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## The quantity theory of money and Friedmanian monetary policy: An empirical investigation

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# The Quantity Theory of Money and Friedmanian Monetary Policy: An Empirical Investigation

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# The Quantity Theory of Money and Friedmanian Monetary Policy: An Empirical Investigation

## Abstract

We introduce an approach for the empirical study of the quantity theory of money (QTM) that is novel both with respect to the specific steps taken as well as the general methodology employed. Empirical studies of the QTM have focused directly on the relationship between the rate of change of the money stock and inflation. We believe that this is an inferior starting point for several reasons and focus instead on the Cambridge form of the QTM. We find that the coefficient  $k$  fluctuates strongly in the short run, but has a low and steady rate of change in the long run, which makes the QTM a useful instrument for the long-run control of inflation. An important finding that contradicts all of the previous literature is that the QTM holds for low inflation as well as for high inflation. We discuss how our findings relate to monetarism generally and propose an adaption of McCallum's rule for a Friedmanian monetary policy.

JEL-Code: E310, E410, E510, E590.

Keywords: Cambridge equation, Friedman's  $k$  rule, monetarism, quantity theory.

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# 1 Introduction

Empirical studies of the quantity theory of money (QTM) have focused directly on the relationship between the rate of change of the money stock and inflation. We believe that this is an inferior starting point for several reasons and focus instead on the Cambridge form of the QTM which can be written as

$$M = kY, \tag{1}$$

where  $M$  is the money stock,  $Y$  is nominal expenditure, in empirical applications usually identified with nominal GDP.<sup>1</sup> To obtain a relationship involving inflation we must first define  $Y = Py$ , where  $P$  is a deflator and  $y$  real expenditure, giving

$$M = kPy. \tag{2}$$

Define the corresponding growth rates  $\hat{M}$ ,  $\hat{k}$ ,  $\hat{P}$ , and  $\hat{y}$ . By logarithmic differentiation, we obtain

$$\hat{M} = \hat{k} + \hat{P} + \hat{y}. \tag{3}$$

All past work on the QTM is based in one way or another on (3). Most studies have concentrated on periods of high inflation when  $\hat{M}$  and  $\hat{P}$  could be expected to be so large as to dwarf  $\hat{k}$  and  $\hat{y}$ . Other studies take  $\hat{y}$  explicitly into account. More recent studies have incorporated the QTM in New Keynesian models and tested the hypothesis  $\hat{k} = 0$ . The literature will be reviewed in the next section; here we will state only the principal result that has emerged: For periods of high inflation a rough proportionality between  $\hat{M}$  and  $\hat{P}$  is clearly given if the observation period is sufficiently long. For periods of moderate or low inflation the results are mixed, the measured relationship being weak or non-significant. There is nothing in economic theory to suggest that the QTM is a relationship restricted to periods of high inflation. We find that the failure to obtain reliable results for moderate or low inflation in previous studies is a defect of the methodology employed and not

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<sup>1</sup>In the original discussions of the QTM,  $Y$  was taken to be total expenditure, including payments for goods that are traded many times. It was this conceptualization that led to the definition of  $v = 1/k$  as ‘velocity’, i.e. the average number of times that a unit of currency changes hands in the course of transactions.

an inherent feature of the data.

All of the work done on the QTM is indirectly an examination of the stability of  $k$ . If it is a true constant, then  $\hat{k} = 0$  and

$$\hat{M} = \hat{P} + \hat{y}. \quad (4)$$

We believe that the constancy assumption is unreasonable, and examine instead if  $k$  is sufficiently stable to make the QTM a useful analytical instrument. Our criterion of stability is the size of the estimate of  $\hat{k}$  defined as an average growth rate over the entire sample. The principal aim of the paper is to show that for this purpose (1) is the superior starting point. The reasons are:

- (i) Students of the QTM have emphasized that the process by which a monetary impulse works its way through the economy to reach a new equilibrium is, in the words of Friedman “long and variable”. Equation (3) is however a relation between highly variable instantaneous rates of change. In empirical work therefore, (3) is not estimated directly, but instead is related to data that are averaged over longer periods. Any such averaging amounts to a reintegration of (3). But why differentiate (1) and then resort to a crude, atheoretical reintegration, when in fact the study of the properties of  $k$  can proceed more directly and easily in terms of (1)? For any series of observations in the range  $(0, T)$  we can determine the variation of  $k$  in a single step by simply comparing  $k_0 = M_0/Y_0$  with  $k_T = M_T/Y_T$ .
- (ii) Working with (3) requires the use of the inflation rate  $\hat{P}$ . This is more problematic than has been generally realized. There is no agreed upon method for computing the GDP deflator. Different countries use different methods and Hillinger (2008) has argued that all of the methods that are in use are unsatisfactory from a theoretical point of view. This introduces an additional and unnecessary source of error.
- (iii) There is still another way in which this paper differs rather radically from at least the more recent work on the QTM. That work is char-

acterized by the use of a variety of prior assumptions. The validity of these remains untested, but is essential for the overall validity of the empirical results. The assumptions include various specifications of a New Keynesian model including the highly questionable assumption of a representative agent.

The ultimate aim of this literature is generally a statistical test of the validity of (4). Such a test requires the validity of assumptions regarding the disturbances, particularly the assumption of independence. In a non-experimental context, this assumption is questionable.<sup>2</sup> Even more fundamentally, the validity of (4) is entirely implausible. The idea that it could be valid is derived from a thought experiment involving a change in  $M$ , while all real magnitudes are assumed constant. With real data over a long period of time, when both tastes and technology have changed dramatically, the assumption is unreasonable. Instead we ask if the QTM relationship is stable enough to be a suitable basis for the conduct of monetary policy.

- (iv) The use of (2) allows us to plot all of the variables involved in the QTM directly. We do this in the form of growth rates. The visual examination of the plots immediately reveals some key features, in particular that  $k$  is not a constant.

The modern interest in the QTM owes much to the work of Milton Friedman and other Chicago economists that resulted in monetarism as a school in macroeconomics. The monetarists combined a belief in the long run stability of the QTM with skepticism regarding the possibility of discretionary stabilization policies. This led to the policy proposal that the money supply should be allowed to grow at a constant rate, which according to the QTM would yield the desired long run inflation rate. But economists and central bankers did not wish to give up on discretionary policies. The QTM was thought to be too unstable in the short run to be useful for this purpose. Interest in the QTM therefore waned. Given that in the light of recent and

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<sup>2</sup>This is the central issue discussed by Sims (2010).

current macroeconomic crises the confidence in the ability of central banks to conduct effective stabilization policies has eroded it may now be a good time to reconsider a monetarist position for the control of inflation beyond the myopic time horizon.

## 2 The history of the QTM

The focus of this survey is on some relevant literature regarding the QTM that may be unfamiliar to contemporary macro-economists.

In 1522 Copernicus testified before the Prussian diet regarding the principles of a sound currency. At the request of the king of Poland he put his observations into writing four years later. The key statement is: “Money usually depreciates when it becomes too abundant.” Regarding this first concise formulation of the QTM, the historian of economic thought Spiegel (1971, p. 88) wrote:

Copernicus’s tract was not published until the nineteenth century and may not have had much influence on the thought of his contemporaries. In any event, his discovery, whatever its range and effect may have been, is especially remarkable because chronologically it antedates the large-scale movement of precious metals from America to Europe. By the power of reasoning and by the ability to invent fruitful hypotheses, a great mind may discover relations that ordinary people can recognize only if driven by the stimulus of observation.

The fame of Copernicus rests of course on his advocacy of the heliocentric hypothesis, not of the QTM. The subsequent fate of these two hypotheses could not have been more different. The initial opposition of the Church was ultimately defeated and no sane person would today deny that the earth turns around the sun. As indicated in the above quotation, the QTM encountered indifference rather than opposition. Belief in its validity has varied in the course of the history of economics and no stable consensus has emerged.

With the rise of classical economics the QTM was incorporated as a ‘veil’ that determined the general level of prices, while leaving relative prices untouched. David Hume wrote: “All augmentation [of gold and silver] has no

other effect than to heighten the price of labour and commodities.”<sup>3</sup> Like the other assumptions of classical and later neoclassical economics, the QTM was taken to be self-evident and not in need of empirical verification.

During the first half of the Twentieth Century the QTM was impacted in opposite directions by two developments, the first empirical, the second theoretical.

The German hyperinflation of 1923-4 drew attention to the QTM as an empirical phenomenon. This was a time also of the increased availability of economic statistics coupled with a rising interest in the use of quantitative methods. The classic and comprehensive study of the German hyperinflation is Bresciani-Turroni (1931, 2007); a more recent work is Holtfrerich (1986). Cagan (1956) fitted an explicit quantitative model of the QTM to data on the German hyperinflation. An innovation of his paper was that he considered the cost of holding cash balances in a high inflation environment. Regression studies linking the monetary growth rate to inflation have continued to appear, especially in relation to episodes of high inflation. Some modifications were introduced, particularly the inclusion of the real growth rate of the economy. The general pattern that emerged was that in cases of high inflation the regression coefficient of inflation on the monetary growth rate tended to be close to one and highly significant. In medium or low inflation environments the relationship tended to be less strong, or to break down entirely. A comprehensive study of many inflationary episodes is Fischer et al. (2002). Capie (1991) reprints 21 such studies.

Two other reviews have come to similar conclusions. Dwyer and Hafer (1999) give the following list of authors who have more recently found a close association between changes in the nominal quantity of money and the price level, noting that the list could be extended: Lucas (1980), Dwyer and Hafer (1988), Barro (1993), McCandless and Weber (1995). They continue:

Despite its long history and the substantial evidence, the predicted association between money and inflation remains disputed. One possible explanation for this seeming paradox is that the empirical relationship between money growth and inflation holds only over time periods that are so long

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<sup>3</sup>The quotation is from Hume (1742), Part II, Essay IV, Of Interest.



that the relationship is uninformative for practitioners and policymakers, who are more concerned about inflation next month or next year. Some of the evidence above is based on average inflation rates and money growth rates over thirty years. If it takes a generation for the relationship between money growth and inflation to become apparent, perhaps it is not surprising that central bankers and practitioners put little weight on recent money growth. (Dwyer and Hafer 1999, pp. 32–33)

The review of von Hagen (2004), which unfortunately is available only in German, comes to a similar, but more differentiated conclusion. He divides the work on the QTM into three broad categories: The first category involves work that is strongly empirical, usually employing regression analysis to determine the relationship between money growth and inflation. Here the finding is that the relationship is very strong in the long run, with different authors defining the long run as covering from 5 to 30 years. The shorter the time interval considered, the weaker this relationship becomes. The second category involves inferences by means of the VAR methodology. Here the statistical methods are more sophisticated and there are stronger prior assumptions involved, particularly regarding the specification of shocks that are presumed to drive the system. The tendency of these findings is the same as for the first category, but the relationships are weaker and there is a propensity to focus on the instability of the short-run effects of monetary changes. The third category is monetary theory. He first analyses how often the words ‘money’, or ‘inflation’ appear in the titles of the main articles of 7 leading journals between about 1970 and 2000. The finding is that those with ‘money’ declined sharply, while those with ‘inflation’ did not. The reason is that money does not play a role in the standard New Keynesian model. As a standard reference for this kind of modeling, von Hagen cites Woodford (2003).

We conclude this section by looking in more detail at two recent papers that concentrate on the issue on which our empirical results differ radically from the rest of the literature. Teles and Uhlig (2010) write: “For countries with low inflation, the relationship between average inflation and the growth rate of money is tenuous at best.” We believe that this negative result is

a direct consequence of their methodology. They use data from 12 OECD countries. For each they observe money growth and inflation in 1970, 1995, and 2005 and average these values. Using only 3 out of 35 data points throws away most of the information in the data. Moreover, their sample is rather small. By comparison, we use data on 148 countries from 1961 to 2005, with a minimum of 15 years for each country. In common with other studies, Teles and Uhlig relate money growth and inflation directly. As mentioned above the inflation measures lack an adequate theoretical foundation and are constructed differently for different countries. We examine the QTM at a more elementary level where we require data only on nominal expenditure, rather than on inflation. Finally, Teles and Uhlig find a modest improvement in their fit when they introduce an interest rate as the cost of holding money. In a macroeconomic context it is not legitimate to take the interest rate as exogenous. It is a price determined by supply and demand. This applies especially to the spectrum of interest rates, but even the rate set by the central bank is set in response to the stage of the business cycle and so is hardly exogenous.

Estrella and Mishkin (1997) continue a line of research that examines how useful monetary aggregates are for the formulation of monetary policy, understood as short-term stabilization policy. Their basic model is a VAR with nominal growth, growth of the money stock and inflation. The data are monthly, with 9 lags included. The basic finding is that no significant relationships are found, using either US or German data. This negative finding remains unchanged over various modifications and alternatives. They explain:

We should note, however, that the majority of the period we focus on has been one of relative price stability in the United States and Germany. The problem with monetary aggregates as a guide to monetary policy is that there frequently are shifts in velocity that alter the relationship between money growth and nominal income. A way of describing this situation is to think of velocity shocks as the noise that obscures the signal from monetary aggregates. In a regime in which changes in nominal income, inflation and the money supply are subdued, the signal-to-noise ratio is likely to be low, making monetary aggregates a poor guide for policy. However, in other

economies or in other time periods in which we experience more pronounced changes in money and inflation, the velocity shocks might become small relative to the swings in money growth, thus producing a higher signal-to-noise ratio. In these situations, the results could very well be different and monetary aggregates could usefully play a role in the conduct of monetary policy. (Estrella and Mishkin 1997, pp. 300–301)

We can agree entirely with the authors' findings as well as with their explanation of these findings, however, we are not content with letting this be the end of the story. Estrella and Mishkin did not claim that the relationships that they vainly looked for do not exist. They point out instead that the correlation methods that they employed cannot detect these relationships when the money stock and inflation change only slowly. This has motivated us to look for a different methodology. With it we find that the QTM is equally stable in the long run in low-inflation environments as it is in high-inflation environments.

There is a second line of thought that the negative results of the literature suggest. Given that no relationship involving the money stock was found that could be the basis of stabilization policies, the question arises if there are other relationships that could be used for this purpose. It seems that none have been discovered. This suggests that we should seriously consider anew the monetarist position that attempts at stabilization and argues that discretionary policies are futile and should be abandoned and be replaced by a monetary policy focused on the control of long run inflation. Such a policy is embodied in Friedman's '*k*-rule' for monetary policy, of which we present a modified version.

### 3 Empirical results

For the empirical analysis we have to operationalize the variables of the QTM. Nominal expenditure ( $Y$ ) is defined as nominal GDP in local currency. The money stock ( $M$ ) is defined broadly as M2 which includes 'near moneys' such as savings deposits. For the deflator ( $P$ ) we use the CPI which we

regard as a better measure than the conventional GDP deflator.<sup>4</sup> This has the consequence that our measure of real GDP,  $y = Y/P$ , differs from the conventional definition.

Our basic data source is the World Bank’s World Development Indicators (WDI) database. For several countries of the European Union, we add data on M2 from local central banks (Finland, Germany, Netherlands, Portugal, Spain, and United Kingdom) or the International Financial Statistics database of the IMF (France, Italy, Luxembourg).<sup>5</sup> From these data we define the time series  $k = M/Y$  (Cambridge coefficient) and real GDP.<sup>6</sup> We then compute the average growth rates for  $k$ ,  $y$ ,  $M$ , and  $P$ , which is equivalent to taking the log-difference between the first and last observations and dividing by the number of years. We take the period 1961–2009, or the years within this period for which data on all four growth rates are available for a particular country, and we exclude countries for which the number of years in the effective sample falls below 15. Slovenia and Zimbabwe are excluded from the analysis due to completely implausible data. This leaves us with 148 out of the original 205 countries of the WDI database, which we refer to as the ‘full sample’.

An inspection of plots of the data reveals a substantial number of oddities that may be related to changes of currency unit, or other definitional changes. Lacking the resources to investigate these at the source we decided to use a statistical procedure to test the robustness of our results in the face of such possible defects of the data. The idea was to identify outliers in the data and then to see to what extent inclusion or exclusion of countries with such outliers changes the results. An outlier was defined as a large spike in the growth rate of  $k$ .<sup>7</sup> Thirty countries were identified as containing outliers.

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<sup>4</sup>Hillinger (2008) argues that the statistical agencies do not have an adequate, theory based methodology for computing the GDP deflator. Also, different agencies use quite different methods.

<sup>5</sup>These additional series have monthly or quarterly frequencies, and we calculate annual figures as the median value in the respective year.

<sup>6</sup>The M2 series from the IMF/central banks and the WDI do not overlap in our sample, and in most cases they are measured in different units (national currencies vs. EURO). No attempt was made to match up the level values, as we only focus on growth rates. We instead set the growth rate to ‘missing’ in the year when the data source changes.

<sup>7</sup>These spikes are defined as studentized residuals larger than 5 in absolute terms,

Subtracting these from the full sample defines our ‘adjusted sample’ with 118 countries. All countries of the full sample are listed in the Appendix which also shows in which sub-samples each country appears.

Before coming to our cross-sectional data, it is useful to look at plots of the four growth rates. For this purpose we selected Brazil, Denmark, South Africa, and the United States. The selection criteria were that we wanted countries with established national accounting traditions and data spanning the entire observation period; the countries should be diverse with regard to size, stage of development and location; finally, the plots should exhibit the characteristic patterns that exist throughout the data set. The plots in Figure 1 have different scales, depending on the magnitude of the inflation that a given country has experienced at different times. The Brazil plot has been divided into two halves, the first a period of hyperinflation of up to 400 percent, the second of moderate inflation of up to 30 percent.

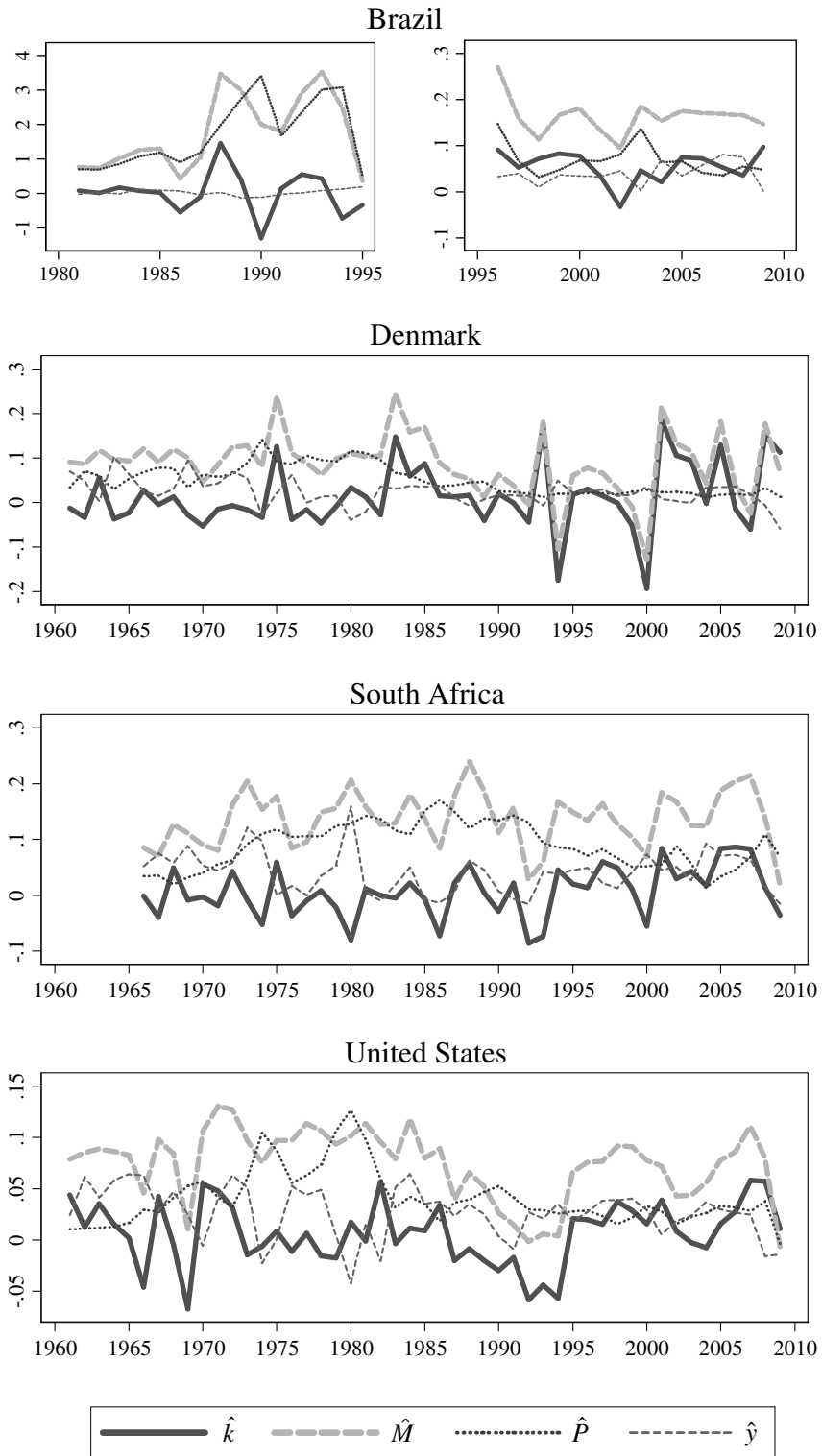
Our principal interest is in the behavior of the parameter  $k$ . The growth rates of  $k$  exhibit substantial fluctuations, but in all cases these appear to be around a mean that is close to zero. For the combined range of Brazil the mean of  $\hat{k}$  is 0.039. For the other countries the values are: Denmark 0.013, South Africa 0.007, and USA 0.007. The parameter is clearly not a constant, not in the long run and even less in the short run. Statistical tests of the QTM, that are by implication tests of the constancy of  $k$ , do not make sense. However, the low and stable long-run growth rate does suggest that the QTM is a suitable instrument for the control of long-run inflation.

Next we examine how the different growth rates are related in the short run. It is seen that the movements of  $\hat{M}$  and  $\hat{k}$  are often very similar, while  $\hat{M}$  has only a weak influence on  $\hat{P}$ . This is particularly clear in the case of Denmark. Inflation is seen to have considerable inertia and responds only gradually to  $\hat{M}$ . These patterns broadly support the monetarist position according to which the QTM is a stable relationship in the long run, but not in the short run.

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obtained from country-specific regressions of the growth rate of  $k$  on a constant. The difference to the use of the usual standard deviation is that the (potential) outlier is excluded from the computation of the standard deviation.

Figure 1: Time series plots of growth rates in selected countries



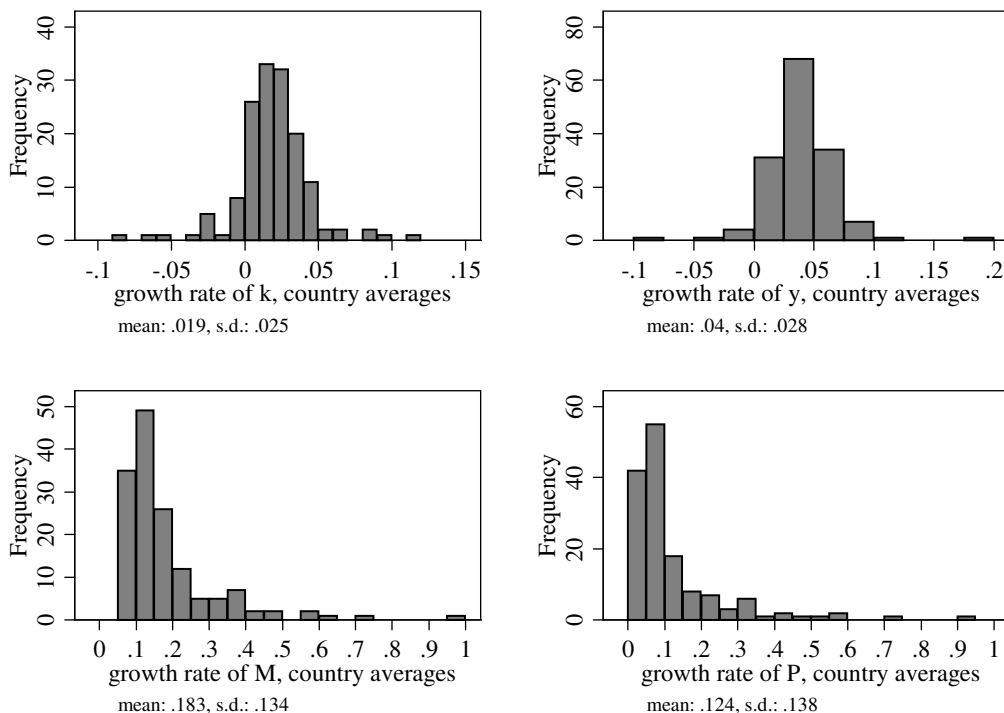
An interesting deviation from the patterns just described is displayed by Brazil in the period of hyperinflation. Here  $\hat{M}$  and  $\hat{P}$  are more closely aligned. It appears that at such times individuals are more aware both of the inflation and of the monetary expansion that is causing it. Witnessing the continuing monetary expansion, sellers quickly raise their prices and buyers accept these increases as inevitable. This changing pattern is one reason for the finding of earlier studies that the QTM can be better confirmed in high inflation episodes. Brazil also illustrates clearly that a high level of volatility is shared by all of the time series. This is at least compatible with the monetarist hypothesis that economic fluctuations are largely caused by shocks emanating from the monetary sector. The US data also tend to support this hypothesis since  $\hat{M}$  and  $\hat{y}$  often move in tandem; this makes it hard to believe that monetary policy has been stabilizing. The explanation is that the central bank controls the monetary base, not the money supply. From a given base, banks are more likely to expand their lending in a time of prosperity than in a recession.

We turn next to summary measures based on our full sample. Figure 2 shows the histograms of our four variables and below the mean values. The averages satisfy the QTM equation; averaging over countries does not destroy the relationship. The equation is  $0.183 = 0.019 + 0.124 + 0.040$ . Monetary expansion over the entire dataset was about 18 percent per annum on average. The impact on inflation was reduced by the annual increase in the demand for money by about 2 percent and real GDP growth of 4 percent, producing an average inflation rate of about 12 percent.

Similar computations for the adjusted sample are reported in Figure 3. Since the results are quite similar, we will not comment them. In the following we report the results from both samples, but concentrate the discussion on the full sample.

In Table 1 we show the mean and standard deviation of  $\hat{k}$  for two sub-samples: high inflation (above the median) and low inflation (below the median). The means are very close to each other and to the overall sample, and this is true both for 148 and for 118 countries. In the case of the adjusted sample, the mean for the low inflation countries is even a bit lower. This

Figure 2: Distribution of average growth rates, 148 countries



evidence suggests—contrary to the received opinion—that *the QTM holds both in low-inflation and in high-inflation environments.*

The positive sign of  $\hat{k}$  is explained by generally rising incomes and increasing income disparity. Financial assets including money rise more than proportionately with rising incomes. A poor person may have more debt than assets, while a wealthy person may derive a large share of his income from them.

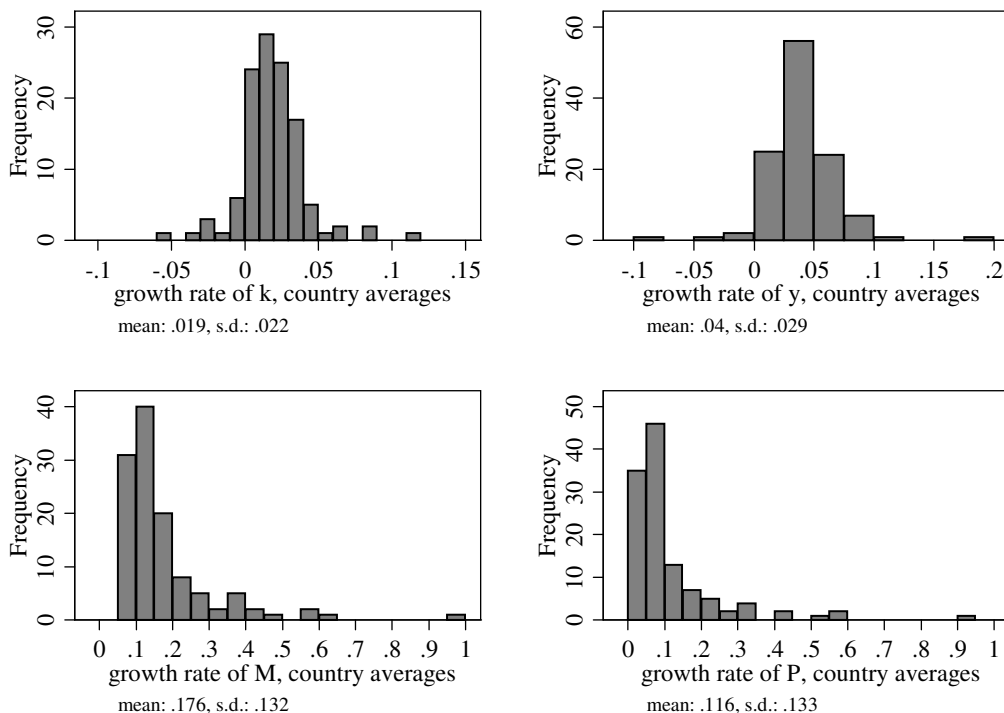
We perform two further types of computations. In the first we construct a

Table 1: Descriptives for growth rates of  $k$  in low- and high-inflation countries

	148 countries			118 countries		
	$N$	$\bar{\hat{k}}$	$\sigma_{\hat{k}}$	$N$	$\bar{\hat{k}}$	$\sigma_{\hat{k}}$
Inflation < median	74	0.0207	0.0241	59	0.0175	0.0236
Inflation $\geq$ median	74	0.0174	0.0256	59	0.0211	0.0203



Figure 3: Distribution of average growth rates, 118 countries



correlation matrix for the four variables based on their country averages. This is more similar to the traditional regression analysis employed in previous studies. The difference is that instead of looking at correlations of annual data, or of averages over sub-intervals, we correlate the averages over the entire sample. Short-run effects are averaged out to the greatest possible extent.

In Table 2 the results are given for both the full and the reduced sample and also for a partition between low- and high-inflation countries. An asterisk denotes statistical significance at the 5% level.

For the 148 countries, significant correlations exist between  $\hat{P}$  and all of the other variables. The correlation with  $\hat{M}$  is close to one. The other correlations are low, but also significant and they have plausible signs. Both a higher rate of real economic growth and an increase in liquidity preference would reduce the inflationary impact of the increase of the money stock. The results for the reduced sample in the right panel of Table 2 are quite similar

except for the fact that two correlations are no longer significant at 5 percent. The results for low- and high-inflation countries are also quite similar in the two panels of the table. The main difference to the results for the complete sample is that in low inflation countries the correlation between  $\hat{P}$  and  $\hat{M}$  is now lower, though still significant and of the correct sign. This is to be expected and simply a consequence of the fact that the variances of these variables are lower here.

Table 3 shows the correlations between the standard deviations of the growth rates. All correlations are positive and significant for both the full and the adjusted sample. This shows the tendency of all variables in a given country to fluctuate strongly, or for all of them to fluctuate weakly. The largest correlations are those involving  $\hat{M}$ . Given that  $\hat{M}$  is also the variable with the largest standard deviation—as shown in Figure 4—these results support the monetarist hypothesis that points at the monetary sector as the principal source of macroeconomic disturbances.

Figure 4: Distribution of standard deviations of growth rates, 148 countries

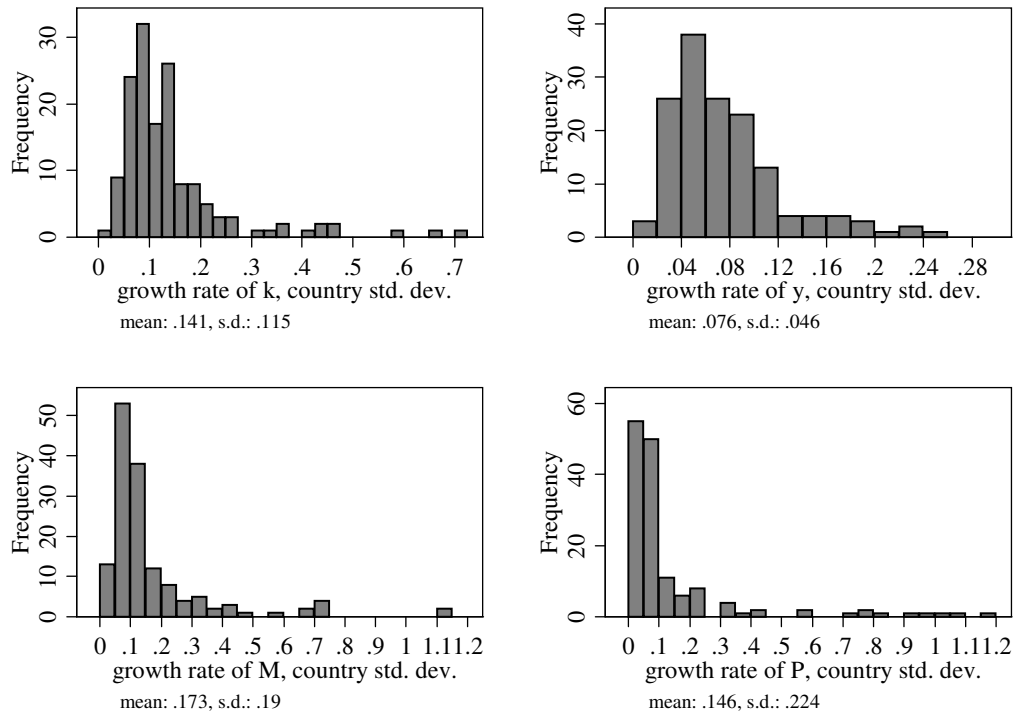


Table 2: Cross-country correlation matrices of average growth rates

	148 countries				118 countries			
	$\hat{P}$	$\hat{M}$	$\hat{y}$	$\hat{k}$	$\hat{P}$	$\hat{M}$	$\hat{y}$	$\hat{k}$
<i>a) All countries</i>								
$\hat{P}$	1				1			
$\hat{M}$	0.9678*	1			0.9670*	1		
$\hat{y}$	-0.1654*	0.0131	1		-0.1574	0.0397	1	
$\hat{k}$	-0.1619*	-0.0074	-0.1230	1	-0.0548	0.0825	-0.1311	1
<i>b) Countries with inflation &lt; median</i>								
$\hat{P}$	1				1			
$\hat{M}$	0.3188*	1			0.2674*	1		
$\hat{y}$	-0.1873	0.5634*	1		-0.2390	0.6077*	1	
$\hat{k}$	0.0474	0.4831*	-0.3182*	1	0.1143	0.4513*	-0.3262*	1
<i>c) Countries with inflation ≥ median</i>								
$\hat{P}$	1				1			
$\hat{M}$	0.9722*	1			0.9744*	1		
$\hat{y}$	-0.1633	0.0098	1		-0.1410	0.0466	1	
$\hat{k}$	-0.2110	-0.0452	0.0557	1	-0.1904	-0.0383	0.1544	1

Remark: \* indicates statistical significance at the 5% level.

Table 3: Cross-country correlation matrices of standard deviations

	148 countries				118 countries			
	$\hat{P}$	$\hat{M}$	$\hat{y}$	$\hat{k}$	$\hat{P}$	$\hat{M}$	$\hat{y}$	$\hat{k}$
$\hat{P}$	1				1			
$\hat{M}$	0.8736*	1			0.9014*	1		
$\hat{y}$	0.3524*	0.3908*	1		0.2944*	0.3647*	1	
$\hat{k}$	0.5470*	0.7844*	0.4535*	1	0.5107*	0.7262*	0.5408*	1

*Remark:* \* indicates statistical significance at the 5% level.

In sum, focusing on the size of  $\hat{k}$  as the central implication of the QTM, there is no difference in regard to stability between high- and low-inflation countries. We find it a bit odd that the contrary results of the existing literature have never been challenged, since they have no foundation in economic theory or in common sense.

## 4 Monetarism and the QTM

Interest in the QTM was always related to questions of monetary policy. Throughout most of its history this involved the explanation and prevention of inflation. The Great Depression of the 1930s and the subsequent rise of Keynesianism moved the focus of economic policy concerns towards the maintenance of aggregate demand in the short run. Money and monetary policy lost their position at the center of the stage.

Following WWII, governments generally belonged to the political left, committed to an activist and expanding role of the government. They embraced a populist version of Keynesianism according to which deficit financed expansion of government programs would stimulate economic growth and advance the general welfare. The eventual consequence was stagflation.

The counterrevolution to the Keynesian revolution, that came to be known as monetarism, originated in the economics department of the University of Chicago, the central role being played by Milton Friedman. Monetarism was Keynesianism stood on its head. The new assumptions were:

- (a) The economy is stable in the sense of tending to its full employment equilibrium, defined as the state in which it exhibits the irreducible ‘natural rate of unemployment’.
- (b) Observed deviations from full employment were attributed to unavoidable random shocks or to misguided attempts at stabilization. The possibility of conducting successful stabilization policies was denied.
- (c) Keynesian macro-econometric models that were intended to provide the foundation for stabilization policies were rejected.

- (d) A central role was assigned to the QTM. It was interpreted as describing a unidirectional causality going from the stock of money to prices and possibly also to short-run effects on output. The QTM was assumed to be a stable long-run relationship, but unstable in the short-run. This short-run instability was taken as a prime cause of the inability to conduct successful stabilization policies.<sup>8</sup>
- (e) Friedman advocated the ‘ $k$ -percent monetary growth’ rule for monetary policy. According to this rule, the central bank should first announce and then carry out a policy of expanding the money supply at a constant rate equal to the expected real growth rate of the economy (Friedman 1959).

Monetarism did have an influence on central bank behavior, particularly in fighting the inflation of the 1970s with more restrictive monetary policies. However, no central bank ever formally adopted Friedman’s  $k$ -percent monetary growth rule. One reason, advanced by the central banks, is that monetary aggregates are not under their direct control and are difficult to influence in the short run.

More tacit, but at least equally important is the fact that central banks are expected to engage in stabilization policies and both they and the economists advising them derive much of their prestige from the claim that they can do this. For both of these reasons, central bankers and macroeconomists embraced the *Taylor rule* which employs the short term interest rate as the key policy parameter available to central banks. Taylor rules were incorporated in New Keynesian and DSGE models and the money stock largely disappeared as a relevant variable from these.

We believe that in the light of both our empirical findings and of the experience with attempted stabilization policies it is appropriate to consider basing monetary policy on a ‘new  $k$  rule’ for monetary policy in which the ‘ $k$ ’ equals the Cambridge parameter. Our proposed rule is

$$\hat{M} = \hat{P}^d + \hat{k}, \tag{5}$$

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<sup>8</sup>Friedman (1956) discusses the QTM as a central concept of the Chicago tradition.

where  $\hat{P}^d$  is the desired inflation rate and  $\hat{k}$  is the observed growth rate of the Cambridge coefficient, estimated as in our paper.

Formally, this equation is a transformation of the one proposed by McCallum (1988). The differences are that he worked with the velocity  $v = 1/k$  and defined  $\hat{Y}$  rather than  $\hat{P}$  as the target variable. McCallum intended his equation to be used in the context of stabilization policy by taking account of the short-run variability of velocity. He estimated  $\hat{v}$  as an average over the observed rates of four years. Estrella and Mishkin (1997) cast doubt on the usefulness of the ‘McCallum rule’ for the intended purpose. Our purpose and procedure is different; we estimate  $\hat{k}$  over the entire available sample and propose to use (5) for the determination of the desired long-run inflation rate.

The choice of any policy rule or strategy should be based on the perceived likelihood of success of the alternatives. Short-run stabilization of the economy including the inflation rate has been the policy of central banks at least since the end of WWII. The result has been questionable. The authors of a recent article find:

Over the past three decades, we find that asymmetric policy responses heavily contributed to manias and bursting bubbles that eventually trapped the major industrial economies into near zero short-term interest rates with rapidly rising public indebtedness. (Hoffmann and Schnabl 2011, p. 382)

In spite of decades of effort on the part of macroeconomists there still does not exist a scientifically validated macroeconomic model that could serve as the basis for the conduct of stabilization policies. Moreover, even if such a model existed, it is questionable that policies derived from it would actually be followed. The reason is the strong political pressure to which central banks are subject. This argument is elaborated by Boettke and Smith (2010). They also write:

A fascinating window into the robust political economy of money and banking can be gleaned by a study of the evolution of the ideas of Nobel Laureates Milton Friedman, F.A. Hayek and James Buchanan on monetary policy. Though they are often seen as clashing vociferously on issues in economics despite their ideological kinship, on the question of monetary policy

they all advocated versions of a monetary rule within a central bank regime only to abandon faith in monetary policy-makers and to advocate the substitution of a computer (Friedman), the denationalization of money altogether (Hayek) and constitutionalization (Buchanan) later in their lives. (Boettke and Smith 2010, p. 4)

The policy that we propose is more modest and, we believe, more likely to succeed. Central banks would be well advised to turn their major effort away from short-run stabilization and towards an improved regulation of financial markets. Eliminating the major source of instability is a better policy than trying continuously to counter act.

## 5 Summary and conclusion

In this paper we do not follow the usual approach of looking at correlations between inflation and money growth. Instead we focus on the parameter  $k$  of the Cambridge equation  $M = kY$  in a sample of 148 countries. Our criterion of stability is the average rate of change of  $k$ . This average is slightly under 2 percent annually and is rather stable in the long-run, in spite of substantial fluctuations in the short run.

Regarding methodology we stress the need to analyze a problem conceptually to find the best way of dealing with it. The routine use of some received economic model or statistical method can lead to inferior results. Our results can serve to re-ignite an interest in the long-run control of inflation. At a time of vast increases in the monetary base and of rising fears of inflation, this seems highly relevant.

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# Appendix

Table 4: Countries included in the analysis

Country	Years			adj.	Country	Years			adj.
	first	last	count	sample		first	last	count	sample
Albania	1995	2009	15	1	Latvia	1994	2009	16	0
Algeria	1970	2009	40	1	Lesotho	1974	2009	33	1
Argentina	1961	2009	49	1	Liberia	1975	1989	15	1
Armenia	1994	2009	16	0	Libya	1991	2009	19	1
Australia	1966	2009	44	1	Lithuania	1994	2009	16	1
Azerbaijan	1993	2009	17	0	Luxembourg	1975	2009	31	1
Bahamas, The	1970	2007	38	1	Macao SAR, China	1989	2009	21	1
Bahrain	1981	2009	29	1	Macedonia, FYR	1994	2009	16	0
Bangladesh	1987	2009	23	0	Madagascar	1965	2009	45	1
Barbados	1967	2009	43	1	Malawi	1981	2009	29	1
Belarus	1995	2009	15	1	Malaysia	1961	2009	49	0
Belize	1981	2009	29	1	Mali	1989	2009	21	1
Benin	1993	2009	17	1	Malta	1971	2009	39	1
Bhutan	1984	2009	26	1	Mauritania	1986	2003	18	1
Bolivia	1961	2009	49	0	Mauritius	1977	2009	33	1
Botswana	1975	2009	35	0	Mexico	1961	2009	49	0
Brazil	1981	2009	29	1	Moldova	1995	2009	15	1
Bulgaria	1992	2009	18	0	Mongolia	1993	2009	17	1
Burkina Faso	1961	2009	49	0	Morocco	1961	2009	49	1
Burundi	1966	2009	44	1	Mozambique	1990	2009	20	1
Cambodia	1995	2009	15	1	Myanmar	1961	2004	44	1
Cameroon	1969	2009	41	1	Nepal	1965	2009	45	1
Canada	1961	2008	48	0	Netherlands	1983	2009	26	1
Cape Verde	1987	2009	23	0	New Zealand	1961	2009	49	0
Central African Rep.	1981	2009	29	1	Niger	1964	2009	46	1
Chad	1984	2009	26	1	Nigeria	1961	2009	49	1
China	1987	2009	23	1	Norway	1961	2003	43	1
Colombia	1961	2009	45	0	Pakistan	1961	2009	49	1
Congo, Dem. Rep.	1964	2008	39	0	Panama	1961	2009	49	1
Congo, Rep.	1986	2009	22	1	Papua New Guinea	1974	2009	36	1
Costa Rica	1961	2009	49	0	Paraguay	1961	2009	49	1
Cote d'Ivoire	1961	2009	49	0	Peru	1961	2009	49	1
Croatia	1994	2009	16	1	Philippines	1961	2008	48	1
Cyprus	1976	2009	34	0	Poland	1986	2009	24	0
Czech Republic	1994	2009	16	1	Portugal	1980	2009	29	1
Denmark	1961	2009	49	1	Qatar	1980	2009	30	1
Dominica	1978	2009	30	1	Romania	1991	2009	19	1
Dominican Republic	1961	2009	49	1	Russian Federation	1994	2009	16	1
Ecuador	1961	2009	49	1	Rwanda	1967	2005	37	0
Egypt, Arab Rep.	1961	2009	49	1	Samoa	1983	2009	27	1
El Salvador	1961	2009	49	0	Saudi Arabia	1969	2009	41	1
Equatorial Guinea	1986	2008	23	1	Senegal	1968	2009	42	1
Estonia	1993	2009	17	1	Seychelles	1972	2009	38	1
Ethiopia	1982	2008	27	1	Singapore	1964	2009	46	1
Fiji	1970	2009	40	1	Slovak Republic	1994	2008	15	1
Finland	1961	2009	48	1	Solomon Islands	1979	2009	31	1
France	1978	2009	31	1	South Africa	1966	2009	44	1
Gabon	1963	2009	47	1	Spain	1963	2009	46	1
Gambia, The	1967	2009	43	1	Sri Lanka	1961	2009	49	1
Germany	1992	2009	17	0	St. Kitts and Nevis	1980	2009	30	1
Ghana	1965	2008	44	0	St. Lucia	1980	2009	30	1
Grenada	1978	2009	32	1	St. Vincent and the G.	1976	2009	34	1
Guatemala	1961	2009	49	1	Sudan	1961	2009	49	1
Guinea-Bissau	1988	2009	22	1	Suriname	1968	2008	41	1
Guyana	1995	2009	15	0	Swaziland	1971	2009	39	1
Haiti	1992	2009	18	1	Sweden	1961	2009	37	1
Honduras	1961	2009	49	1	Switzerland	1961	2009	49	1
Hong Kong SAR, China	1992	2009	18	1	Syrian Arab Republic	1961	2009	49	1
Hungary	1983	2009	27	1	Tanzania	1989	2009	21	1
Iceland	1961	2007	47	1	Thailand	1961	2009	49	1
India	1961	2009	49	1	Togo	1967	2009	43	1
Indonesia	1970	2009	40	1	Tonga	1990	2009	20	1
Iran, Islamic Rep.	1966	2009	44	0	Trinidad and Tobago	1961	2009	49	1
Iraq	1961	1976	16	1	Tunisia	1984	2009	26	1
Israel	1961	2009	49	0	Turkey	1961	2009	49	1
Italy	1975	2009	34	1	Uganda	1981	2009	29	1
Jamaica	1961	2009	49	0	Ukraine	1993	2009	17	1
Japan	1961	2009	49	0	United Kingdom	1983	2009	27	1
Jordan	1970	2009	40	1	United States	1961	2009	49	1
Kazakhstan	1994	2009	16	1	Uruguay	1961	2009	49	1
Kenya	1962	2009	48	0	Vanuatu	1980	2009	30	1
Korea, Rep.	1967	2009	43	1	Venezuela, RB	1961	2008	48	1
Kuwait	1973	2008	34	1	Yemen, Rep.	1991	2009	19	1
Lao PDR	1989	2008	20	1	Zambia	1986	2009	22	1