NBER WORKING PAPER SERIES

THE PERFORMANCE OF ALTERNATIVE MONETARY REGIMES

Laurence M. Ball

Working Paper 16124
http://www.nber.org/papers/w16124

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2010

This paper will be a chapter in the Handbook of Monetary Economics (Friedman and Woodford, eds). I am grateful for research assistance from James Lake, Connor Larr, Xu Lu, and Rodrigo Sekkel, and for suggestions from Patricia Bovers, Jon Faust, Benjamin Friedman, Petra Geraats, Carlos Goncalvez, Yingyao Hu, Andrew Levin, Lars Svensson, Tiemen Woutersen, Jonathan Wright, participants in the ECB's October 2009 conference on Key Developments in Monetary Economics, and seminar participants at the University of Delaware. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

The Performance of Alternative Monetary Regimes
Laurence M. Ball
NBER Working Paper No. 16124
June 2010
JEL No. E42,E52,E58

ABSTRACT

This paper compares the performance of economies with different monetary regimes during the last quarter century. The conclusions include: (1) There is little evidence that inflation targeting affects performance in advanced economies, but some evidence of benefits in emerging economies; (2) Europe's monetary union has increased intra-European trade and capital flows, but divergence in national price levels may destabilize output in the future; (3) The "monetary analysis" of the European Central Bank has little effect on the ECB's policy decisions; and (4) Countries with hard currency pegs experience unusually severe recessions when capital flight occurs.

Laurence M. Ball
Department of Economics
Johns Hopkins University
Baltimore, MD 21218
and NBER
lball@jhu.edu

I. INTRODUCTION

The choice of monetary regime is a perennial issue in economics. For decades, advocates of discretionary or "just do it" monetary policy have debated supporters of regimes that constrain policymakers. Such regimes range from money targeting, advocated by Milton Friedman in the 1960s, to the inflation targeting practiced by many countries today.

This chapter compares monetary regimes that have been popular in advanced and emerging economies during the last 25 years. I examine countries with discretionary policy, such as the United States, and countries with inflation targets. I also examine countries that have given up national monetary policy, either by forming a currency union or through a hard peg to a foreign currency. Finally, I examine a remnant of the once-popular policy of money targeting: the European Central Bank's use of "monetary analysis" in setting interest rates.[1]

---

[1] To keep this chapter manageable, I limit the analysis in two ways. First, while I examine hard exchange rate pegs – currency boards and dollarization – I otherwise deemphasize exchange-rate policy. I do not address the relative merits of flexible exchange rates, managed floats, and adjustable pegs. Frankel's chapter in this Handbook discusses these issues.

Second, I examine both advanced economies and emerging economies, but not the world's poorest countries. Emerging economies include such countries as Brazil and the Czech Republic; they do not include most countries in Africa. Many of the poorest countries target monetary aggregates, a policy that has lost favor among richer countries (see IMF [2008] for a list of money targeters).

Other chapters in this Handbook examine the theoretical arguments for alternative policies (e.g. Svensson on inflation targets). This chapter deemphasizes theory and examines the actual economic performance of countries that have adopted alternative regimes. I focus on the behavior of core macroeconomic variables: output, inflation, and interest rates.

Section II of this chapter examines two monetary regimes adopted by many countries: inflation targeting (IT), and membership in Europe's currency union. I focus on advanced economies and the period from 1985 to mid-2007 –- the Great Moderation. Simple statistical tests suggest that neither IT nor the euro had major effects on economic performance, either good or bad, during the sample period. An important topic for future research is the performance of the two regimes during the recent financial crisis.

Section III reviews the previous literature on inflation targeting. Many papers confirm my finding that IT does not have major effects in advanced economies. Some authors report beneficial effects, but their evidence is dubious. The story is different when we turn to emerging economies: there is substantial evidence that IT reduces average inflation in these economies and stabilizes inflation and output. Even for emerging economies, however, the effects of IT are not as clear-cut as

some authors suggest.

Section IV surveys research on the effects of the euro and adds some new results. The evidence to date suggests that the currency union has produced a moderate increase in intra-European trade and a larger increase in capital-market integration. On the downside, price levels in different countries have diverged, causing changes in competitiveness. This problem could destabilize output in the future.

Section V turns to the role of money in policymaking at the European Central Bank. On its face, the ECB's reliance on a "monetary pillar" of policy differs from the practices of most central banks. However, a review of history suggests that this difference is largely an illusion. ECB policymakers regularly discuss the behavior of monetary aggregates, but these variables rarely if ever influence their setting of interest rates.

Finally, Section VI discusses hard exchange-rate pegs, including currency boards and dollarization. History suggests that these policies are associated with substantial risk of economic downturns. In most economies with hard pegs, episodes of capital flight have produced deep recessions.

Section VII concludes.

II. SOME SIMPLE EVIDENCE

In the past quarter century, two development in monetary policy stand out: the spread of inflation targeting and the creation of the euro. I estimate the effects of these regime shifts on economic performance during the period from 1985 to mid-2007––an era of economic stability commonly known as the Great Moderation. I examine 20 advanced economies, including countries that adopted inflation targeting, joined the euro, did neither, or did both (Spain and Finland adopted IT and then switched to the euro). I find that neither of the two regimes has substantially changed the behavior of output, inflation, or long-term interest rates.

Background

New Zealand and Canada pioneered inflation targeting in the early 1990s. Under this regime, the central bank's primary goal is to keep inflation near an announced target or within a target range. This policy quickly gained popularity, and today approximately 30 central banks are inflation targeters (IMF, 2008).

In 1999, 11 European countries abolished their national currencies and adopted the euro; 15 countries used the euro in 2009. This currency union dwarfs all others in the world. I will interpret euro adoption as a choice of monetary regime:

rather than choose discretionary policy or inflation targeting, a country cedes control of its monetary policy to the ECB.

I compare inflation targeting and euro membership to a group of policy regimes that I call “traditional.” This group includes all regimes in advanced economies since 1985 that are *not* IT or the euro. Some of these regimes, such as those of the United States and Japan, fit the classic notion of discretion. In classifying policy regimes, the IMF (2008) categorizes the U.S. and Japan as “other,” with a footnote saying they “have no explicitly stated nominal anchor, but rather monitor various indicators in conducting monetary policy.”

Other regimes in the traditional category do involve some nominal anchor, at least in theory. These regimes include money targeting in Germany and Switzerland in the 1980s and 1990s. They also include the European Monetary System (EMS) of the same era, which featured target ranges for exchange rates.

In most cases, traditional monetary regimes are highly flexible. Germany and Switzerland’s money targets were medium-run guide-posts; policymakers had considerable discretion to adjust policy from year to year (Bernanke and Mishkin, 1992). The EMS also gave central banks substantial latitude in setting policy. A country could belong to the System *and* adopt another regime: Germany targeted money and Spain and Finland targeted inflation.

Exchange-rate bands were adjusted a number of times, and countries could leave the System (the U.K. and Italy) and reenter (Italy).

Economists have suggested many effects of switching from traditional policy regimes to IT or the euro. For example, proponents of IT argue that this policy anchors inflation expectations, making it easier to stabilize the economy (e.g. King, 2005). Skeptics, on the other hand, suggest that IT stabilizes inflation at the expense of more volatile output (e.g. Kohn, 2005). Proponents argue that IT increases the accountability of policymakers (e.g. Bernanke et al., 1999), while skeptics argue that IT reduces accountability (Friedman, 2004).

Many students of the euro cite both benefits and costs of this regime (e.g. Lane, 2006, 2009). For example, a common currency increases the integration of European economies, promoting efficiency and growth. On the other hand, “one size fits all” monetary policy produces sub-optimal responses to country-specific shocks.

Methodology

Here I seek to measure the effects of IT and the euro in simple ways. I focus on basic measures of economic performance: the means and standard deviations of inflation, output, and long-

term interest rates. The basic approach is “differences in differences”: I compare changes in performance over time in countries that adopted IT or the euro and countries that did not. An important detail is that, following Ball and Sheridan (2005), I control for the initial level of performance. This approach addresses the problem that changes in policy regime are endogenous.

Gertler (2005) and Geraats (2010) criticize the Ball-Sheridan methodology, suggesting that it produces misleading estimates of the effects of regime changes. Here I present the method and discuss informally why it eliminates the bias in pure diffs-in-diffs estimates. Appendix 1 to this chapter formally derives conditions under which the Ball-Sheridan estimator is unbiased.

Ball and Sheridan examine two time periods and two policy regimes, inflation targeting and traditional policy. In this chapter’s empirical work, I add a third regime, the euro, and examine three time periods. To build intuition, I first discuss estimation of the effects of IT in the two-period / two-regime case, and then show how the approach generalizes.

Two Periods and Two Regimes Let X be some measure of economic performance, such as the average rate of inflation. X_{i1} and X_{i2} are the levels of X in country i and periods 1 and 2. In

period 1, all countries have traditional monetary policy; in period 2, some countries switch to inflation targeting.

At first blush, a natural way to estimate the effect of IT on X is to run a diffs-in-diffs regression:

(1) $X_{i2} - X_{i1} = a + bI_i + \epsilon_i$,

where I_i is a dummy variable that equals one if country i adopted IT in period 2. The coefficient b is the average difference in the change in X between countries that switched to IT and countries that did not. One might think that b captures the effect of IT.

Unfortunately, the dummy variable I is likely to be correlated with the error term ϵ, causing bias in the OLS estimate of b. To see this point, suppose for concreteness that X is average inflation. The correlation of ϵ and I has two underlying sources:

(A) Dissatisfaction with inflation performance in period 1 is one reason that a country might adopt IT in period 2. That is, a high level of X_{i1} makes it more likely that I_i=1. The data confirm this effect: the average X_{i1} is significantly higher for IT adopters than for non-adopters.

(B) A high level of X_{i1} has a negative effect on X_{i2}-X_{i1}. This effect reflects the basic statistical phenomenon of regression to the mean: high values of X_{i1} are partly the result of transitory

factors, so they imply that X_i is likely to fall in period 2. This effect exists regardless of whether a country adopts IT; thus a high X_{i1} has a negative effect on the error term ϵ_i in equation (1).

To summarize, X_{i1} has a positive effect on I_i and a negative effect on ϵ_i. As a result, variation in X_{i1} induces a negative correlation between I_i and ϵ_i, which biases downward the OLS estimate of b. If IT has no true effect on inflation, the estimate of b is likely to suggest a negative effect. For more on this point, readers who like folksy intuition should see the analogy to baseball batting averages in Ball and Sheridan (p. 256). Readers who prefer mathematical rigor should see Appendix 1 to this chapter.

Ball and Sheridan address the problem with equation (1) by adding X_{i1}:

(2) $X_{i2} - X_{i1} = a + bI_i + cX_{i1} + \epsilon_i$

In this specification, ϵ_i is the change in X_i that is not explained by either I_i or X_{i1}. Variation in X_{i1} does not affect this term, so effect (B) discussed above does not arise. X_{i1} still affects I_i (effect (A)), but this no longer induces correlation between I_i and ϵ_i. The bias in the OLS estimate of b disappears.

Again, Appendix 1 expands on this argument: it derives

conditions under which OLS produces an unbiased estimate of b in equation (2). The intuition is that adding X_{i1} to the equation controls for regression to the mean. Now if b is significant, it means that adopting IT has an effect on inflation that is unrelated to initial inflation.

Three Periods and Three Regimes In this chapter's empirical work, I compare three policy regimes: traditional policy, IT, and the euro. I also split the data into three time periods: t = 1, 2, 3; as detailed below, this is natural given the observed timing of regime shifts. To capture these changes, I generalize equation (2) to

$$(3)\quad X_{it} - X_{it-1} = aD^2_t + bD^3_t + cI_{it} + dE_{it} + eX_{it-1}(D^2_t) + fX_{it-1}(D^3_t) + \varepsilon_{it}\ ,\ t=2,3$$

where D^2_t and D^3_t are dummy variables for periods 2 and 3. In this regression, there are two observations for each country. For one observation, the dependent variable is the change in X from period 1 to period 2; in the other, it is the change from 2 to 3.

On the right side of equation (3), the variables of interest are I_{it} and $E_{it,}$ which indicate changes in regime from period t-1 to period t. These variables are defined by

I_{it} = 1 if country i switched from traditional policy in period t-1 to IT or the euro in period t;

= 0 otherwise .

E_{it} = 1 if country i switched from traditional policy or IT in period t-1 to the euro in period t;

= 0 otherwise .

To interpret these variables, it is helpful to look ahead to the data. In period 1, all countries have traditional monetary policy. In period 2, which starts in the early 1990s, some switch to IT. In period 3, which starts in the late 1990s, additional countries adopt IT, and some countries switch from their period-2 regime to the euro. In the entire sample, we observe three types of regime changes: traditional to IT, IT to the euro, and traditional to the euro.

If country i switches from traditional policy to IT in period t, then I_{it}=1 and E_{it}=0. The coefficient on I gives the effect of this regime change. If a country switches from IT to the euro, then I_{it}=0 and E_{it}=1; the coefficient on E gives the effect. Finally, if a country switches from traditional policy to the euro, then I_{it}=1 and E_{it}=1. Thus the effect of a traditional-to-euro switch is the sum of the coefficients on I and E.

The dummy variables D^2_t and D^3_t allow the constant in the regression to differ across time periods. Similarly, the interactions of the dummies with X_{it-1} allow different regression-to-the-mean effects. Appendix 1 discusses the interpretation of

these differences.

The Data

I estimate equation (3) for 20 advanced economies: all countries with populations above one million that were members of the OECD in 1985. This choice of countries follows Ball and Sheridan. Table 1 lists the countries and their policy regimes in three time periods. In the 20 countries, regime shifts occurred in two waves: seven countries adopted IT from 1990 to 1995, and twelve adopted either IT or the euro from 1999 to 2001. Thus the data break naturally into three periods: before the first wave of regime changes, between the two waves, and after the second wave.

The precise dating of the periods differs across countries. In all cases, period 1 begins in 1985:1. For countries that adopted IT in the early 1990s, period 2 starts in the first quarter of the new policy. For countries that did *not* adopt IT in the early 90s, period 2 begins at the average start date of adopters (1993:3). Similarly, for countries that switched regimes between 1999 and 2001, period 3 starts in the first quarter of the new policy, and the start date for non-switchers is the average for switchers (1999:2). Period 3 ends in 2007:2 for all countries.

I estimate equation (3) for six versions of the variable X: the means and standard deviations of consumer price inflation,

real output growth, and nominal interest rates on long-term government bonds. The inflation data are from the IMF's International Financial Statistics; output and interest rates are from the OECD. The inflation and interest-rate data are quarterly. The output data are annual because accurate quarterly data are not available for all countries. (In studying output behavior, I include a year in the time period for a regime only if all four quarters belong to the period under my quarterly dating.)

Appendix 2 to this chapter provides further details about the data. It also provides complete results of the regressions discussed here.

Main Results

Table 2 summarizes the key coefficient estimates: the coefficients on I and E for the six measures of performance. The Table also shows the sum of the coefficients, which gives the effect of a traditional-to-euro switch.[2]

Effects of IT: The first row of Table 2 shows the effects of switching from traditional policy to IT. There is only one

[2] Table 2 reports OLS standard errors. It does *not* report robust standard errors that account for heteroscedasticity or correlations between a country's errors in periods 2 and 3. The good properties of robust standard errors are asymptotic; with 40 observations, OLS standard errors may be more accurate. (The folk wisdom of applied econometricians appears to support OLS standard errors for small samples, but I have not found a citation.) In any case, I have also computed robust standard errors for my estimates, and they do not change my qualitative results.

beneficial effect: IT reduces average inflation by -0.7 percentage points (t=2.6). To interpret this result, note that average inflation for IT countries is 1.7% in period 2 and 2.1% in period 3. My estimate implies that these numbers would be 2.4% and 2.8% without IT. This effect is not negligible but not dramatic either.

Point estimates imply that IT raises the mean and standard deviation of long-term nominal interest rates. The statistical significance of these effects is borderline, however, and they do not have a compelling theoretical explanation; to the contrary, if IT anchors inflation expectations, it ought to stabilize long-term interest rates at a low level. I am inclined to dismiss the interest-rate results as flukes. In any case, there is no evidence whatsoever that IT improves the behavior of interest rates or output.

Effects of the Euro: The estimated effects of euro adoption are shown in the second and third rows of Table 2. The second row shows effects of an IT-euro switch; the third row, a traditional-euro switch.

Once again, the results do not point to large benefits of a new regime. Euro adoption can reduce average interest rates––but the effect has borderline significance (t=2.0) and arises only for an IT-euro switch, not a traditional-euro switch. A priori,

one might expect a larger effect for the second type of switch. There is also an adverse, borderline-significant effect of a traditional-euro switch on output volatility.

Robustness

I have varied my estimation of equation (3) in several ways:

• I have dropped countries from the sample to make the set of “traditional” policy regimes more homogeneous. In one variation, I eliminate Denmark, which fixes its exchange rate against the euro. In another, I eliminate all countries that belonged to the pre-1999 European Monetary System. (In this variation I can estimate the effects of IT but not of the euro, as only EMS members adopted the euro).

• I have varied the dating of the three time periods, making them the same for all countries. Specifically, periods 2 and 3 begin on the average dates of regime switches, 1993:3 and 1999:2. Consistency in time periods has the cost of less precise dating of individual regime changes.

• Finally, I allow inflation targeting to have different short-run and long-run effects. This could occur if it takes time for expectations to adjust to a new regime. In equation (3), I add a third dummy variable that equals one if a country is an

inflation targeter in both t-1 and t. In this specification, the coefficient on I is the immediate effect of adopting IT, and the sum of coefficients on I and the new dummy is the effect in the second period of targeting.

Appendix 2 gives the results of these robustness checks. To summarize, the weak effects in Table 2 generally stay the same or become even weaker. In some cases, the effect of IT on average inflation becomes insignificant.

Future Research: Policy Regimes and the Financial Crisis

It is not surprising that effects of regime changes are hard to detect for the period from 1985 to 2007. During this period –- the Great Moderation –- central banks in advanced economies faced few adverse shocks. As a result, they found it relatively easy to stabilize output and inflation with or without IT or the euro. An important topic for future work is the performance of policy regimes during the world financial crisis that ended the Great Moderation period.

A starting point for future work is the different behavior of the Federal Reserve and other central banks. The Fed started reducing interest rates in September 2007, after interbank lending markets froze temporarily. In contrast, the ECB and most

IT central banks kept rates steady until October 2008, after the failure of Lehman Brothers caused panic in financial markets. Inflation targeters that kept rates steady include the U.K., whose financial system experienced problems over 2007-08 that were arguably just as bad or worse than those in the U.S. An open question is whether the Fed's discretionary policy regime was part of the reason for its quick reaction to the financial crisis.

III. PREVIOUS WORK ON INFLATION TARGETING

A large literature estimates the effects of inflation targeting, with varying results. Much of the variation is explained by which countries are examined. Inflation targeting has spread from advanced economies to emerging economies, such as Brazil, South Africa, and the Czech Republic. Table 3 lists emerging-economy inflation targeters. Most work on advanced economies, although not all, confirms the findings of Section II: the effects of IT are weak. In contrast, papers that examine emerging economies report significant benefits of IT. Most researchers find that IT reduces average inflation in emerging economies, and some also find effects on output and inflation

stability. Surveying the literature, Walsh (2009) concludes that IT does not matter for advanced economies but does matter for emerging economies.

This conclusion makes sense, as pointed out by Goncalvez and Salles (2008). Central banks in advanced economies are likely to have higher levels of credibility and expertise than those in emerging economies, and to face smaller shocks. These advantages may allow policymakers to stabilize the economy without an explicit nominal anchor, while emerging economies need the discipline of IT.

Here, I critically review past research on inflation targeting. In choosing papers to examine, I have sought to identify the most influential work in an objective way. To that end, I searched Google Scholar in January 2010 for all papers dated 2000 or later with “Inflation Targeting” or “Inflation Targeter” in the title. Of those papers, I chose all that satisfied two criteria: they contain empirical work comparing countries with and without inflation targets, and they had at least 20 citations. I ended up with 14 papers.[3]

[3] I include two papers with fewer than 20 citations: Lin and Ye (2009) and Gurkaynak (2008). These papers are helpful for interpreting other papers by the same authors with more

These papers address three broad topics: the effects of IT on the means and variances of output and inflation; effects on the persistence of shocks to inflation; and effects on inflation expectations. Here I give an overview of this work; Appendix 3 provides further details. Unfortunately, a variety of problems casts doubt on the conclusions of most studies.

Means and Variances

Many papers ask how IT affects the first two moments of inflation and output. As discussed earlier, it is tricky to answer this question because IT adoption is endogenous. Studies can be categorized by how they address this endogeneity problem.

Differences-in-differences: Some early papers measure the effects of IT with a pure differences-in-differences approach: they estimate equation (1) or do something similar. This work includes Cecchetti and Ehrman (2000), Hu (2003), and Neuman and von Hagan (2002). These papers generally find that IT reduces the mean and variance of inflation; they report mixed results about the variance of output.

---

than 20 cites. I leave out one paper with more than 20 cites, Corbo et al. (2002). This paper appears to be superceded by Mishkin and Schmidt-Hebbel (2007), which has a common coauthor and the same title.

These papers were natural first steps in studying the effects of IT. However, subsequent work has established that estimates of equation (1) are biased because initial conditions affect IT adoption. Studies that ignore this problem do not produce credible results.

Controlling for Initial Conditions: As described above, Ball and Sheridan (2005) address the endogeneity problem by estimating equation (2), a diffs-in-diffs equation that controls for the initial level of performance. They examine advanced economies and, like the empirical work above, find no effects of IT except a weak one on average inflation (a decrease of 0.6 percentage points with a t-statistic of 1.6).

Goncalvez and Salles estimate equation (2) for a sample of 36 emerging economies and find substantial effects of IT. Switching to this policy reduces average inflation by 2.5 percentage points. It also reduces the standard deviation of annual output growth by 1.4 percentage points. For the average IT adopter, the standard deviation of output growth under IT is 2.2 percentage points; Goncalvez and Salles's results imply that this number would be 3.6 points without IT. The combination of these results and Ball and Sheridan's support the view that IT has

stronger effects in emerging economies than in advanced economies.

Goncalvez and Salles's results are important, but they raise questions of interpretation and robustness. Five of the non-IT countries in the study, including Argentina and Bulgaria, have hard currency pegs during parts of the sample period. As discussed in Section VI, hard pegs can increase output volatility. It is not clear how Goncalvez and Salles's results would change if the non-IT group included only countries with flexible policy regimes.

One can also question Goncalvez and Salles's dating of regime changes and their treatment of years with very high inflation. These issues are discussed in Appendix 3. More work is needed to test the validity of Goncalvez and Salles's conclusions.

Instrumental Variables If inflation targeting is endogenous, it might seem natural to estimate its effects by instrumental variables. Mishkin and Schmidt-Hebbel (2007) take this approach with quarterly data for 21 advanced and 13 emerging economies. In the equation they estimate, inflation depends on lagged inflation and a dummy variable for IT. Mishkin and Schmidt-Hebbel find no

significant effect of IT for advanced economies, but a big effect for emerging economies: in the long run, IT reduces inflation by 7.5 percentage points. This estimate is three times the effect found by Goncalvez and Salles.

Mishkin and Schmidt-Hebbel's results are not credible, however, because of the instrument they use for the IT dummy: the lagged IT dummy. Mishkin and Schmidt-Hebbel motivate their use of IV by arguing that the IT dummy is influenced by variables that also affect inflation directly, such as central bank independence and the fiscal surplus –- variables captured by the error term in their equation. If these variables affect the IT dummy, then they also affect the lagged IT dummy. For example, the features of New Zealand that help explain why it targeted inflation in the first quarter of 2000 also help explain why it targeted inflation in the last quarter of 1999. Mishkin and Schmidt-Hebbel's instrument is correlated with the error in their equation, making it invalid.

Propensity Score Matching: A final approach to the endogeneity problem is propensity score matching. This method is relatively complex, but the idea is to compare the performance of IT and non-IT countries that are similar along other dimensions.

Two papers by Lin and Ye (2007, 2009) take this approach. Consistent with other work, they find that IT matters in emerging economies but not advanced economies. For emerging economies, they find that IT reduces average inflation by 3%, not far from Goncalvez and Salles's estimate. They also find that IT reduces inflation volatility.

Vega and Winkelreid (2005) also use propensity score matching. They find that IT reduces the level and volatility of inflation in *both* advanced and emerging economies. In my view, there are several reasons to doubt the results for advanced economies. The issues are somewhat arcane, so I leave them for Appendix 3.[4]

Inflation Persistence

Advocates of inflation targeting, such as Bernanke et al (1999), argue that this policy reduces inflation persistence: shocks to inflation die out more quickly. The Ball-Sheridan and Mishkin-Schmidt-Hebbel papers introduced above both test for such an effect. For advanced economies, Ball and Sheridan find that IT

[4] Duecker and Fischer (2006) match inflation targeters with similar non-targeters informally. Like Lin and Ye, they find no effects of IT in advanced economies.

has no effect on persistence in the univariate inflation process. For emerging economies, Mishkin and Schmidt-Hebbel find that IT reduces the persistence of inflation movements resulting from oil-price and exchange-rate shocks. These results support the distinction between advanced and emerging economies that runs through the IT literature.

Probably the best-known work on IT and inflation persistence is Levin et al. (2004). This paper is unusual in reporting strong effects of IT in advanced economies. Levin et al. estimate quarterly AR processes for inflation and "core inflation" and compute persistence measures such as the largest autoregressive root. For the period 1994-2003, Levin et al. conclude that persistence is "markedly lower" in five IT countries than in seven non-IT countries.

Once again, there are reasons to doubt the conclusion that IT matters. One is that the IT countries in the sample are smaller and more open economies than the non-IT countries. This difference, rather than the choice of policy regime, could explain different inflation behavior in the two groups. Appendix 3 discusses this point and related questions about Levin et al.'s results.

Inflation Expectations

Four papers present evidence that IT affects either short run or long run inflation expectations.

Short Run Expectations: Johnson (2002) examines eleven advanced economies that reduced inflation in the early 1990s. He compares countries that did and did not adopt inflation targets near the start of disinflation. Johnson measures expected inflation with the one-year-ahead forecast from Consensus Forecasts, and finds that this variable fell more quickly for inflation targeters than for non-targeters.

There are no obvious flaws in Johnson's analysis, but it raises a puzzle. As Johnson points out, a standard Phillips curve implies that a faster fall in expected inflation should allow targeters to achieve greater disinflation for a given path of output. In other words, the sacrifice ratio should fall. Yet other work finds that IT does not affect the sacrifice ratio, at least in advanced economies (e.g. Bernanke et al. 1999).

Long Run Expectations Proponents of IT argue that this regime anchors long run inflation expectations (e.g. Bernanke et al; King, 2005). Once IT is established, expectations remain at the target even if actual inflation deviates from it temporarily.

This effect makes it easier for policymakers to stabilize the economy.

Three papers present evidence for this effect. The first is the Levin et al. paper introduced above. In addition to measuring persistence in actual inflation, the paper examines professional forecasters' expectations of inflation from three to ten years in the future. For each country in their sample, the authors estimate an effect of past inflation on expected inflation. The estimates are close to zero for inflation targeters but significant for non-targeters.

Levin et al.'s regressions appear to uncover some difference between targeters and non-targeters. Yet the specification and results are odd. Levin et al. regress the change in expected inflation from year t-1 to year t on the difference in actual inflation between t and t-3 (although they do not write their equation this way). One would expect the change in expectations to depend more strongly on the current inflation change than the three-year change. Yet Levin et al. find large effects of the three-year change in non-IT countries (again, see Appendix 3 for details).

The other two papers on long-term expectations are Gurkaynak

et al. (2006) and Gurkaynak et al. (2008). These papers estimate the effects of news, including announcements of economic statistics and policy interest rates, on expected inflation. They measure expectations with daily data on interest rates for nominal and indexed government bonds. Together, the two papers find that news has significant effects on expectations in the United States, a non-inflation-targeter, but not in three targeters, Sweden, Canada, and Chile. For the U.K., a targeter, they find effects before 1997, when the Bank of England became independent, but not after. Gurkaynek et al. (2006) conclude that “a well-known and credible inflation target” helps anchor expectations.

These papers are among the more persuasive in the IT literature. The worst I can say is that they examine only one non-IT country, the United States, where bond markets may differ from those of smaller countries in ways unrelated to inflation targeting. Also, part of the U.S. data come from the first few years after indexed bonds were created, when the market for these bonds was thin. For those years, yield spreads may not be accurate measures of expectations. Future research should extend the Gurkaynak analysis to later time periods and more countries.

Summary

Many papers find beneficial effects of IT in emerging economies, but the evidence is not yet conclusive. For advanced economies, most evidence is negative. However, IT may affect long-term inflation expectations in bond markets.

IV. THE EURO

How has the euro affected the countries that joined? We saw earlier that, for the Great Moderation period, euro adoption had no detectable effects on the level or volatility of output growth, inflation, or interest rates (Table 2). Starting in 2008, the euro area experienced a deep recession along with the rest of the world. It is not obvious that currency union was either beneficial or harmful during this episode.

Yet the euro has not been irrelevant. Some of the effects predicted when the currency was created have started to appear. Here I review evidence for two widely-discussed effects: greater economic integration, and costs of a "one size fits all" monetary policy.[5]

[5] As this chapter neared completion in early 2010, a crisis in Greece spurred controversy about the euro. Greece found itself in the position of countries with hard pegs, which cannot use

Economic Integration

Euro proponents argue that a common currency promotes trade and capital flows within the euro area. These effects follow from lower transaction costs, more transparent price comparisons, and the elimination of any risk of speculative attacks. Greater integration should increase competition and the efficiency of resource allocation, raising economic growth (see, e.g., Papademos [2009]).

Trade: Previous Research A large literature estimates the deteminants of trade with "gravity equations," in which trade between two countries depends on their size, distance from each other, income, and so on –- and whether the countries use a common currency. Using this approach, Rose (2000) famously estimated that a currency union increases trade among its members by 200%. This finding was based on data for small currency unions that predate the euro; some used it to predict the effects of euro adoption.

In recent years, researchers have had enough data to

---

exchange rates as shock absorbers when capital flight occurs (see Section VI). The ultimate effects on Greece and other euro countries are unclear, but they will likely influence future assessments of the costs and benefits of currency unions.

estimate the actual effects of the euro. They report effects that are much smaller than those found by Rose, but non-negligible. A survey by Baldwin (2006) concludes that the euro has raised trade among members by 5-10%. A survey by Frankel (2010) says 10-15%.

One might think the effects of a currency union grow over time as trade patterns adjust to the new regime. But Frankel finds that the effects stop growing after five years or so, based on data for both the euro and other currency unions.

Trade: New Evidence I supplement previous research with some simple new evidence. If a common currency promotes trade within the euro area, this trade should increase relative to trade between euro countries and other parts of the world. Figure 1 looks for this effect in the DOTS data on bilateral trade from the IMF.

In the Figure, trade within the euro area is measured by all exports from one euro country to another, as a percent of euro area GDP. Trade with another group of countries is measured by exports from the euro area to the other countries plus imports from the other countries, again as a percent of euro area GDP. All variables are normalized to 100 in 1998, the year before the

euro was created.

In Figure 1, one group of non-euro countries has just one member, the United Kingdom. The U.K. is the European Union's most prominent non-adopter of the euro. Another group of countries includes 11 advanced economies, specifically non-euro countries that were members of the OECD in 1985. The final group is all 183 non-euro countries in the DOTS data set.

The Figure suggests that the euro has boosted trade among euro countries. Trade with other regions rose more rapidly than intra-euro trade from 1993 through 1998. But starting in 1999, the first year of the common currency, intra-euro trade rose relative to trade with the U.K. and other advanced economies. This divergence accelerated after 2002. In 2008, intra-euro trade was almost 40% higher than it was in 1998. In contrast, euro-OECD trade rose less than 10% from 1998 to 2008, and euro-UK trade was almost unchanged.

These results suggest a larger impact of the euro on trade than the 5-15% reported in previous work. They also suggest, contrary to Frankel, that the effects of the euro were still growing ten years after the currency was created. A caveat is that my analysis does not control for time-varying determinants

of trade patterns, such as income levels and exchange-rate volatility.

Notice that trade among euro countries has *not* risen more than trade with all DOTS countries. From 1998 to 2008, the changes in intra-euro trade and in trade with the rest of the world are almost identical. This fact reflects rising trade with emerging economies such as India and China, which have become larger parts of the world economy. One way to interpret the euro's influence is that it has helped intra-euro trade keep pace with trade between Europe and emerging markets.

Capital Markets: Lane (2009) surveys the effects of the euro on capital market integration and finds they are large. He discusses three types of evidence. The first are estimates of the euro's effects on cross-border asset holdings, which are based on gravity equations like those in the trade literature. Papers such as Lane and Milesi-Ferretti (2007, 2008) find that the euro has roughly doubled cross-border holdings of bonds within the currency union. It has increased cross-border holdings of equity by two thirds. Other studies find smaller but significant effects on foreign direct investment and cross-border bank loans.

The second type of evidence is convergence of interest

rates. Money market rates have been almost identical in different euro countries, except at the height of the financial crisis. Cross-country dispersion in long-term interest rates has also fallen, and the remaining differences can be explained by risk and liquidity.[6]

Finally, Lane presents scattered but intriguing evidence that the integration of capital markets has contributed to overall financial development. A striking fact is that the quantity of bonds issued by euro-area corporations tripled between 1998 and 2007. Papaioannou and Portes (2008) find that joining the euro increases a country's bank lending by 17% in the long run. Using industry data, Dvorak finds that the euro has increased physical investment, especially in countries with less-developed financial systems.

Does One Size Fit All?

When a country adopts the euro, it gives up independent monetary policy. It can no longer adjust interest rates to offset country-specific shocks. Critics of monetary union (e.g.

[6] Since Lane (2009) surveyed the evidence for interest-rate convergence, rates on government bonds have diverged as a result of the Greek debt crisis of 2009-2010. However, this development may be explained by default risk rather than decreased integration of capital markets. The long-term effects of the Greek crisis on capital markets remain to be seen.

Feldstein, 2009) suggest that the reduced scope for policy leads to greater output volatility.

As discussed by Blanchard (2006, 2007), this problem may be exacerbated by the behavior of national price levels. When a country experiences an economic boom, its inflation rate is likely to exceed the euro average. Higher prices make the economy less competitive; in effect, it experiences a real appreciation of its currency. The loss of competitiveness eventually reduces output.

In this scenario, the return to long-run equilibrium is a painful process. To reverse the divergence of price levels, an economy that has experienced high inflation needs to push inflation *below* the euro average temporarily. This disinflation may require a deep recession. Based on this reasoning, Blanchard predicts "long rotating slumps" as national price levels diverge and are brought back in line. He calls the euro a "suboptimal currency area."

Evidence on Output Fluctuations Is there evidence of these effects? Blanchard suggests that real appreciation has contributed to recessions in Portugal and Italy. Yet the evidence in Section II of this chapter suggests that, overall, the euro

has not increased output volatility.

We can examine this issue another way. Currency union means that monetary policy cannot be tailored to the circumstances of individual countries. In a given year, some countries will experience booms and recessions that could be smoothed out if the countries had separate monetary policies. If this phenomenon is important, currency union should create greater dispersion in output growth across countries.

There is no evidence of this effect. Figure 2 shows the standard deviation of output growth across 11 euro members (all countries that adopted the currency by 2000 except Luxembourg). If there is any trend in this series since 1998, it is down rather than up.

Evidence on Price Levels On the other hand, there may be reason to worry about larger output fluctuations in the future. The euro era has seen a significant divergence in price levels across countries, causing changes in competitiveness that may destabilize output.

The dispersion in inflation rates across euro countries has fallen sharply since monetary union. In recent years, this dispersion has been comparable to inflation dispersion across

regions in the United States –- where economists do not worry about rotating slumps caused by a common currency. Mongelli and Wyploz (2009) call this phenomenon “price convergence.”

However, as Lane (2006) points out, the serial correlation of relative inflation rates is higher in European countries than in U.S. regions. A possible explanation is that inflation expectations depend on past inflation at the national level, even in a currency union. In any event, higher serial correlation means that inflation differences cumulate to larger price-level differences in Europe than in the U.S.

Figures 3 and 4 illustrate this point. Figure 3 compares the 11 major euro economies to 27 metropolitan areas in the U.S. The Figure shows the standard deviation of inflation rates across countries or metro areas and the standard deviation of price levels. All price levels are normalized to 100 in 1998, so the standard deviation of price levels is zero in that year. The Figure confirms that inflation differences within Europe have fallen to U.S. levels. At the same time, price levels are diverging at a faster rate in Europe.

Figure 4 compares four broad regions of the United States to the four largest euro economies. Here, price level dispersion

in 2008 is more than three times as large in Europe as in the U.S.

Europe's price-level dispersion may partly reflect changes in equilibrium real exchange rates. However, much of the dispersion is likely due to demand-driven inflation differences. For the period 1999-2004, Lane reports a correlation of 0.62 between the cumulative change in a country's price level and cumulative output growth. Both of these variables are highest in Ireland and lowest in Germany. Lane interprets the correlation between price and output changes as a "medium run Phillips curve."

As of 2008, the spreading out of European price levels was continuing. This fact suggests that countries are building up real exchange rate misalignments that must eventually be reversed. This process could involve the rotating slumps that Blanchard predicts.

V. THE ROLE OF MONETARY AGGREGATES

A generation ago, any discussion of monetary regimes would emphasize targeting of a monetary aggregate. Versions of this policy, advocated by Milton Friedman in the 1960s, were practiced

by the U.S. during the “monetarist experiment” of 1979-82 and by Germany and Switzerland during the 1980s and 90s. Today, however, most central banks in advanced and emerging economies pay little attention to monetary aggregates. They believe that instability in money demand makes the aggregates uninformative about economic activity and inflation. Policymakers rarely mention the behavior of money in explaining their interest-rate decisions (see Bernanke, 2008).

The major exception is the European Central Bank, which says that monetary aggregates play a significant role in its policymaking. Here I ask how the ECB’s attention to money has affected policy decisions and economic outcomes. The answer is anti-climactic: the ECB’s attention to money does not matter. While policymakers discuss monetary aggregates extensively, these variables have rarely if ever influenced their choices of interest rates.

The Two Pillars

The primary goal of the ECB is price stability, defined as inflation “below but close to 2%” (ECB, 2010). The Governing Council adjusts short-term interest rates to achieve this goal. The ECB says that “two pillars” underlie its choices of rates.

One is “economic analysis,” in which the ECB forecasts inflation based on real activity and supply shocks. This process is similar to inflation forecasting at inflation-targeting central banks. The second pillar is “monetary analysis,” in which policymakers examine measures of money and credit. The primary focus is the growth rate of the M3 aggregate (roughly equivalent to M2 in the U.S.). The ECB compares M3 growth to a “reference value” of 4.5%. Policymakers say this comparison influences their choices of interest rates; everything else equal, higher M3 growth may lead to tighter policy.

The ECB argues that its monetary analysis helps it achieve price stability because money growth is a signal of inflation at medium to long horizons. Many outsiders criticize the ECB’s logic and argue that it should switch to pure inflation targeting. The ECB volume edited by Beyer and Reichlen (2008) presents both sides of this debate (see the explanations of ECB policy by Trichet and Issing and the critiques by Woodford and Uhlig).

I examine the roles of the ECB’s two pillars over its history. I find that economic analysis and monetary analysis usually produce the same prescriptions for policy. On the rare

occasions when the two analyses conflict, economic analysis appears to determine policy. Therefore, the ECB's policy decisions have always been close to those it would have made if economic analysis were its only pillar.

Collinearity

I base my conclusions largely on editorials in the ECB Monthly Bulletin, which explain the interest-rate decisions of the Governing Council. A typical editorial summarizes the ECB's current economic analysis and what it suggests for the direction of policy. The editorial then "cross-checks" this prescription with monetary analysis. Usually the monetary analysis confirms the economic analysis.

As an example, consider the Monthly Bulletin of July 2008, which explains a decision to raise interest rates by a quarter point. The summary of the ECB's economic analysis concludes that "risks to price stability at the policy-relevant medium horizon remain clearly on the upside." This judgment reflects current inflation above the 2% limit and fears about rising food and energy prices. The economic analysis implies that a policy tightening is warranted.

The editorial goes on to say that "the monetary analysis

confirms the prevailing upside risks to price stability at medium-to-longer-term horizons." It notes that annual M3 growth exceeds 10%. This number "overstates the underlying path of monetary expansion, owing to the impact of the flat yield curve and other temporary factors." Nonetheless, the monetary analysis "confirms that the underlying rate of money and credit growth remains strong." The monetary analysis points to the same need for tightening as the economic analysis.

ECB economists acknowledge that situations like July 2008 are typical. At most policy meetings, the economic and monetary analyses point to the same action. Fischer et al (2008) is perhaps the ECB's most detailed review of the role of money in its policymaking. That paper concludes "there is a high degree of collinearity between the communication regarding the monetary and economic analyses." This collinearity makes the role of money "difficult to assess."

Exceptions to Collinearity

The ECB's economic and monetary analyses do not *always* point in the same direction. Fischer et al and Trichet (2008) cite two episodes in which the two pillars produced conflicting signals. In my reading of the record, in one case policy followed the

prescription of the economic analysis; in the other, the two signals did not really differ by much. Since Fischer et al and Trichet wrote, there has been one clear case of conflicting signals, and again the economic analysis prevailed.

2001-2003: This period is one of the episodes identified by Fischer et al. and Trichet. It was a period of low output growth when the ECB eased policy. Fischer et al report:

> Between mid-2001 and mid-2003, the monetary analysis... pointed to relatively balanced risks to price stability, whereas the economic analysis saw risks on the downside. Overall, the successive cuts of interest rates of this period suggest that the economic analysis played the decisive role in explaining monetary policy decisions.

Fischer et al explain why policymakers disregarded their monetary analysis. In 2001-03, M3 was growing rapidly, but this reflected unusual temporary factors. Savers were shifting to safe assets in the wake of the global stock market decline and the September 11 terrorist attacks. This shift did not necessarily indicate inflationary pressures.

Trichet (2008) interprets this episode differently than Fischer et al. He says “the underlying monetary expansion was rather sustained” and “monetary analysis had a particularly decisive influence” on policy. In Trichet’s view, rapid money

growth prevented the ECB from lowering interest rates more than it did. Yet the ECB eased aggressively: from May 2001 through June 2003, it cut its interest-rate target seven times, taking it from 4.75% to 2.0%. The June 2003 target was the lowest in the ECB's first decade. We do not know what would have happened over 2001-2003 if money growth were lower. It seems dubious, however, that the young ECB, eager to establish its credibility as an inflation fighter, would have pushed interest rates much below 2%.

December 2005: In this month the ECB raised its interest-rate target from 2% to 2.25%; this increase was the first in a series that reversed the easing of 2001-03. Both Fischer et al. and Trichet say the ECB's monetary and economic analyses gave different signals in December 2005. They agree that monetary analysis was decisive in this episode.

Trichet gives this account:

> In December 2005, when we first increased policy rates, many commentators judged our move as premature against the background of a seemingly fragile economic recovery. In fact, at that time the signals coming from the economic analysis were not yet so clear and strong. But the continued strong expansion of money and credit through the course of 2005 gave an intensifying indication of increasing risks to medium term price stability which played a decisive role in our decision to start increasing policy rates in late 2005.... Without our thorough monetary

analysis, we probably would have been in danger of falling behind the curve...

Fischer et al. contrast the “degree of uncertainty” in the economic analysis to the “stark signal” provided by monetary analysis.

In my reading, the real-time policy record does not support this interpretation. It suggests a typical case of collinearity rather than a decisive role for money. In the Monthly Bulletin of December 2005, the editorial says the decision to raise rates reflected “risks to price stability identified in the economic analysis and confirmed by cross-checking with the monetary analysis.” After that, the editorial devotes six paragraphs to summarizing the economic analysis, concluding that “the main scenario for price stability emerging from the economic analysis remains subject to upside risks.” Then a single paragraph makes the point that “evidence pointing to increased upside risks to price stability over the medium to longer term comes from the monetary analysis.” The editorial concludes by repeating that the economic analysis was “confirmed by cross-checking” with the monetary analysis.

Fall 2008 Like many central banks, the ECB lowered interest

rates rapidly during the financial crisis following the failure of Lehman Brothers. At least in the early stages, this easing was motivated entirely by economic analysis. Monetary analysis did not support an easing, but it was disregarded.

The ECB first cut rates by half a percent on October 8, in between policy meetings. The press release explaining this action includes only economic analysis. It discusses the influence of falling output growth and other non-monetary factors on inflation. The 12-month growth rate of M3 was 8.8%% for August (the last month for which data were available on October 8). M3 growth far exceeded the reference value of 4.5%, but the press release ignores this fact.

At its November meeting, the Governing Council cut rates by another half percent. In the Monthly Bulletin, this decision is explained by economic analysis: as the world economy slumped, “a number of downside risks to economic activity have materialized.” The monetary analysis does *not* support a cut in interest rates. To the contrary, “taking the appropriate medium-term perspective, monetary data up to September confirm that upside risks to price stability are diminishing but that they have not disappeared completely.” The 12-month growth rate of M3 was 8.6% for

September. If policymakers put a significant weight on monetary analysis, it is unlikely they would have cut interest rates as sharply as they did.

VI. HARD CURRENCY PEGS

The final monetary regime that I examine is a hard peg to a foreign currency. Under this policy, as in a currency union, a country gives up independent monetary policy. There are two basic versions of a hard peg: dollarization and a currency board. In the first, a country abolishes its national currency and uses a foreign one. In the second, the country maintains its currency but seeks a permanently fixed exchange rate against a foreign currency. It pledges not to change the exchange rate, and it maintains enough foreign-currency reserves to prevent a speculative attack from forcing devaluation.

Nine economies have adopted hard pegs since 1980 (eight independent countries plus Hong Kong). Table 4 lists these economies and when they began their pegs. The European countries on the list pegged to the Deutschmark and switched to the euro when it was created; the other countries pegged to the U.S. dollar. The pegs are still in effect everywhere but Argentina,

which created a currency board in 1991 and ended it in 2002.[7]

The Argentina example shows that a hard peg is not guaranteed to last forever. Even if a country has enough reserves to maintain the peg, doing so may be costly enough that political leaders choose to change course. Argentina's case also suggests, however, that extreme circumstances are needed to break a hard peg. Argentina ended its currency board only after economic distress produced riots and three changes of governments in two months. As we will see, other countries have maintained their pegs despite huge recessions.

Why Hard Pegs?

Countries have adopted hard pegs for two different reasons, to reduce inflation and to increase integration with other economies.

Inflation Control: In seven of the countries in Table 4 (all cases *except* Hong Kong and El Salvador), the peg was adopted

[7] In categorizing countries as hard peggers, I generally follow the IMF (2008). The only exception is Latvia, which the IMF counts as a "conventional fixed peg" – a softer policy than a currency board. I count Latvia as a currency board because its central bank's web site says, "The exchange rate policy of the Bank of Latvia is similar to that of a currency board, and the monetary base is backed by gold and foreign currency reserves."

A number of countries have hard pegs that predate 1980. Most are tiny (e.g. San Marino and the Marshall Islands). The largest is Panama, which has used the U.S. dollar since 1903, when it ceded the Canal Zone to the United States.

during a period of high inflation –- annual rates of three digits or more. Policymakers sought to end inflation by tying their currency to that of a low-inflation country, or by abolishing it.

This approach to stopping inflation has always been successful. As an example, Figure 5 shows what happened in Bulgaria. The inflation rate was over 1000% when the country introduced a currency board in 1997; a year later, inflation was 5%. In six of the high-inflation countries that adopted hard pegs, inflation fell below 20% within three years; in the seventh country, Estonia, it took five years. Once inflation was below 20%, it stayed there permanently, except in Argentina when its currency board collapsed.

On the other hand, a hard peg is far from essential for stopping inflation. Many countries, including most in Latin America and Eastern Europe, experienced high inflation in the 1980s or 1990s. Almost all have eliminated this problem (in 2008, Zimbabwe was the only country with inflation over 100%.) Countries stopped inflation with policies less drastic than a hard peg, such as a temporary peg or a monetary tightening under flexible exchange rates.

Therefore, the argument for a hard peg must be political

rather than economic. Arguably, if some countries are left with any discretion, they will not manage to reduce inflation. A conventional stabilization program will encounter opposition, and policymakers will be replaced or forced to change course. A hard peg is needed to prevent backsliding in countries with histories of failed stabilizations, such as Argentina. (For more on this point, see De la Torre et al. [2003], who compare Argentina's currency board to Hernan Cortes's decision to burn his ships.)

Economic Integration: Hong Kong and El Salvador had moderate inflation rates when they adopted hard pegs (about 10% in Hong Kong and 3% in El Salvador). Their motivation was to eliminate exchange-rate fluctuations and increase integration with foreign economies. Each economy had special reasons to value exchange-rate stability. Hong Kong has an unusually high level of foreign trade: imports and exports both exceed 100% of GDP. El Salvador dollarized because it has high levels of trade with the United States and Panama, which uses the dollar. In addition, prices are often quoted in dollars in trade throughout Central America.

While Hong Kong and El Salvador adopted hard pegs for sensible reasons, it is difficult to isolate the effects on economic integration. To my knowledge, no research has tried to

quantify the effects of the two countries' pegs on trade or capital flows.

The Costs of Capital Flight

The primary disadvantage of a hard peg, like membership in a currency union, is the inability to adjust monetary policy in response to shocks. In the experience of hard peggers, one type of shock has proved most problematic: capital flight. Countries with hard pegs are emerging economies, which often experience capital inflows followed by sudden stops. In many emerging economies, the exchange rate serves as a "shock absorber": depreciation reduces the output losses following capital flight. Lacking this shock absorber, hard peggers experience deeper slumps.

The crisis of the Argentine currency board is a classic example. Capital flight started in the late 1990s as a result of rising government debt and real appreciation; the latter occurred because Argentine inflation exceeded U.S. inflation over the 90s (see Hausmann and Velasco, 2002). The result was a severe recession: cumulative output growth from 1999 through 2002 was -29.5%, and the unemployment rate rose to 20%. As mentioned before, the recession created enough political turmoil to break

the hard peg.

In that case, capital flight was specific to one country. At other times, capital flight has hit a region of the world. Within the region, some countries had hard pegs and others did not. As a result, we have episodes that approach natural experiments: we can compare output losses in peggers and neighboring non-peggers hit by similar shocks.

I examine three episodes: the “Tequila crisis” that followed Mexico’s debt default in 1994; the East Asian financial crisis of 1997-98; and the world financial crisis that began in 2008. In the last case, I focus on emerging markets in Central and Eastern Europe, where capital flight was most severe. For each of the three crises, I examine countries’ output changes in the worst year of the crisis and the following year.

Table 5 presents the results. For the Tequila crisis, I examine the six largest countries in Latin America. This group includes one pegger, Argentina, which was in the middle of its currency-board period. The hardest hit economy was Mexico, as one would expect since the crisis started in Mexico. It is noteworthy that the second-worst performer was Argentina. It was the only country besides Mexico to experience a year of negative growth.

For the East Asian crisis, I examine the four “Asian tigers.” The one hard pegger, Hong Kong, was hardest-hit: it was the only country with negative growth over two years. One symptom of Hong Kong’s deep slump was deflation: its price level fell 15% from 1998 to 2004.

Finally, I examine seven European economies in 2009-2010 (using IMF output forecasts from Fall 2009). These seven are the formerly Communist countries that now belong to the European Union. They received capital inflows before 2008, but perceptions of increased risk caused sudden stops (IMF, 2009).

Four of the seven countries are hard peggers. As shown in Table 5, these four have the largest forecasted output losses. For three of them, the Baltic countries, cumulative output growth is less than -15%.

In all three episodes of capital flight, the currencies of the non-pegging countries in Table 5 depreciated. As in the textbook story, the exchange rate served as a shock absorber. Countries with rigid exchange rates suffered more.

Summary

On balance, the economic performance of hard peggers has been poor. They have reduced inflation, but so have countries

without hard pegs. And capital flight has caused deep recessions in six of the nine peggers. The only ones to escape so far are Ecuador, El Salvador, and Bosnia. These countries are in regions where capital flight was relatively mild in 2008 (Latin America and the former Yugoslavia).

VII. CONCLUSION

This chapter has reviewed the experiences of economies with alternative monetary regimes. The introduction lists the main findings. Perhaps the clearest lesson is the risk of severe recessions under hard exchange-rate pegs, which is illustrated vividly by the experiences of Argentina and the Baltic countries. One topic that deserves more research is inflation targeting in emerging economies. The current literature suggests benefits, but it is not conclusive.

Most of the evidence in this chapter comes from the Great-Moderation era that ended in 2007. In the coming years, researchers should examine how different monetary regimes handled the world financial crisis. This episode may reveal features of regimes that were not apparent when economies were more tranquil.

APPENDIX 1: ESTIMATING THE EFFECTS OF REGIME SHIFTS

This Appendix outlines the econometric justification for the empirical work in Section II. I first consider the two-period, two-regime case studied by Ball and Sheridan. I show that OLS applied to equation (1) produces biased estimates of the effects of regime shifts, but equation (2) produces unbiased estimates. I then discuss generalizations to three regimes and three periods.

The Underlying Model

Assume that X_{it}, a measure of economic performance in country i and period t, is determined by

(A1) $X_{it} = bI^*_{it} + \alpha_i + \gamma_t + \nu_{it}$, t=1,2 ,

where I^*_{it} is a dummy that equals one if country i targets inflation in period t, and the other terms on the right side are country, time, and country-time effects that are independent of each other. These effects capture all determinants of inflation besides IT. I* is zero for all countries in period 1. We are interested in estimating the coefficient b, which gives the effect of IT on performance.

Taking the difference in equation (A1) for t=2 and t=1 yields

(A2) $\Delta X_i = a + bI_i + \nu_{i2} - \nu_{i1}$,

where ΔX_i is $X_{i2}-X_{i1}$, $a=\gamma_2-\gamma_1$, and $I_i=I^*_{i2}-I^*_{i1}$. I_i is a dummy that equals one if country i adopts IT in period 2. Equation (A2) is the same as equation (1) in the text with $\varepsilon_i=\nu_{i2}-\nu_{i1}$.

I assume that I_i depends on the initial level of inflation, X_{i1}:

(A3) $I_i = u + dX_{i1} + \eta_i$,

where η_i captures other determinants of the decision to adopt IT. I assume this error is independent of the three errors in equation (A1).[8]

A Biased Estimator of b

As discussed in the text, it seems natural to estimate equation (1) by OLS. However, under my assumptions, the error term ε_i equals $\nu_{i2}-\nu_{i1}$. Substituting (A1) into (A3) shows that I_i depends on ν_{i1}. Since both ε_i and I_i depend on ν_{i1}, they are correlated. This implies that OLS estimation of (1) produces a biased estimate of b.

An Unbiased Estimator of b

Ball and Sheridan run the regression

(A4) $\Delta X_i = a + wI_i + cX_{i1} + \varepsilon_i$.

[8] Equation (A3) is a linear probability model. I conjecture, but have not proven, that the unbiasedness of my estimator extends to the general case of $I_i=h(X_{i1},\eta_i)$.

Notice that the coefficient on I_i is labeled w. Let the OLS estimate of w be w_0. We do not pre-judge the relationship between w and the structural parameter b in equation (1). However, we can show that $E[w_0] = b$, so the Ball-Sheridan equation produces an unbiased estimate of the parameter of interest.

To establish this result, we "partial out" the terms a and cX_{i1} from the right side of (A4):

(A5) $\Delta X_i = wI'_i + \epsilon_i$,

where I'_i is the residual from regressing I_i on a constant and X_i. Equation (A3) implies

(A6) $I'_i = \eta_i + (u-u_0) + (d-d_0)X_{i1}$,

where u_0 and d_0 are OLS estimates of the coefficients in (A3). The OLS estimate of w in equation (A5) is identical to w_0, the estimate from equation (A4). We need to show that the expected value of this estimate is b.

This result follows from algebra that I sketch. The OLS estimate of w in (A5) is defined as $[\Sigma(I'_i)(\Delta X_i)]/[\Sigma(I'_i)^2]$, where sums are taken over i. If we use (A2) to substitute for for ΔX_i and break the result into three terms, we get

(A7) $w_0 = b[\Sigma(I'_i I_i)/\Sigma(I'_i)^2]$

$+ [\Sigma(I'_i)(\nu_{i2}-\nu_{i1})]/[\Sigma(I'_i)^2]$

$$+ a[\Sigma(I'_i)]/[\Sigma(I'_i)^2] \ .$$

In this expression, the third term is zero.

To find the expectations of the first two terms, I first take expectations conditional on I'_i. The conditional expectation of the second term is zero because I'_i is uncorrelated with the ν's. This follows from the facts that (1) I'_i is determined by η_i and the η's for all observations, which determine $u-u_0$ and $d-d_0$; and (2) the η's are uncorrelated with the ν's.

Turning to the first term in (A7), note that $\Sigma(I'_i\, I_i) = [\Sigma(I'_i)^2]+[\Sigma(I'_i)(I_i-I'_i)] = [\Sigma(I'_i)^2]$ (because the products of a regression's fitted values and residuals sum to zero). Substituting this result into the first term in (A7) establishes that this term equals b.

Combining all these results, the expectation of w_0 conditional on I'_i is b. Trivially, taking expectations over I'_i establishes that the unconditional expectation, $E[w_0]$, is b.

Three Time Periods

In this paper's empirical work, the data cover three time periods rather than two. Here I sketch the generalization of the Ball-Sheridan analysis to this case. For now, I continue to assume there are only two policy regimes, IT and non-IT.

The underlying model is again given by equation (A1), but with t=1,2,3. Differencing this equation yields

(A8) $\Delta X_{it} = a_t + bI_{it} + \nu_{it} - \nu_{it-1}$, t=2, 3 ,

where $a_t=\gamma_t-\gamma_{t-1}$ and $I_{it}=I^*_{it}-I^*_{it-1}$. I_{it} equals one if country i switches from traditional policy to IT in period t.

This model assumes that the policy regime, as measured by the dummy variable I*, affects the level of performance X. It follows that changes in regime, measured by I, affect the change in performance ΔX. The level of I* does not matter for ΔX. In particular, if a country does not switch regimes between periods 2 and 3, it does not matter whether the country has traditional policy in both periods or IT in both period. As discussed in the text, this restriction is not valid if the adoption of IT has different short-run and long-run effects. Therefore, one of the robustness checks in my empirical work relaxes the restriction. I allow different short-run and long-run effects of IT by introducing a dummy that equals one in period t if a country is a targeter in both t and t-1.

With three time periods, one can pool data on ΔX_{i3} and ΔX_{i3} to estimate b, the effect of IT. Once again, OLS estimates of (A2) are biased but the bias can be eliminated by adding X_{it-1} to

the equation. One can show that the proper specification allows both a_t, which captures international changes in performance, and the coefficient on X_{it-1} to differ across periods. The coefficient on X_{it-1} depends on the relative importance of permanent and transitory shocks to X, which can change over time.

Three Regimes

Finally, consider the case of three policy regimes--traditional, IT, and the euro--as well as three periods. In this case, the underlying model can be written as

(A9) $X_{it} = I^*_{it} + (c+d)E^*_{it} + \alpha_i + \gamma_t + \nu_{it}$, t=1,2 3,

where E^*_{it}=1 if country i uses the euro in period t, and once again I^*_{it}=1 if the country is an inflation targeter. In this specification, the parameter c gives the effect of IT relative to a baseline of traditional policy, and d is the effect of the euro relative to IT. The effect of the euro relative to traditional policy is b+c.

Differencing (A9) yields

(A10) $\Delta X_{it} = a_t + c(I^*_{it}-I^*_{it-1})+ (c+d)(E^*_{it}-E^*_{it-1}) + \nu_{it} + \nu_{it-1}$

$= a_t + cI_{it} + dE_{it} + \nu_{it} + \nu_{it-1}$,

where again $a_t=\gamma_t-\gamma_{t-1}$ and the second line follows from the definitions of I_{it} and E_{it} in the text. Once again, I add X_{it-1} to

the equation to eliminate bias in the coefficient estimates, and allow a_t and the coefficient on X_{it-1} to vary with t. The result is equation (3), the main specification in my empirical work.

APPENDIX 2: DETAILS OF EMPIRICAL WORK

The empirical work in Section II is based on the countries and sample periods in Table 1. In quarterly data, the dating of IT adoption follows Ball and Sheridan. The period of traditional policy ends in either the last quarter before IT or the quarter before that; if IT is adopted in the middle of a quarter, the quarter is not included in either the IT or pre-IT period.

For all countries that adopted the euro, the euro period begins in 1999:1 and the pre-euro period ends in 1998:4.

I use annual data in studying output behavior. With annual data, a year belongs to a regime period only if all four quarters belong under the quarterly dating.

The central empirical results are estimates of equation (3) for different measures of economic performance. Table 2 gives key coefficients; Table A1 gives the full regression results.

Table A2 presents the robustness exercises discussed in the text. Mostly, the qualitative results do not change. One result

worth noting comes from Panel D of the table, where I estimate short-run and long-run effects of inflation targeting. The short-run effect on average inflation is significantly negative, but the long-run effect (the sum of coefficients on I and R) is insignificant with a positive point estimate. These results suggest that the benefit of IT relative to traditional policy declines over time.

(An odd result pops up in Panel B: a strong positive effect of IT on the standard deviation of the interest rate. A possible explanation is that only seven countries belong to the sample and Japan is an outlier. Japan is a non-ITer with a large fall in interest rate volatility due to the zero bound on rates.)

APPENDIX 3: DETAILS ON PREVIOUS RESEARCH

Here I give further details about some of the IT studies reviewed in Section III:

Goncalvez and Salles: This paper's results are plausible, but more work is needed to establish robustness. As discussed in the text, we would like to know how things change if countries with hard pegs are excluded from the sample. Other issues include:

• Goncalvez and Salles do not say how they choose the non-IT countries in their sample. It is not obvious which countries should be categorized as emerging markets. Future work might use some objective criterion, such as a range for income per capita.

• There is one significant mistake in the data: Peru's IT adoption year is listed as 1994, while the correct year is 2003. Goncalvez and Salles's dating follows Fraga et al. (2003); evidently there is a typo in that paper.

• The dates of IT adoption range from 1991 to 2003 (when Peru's date is corrected). Thus the pre- and post-IT time periods differ substantially across countries. Future research might break the data into three periods, with splits in the early 1990s, when Israel and Chile adopted targets, and around 2000, when other emerging economies adopted targets.

• For each country, Goncalvez and Salles drop years with inflation above 50%, while leaving all other years. It is not clear how this truncation of the data affects the results.

Vega and Winkelreid

This paper reports beneficial effects of IT in both advanced and emerging economies. One reason to doubt this conclusion is the contrary findings of Lin and Ye (2009). Another is a feature

of Vega and Winkelreid's specification: while they allow different effects of IT in advanced and emerging economies, they assume the equation determining IT adoption is the same. One might think the variables in this equation, such as the fiscal balance, have different effects on monetary policy in the two groups.

In addition, the paper's results raise several related puzzles:

- The paper finds that "soft" inflation targeting reduces the mean and standard deviation of inflation by more than "fully-fledged" targeting, even though the latter is a bigger shift from traditional policy.
- The ten advanced-economy inflation targeters have a total of seven years of soft IT. Usually these countries move quickly from traditional policy to fully-fledged targeting. Yet the paper reports precise estimates of the effects of soft IT in advanced economies. Many t-statistics are near 4.
- For advanced economies, estimates of the effects of soft IT on average inflation are around -3 percentage points. These estimates imply that most countries with traditional policy would have negative inflation rates if they adopted soft IT.

Levin et al.: Inflation Persistence

This paper estimates univariate time series models for five IT countries and seven non-IT countries, plus the non-IT euro area. Levin et al. report that, on average, inflation persistence is lower in the IT countries: shocks to inflation die out more quickly.

There are several related reasons to doubt the paper's conclusion:

- The results are sensitive to the choice of an inflation variable. The persistence of core inflation (inflation excluding food and energy) is lower for IT countries than for non-IT countries. The persistence of total inflation, however, is similar for the two groups.
- The IT countries in the sample--Australia, Canada, Sweden, New Zealand, and the UK--are on average smaller and more open than the non-IT countries. In some of the analysis, the non-IT group is four economies--the U.S., Japan, the euro area, and Denmark–-of which three are the world's largest and most closed. Openness is likely to affect the behavior of inflation; for example, fluctuations in exchange rates should cause larger inflation movements in more open economies. Differences in

openness rather than policy regimes could explain the different inflation behavior in IT and non-IT countries.[9]

• Levin et al. find that inflation persistence is lower in IT countries, but innovations in inflation are larger than in non-IT countries. In fact, innovations are so much larger that the unconditional variance of inflation is higher in IT countries despite lower persistence. There is no reason to expect this result if the adoption of IT is the cause of low persistence. Instead, the result suggests that the shocks hitting IT and non-IT countries are different. In particular, it is consistent with the hypothesis that external shocks have larger effects in IT countries because they are more open. If these shocks cause large transitory movements in inflation, they can explain both low persistence and a high variance of inflation.

Levin et al.: Expectations

The Levin et al. paper also estimates the effects of inflation on expected inflation, as measured by professional

[9] Levin et al. report larger differences between IT and non-IT countries when they exclude Denmark from the non-IT group. In particular, there is some difference in the persistence of total inflation as well as core inflation. However, excluding Denmark magnifies the difference in openness between the two groups.

forecasts. For a given country, they estimate

(A8) $\Delta\pi^{q}_{t} = \lambda + \beta\Delta\bar{\pi}_{t} + \epsilon_{t}$,

where π^{q}_{t} is the expectation in year t of inflation in year t+q and $\bar{\pi}_{t}$ is a three-year moving average of inflation: $\bar{\pi}_{t} = (1/3)(\pi_{t} + \pi_{t-1} + \pi_{t-2})$. Equation (A8) can be rewritten as

(A9) $\pi^{q}_{t} - \pi^{q}_{t-1} = (\beta/3)(\pi_{t} - \pi_{t-3})$.

That is, Levin et al. estimate the effect of a three-year change in inflation on a one-year change in expectations. The rationale for this specification is unclear.

For non-IT countries and q between 3 and 10, the paper reports estimates of β in the neighborhood of 0.25. These estimates imply that a one point change in $(\pi_{t} - \pi_{t-3})$ causes a 0.75 point change in $\pi^{q}_{t} - \pi^{q}_{t-1}$, a surprisingly large effect.

REFERENCES

Baldwin, Richard E. 2006. The Euro's Trade Effects. European Central Bank Working Paper Series No. 594, Frankfurt: European Central Bank, March.

Ball, Laurence and Niamh Sheridan. 2005. Does Inflation Targeting Matter? In *The Inflation Targeting Debate*, NBER Studies in Business Cycles, Vol. 32, ed. Ben S. Bernanke and Michael Woodford. Chicago: University of Chicago Press.

Bernanke, Ben and Mishkin, Frederic. 1992. Central Bank Behavior and the Strategy of Monetary Policy: Observations from Six Industrialized Countries, *NBER Macroeconomics Annual*, Vol. 7: 183-228

Bernanke, Ben S., Thomas Laubach, Frederic S. Mishkin, and Adam S. Posen. 1999. *Inflation Targeting, Lessons from the International Experience*, Princeton, NJ: Princeton University Press.

Beyer, Andreas and Lucrezia Reichlin, ed. 2008. *The Role of Money-Money and Monetary Policy in the Twenty-First Century*. Frankfurt: European Central Bank.

Blanchard, Olivier. 2006. Portugal, Italy, Spain, and Germany: The Implications of a Suboptimal Currency Area. WEL-MIT Meeting, April.

Blanchard, Olivier. 2007. Adjustment Within the Euro: The Difficult Case of Portugal. *Portuguese Economic Journal*, Vol. 6, No. 1, April: 1-21.

Cecchetti, Stephen G. and Michael Ehrmann. 2000. Does Inflation Targeting Increase Output Volatility? An International Comparison of Policymakers' Preferences and Outcomes. NBER Working Paper No. 7436. Cambridge, Mass.: The National Bureau of Economic Research.

Corbo, Vittorio, Oscar Landerretche, and Klaus Schmidt-Hebbel. 2002. Does Inflation Targeting Make a Difference? In *Inflation Targeting: Design, Performance, Challenges*, ed. Norman Loayza and Raimundo Soto. Central Bank of Chile, Santiago: 221-269.

De la Torre, Augusto, Eduardo Levy-Yeyati, and Sergio L. Schmukler. 2003. Living and Dying with Hard Pegs: The Rise

and Fall of Argentina's Currency Board, Economía, Vol 3(2), Spring 2003: 43-99.

Duecker, Michael J., and Andreas M. Fischer. 2006. “Do Inflation Targeters Outperform Non-Targeters?,” *Federal Reserve Bank of St. Louis Economic Review* (September/October): 431-450.

Dvorak, T. 2006. The Impact of the Euro on Investment: Sectoral Evidence. In *Financial Development, Integration and Stability: Evidence from Central, Eastern and South-Eastern Europe*, ed. K. Liebscher, J. Christl, P. Mooslechner and D. Ritzberger-Grunwald. Northampton, MA: Edward Elgar Publishing.

European Central Bank. *Monthly Bulletin*. Various issues.

European Central Bank. 2010. Home page (www.ecb.int).

Feldstein, Martin S. 2009. Optimal Currency Areas, In *The Euro at Ten—Lessons and Challenges*. Frankfurt: European Central Bank.

Fischer, Bjorn, Michele Lenza, Huw Pill and Lucrezia Reichlin. 2008. Money and Monetary Policy: the ECB Experience 1999-

2006. In *The Role of Money-Money and Monetary Policy in the Twenty-First Century*. Frankfurt: European Central Bank. 102-175.

Frankel, Jeffrey A. 2008. The Estimated Effects of the Euro on Trade: Why Are They Below Historical Effects of Monetary Unions Among Smaller Countries? NBER Working Paper No. 14542. Cambridge, Mass.: The National Bureau of Economic Research.

Friedman, Benjamin M. 2004. "Why the Federal Reserve Should Not Adopt Inflation Targeting," *International Finance* Vol. 7 (1): 129-136.

Geraats, Petra. 2009. Discussant Report: The Performance of Alternative Monetary Regimes, 2009 ECB conference on Key Developments in Monetary Economics.

Gertler, Mark. 2005. Comment. In *The Inflation Targeting Debate*, NBER Studies in Business Cycles, Vol. 32, ed. Ben S. Bernanke and Michael Woodford. Chicago: University of Chicago Press.

Goncalves, Carlos Eduardo S. and Joao M. Salles. 2008. Inflation Targeting in Emerging Economies: What do the Data Say? *Journal of Development Economics*, Vol. 85 (1-2): 312-18.

Gurkaynak, Refet S., Andrew T. Levin and Eric T. Swanson. 2006. Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence From Long-Term Bond Yields in the U.S., U.K., and Sweden. Working Paper No. 2006-09, Federal Reserve Bank of San Francisco.

Gurkaynak, Refet S., Andrew T. Levin, Andrew N. Marder, and Eric T. Swanson. 2008. “Inflation Targeting and the Anchoring of Inflation Expectations in the Western Hempishere,” Central Bank of Chile Working Paper No. 400.

Hausmann, Ricardo and Andrés Velasco. 2002. Hard Money's Soft Underbelly: Understanding the Argentine Crisis, *Brookings Trade Forum*, 59-104.

Hu, Y. 2003. Empirical Investigations of Inflation Targeting. Working Paper No. 03-6, Washington: Institute for International Economics.

IMF. 2009. Country and Regional Perspectives. *World Economic Outlook*, October: 67-91

IMF. 2008. De Facto Classification of Exchange Rate Regimes and Monetary Policy Frameworks, http://www.imf.org/external/np/mfd/er/2008/eng/0408.html

Johnson, David R. 2002. The Effect of Inflation Targeting on the Behavior of Expected Inflation: Evidence from an 11 Country Panel. *Journal of Monetary Economics*, 49: 1521-1538.

King, Mervyn. 2005. What Has Inflation Targeting Achieved? In *The Inflation Targeting Debate*, NBER Studies in Business Cycles, Vol. 32, ed. Ben S. Bernanke and Michael Woodford. Chicago: University of Chicago Press.

Kohn, Donald. L. 2005. Comment. In *The Inflation Targeting Debate*, NBER Studies in Business Cycles, Vol. 32, ed. Ben S. Bernanke and Michael Woodford. Chicago: University of Chicago Press.

Lane, Philip. 2006. The Real Effects of European Monetary Union. *Journal of Economic Perspectives*, Vol. 20, No. 4, Fall: 47-66.

Lane, Philip. 2009. EMU and Financial Integration. In *The Euro at Ten—Lessons and Challenges*, Frankfurt: European Central Bank.

Lane, Philip and Gian-Maria Milesi-Ferretti. 2007a. The International Equity Holdings of Euro Area Investors. In *The Importance of the External Dimension for the Euro Area: Trade, Capital Flows, and International Macroeconomic Linkages*, ed. R. Anderson and F. di Mauro. New York: Cambridge University Press.

Lane, Philip and Gian-Maria Milesi-Ferretti. 2007b. Capital Flows to Central and Eastern Europe. *Emerging Markets Review*, Vol. 8(2): 106-123.

Levin, Andrew T., Fabio M. Natalucci and Jeremy M. Piger. 2004. The Macroeconomic Effects of Inflation Targeting. *Federal Reserve Bank of St. Louis Review*, Vol. 86, No. 4, (July-August): 51-80.

Lin, Shu and Haichun Ye. 2007. Does Inflation Targeting Make a Difference? Evaluating the Treatment Effect of Inflation

Targeting in Seven Industrial Countries. *Journal of Monetary Economics*, 54: 2521-2533.

Lin, Shu and Haichen Ye. 2009. Does Inflation Targeting Make a Difference in Developing Countries?. *Journal of Monetary Economics*, Vol. 89(1): 118-123.

Mishkin, Frederic and Klaus Schmidt-Hebbel. 2007. Does Inflation Targeting Make a Difference?, NBER Working Paper No. 12876. Cambridge, Mass.: The National Bureau of Economic Research.

Mongelli, Francesco P. and Charles Wyplosz. 2009. The Euro at Ten: Unfulfilled Threats and Unexpected Challenges. In *The Euro at Ten—Lessons and Challenges*, Frankfurt: European Central Bank.

Neumann, Manfred J.M. and Jurgen von Hagen. 2002. Does Inflation Targeting Matter? *Federal Reserve Bank of St. Louis Review*, Vol. 84, No. 4 (July-Aug): 127-48.

Papademos, Lucas, “Opening Address.” In *The Euro at Ten—Lessons and Challenges*, Frankfurt: European Central Bank.

Papaionnou, E. and R. Portes. 2008. The International Role of the Euro: A Status Report. European Economy Economic Papers No. 317.

Rose, Andrew. 2000. One Money, One Market: Estimating the Effect of Common Currencies on Trade. *Economic Policy* 30: 9-45.

Trichet, Jean-Claude. 2008. The Role of Money: Money and Monetary Policy at the ECB. In *The Role of Money-Money and Monetary Policy in the Twenty-First Century*. Frankfurt: European Central Bank. 331-336.

Vega, Marco and Diego Winkelreid. 2005. Inflation Targeting and Inflation Behavior: A Successful Story. *International Journal of Central Banking* 1(3), December: 152-175.

Walsh, Carl E. 2009. Inflation Targeting: What Have We Learned? *International Finance*, Vol. 12, No. 2, Summer: 195-233.

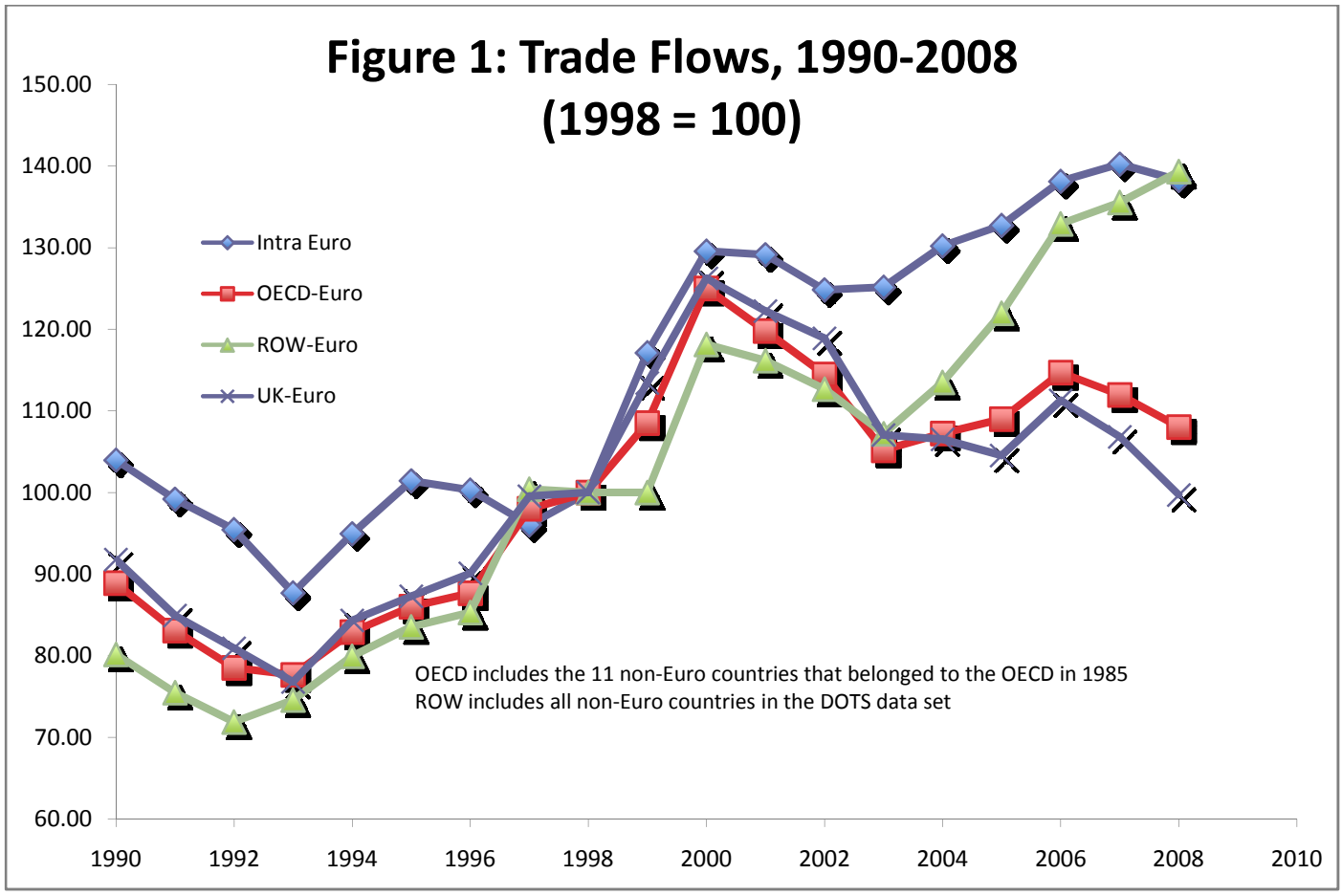


Figure 1: Trade Flows, 1990-2008
(1998 = 100)
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Intra Euro
OECD-Euro
ROW-Euro
UK-Euro
OECD includes the 11 non-Euro countries that belonged to the OECD in 1985
ROW includes all non-Euro countries in the DOTS data set

Figure 2

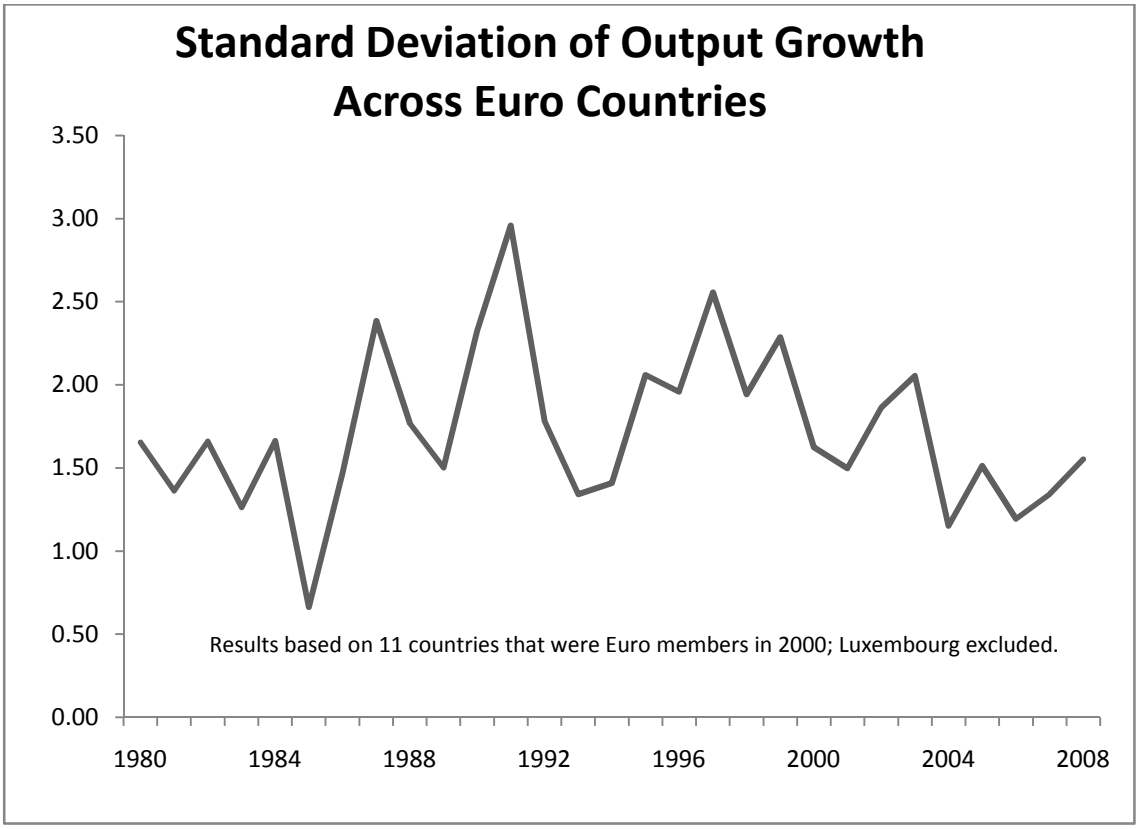
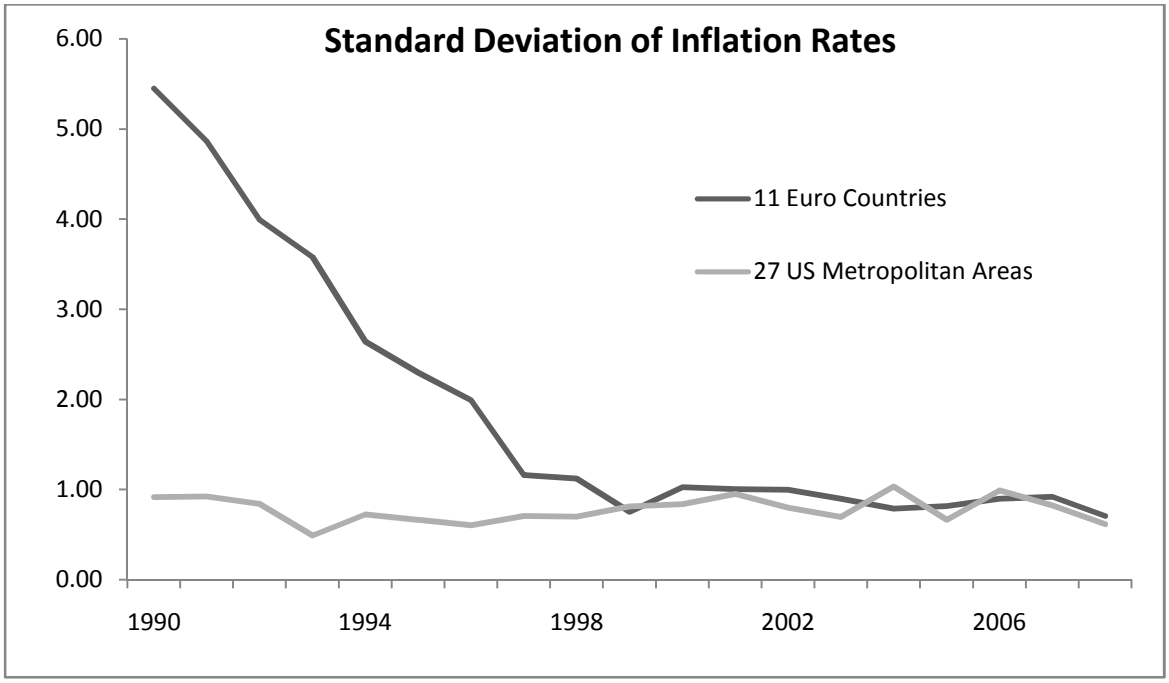

Standard Deviation of Output Growth
Across Euro Countries
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1980
1984
1988
1992
1996
2000
2004
2008
Results based on 11 countries that were Euro members in 2000; Luxembourg excluded.

Figure 3


Standard Deviation of Inflation Rates
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1990
1994
1998
2002
2006
11 Euro Countries
27 US Metropolitan Areas

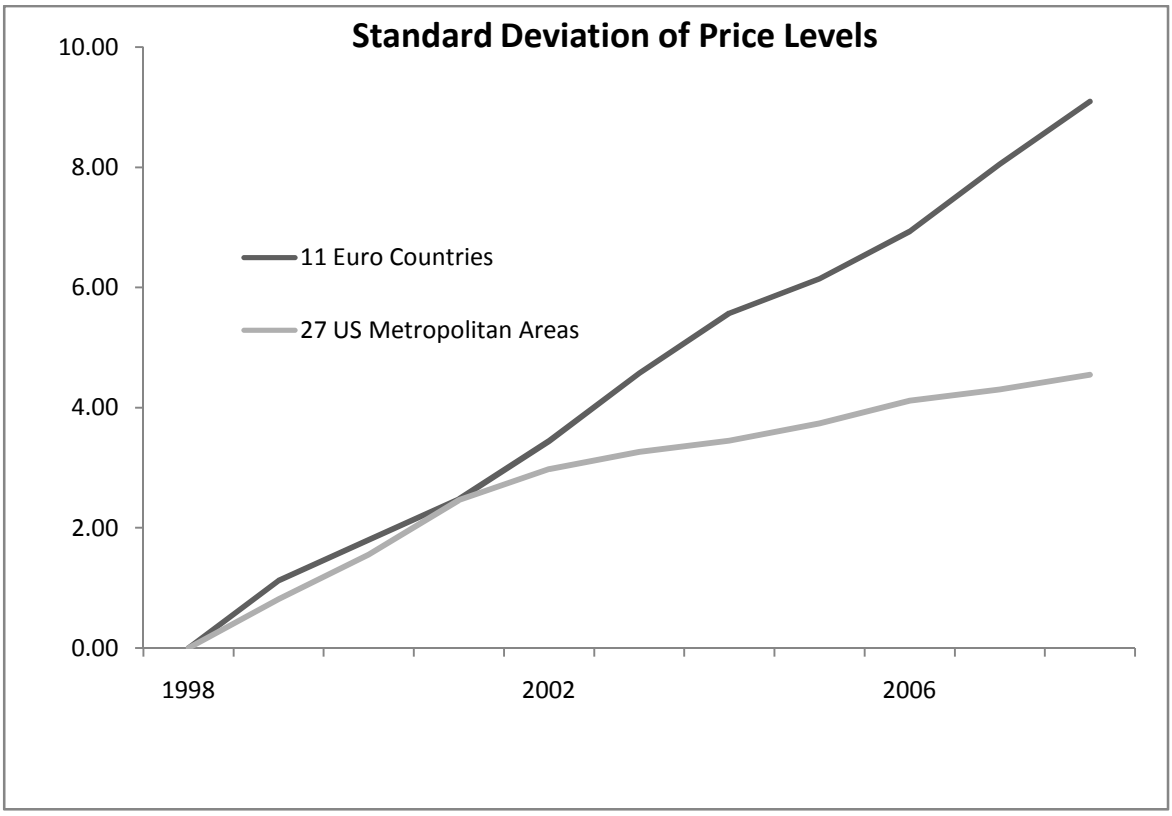
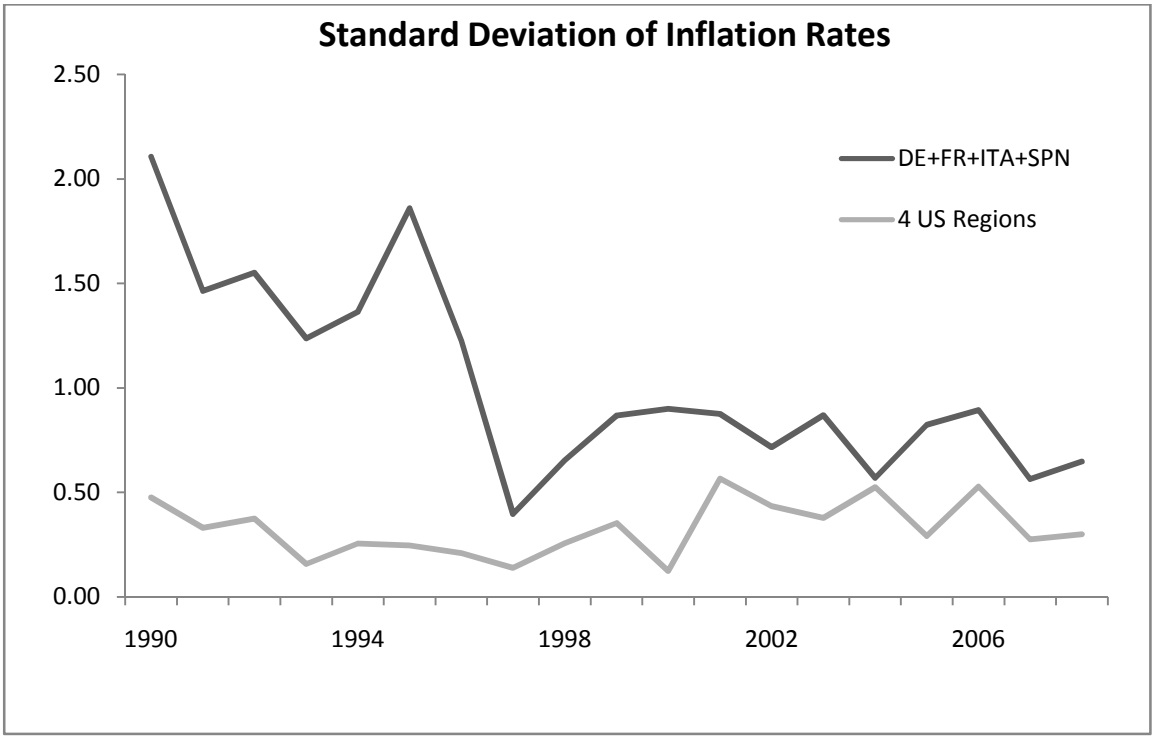

Standard Deviation of Price Levels
10.00
8.00
6.00
4.00
2.00
0.00
1998
2002
2006
11 Euro Countries
27 US Metropolitan Areas

Figure 4


Standard Deviation of Inflation Rates
2.50
2.00
1.50
1.00
0.50
0.00
1990
1994
1998
2002
2006
DE+FR+ITA+SPN
4 US Regions

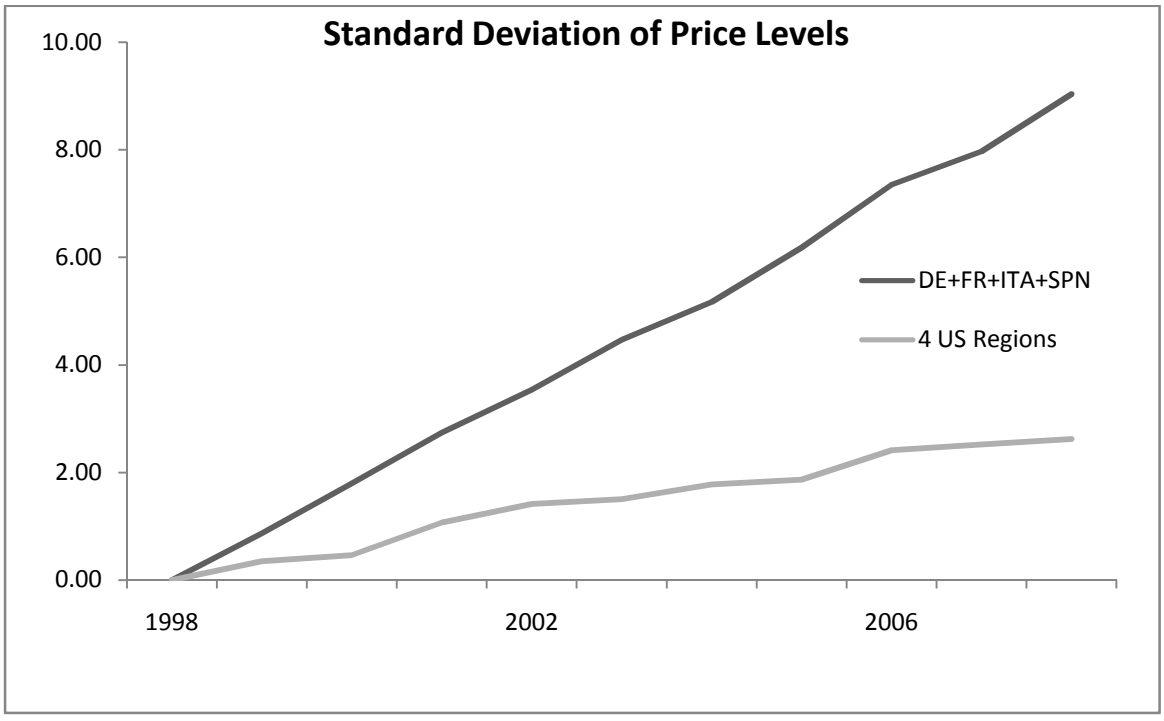
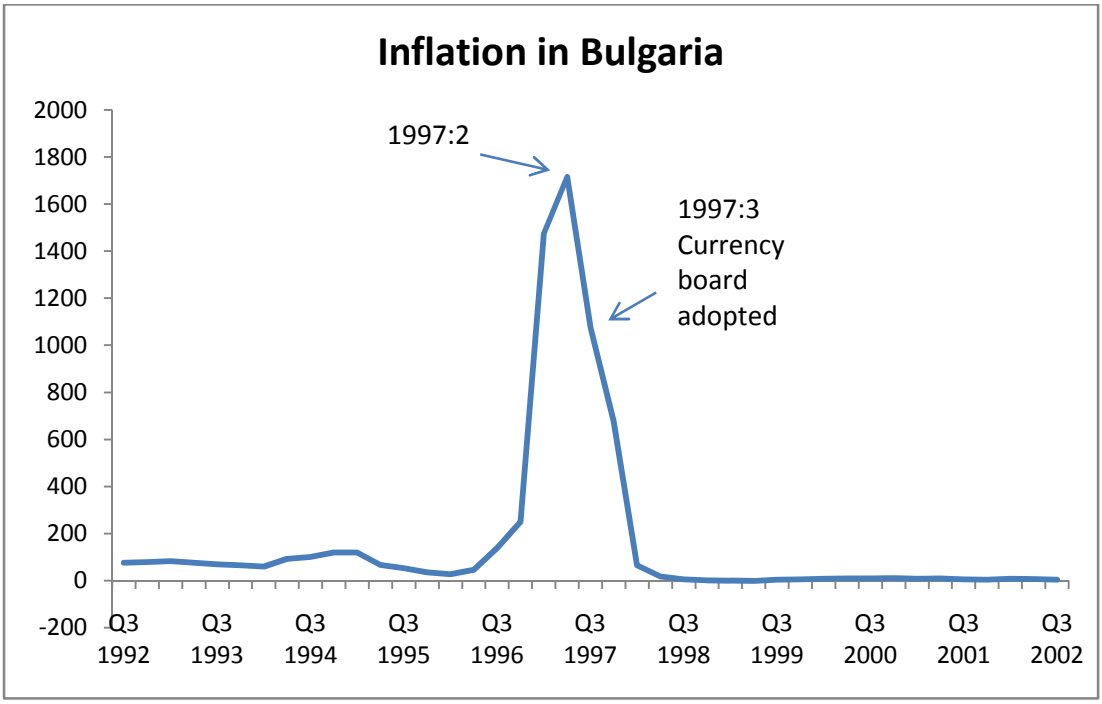

Standard Deviation of Price Levels
10.00
8.00
6.00
4.00
2.00
0.00
1998
2002
2006
DE+FR+ITA+SPN
4 US Regions

Figure 5



Inflation in period t is the percentage change in the price level from t-4 to t

Table 1

Policy Regimes

Country	Period 1	Regime	Period 2	Regime	Period 3	Regime
Australia	1985:1-1994:2	T	1994:4-1999:1	I	1999:2-2007:2	I
Austria	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Belgium	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Canada	1985:1-1991:4	T	1992:1-1999:1	I	1999:2-2007:2	I
Denmark	1985:1-1993:2	T	1993:3-1999:1	T	1999:2-2007:2	T
Finland	1985:1-1993:4	T	1994:1-1998:4	I	1999:1-2007:2	E
France	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Germany	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Ireland	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Italy	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Japan	1985:1-1993:2	T	1993:3-1999:1	T	1999:2-2007:2	T
Netherlands	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
New Zealand	1985:1-1990:1	T	1990:3-1999:1	I	1999:2-2007:2	I
Norway	1985:1-1993:2	T	1993:3-2000:4	T	2001:1-2007:2	I
Portugal	1985:1-1993:2	T	1993:3-1998:4	T	1999:1-2007:2	E
Spain	1985:1-1995:1	T	1995:2-1998:4	I	1999:1-2007:2	E
Sweden	1985:1-1994:4	T	1995:1-1999:1	I	1999:2-2007:2	I
Switzerland	1985:1-1993:2	T	1993:3-1999:4	T	2000:1-2007:2	I
United Kingdom	1985:1-1992:3	T	1993:1-1999:1	I	1999:2-2007:2	I
United States	1985:1-1993:2	T	1993:3-1999:1	T	1999:2-2007:2	T

T = Traditional, I = Inflation Targeting, E = Euro

Table 2
Effects of Inflation Targeting and Euro Adoption

	Mean			Standard Deviation		
	Inflation	**Output growth**	**Interest rate**	**Inflation**	**Output growth**	**Interest rate**
Coefficient on I_{it}	-0.65	0.14	0.46	0.02	0.21	0.26
	(0.25)	(0.49)	(0.27)	(0.23)	(0.18)	(0.13)
Coefficient on E_{it}	0.36	-0.27	-0.75	-0.42	0.23	-0.09
	(0.34)	(0.65)	(0.37)	(0.30)	(0.23)	(0.18)
Sum of I_{it} and	-0.29	-0.13	-0.29	-0.41	0.44	0.17
E_{it} coefficients	(0.33)	(0.60)	(0.34)	(0.29)	(0.22)	(0.17)

Table 3

Emerging Economy Inflation Targeters

Country	Adoption Year*
Brazil	1999
Chile	1991
Colombia	2000
Czech Republic	1998
Hungary	2001
Indonesia	2006
Israel	1992
Mexico	1999
Peru	2003
Phillippines	2002
Poland	1999
South Africa	2000
South Korea	1998
Thailand	2000

* Adoption dates for Peru and Indonesia come from central bank websites; all other adoption dates come from Goncalvez and Salles (2008)

Table 4
Hard Pegs Adopted Since 1980

Country	Adoption Date	Type of Peg
Argentina*	April 1991	Currency Board
Bosnia and Herzegovina	August 1997	Currency Board
Bulgaria	July 1997	Currency Board
Ecuador	January 2000	Dollarization
El Salvador	January 2001	Dollarization
Estonia	June 1992	Currency Board
Hong Kong	October 1983	Currency Board
Latvia	June 1993	Currency Board
Lithuania	April 1994	Currency Board

* Peg collapsed in 2002

Table 5
Hard Pegs and Capital Flight

Tequila Crisis

	Output Growth (% points)		
Country	**1995**	**1996**	**Total**
Mexico	-6.167	5.153	-1.014
Argentina	**-2.845**	**5.527**	**2.681**
Venezuela	3.952	-0.198	3.754
Brazil	4.220	2.150	6.370
Colombia	5.202	2.056	7.258
Peru	8.610	2.518	11.128

East Asian Crisis

	Output Growth (% points)		
Country	**1998**	**1999**	**Total**
Hong Kong	**-6.026**	**2.556**	**-3.471**
South Korea	-6.854	9.486	2.632
Singapore	-1.377	7.202	5.826
Taiwan	4.548	5.748	10.296

Eemerging Markets in World Crisis

	IMF Predicted Output Growth (% points)		
Country	**2009**	**2010**	**Total**
Lithuania	**-18.500**	**-4.000**	**-22.501**
Latvia	**-18.003**	**-3.971**	**-21.974**
Estonia	**-14.016**	**-2.573**	**-16.589**
Bulgaria	**-6.500**	**-2.500**	**-9.000**
Romania	-8.456	0.496	-7.960
Hungary	-6.730	-0.876	-7.606
Poland	0.975	2.189	3.164

Countries with hard pegs are in bold

Table A1
Effects of IT and the Euro: full regression results

Dependent vbl: change in	**Mean Inflation**	**Std Dev of Inflation**	**Mean Growth**	**St Dev of Growth**	**Mean Interest rate**	**Std Dev of Interest rate**
D_t^2	0.77	2.70	0.71	0.68	0.39	0.47
	(0.38)	(0.48)	(0.69)	(0.29)	(0.83)	(0.22)
D_t^3	-0.37	1.55	-1.73	-0.37	-3.10	-0.12
	(0.49)	(0.58)	(1.16)	(0.41)	(0.98)	(0.29)
I_{it}	-0.65	0.02	0.14	0.21	0.46	0.26
	(0.25)	(0.23)	(0.49)	(0.18)	(0.27)	(0.13)
E_{it}	0.36	-0.42	-0.27	0.23	-0.75	-0.09
	(0.34)	(0.30)	(0.65)	(0.23)	(0.37)	(0.18)
$X_{i,t-1}\left(D_t^2\right)$	-0.80	-0.83	-0.73	-0.98	-0.71	-0.45
	(0.06)	(0.10)	(0.33)	(0.15)	(0.05)	(0.12)
$X_{i,t-1}\left(D_t^3\right)$	-0.17	-1.29	-0.37	-0.74	-0.37	-0.93
	(0.20)	(0.25)	(0.19)	(0.20)	(0.13)	(0.14)

Table A2
Effects of IT and the Euro: robustness checks

A: Denmark dropped from sample

	Mean			Standard Deviation		
	Inflation	**Output growth**	**Interest rate**	**Inflation**	**Output growth**	**Interest rate**
Coefficient on I_{it}	-0.66	0.16	0.47	-0.04	0.23	0.27
	(0.26)	(0.51)	(0.27)	(0.23)	(0.18)	(0.14)
Coefficient on E_{it}	0.33	-0.38	-0.77	-0.47	0.25	-0.07
	(0.36)	(0.67)	(0.39)	(0.31)	(0.24)	(0.19)
Sum of I_{it} and	-0.33	-0.22	-0.30	-0.51	0.48	0.20
E_{it} coefficients	(0.35)	(0.64)	(0.36)	(0.30)	(0.23)	(0.17)

B: EMS countries dropped from sample

	Mean			Standard Deviation		
	Inflation	**Output growth**	**Interest rate**	**Inflation**	**Output growth**	**Interest rate**
Coefficient on I_{it}	-0.53	-0.01	0.65	0.50	0.36	0.41
	(0.46)	(0.67)	(0.42)	(0.42)	(0.30)	(0.13)

C: Same time periods for all countries

	Mean			Standard Deviation		
	Inflation	**Output growth**	**Interest rate**	**Inflation**	**Output growth**	**Interest rate**
Coefficient on I_{it}	-0.42	0.13	0.57	-0.04	0.04	0.20
	(0.25)	(0.49)	(0.27)	(0.22)	(0.15)	(0.17)
Coefficient on E_{it}	0.27	-0.28	-0.82	-0.33	0.22	-0.05
	(0.36)	(0.64)	(0.38)	(0.28)	(0.20)	(0.25)
Sum of I_{it} and	-0.14	-0.15	-0.25	-0.37	0.25	0.14
E_{it} coefficients	(0.33)	(0.60)	(0.35)	(0.27)	(0.18)	(0.22)

D: Short run and long run effects of IT

	Mean			Standard Deviation		
	Inflation	**Output growth**	**Interest rate**	**Inflation**	**Output growth**	**Interest rate**
Coefficient on I_{it}	-0.55	0.26	0.49	0.02	0.17	0.25
	(0.25)	(0.50)	(0.27)	(0.24)	(0.18)	(0.13)
Coefficient on R_{it}	0.74	0.82	0.51	0.03	-0.24	-0.09
	(0.41)	(0.83)	(0.57)	(0.43)	(0.30)	(0.24)
Coefficient on E_{it}	0.68	0.08	-0.46	-0.41	0.13	-0.14
	(0.37)	(0.74)	(0.49)	(0.35)	(0.26)	(0.23)
Sum of I_{it} and	0.19	1.08	1.00	0.05	-0.07	0.16
R_{it} coefficients	(0.53)	(1.06)	(0.66)	(0.54)	(0.39)	(0.29)
Sum of I_{it} and	0.13	0.34	0.03	-0.39	0.30	0.12
E_{it} coefficients	(0.39)	(0.76)	(0.49)	(0.37)	(0.28)	(0.22)

R_{it} equals 1 if country i targeted inflation in periods t-1 and t