able to explain the observed variation in performance across countries during a fixed period of time. We are not able to study how changes in the structure of policymaking have affected changes in macroeconomic outcomes.

With the exception of the measure of credibility, our data on the monetary policy framework in each country are from the Bank of England's Center for Central Bank Studies survey of 93 central banks reported in Fry, Julius, Mahadeva, Roger and Sterne (2000). This survey contains an incredible wealth of information, including measures of the degree of independence, accountability and transparency of central banks. But Fry et al. only did their survey once in 1998 (with revisions in 1999), and so that is all that is available.

Our starting point in Section 2 is the development of measures of macroeconomic performance and monetary policy efficiency. We describe how both of them arise from an optimal policy problem. Following our previous work with Flores-Lagunes [Cecchetti, Flores-Lagunes and Krause (2001)] we measure performance as a weighted average of output and inflation

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<sup>4</sup>See Cecchetti, Flores Lagunes and Krause (2001) for details on these calculations.

variability, while policy efficiency (or inefficiency) is presumed to be related to the distance of the economy's performance point to the inflation-output variability frontier.

In Section 3 we discuss how we measure the credibility of monetary policy. This is clearly a difficult undertaking and there are a number of possible ways to proceed. One possibility would be to use surveys or press reports to examine what people think about central bankers actions. But since we study a large number of countries, collecting such data is an almost impossible task. Instead, we have adopted the view that credibility comes from what you do, not what you say or what someone else says about it. This leads us to measure credibility by looking at past inflation performance. We define a credible central bank as one that has successfully delivered low inflation.

The remainder of the paper puts all of these pieces together and looks for correlations among them. This is the subject of Section 4, and our findings are somewhat discouraging. In the end, we conclude that credibility trumps virtually everything else: countries with high past inflation exhibit comparatively worse macroeconomic and policy performance, regardless of the framework in which their central banks operate. Section 5 concludes.

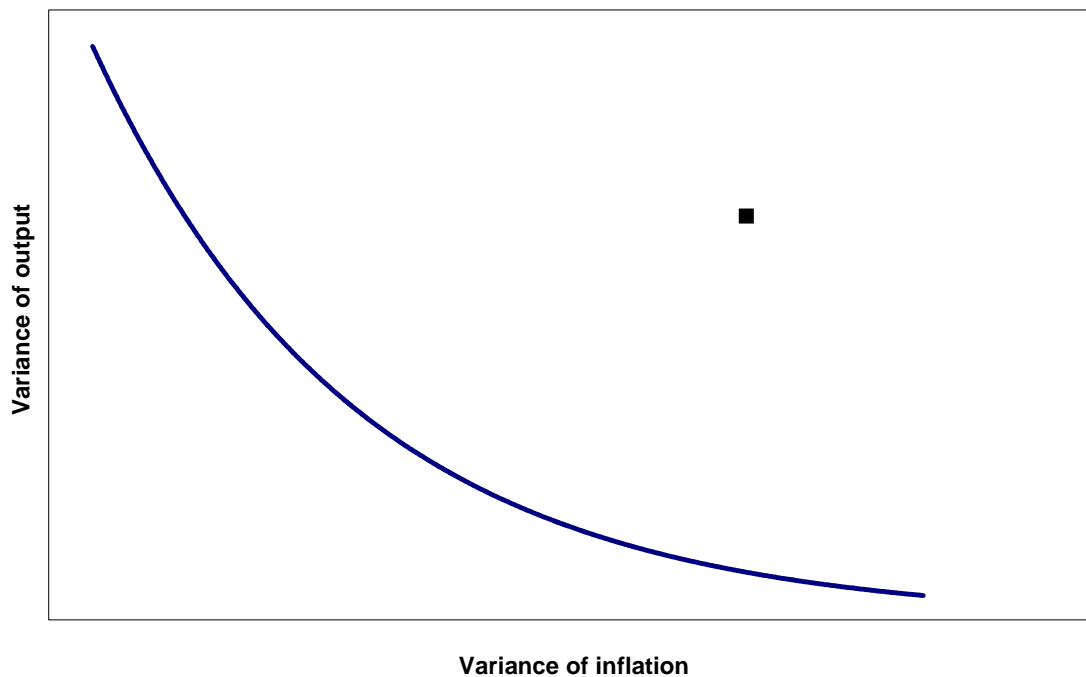
## **2 Measuring Macroeconomic Performance and Efficiency of Monetary Policy**

Following Cecchetti et al. (2001) we derive measures of macroeconomic performance and policy efficiency using the inflation-output variability trade-off, or efficiency frontier. We will summarize the work that we have done there. This is done in two steps. First, we describe how to derive the performance and efficiency measures assuming that we know the location of the inflation-output variability frontier. Then, we describe the methodology used to estimate the frontier. Finally, we report the results on macroeconomic performance and policy efficiency loss for the period of 1990:I-1997:IV.

## 2.1 Theoretical Derivation of the Measures

The measures of interest can be derived using a two-dimensional graph, and so we begin with a simple intuitive explanation. The concept of an inflation-output variability frontier is easiest understood by considering a simple economy that is affected by two general types of disturbances, both of which may require policy responses. These are aggregate demand shocks - that move output and inflation in the same direction – and aggregate supply shocks - that move output and inflation in opposite directions. Since monetary policy can move output and inflation in the same direction, it can completely offset the effect of aggregate demand shocks. By contrast, aggregate supply shocks will force the monetary authority to face a trade-off between the variability of output and that of inflation.<sup>5</sup>

**Figure 1: Efficiency frontier and performance point**



This trade-off allows us to construct an efficiency frontier for monetary policy that traces the points of minimum inflation and output variability. This is the curved line in Figure 1,

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<sup>5</sup>For a simple algebraic model and a discussion of the derivation of the output-inflation variability frontier see Cecchetti and Ehrmann (2001).

known in the literature as the Taylor Curve (Taylor, 1979). The location of the efficiency frontier depends on the variability of aggregate supply shocks - the smaller such variability the closer the frontier will be to the origin. If monetary policy is optimal, the economy will be on this curve. The location of the economy on the frontier depends on the policymaker's preferences for inflation and output stability.

When policy is sub-optimal, the economy will not be on this frontier. Instead, the performance point will be up and to the right, with inflation and output variability both in excess of other feasible points. Movements of the performance point toward the frontier are an indication of improved policymaking.

We require measures of an economy's performance, in terms of output and inflation variability, as well as the distance of that point from the efficiency frontier. To compute these, we assume that the objective of the central banker is to minimize a weighted sum of inflation and output variability. This is the standard quadratic loss function used in most contemporary analyses of central bank policy. We can summarize this loss through the following specific representation:

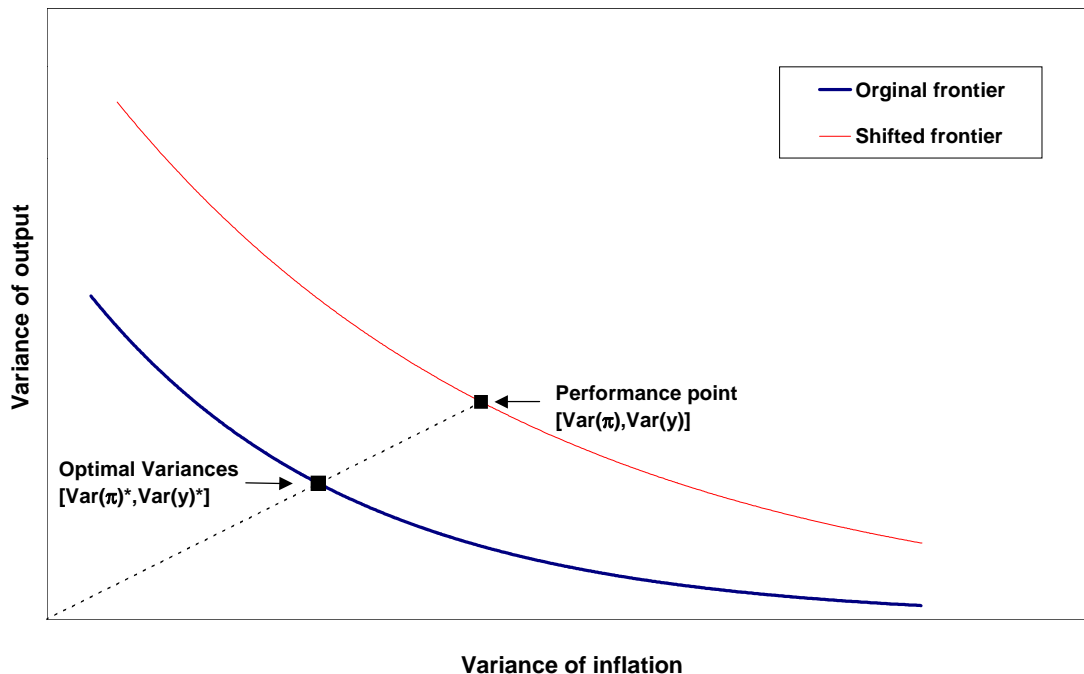
$$Loss = \lambda Var(\pi) + (1 - \lambda)Var(y), 0 \leq \lambda \leq 1, \quad (1)$$

where  $\pi$  is inflation,  $y$  is output, and  $\lambda$  is the policymaker's preference parameter - Cecchetti and Ehrmann (2001) call this the policymaker's inflation variability aversion.

But measuring the loss associated with a particular performance point requires that we have an estimate of the preference parameter  $\lambda$ . We obtain this using the following procedure. Beginning with Figure 1, we shift the efficiency trade-off homothetically outward until it passes through the performance point representing the observed variances of inflation and output. Figure 2 shows the original and shifted frontiers. Next, assuming that the performance point is representative of policymakers preferences, we measure the value of  $\lambda$  that is associated with this point on the shifted efficiency frontier. For future reference, we also define the optimal variances as the point on the original frontier associated with this

same preference parameter. Cecchetti et al. show how to derive both  $\lambda$  and the optimal variances analytically, given the location of the efficient frontier. We simply note here that the optimal variances are at the intersection of the original frontier with a line from the origin to the performance point.

**Figure 2: Derivation of the Optimal Variances**



We can now define the measures of performance and policy efficiency that we will use in our empirical computations. To compute macroeconomic performance, we combine the observed variances of output and inflation together to construct a single measure of stability. We define performance,  $P$ , as

$$P = \lambda Var(\pi) + (1 - \lambda) Var(y) . \quad (2)$$

The lower  $P$ , the more stable the economy.

We gauge monetary policy efficiency by looking at how close the actual performance is to the one under optimal policy. Policy *inefficiency* is measured by

$$E = \lambda [Var(\pi) - Var(\pi)^*] + (1 - \lambda) [Var(y) - Var(y)^*], \quad (3)$$

where  $Var(\pi)^*$  and  $Var(y)^*$  are the variances of inflation and output under optimal policy, respectively. The more efficient policymakers are at implementing the optimal policy, the closer  $E$  will be to zero.

## 2.2 Estimating the Efficiency Frontier

Implementing our procedure for computing macroeconomic performance and policy efficiency requires an empirical estimate of the output-inflation variability frontier. The basic procedure is to find the optimal policy by assuming that policymakers minimize a quadratic loss subject to the constraints imposed by the structure of the economy. The loss is assumed to be a weighted sum of inflation and output variability, while the structure is linear in inflation, output and the interest rate instrument used by policymakers. In such a setup, the interest rate is set as a linear combination of the shocks that are hitting the economy.

We can solve this problem for a given loss function, with a given weight on inflation and output variability in the policymaker's loss function. Doing this empirically gives us one point on the variability frontier for a given relative weight in the loss function. Varying the weight in the loss function allows us to trace out the entire frontier.

Econometrically we proceed in two main steps. First we estimate simple structural models of inflation and output for each of the 23 countries in our sample. Next we construct the estimated efficiency frontier from the model estimates. This will allow us to compute the macroeconomic performance and policy efficiency loss.

We consider linear two-equation systems for each country based on a dynamic aggregate demand - aggregate supply model. The basic model consists of the following two equations:

$$y_t = \sum_{l=1}^2 \alpha_{1l} i_{t-l} + \sum_{l=1}^2 \alpha_{1(l+2)} y_{t-l} + \alpha_{15} \pi_{t-1} + \alpha_{16} x_{t-1} + \varepsilon_{1t} \quad (4)$$

$$\pi_t = \alpha_{21} y_{t-1} + \sum_{l=1}^3 \alpha_{2(l+1)} \pi_{t-l} + \alpha_{25} x_{t-1} + \varepsilon_{2t} \quad (5)$$

The first equation represents an aggregate demand curve. It relates (demeaned and detrended) log industrial production,  $y$ , to two of its own lags, two lags of the nominal

interest rate,  $i$ , one lag of demeaned inflation,  $\pi$ , and one lag of demeaned external price inflation,  $x$ . The second equation is an aggregate supply curve. Here, inflation is assumed to be a function of three of its own lags, representing inflation expectations, one lag of (demeaned and detrended) log industrial production and one lag of demeaned external price inflation. The error terms  $\varepsilon_1$  and  $\varepsilon_2$  are assumed to be mean zero and constant variance, respectively.

We estimate equations (4) and (5) for each country separately using ordinary least squares.<sup>6</sup> The Durbin-h test allows us to determine whether additional lags of the variables were required to correct for autocorrelation.<sup>7</sup> In some cases we also included dummy variables to account for currency crises, sharp recessions, or structural changes.

The next step consists of employing the estimated model to construct the efficiency frontier. We assume that the policymaker's objective is to minimize an objective function (given by the loss function in (1)) subject to the constraints imposed by the dynamic structure of the economy given by equations (4) and (5). This optimization allows us to obtain a pair of optimal variances of inflation and output for a given value of  $\lambda$ . By varying the  $\lambda$  over an the interval [0.001,0.999] with an increment of 0.001, we are able to trace out an entire frontier similar to the one in Figure 1.

Given this estimate of the efficiency frontier, we perform the homothetic shift of the frontier so that it will pass through the data given by the observed variances of inflation and output. The estimate of the policymaker's preference for inflation stability,  $\lambda$ , is the one associated with the performance point on the shifted frontier, while the optimal variances of inflation and output will be given by the point on the original frontier that results from that estimate of  $\lambda$ . Given the estimates of  $\lambda$  and the optimal variances for each country we

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<sup>6</sup>We tested for contemporaneous correlation of the error terms of the two-equation model for each of the countries in our sample, using seemingly unrelated regression when we were able to reject a zero correlation. The affected countries included Austria, Denmark, France, Ireland, Italy, and Sweden.

<sup>7</sup>We tested for non-stationarity of the error terms in both equations using the Phillips-Perron test. We were able to reject the null hypothesis of non-stationarity at the 1% significance level in all countries for both subperiods.

can compute the measures of interest.

### 2.3 Estimates of Macro Performance and Policy Efficiency Loss

We now look at the estimates of performance and efficiency loss for the 23 countries in the Cecchetti et al. study, using data for 1990:I-1997:IV. The results are plotted in Figures 3.a and 3.b. and the estimates of the measures are reported in Table A.1 in the Data Appendix.<sup>8</sup> For each country, the vertical height of the bar measures the performance loss  $P$ . This is divided into a portion we will call the minimal performance loss, that would be attained if the economy were on its inflation-variability frontier, and the remainder, which measures policy inefficiency. The differences in scale require that we divide the countries into two groups, those with relatively stable performance in Figure 3.a, and those with higher output and inflation variability in Figure 3.b.

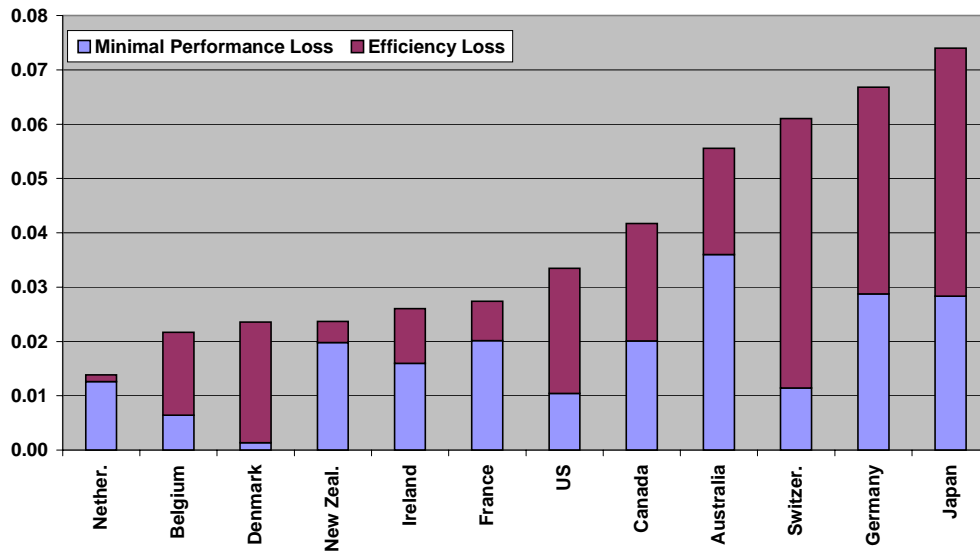
Overall, the results suggest that there is high variation in both performance and policy efficiency. Netherlands, for example, has the lowest value for both  $P$  and  $E$ , while Israel has the most inefficient policymakers and most volatile economy. There are also cases between these, such as Finland where policy is efficient but the economy is relatively unstable, and Switzerland where performance is good but policy is not.<sup>9</sup>

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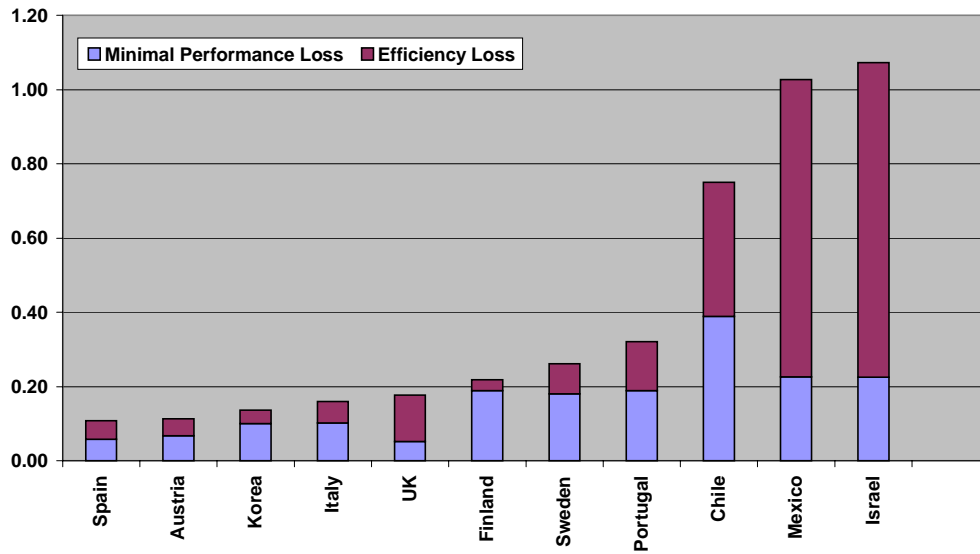
<sup>8</sup>Both the performance loss and efficiency measure have been scaled up by a factor of 100.

<sup>9</sup>For a more detailed discussion of these results, as well as an examination of changes in performance and policy efficiency over time, see Cecchetti, Flores-Lagunes and Krause (2001). They also report estimates of the inflation variability aversion parameter  $\lambda$ . These vary from 0.165 for Mexico to 0.999 for a number of countries, with the bulk of the estimates being above 0.9.

**Figure 3.a: Macroeconomic Performance Loss**



**Figure 3.b: Macroeconomic Performance Loss**



Our goal is to examine whether the cross-sectional variation in these measures of performance and policy efficiency can be explained by differences in central bank independence, accountability, transparency and credibility. Before undertaking this task, we need to de-

scribe the data on monetary policy framework variables, which we proceed to do in the following section.

### **3 Measures of Monetary Framework Characteristics**

In order to relate macroeconomic performance and policy efficiency to central bank features, we require quantitative measures of the several institutional characteristics of the central bank. For this purpose we employ the measures of central bank independence, accountability and transparency derived by Fry et al. (2000) and based on survey information. We first describe these, and then proceed to discuss our construction of a measure of policy credibility that is based on past inflation performance.<sup>10</sup>

#### Central Bank Independence

Fry et al. construct a weighted index for independence by studying the responses to five questions on their survey. These questions look at the following elements: how important is price stability as an objective; how important is the role of the central bank in choosing the levels of the target variable (goal independence) and the policy instrument (instrument independence); to what extent does the government rely on central bank financing and how long is the term of office of the governor/chairman.

#### Central Bank Accountability

The Fry et al. survey looks at two main forms of accountability. First, it asks whether the policy contract between the government and the central bank incorporates a numerical target for the goal variable, what is the role of the government in setting this target and which are the procedures that take place in case the target is missed. The second form of accountability measures how the government and parliament monitor the central bank. The index of accountability is constructed by taking the average of these two measures.

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<sup>10</sup>We report the values of these indices in Table A.2 in the Data Appendix.

## Central Bank Transparency

To derive a measure of transparency or policy explanations, Fry et al. look at the responses to the degree and frequency in which each central bank provides reports on its policy decisions, assessments about the state of the economy, and public explanations of forecasts. The index of transparency is obtained as a simple average of these three criteria.

## Central Bank Credibility

We now turn to the derivation of the credibility index.<sup>11</sup> Cukierman and Meltzer (1986) define monetary policy credibility as “the absolute value of the difference between the policymaker’s plans and the public’s beliefs about those plans.”<sup>12</sup> The further realized inflation is from the announced target level, the less credible is the policymaker. If the monetary authority has an explicit inflation target, credibility can be measured by the distance from the expected inflation to the target (Svensson (1999)).

Consistent with these suggestions, we construct an index of policy credibility which takes into account the deviations of expected inflation from the central bank’s target level. In order to normalize this index between 0 and 1, we define it as:

$$IC = \left\{ \begin{array}{ll} 1 & \text{if } E(\pi) \leq \pi^t \\ 1 - \frac{1}{0.2 - \pi^t}(E(\pi) - \pi^t) & \text{if } \pi^t < E(\pi) < 20\% \\ 0 & \text{if } E(\pi) \geq 20\% \end{array} \right\} \quad (6)$$

The index of credibility takes a value of 1 if expected annual inflation is less or equal than the target level of inflation,  $\pi^t$ , and it decreases linearly as expected inflation rises. If expected inflation is greater than 20%, we assign the index a value of 0.

Finally, to compute this index we assume that the target level for inflation is equal to 2% for all countries and we proxy  $E(\pi)$  as the average realized inflation for the period between

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<sup>11</sup>While use the term "credibility" to describe this measure, we could have labeled it reputation or inflation persistence.

<sup>12</sup>Cukierman and Meltzer (1986) p. 1108.

1985:I and 1989:IV for all 63 countries in our sample.<sup>13</sup> The data on the index of credibility is presented in Table A.2 in the Data Appendix.<sup>14</sup>

## 4 Empirical Results

We now turn to an examination of all of the information on performance, efficiency and institutional structure. We expect that countries with more independent, transparent, accountable and credible central banks will exhibit in general better macroeconomic outcomes. We take this hypothesis to the data and consider the relationships between macroeconomic performance, as measured by  $P$  and by average inflation, and policy efficiency, measured by  $E$ , and policy framework variables described in the previous section. We look at both simple correlations and multivariate analysis.

**Table 1: Performance, Efficiency and Monetary Policy Framework  
(Correlation coefficients)**

|                | <b>Average<br/>Inflation<br/>(95-99)</b> | <b>Macro<br/>Perfor.<br/>(90-97)</b> | <b>Policy<br/>Ineff.<br/>(90-97)</b> |
|----------------|--|--------------------------------------|--------------------------------------|
| Independence   | -0.129<br>(0.17)                         | -0.276<br>(0.29)                     | -0.346<br>(0.20)                     |
| Accountability | -0.093<br>(0.48)                         | 0.077<br>(0.75)                      | 0.134<br>(0.52)                      |
| Transparency   | -0.349<br>(0.04)                         | -0.075<br>(0.61)                     | -0.106<br>(0.50)                     |
| Credibility    | -0.571<br>(0.00)                         | -0.896<br>(0.00)                     | -0.844<br>(0.00)                     |

Note: Better macro performance and more efficient policy are identified with values closer to zero, while higher independence, accountability, transparency and credibility are identified with higher values. The heteroskedasticity-corrected p-values are in parenthesis.

<sup>13</sup>For the industrialized countries in our smaller sample of 23 countries we believe 2% to be a reasonable measure of the implied target for policymakers. For the larger samples, including many lesser developed countries, this may be less accurate.

<sup>14</sup>It is important to emphasize that this is by no means the only possible measure of credibility. Measures based on expectations derived from interest rates or surveys are other alternatives. Our measure has the virtue that is easy to compute.

## 4.1 Simple correlations

Table 1 displays the simple correlations between the four indices of central bank framework and our measures of macroeconomic performance and policy efficiency, as well as average inflation for the period of 1995:I-1999:IV.

First, we observe that there is a negative correlation between central bank independence and the performance and efficiency loss measures. For our broader cross-section of countries, independence is negatively correlated with average inflation. This relationship has been extensively documented for industrialized countries, and it is still present when considering transition and developing economies. Nevertheless, none of these correlations is significantly different from zero at even the 10% level.

Proceeding down the table, we see that the index of central bank accountability is negatively correlated with average inflation and positively correlated with performance and efficiency loss. But as with the case of independence, neither of these correlations is significant, suggesting that this particular characteristic of the monetary framework, at least by itself, does not play a crucial role in explaining the cross-country differences in inflation, performance and policy efficiency.

Looking at the one-dimensional relationship with transparency, we see that all of the correlations are negative. The result for average inflation is also significantly different from zero at the 5% level. Furthermore, our point estimate of -0.35 in this case basically indistinguishable from the correlation between average log inflation and the alternative (Guttman) index of transparency reported in Chortareas et al. (2001).<sup>15</sup>

Finally, we find that the correlation between the index of credibility and the three outcome measures is negative and significant at the 1% level. This is our most clear result. Countries that maintained a low inflation in the past are expected to exhibit a lower current inflation and less variable inflation and output. Good policymaking is positively serially correlated.

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<sup>15</sup>Chortareas et al. also use a larger data set, which includes 87 countries.

## 4.2 Multivariate Analysis

We now turn to a simple multivariate analysis. Table 2 reports the results of regressing average inflation, macroeconomic performance and policy efficiency on the four monetary framework variables simultaneously, and compares these results with the ones arising from excluding the credibility index as explanatory variable. We present two sets of results, one including the credibility measure and one without it.

The results are clearly dominated by the credibility measure.<sup>16</sup> The coefficient estimates are both precisely estimated and of the expected sign. Higher credibility means lower inflation, better inflation and more efficient policy.<sup>17</sup> While the coefficients on the remaining three regressors are negative in 8 of the 9 cases, they are all estimated very imprecisely, as indicated by the relatively high p-values reported in the table.<sup>18</sup> If we drop the credibility measure from the specification we observe, as expected, a sharp drop in the goodness of fit. All of the coefficients in the regression remain insignificantly different from zero, with the exception of transparency, which enters the regression of average inflation on the framework variables with a negative and p-value of 0.05. These results provide further evidence supporting the view that central bank credibility - represented by past inflation performance - is the main determinant of current macroeconomic performance and policy efficiency.<sup>19</sup>

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<sup>16</sup>It is important to note that the results are not dominated by the fact that for some countries credibility is zero. This is particularly true of the performance and efficiency regressions, where nearly all countries have non-zero values of the variable IC.

<sup>17</sup>The result is even sharper when we use the data on average inflation for the period 1990:I-1994:IV to construct the index of credibility. Under these circumstances, both the  $R^2$  and the coefficients associated with credibility rise, giving further support to the argument that countries with high past inflation exhibit a poor performance regardless of their framework.

<sup>18</sup>The fact that our performance and efficiency measures are based on the weighted average of inflation and output variability, and that credibility is based on the average level of inflation, brings up the possibility that we are recovering the well-known contemporaneous relationship between the level and variability of inflation. This would be true if weight  $\lambda$  in the loss equation (1) were close to one. We note both that our measure of inflation is for the previous five years, and so we find that high inflation means poor performance in the future, and that  $\lambda$  is not uniformly high across countries with large improvements in performance and efficiency.

<sup>19</sup>were associated with the cross-country differences in the sacrifice ratio (which we approximate using the estimated efficiency frontier for 23 countries), but failed to find any significant relationship.

**Table 2: Performance, Efficiency and Monetary Policy Framework  
(Regression results)**

|                | Average Inflation<br>(95-99) |                  | Macro Perfor.<br>(90-97) |                 | Policy Ineff.<br>(90-97) |                  |
|----------------|------------------------------|------------------|--------------------------|-----------------|--------------------------|------------------|
| Intercept      | 0.289<br>(0.00)              | 0.222<br>(0.01)  | 1.206<br>(0.00)          | 0.970<br>(0.00) | 0.994<br>(0.00)          | 0.828<br>(0.00)  |
| Independence   | 0.003<br>(0.97)              | 0.026<br>(0.74)  | -0.235<br>(0.57)         | 0.994<br>(0.28) | -0.392<br>(0.27)         | 0.036<br>(0.82)  |
| Accountability | -0.062<br>(0.28)             | -0.030<br>(0.60) | -0.067<br>(0.51)         | 0.001<br>(0.99) | -0.011<br>(0.92)         | -0.923<br>(0.21) |
| Transparency   | -0.108<br>(0.23)             | -0.217<br>(0.05) | -0.167<br>(0.31)         | 0.126<br>(0.71) | -0.129<br>(0.38)         | 0.075<br>(0.78)  |
| Credibility    | -0.172<br>(0.00)             |                  | -0.852<br>(0.00)         |                 | -0.596<br>(0.00)         |                  |
| R <sup>2</sup> | 0.364                        | 0.121            | 0.822                    | 0.069           | 0.753                    | 0.117            |
| No. of obs.    | 60                           | 60               | 21                       | 21              | 21                       | 21               |

Note: Better macro performance and more efficient policy are identified with values closer to zero, while higher independence, accountability, transparency and credibility are identified with higher values. The heteroskedasticity-corrected p-values are in parenthesis.

Since our results suggest that credibility, and, to a somewhat lesser extent, transparency, are the two factors that explain most of the cross-country variation in macroeconomic outcomes, it is interesting to ask how large the impact is. To address this, we calculate the extent to which changes in the levels of transparency and credibility translate into lower average inflation. That is, we find the inflation that would have had to take place (as a deviation from 2%) after these changes, holding output variation in the loss function constant. For the case of Spain, an increase in transparency from 0.59 to the sample median, 0.79, is equivalent to a drop of 0.51 percentage points in average inflation. An increase in credibility for the UK from 0.82 to 0.91 (estimated value for the US and France) would represent a drop in average inflation of 1.06 percentage points.

### 4.3 Interpreting the Results

Our findings suggest that credibility is the primary factor explaining the cross-country variation in macroeconomic outcomes, trumping the contribution of the other framework

variables. This result is consistent with Jensen's (2000) argument that a committed (i.e., credible) central bank will not necessarily provide economic agents with substantial information about the behavior of instruments and targets. He derives an optimal level of transparency, which will depend on the initial credibility of the bank and the amount of information available to the agents. The model suggests that a high degree of transparency need not always be an advantage to the central bank. On the other hand, it is reasonable to believe that independence, accountability and transparency actually lead to increased central bank credibility. Given that we lack a time-series for the data on the policy framework, we are unable to examine this claim head on. All we can do is to see whether credibility is highly correlated with accountability, independence and transparency. We find that credibility and transparency have a correlation of 0.31, but that credibility is virtually uncorrelated with the measures of accountability and independence. Looking back at the performance and efficiency measures plotted in Figure 3.b, we see that Israel and Mexico are substantial outliers. This naturally leads us to ask if our results are dominated by these two countries. Deleting them from the sample, we find that the general character of the results is largely unchanged. While coefficients on the other framework variables remain not significant, the coefficient associated with the credibility index changes from -0.852 to -0.541 in the macro performance regression (with the  $R^2$  dropping from 0.822 to 0.711) and from -0.596 to -0.247 in the policy efficiency regression (with the  $R^2$  slightly falling from 0.753 to 0.736). The coefficients still remain significant at the 1% level.

## 5 Conclusions

This paper explores the empirical relationships between economic outcomes and the monetary policy framework. Our findings suggest that a better macroeconomic performance and more efficient policy are present in more credible, and, to some extent, more transparent central banks. Independence and accountability, to the extent that we are able to measure

them, do not seem to explain much of the cross-country variation in macroeconomic outcomes, either individually or in conjunction with other variables. Further exploration of the relationship of macroeconomic performance awaits new, time-series, data.

## Data Appendix

Table A.1 presents the estimates for the measures of *macroeconomic performance* and *policy inefficiency* obtained by Cecchetti, Flores-Lagunes and Krause (2001).

**Table A.1: Macroeconomic Performance and Monetary Policy Inefficiency**

| Country        | Macro Perfor. (90-97) | Policy Ineff. (90-97) |
|----------------|-----------------------|-----------------------|
| Netherlands    | 0.0138                | 0.0012                |
| Belgium        | 0.0217                | 0.0153                |
| Denmark        | 0.0235                | 0.0222                |
| New Zeal.      | 0.0237                | 0.0039                |
| Ireland        | 0.0260                | 0.0101                |
| France         | 0.0274                | 0.0072                |
| USA            | 0.0335                | 0.0231                |
| Canada         | 0.0417                | 0.0216                |
| Australia      | 0.0556                | 0.0196                |
| Switzerland    | 0.0610                | 0.0496                |
| Germany        | 0.0668                | 0.0381                |
| Japan          | 0.0740                | 0.0457                |
| Spain          | 0.1080                | 0.0501                |
| Austria        | 0.1126                | 0.0446                |
| Korea          | 0.1364                | 0.0357                |
| Italy          | 0.1595                | 0.0573                |
| UK             | 0.1770                | 0.1253                |
| Finland        | 0.2187                | 0.0298                |
| Sweden         | 0.2612                | 0.0813                |
| Portugal       | 0.3207                | 0.1316                |
| Chile          | 0.7503                | 0.3612                |
| Mexico         | 1.0269                | 0.8009                |
| Israel         | 1.0731                | 0.8481                |
| <b>Average</b> | <b>0.2093</b>         | <b>0.1227</b>         |

Note: Better macro performance and more efficient policy are identified with values closer to zero

Table A.2 reports the data on inflation and the monetary policy framework variables. *Average inflation* is obtained from the simple mean of quarterly data of CPI inflation for the period 1995:I-1999:IV, from the IFS Statistics. The data for the indices used for *independence* and *accountability* are obtained from the weighted total scores in Tables A.5 and A.6 of Fry et al. (2000), respectively, while *transparency* is measured using the unweighted total score for explaining policy, presented in Table A.7 of Fry et al. Finally, the index of policy *credibility* is constructed as specified in Section 3, using the average CPI inflation for the period between 1985:I and 1989:IV from the IFS Statistics.

**Table A.2: Average Inflation and Policy Framework Variables**

| <b>Country</b> | <b>Average Inflation (%) (95-99)</b> | <b>Index of Indepen.</b> | <b>Index of Account.</b> | <b>Index of Transp.</b> | <b>Index of Credib.</b> |
|----------------|--------------------------------------|--------------------------|--------------------------|-------------------------|-------------------------|
| Argentina      | 0.77                                 | 0.79                     | 1.00                     | 0.53                    | 0.00                    |
| Australia      | 1.97                                 | 0.73                     | 0.83                     | 0.78                    | 0.68                    |
| Austria        | 1.38                                 | 0.68                     | 0.67                     | 0.27                    | 0.99                    |
| Bahamas        | 1.32                                 | 0.39                     | 1.00                     | 0.50                    | 0.83                    |
| Bahrain        | 1.08                                 | 0.54                     | 0.75                     | 0.18                    | 1.00                    |
| Barbados       | 2.46                                 | 0.24                     | 0.92                     | 0.73                    | 0.89                    |
| Belgium        | 1.45                                 | 0.77                     | 0.33                     | 0.68                    | 0.98                    |
| Belize         | 1.66                                 | 0.43                     | 0.42                     | 0.48                    | 0.97                    |
| Canada         | 1.61                                 | 0.91                     | 1.00                     | 0.79                    | 0.87                    |
| Chile          | 6.04                                 | 0.93                     | 0.17                     | 0.83                    | 0.00                    |
| China, P.R.    | 5.20                                 | 0.68                     | 1.00                     | 0.63                    | 0.28                    |
| Croatia        | 4.53                                 | 0.79                     | 0.83                     | 0.42                    | 0.00                    |
| Cyprus         | 2.62                                 | 0.77                     | 0.58                     | 0.48                    | 0.93                    |
| Denmark        | 2.15                                 | 0.88                     | 0.75                     | n.a.                    | 0.87                    |
| East. Carib.   | 2.17                                 | 0.49                     | 0.92                     | 0.48                    | 0.98                    |
| Ecuador        | 33.14                                | 0.93                     | 0.75                     | 0.59                    | 0.00                    |
| Egypt          | 7.09                                 | 0.53                     | 0.83                     | 0.47                    | 0.06                    |
| Fiji           | 3.26                                 | 0.73                     | 0.17                     | 0.64                    | 0.78                    |
| Finland        | 1.07                                 | 0.91                     | 0.92                     | 0.74                    | 0.84                    |
| France         | 1.24                                 | 0.90                     | 0.83                     | 0.53                    | 0.91                    |
| Germany        | 1.31                                 | 0.96                     | 0.17                     | 0.70                    | 1.00                    |
| Ghana          | 32.44                                | 0.60                     | 0.58                     | 0.36                    | 0.00                    |
| Greece         | 6.02                                 | 0.86                     | 0.33                     | 0.36                    | 0.16                    |
| Hungary        | 18.85                                | 0.86                     | 0.83                     | 0.49                    | 0.51                    |
| Iceland        | 2.13                                 | 0.59                     | 0.92                     | 0.65                    | 0.00                    |
| India          | 8.89                                 | 0.83                     | 0.67                     | 0.75                    | 0.68                    |
| Indonesia      | 21.03                                | 0.66                     | 0.83                     | 0.83                    | 0.73                    |
| Ireland        | 1.95                                 | 0.87                     | 0.83                     | 0.78                    | 0.90                    |
| Israel         | 8.22                                 | 0.66                     | 1.00                     | 0.68                    | 0.00                    |
| Italy          | 2.97                                 | 0.88                     | 0.58                     | 0.81                    | 0.77                    |
| Jamaica        | 14.19                                | 0.39                     | 0.42                     | 0.65                    | 0.33                    |
| Japan          | 0.41                                 | 0.93                     | n.a.                     | 0.89                    | 1.00                    |
| Jordan         | 3.39                                 | 0.74                     | 0.75                     | 0.60                    | 0.72                    |
| Kenya          | 6.06                                 | 0.66                     | 0.67                     | 0.52                    | 0.56                    |
| Korea          | 4.42                                 | 0.73                     | 0.83                     | 0.88                    | 0.88                    |
| Kuwait         | 2.01                                 | 0.63                     | 0.67                     | 0.38                    | 1.00                    |
| Malaysia       | 3.92                                 | 0.75                     | 0.67                     | 0.71                    | 1.00                    |
| Malta          | 2.82                                 | 0.83                     | 0.83                     | 0.67                    | 1.00                    |
| Mauritius      | 6.63                                 | 0.70                     | 0.33                     | 0.20                    | 0.77                    |
| Mexico         | 24.67                                | 0.82                     | 0.92                     | 0.69                    | 0.00                    |
| Namibia        | 8.33                                 | 0.50                     | 0.33                     | 0.56                    | 0.36                    |
| Netherlands    | 2.06                                 | 0.91                     | 0.83                     | 0.79                    | 1.00                    |
| New Zeal.      | 1.68                                 | 0.89                     | 1.00                     | 0.92                    | 0.48                    |
| Nigeria        | 26.08                                | 0.42                     | 0.92                     | 0.37                    | 0.00                    |

**Table A.2: Average Inflation and Policy Framework Variables  
(continued)**

| <b>Country</b> | <b>Average<br/>Inflation<br/>(%) (95-99)</b> | <b>Index of<br/>Indepen.</b> | <b>Index of<br/>Account.</b> | <b>Index of<br/>Transp.</b> | <b>Index of<br/>Credib.</b> |
|----------------|--|------------------------------|------------------------------|-----------------------------|-----------------------------|
| Norway         | 2.18   | 0.57                         | 0.50                         | 0.89                        | 0.75                        |
| Peru           | 8.41   | 0.89                         | 0.92                         | 0.38                        | 0.00                        |
| Poland         | 16.47  | 0.86                         | 0.58                         | 0.69                        | 0.00                        |
| Portugal       | 2.90   | 0.85                         | 0.83                         | 0.78                        | 0.41                        |
| S. Africa      | 7.34   | 0.85                         | 0.75                         | 0.70                        | 0.24                        |
| S. Leone       | 27.53  | 0.62                         | 0.83                         | 0.47                        | 0.00                        |
| Singapore      | 0.97   | 0.90                         | 0.25                         | n.a.                        | 1.00                        |
| Spain          | 2.87   | 0.80                         | 0.83                         | 0.59                        | 0.73                        |
| Sri Lanka      | 9.49   | 0.54                         | 0.58                         | 0.48                        | 0.64                        |
| Sweden         | 0.77   | 0.97                         | 0.83                         | 0.95                        | 0.80                        |
| Switzerland    | 0.80   | 0.90                         | 0.17                         | 0.86                        | 1.00                        |
| Tanzania       | 17.12  | 0.60                         | 0.92                         | 0.51                        | 0.00                        |
| Thailand       | 5.11   | 0.82                         | 0.50                         | 0.67                        | 0.93                        |
| Tonga          | 2.86   | 0.52                         | 0.00                         | 0.30                        | 0.46                        |
| Turkey         | 81.60  | 0.70                         | 0.42                         | 0.24                        | 0.00                        |
| UK             | 2.79   | 0.77                         | 1.00                         | 0.94                        | 0.82                        |
| Uruguay        | 21.54  | 0.70                         | 0.83                         | 0.04                        | 0.00                        |
| USA            | 2.36   | 0.92                         | 0.83                         | 0.95                        | 0.91                        |
| Zambia         | 35.17  | 0.66                         | 0.17                         | 0.57                        | 0.00                        |

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