GREAT MODERATION AND INFLATION TARGETING IN THE WORLD

KLAUS SCHMIDT-HEBBEL

Distinguished Lecture Series 27

A PUBLICATION OF
THE EGYPTIAN CENTER FOR ECONOMIC STUDIES

CONTENTS

FOREWORD

The world economy has experienced wide-spread and vigorous economic growth for several years. Business cycles in major world regions seem to have become less pronounced and longer lasting, implying less volatile output growth. Inflation has also fallen significantly. This Great Moderation is likely to reflect the influence of several forces at work, including better institutions, stronger political and policy consensus on the benefits of macroeconomic stability, stronger, more accountable, and more sophisticated macroeconomic regimes and policies, and structural improvements.

In this edition of the *Distinguished Lecture Series*, Klaus Schmidt-Hebbel, an economist of international renown, assesses the relative contribution of the ultimate causes of the Great Moderation, and the likelihood of its future sustainability. He shows that inflation targeting helps countries attain lower inflation levels in the long run and become more resilient to external shocks. The discussion that followed his rich lecture was highly relevant and the answers provided by Dr. Schmidt-Hebbel were insightful and constructive. Both the lecture and the discussion are included in this publication.

Hanaa Kheir-El-Din,
Executive Director and Director of Research, ECES
February 2008

تقديم

شهد الاقتصاد العالمي خلال السنوات العديدة الماضية تزايدا في معدلات النمو الاقتصادي، كما أصبحت الدورات الاقتصادية أقل وضوحا وأطول أمدا في مختلف مناطق العالم، الأمر الذي يعني ضمنا انخفاض التقلبات في نمو الناتج. كذلك انخفضت معدلات التضخم بشكل ملموس. وهذا "الاعتدال الكبير" ربما يعكس تأثير العديد من العوامل، ومنها تطور المؤسسات، وتزايد الإجماع على الصعيدين السياسي والاقتصادي حول مزايا الاستقرار الاقتصادي الكلي، ووجود سياسات وأنظمة اقتصاد كلي أكثر تطورا وخضوعا للمساءلة، فضلا عن التقدم الذي تحقق على صعيد الإصلاح الهيكلي.

وفي هذا العدد من سلسلة المحاضرات المتميزة، يناقش كلاوس شميت-هيبل، وهو أحد الاقتصاديين ذوي الشهرة العالمية، المساهمة النسبية للعوامل التي أدت إلى هذا "الاعتدال الكبير"، واحتمالات استمراره في المستقبل. كما يوضح أن استهداف التضخم يساعد البلدان على تخفيض مستويات التضخم في الأجل الطويل وعلى زيادة قدرتها على الصمود أمام الصدمات الخارجية. وقد تطرقت المداخلات الثرية والمفيدة التي أعقبت هذه المحاضرة إلى العديد من الملاحظات والأسئلة المتعمقة، وجاءت إجابات شميت-هيبل عن استفسارات الحضور بذات القدر من التعمق والوضوح. ويضم هذا الإصدار كل من المحاضرة وملخص المناقشات.

أ. د. هناء خير الدين
المدير التنفيذي ومدير البحوث
المركز المصري للدراسات الاقتصادية
فبراير ٢٠٠٨

ABOUT THE SPEAKER

Klaus Schmidt-Hebbel D.

Division Chief, Economic Research,

Central Bank of Chile

Klaus Schmidt-Hebbel is currently chief of the economic research division at the Central Bank of Chile and full professor of economics at the Catholic University of Chile. He is also professor of economics at the University of Chile. Mr. Schmidt-Hebbel was associate professor and assistant professor at the Catholic University of Chile, instructor at the Massachusetts Institute of Technology and assistant professor at the University of Santiago. In addition, he was principal economist, senior economist and economist at the World Bank (1988-1996). His main areas of research include macroeconomics, social security, monetary economics and cultural economics. He is co-editor of two economic journals. Dr. Schmidt-Hebbel holds a Ph.D. in economics from the Massachusetts Institute of Technology.

PART I

GREAT MODERATION AND INFLATION TARGETING IN THE WORLD[1]

1. INTRODUCTION

The last two decades have seen a major improvement in the world's macroeconomic performance. Inflation levels and volatilities have declined and output growth rates are more stable in all major world regions. The inflation decline and the overall reduction in second moments of both inflation and output growth have been dubbed as the "Great Moderation" after the more unstable decades of the 1970s and 1980s.

Possible explanations for the Great Moderation phenomenon can be grouped into four categories. First, improved institutional quality and stronger political and policy consensus in most countries could reflect a shift in preferences toward more macroeconomic stability. Better choices and improved implementation of macroeconomic regimes and policies are likely to be a second driving force. Third, structural and technological changes of how economies operate—including market creation, financial development, and information technology improvement—could contribute to stabilization. Finally, there is good luck: stability could be a result of smaller and less frequent supply shocks observed during the last two decades.

Assessing the relative contribution of the ultimate causes of the Great Moderation is important both for the assessment of policies and the likelihood of its future sustainability. The world supply shock reflected by high commodity prices that is unfolding since 2006 and the turmoil observed in world financial markets since mid-2007 will provide a test case to check if global macroeconomic stability—and its underlying policies—is robust to a world environment of adverse luck.

This paper focuses only on one policy candidate that may have contributed to world-wide stabilization: the potential improvement in monetary policy derived from the adoption of inflation targeting (IT) in many industrial and emerging-market economies (EMEs). Therefore, this paper assesses the success of IT by reporting panel-data evidence for inflation-targeting countries in comparison to their own past performance and relative to a control group of high-achieving industrial countries that do not target inflation. It is shown that the adoption of IT improves macroeconomic performance compared to the pre-adoption stage, with special quantitative importance in EMEs. This improvement in macroeconomic performance reflects the contribution of IT to world-wide Great Moderation. Despite the latter's favorable results for IT, the evidence does not generally show that countries under IT have

[1] A first version of this paper was presented at the November 2007 ECES Conference on "What Drives Prices in Egypt?" I thank Hanaa Kheir-El-Din and conference participants for valuable comments. I also thank Mauricio Calani for excellent research assistance. The usual disclaimer applies.

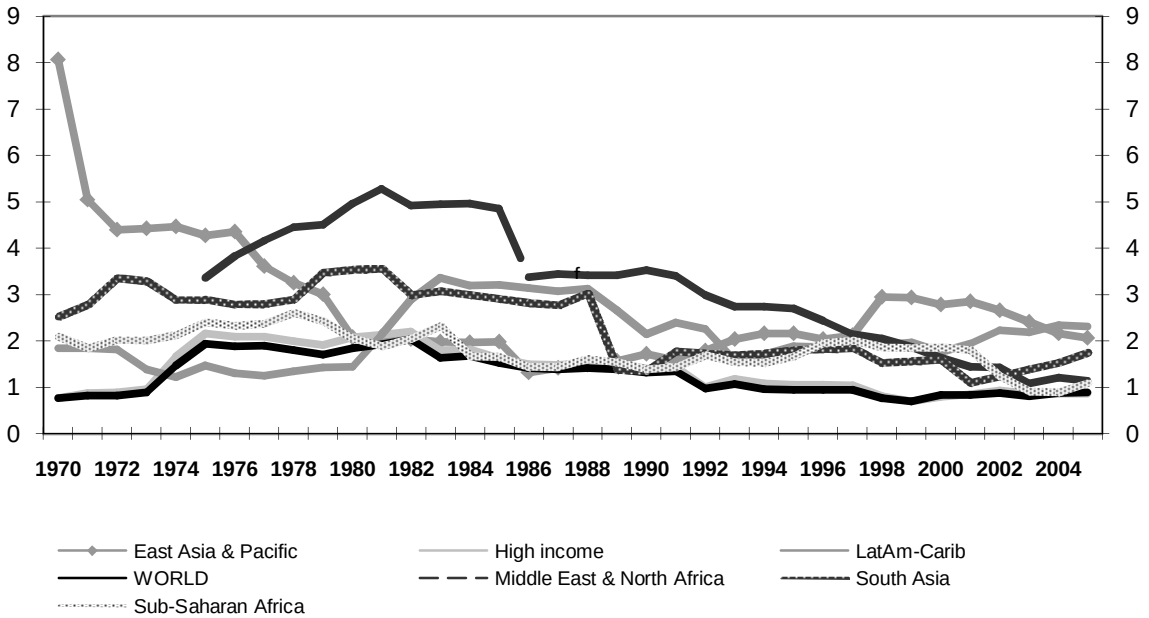
attained better monetary policy performance relative to the control group of highly successful non-inflation targeting industrial countries.

The paper is organized as follows. Section 2 discusses the world-wide trend toward lower inflation and growth volatility, and reviews its possible driving forces. Section 3 documents facts on IT adoption, convergence and accuracy. Section 4, the paper's core part, reports comparative data on macroeconomic performance and monetary policy efficiency in IT countries, both over time and in comparison to industrial non-IT countries. Section 5 concludes.

2. THE GREAT MODERATION

Economic growth has been nothing but vigorous in the past decade. International financial crises in the late 1990s, followed by the dotcom burst, had certainly a negative effect on world economic growth, but subsequent recovery was particularly fast and vigorous when compared to previous crises and cyclical downturns. World economic growth has not only been strong but it has also been remarkably stable. Output growth volatility has declined in all major regions of the world, as depicted in Figure 1, which shows GDP growth volatility, measured by its standard deviation for 10-year rolling windows. After a somewhat long period of higher world growth volatility (from 1972 to 1982), it displays a systematic downward trend. Only Asia and, to a smaller extent, Latin America exhibit higher growth volatility during the Asian Crisis, but reverting towards low trend world growth volatility in the subsequent years.

Figure 1. GDP Growth Volatility in Major Regions, 1960-2006
Standard Deviation of 10-Year Rolling Windows (%)



Source: Author's calculation based on World Bank: World Development Indicators (2007).

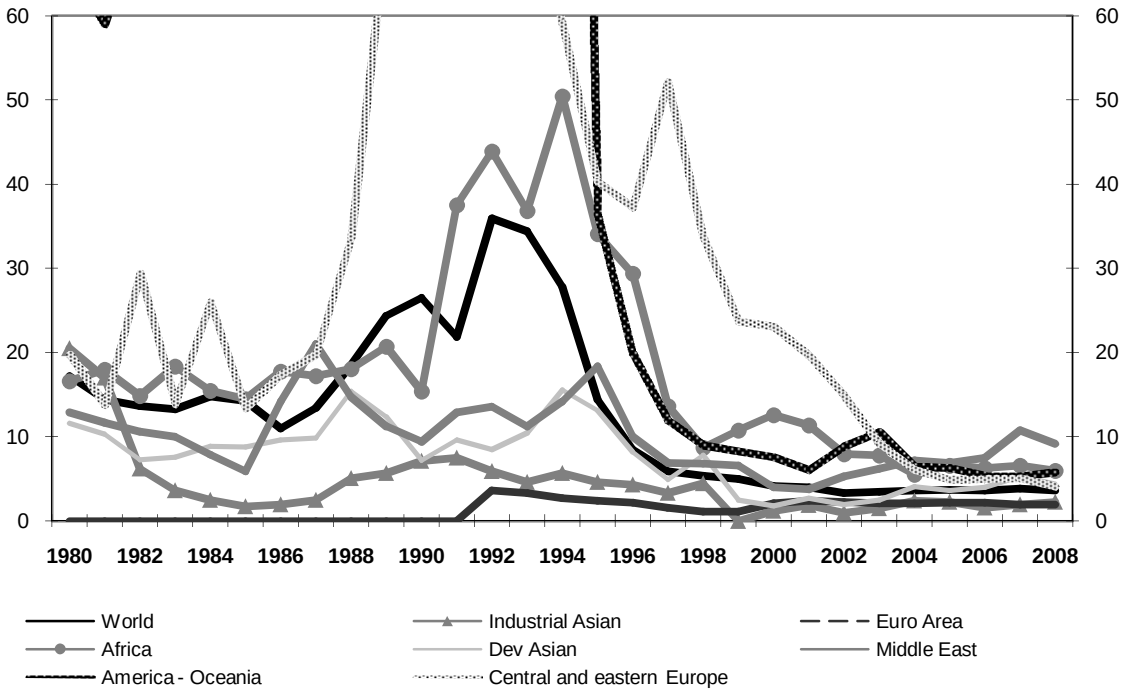
During the decade spanning from 1996 to 2006, world GDP growth volatility has reached the low value of the 1960s (0.9 percent), after a spike of high volatility (2 percent) in the decade from 1975 to 1985. As reported in the IMF's World Economic Outlook (2007), even though world volatility is the same as in the 1960s, individual-country volatilities are rather lower. The standard deviation of median country growth declined from 3.8 percent in 1960 to 2.7 percent in 2006. Thus the apparently similar world standard deviations of the 1960s and the last decade (1996-2006) hide the effect of larger covariances between countries. Forty years ago, individual country growth volatilities were higher but countries' business cycles were less correlated (lower covariances), whereas in the most recent decade individual country GDP growth volatilities have dropped further while cross-country covariances have increased and are generally positive. Globalization—larger financial and trade integration—is behind countries' increased cyclical co-movements.

Similar results are observed for inflation convergence. Inflation levels have declined in all world regions. Chronic inflation has been almost wiped out, while world and regional inflation levels have become very stable around low average levels. Figure 2 depicts CPI headline inflation averages for different regions and the world at large. Except for Central and Eastern Europe, where many countries underwent intense but temporary macroeconomic instability in their transition toward market economies in the early 1990s, the last decade has been predominantly characterized by one-digit inflation rates converging to levels around or below 5 percent per year.[2] The convergence toward low inflation is also associated with a major reduction of inflation volatility in all regions.

[2] However, Central and Eastern Europe exhibit Great Moderation during the last five sample years.

Figure 2. CPI Headline Inflation in Selected Groups of Countries, 1980-2007 (%)

GDP Weighted Average



Source: Author's calculation based on International Monetary Fund: World Economic Outlook (2007).

While reduced variability of output growth and inflation is a world-wide phenomenon, the start of the Great Moderation differs among countries and regions. Summers (2005) estimates the probability of experiencing high and low volatility of GDP growth for the G-7 and Australia. The likelihood associated with high volatility is estimated to be very high in the 1970s-1980s, at values close to 1, and then declines to values close to zero at quite different dates. Indeed, the timing of this abrupt change differs markedly across these eight industrial countries: Germany experiences it around 1971, Japan and France in the mid-1970s, Italy and the UK in the early 1980s, Australia and the United States in 1984, and Canada in 1988.

The reduction in output and inflation volatility started much earlier among industrial countries than in developing-country regions, as Figures 1 and 2 make clear. In fact, inflation reached hyper-inflation levels in many Latin American and transition economies in the 1980s and early 1990s. The Great Moderation is a relatively new phenomenon in most emerging-economy, transition, and developing countries, in contrast to two decades or more of macroeconomic stability in industrial or high-income countries.

The differences in the timing of changes in volatility suggest that there is no unique common external force behind the Great Moderation—it is neither common world shocks nor common structural changes like the

integration of China and India into the world economy. Hence, domestic changes—which may be of the same nature but are adopted at different dates by individual countries—are more likely to lead to macroeconomic stability. Such reforms are probably related to changes in macroeconomic regimes and policies.

2.1. What Drives the Great Moderation?

Price stability is widely recognized in the literature as a welfare-enhancing condition, which fosters economic growth, makes business planning easier, facilitates financial deepening, reduces resources devoted to uncertainty hedging, and supports more equal income distribution. Output growth volatility is positively correlated to income and consumption volatility—hence output stability also leads to larger welfare. The concern for welfare, policy sustainability, and the assessment of future macroeconomic stability in the world leads to a search for the causes behind the Great Moderation. The literature has identified four categories of driving forces.

The first set of explanations is related to stronger political and policy consensus and improved institutions that support macroeconomic stability. If consensus among the main political parties is reached, sustainable institutions that provide a general framework for macroeconomic stability are more likely to be adopted, maintained and refined over time. Among the institutional changes where most economies exhibit major improvements during the past two decades are improved property rights, better governance and accountability of governments and public sector institutions, and major gains in central bank independence.

Improvements in macroeconomic regimes and policies comprise the second set of candidates leading to macro stability in the world. Most economists would agree that macroeconomic policy conduct has greatly evolved since the 1960s and 1970s, when policy conduct was particularly poor. Bernanke (2004) highlights the fact that during the 1970s monetary policy decisions were taken under the influence of misconceived understandings and models of monetary policy and the functioning of the economy. At that time, central bankers were excessively confident about the ability of monetary policy as a counter-cyclical tool, and, much worse, as an instrument for fostering longer-term employment and output growth. In addition, they seem to have underestimated the contribution of their policies to inflation, by believing that, at least to some extent, inflation was determined by forces other than monetary policy. These non-monetary or non-demand causes of inflation were the so-called *cost push shocks* observed in the late 1960s and 1970s, including oil and other commodity-price shocks and large wage hikes obtained by unions. The combination of such output optimism and inflation pessimism, in Bernanke's terminology, led to an abuse of activist monetary policy, which resulted in high and volatile inflation, as well as volatile output growth. After this experience, major improvements in monetary theory and empirics—related to the rational-expectations revolution—led to a better understanding of the role of monetary policy and the structure of the underlying economy, and to subsequent policy improvements. At different points in time, industrial countries (first) and developing countries (later) improved their macroeconomic regimes and policies, adopting more sustainable fiscal policies, monetary policies more clearly focused on price stability, and more flexible exchange-

rate arrangements. This policy shift in the realm of monetary regime change, toward IT, is the focus of the next sections in this paper.

A third set of possible explanations of the Great Moderation is comprised of structural and technological changes of how economies operate—including market creation, financial development, and information technology improvement. These changes improve macroeconomic stability by influencing an economy's capacity to absorb shocks and face uncertainty. More efficient financial systems and deeper financial markets allow consumers to improve inter-temporal consumption smoothing and risk hedging by holding better diversified portfolios, leading to more stable consumption. Deeper and more efficient financial intermediation also improves credit access by small enterprises, leading to more stable investment and production. Improvements in the structure and diversification of output reduce the sensitivity of aggregate output to external shocks. Blanchard and Simon (2001) find evidence that inventory management has become more counter-cyclical, helping stabilize business cycles. This is a by-product of new information technologies that help to improve planning of production and sales. Finally, more flexible labor and goods markets contribute to larger macroeconomic stability.

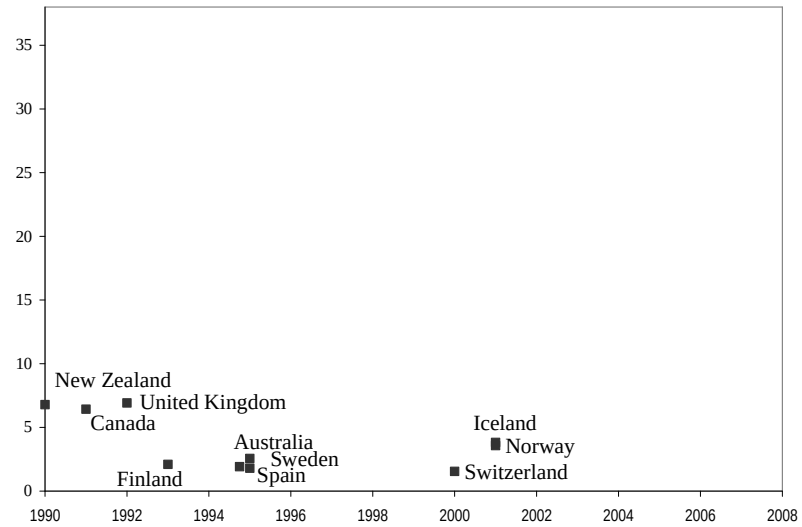
Finally, there is good luck, reflected by smaller and less frequent supply shocks affecting economies, leading to less volatility in domestic macroeconomic variables. This residual explanation of the Great Moderation, if derived from common world shocks, does not seem to be a persuasive factor driving Great Moderation because of the differences in the timing of its start across different countries, as noted above. Yet the world energy and food price shocks unfolding since 2006, and the more recent turmoil observed in world financial markets, will put the world's Great Moderation to the test, either vindicating or rejecting the view that good or bad luck is key in its accomplishment.

3. Inflation Targeting Adoption, Convergence and Accuracy

Eight industrial countries and eighteen emerging economies had adopted full-fledged, explicit IT as their monetary regime by mid-2007.[3] Most industrial countries adopted IT when inflation rates were already at low single-digit levels, as depicted by Figure 3. IT adoption started worldwide in 1990 (in New Zealand) and extended in industrial countries through 2001 (in Iceland and Norway). At the time of IT adoption, annual inflation rates were below 10 percent in all industrial countries but never below 5 percent. By contrast, most EMEs adopted IT at higher initial inflation levels (Figure 4). IT adoption timing ranges in EMEs from 1991 (Chile) to late 2006 (Republic of Serbia). Countries like Peru, Chile, Mexico and Israel adopted IT while their inflation rates were still well above 15 percent, typically using annual declining inflation target levels under attaining stationary targets.

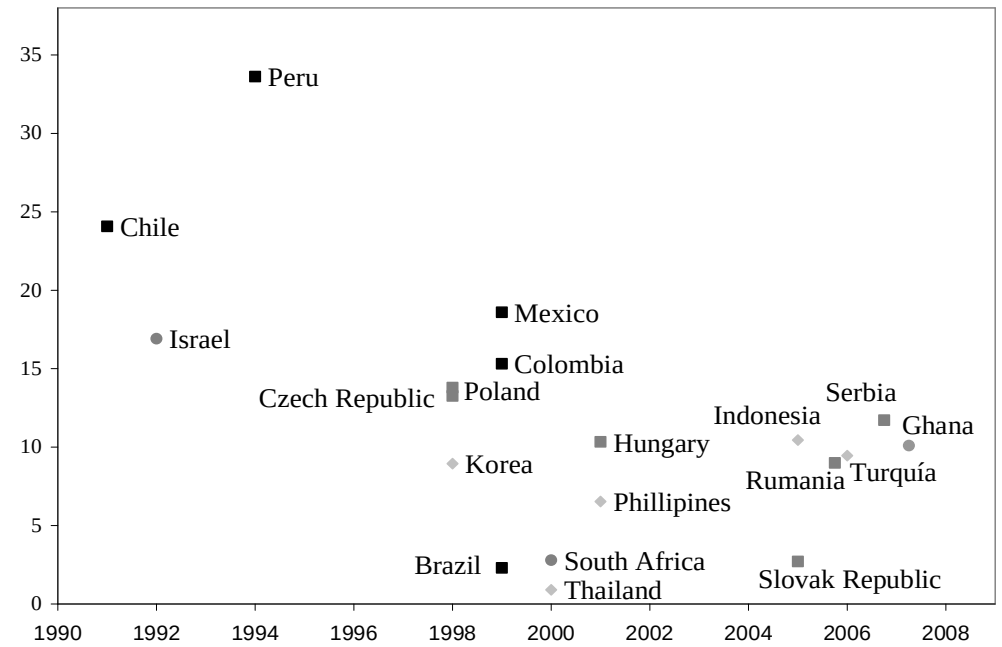
[3] Mishkin and Schmidt-Hebbel (2002) assess empirically the determinants of adopting inflation targeting, identifying significant policy and structural variables that explain IT adoption, in comparison to a control group of countries that have not adopted the latter regime.

Figure 3. Inflation Rate (%) of Industrial Economies at the Time of Adoption of Inflation Targeting



Source: Author's data based on central banks' websites.

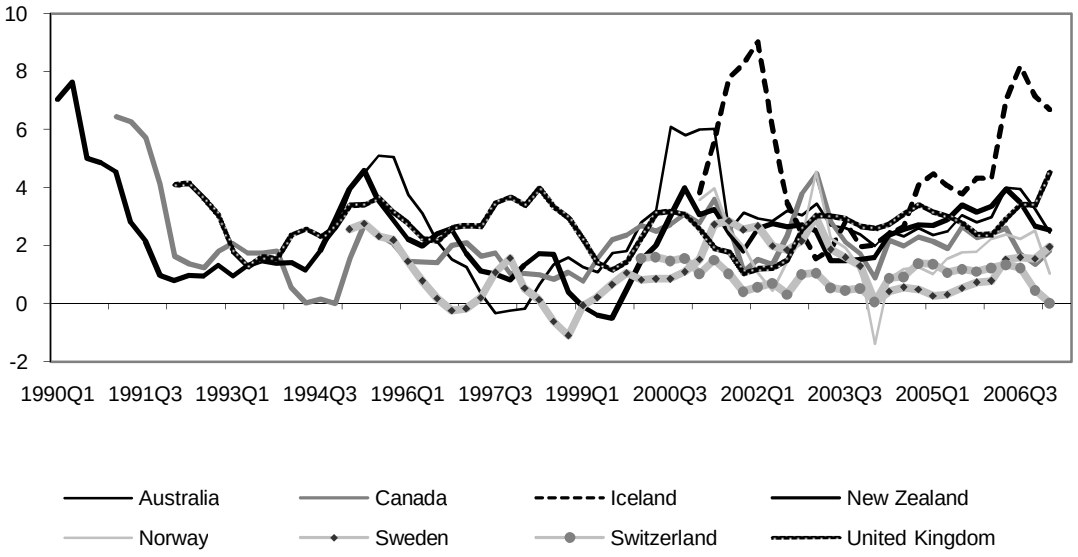
Figure 4. Inflation Rate (%) of Emerging Market Economies at the Time of Adoption of Inflation Targeting



Source: Author's data based on central banks' websites.

All industrial ITers exhibit low and stationary inflation levels (Figure 5).[4] In the group of EMEs, Latin American ITers seem to have experienced the largest disinflation process, which is natural since countries like Chile and Peru adopted IT when their effective annual inflation rates were close to 25 percent and 33 percent, respectively (Figure 6). Asian, Central European, and other EME ITers experienced convergence to low inflation levels as well, although their required disinflation—from initially lower inflation levels—was typically less severe and was attained more quickly than in Latin America (see Figures 7 and 8).

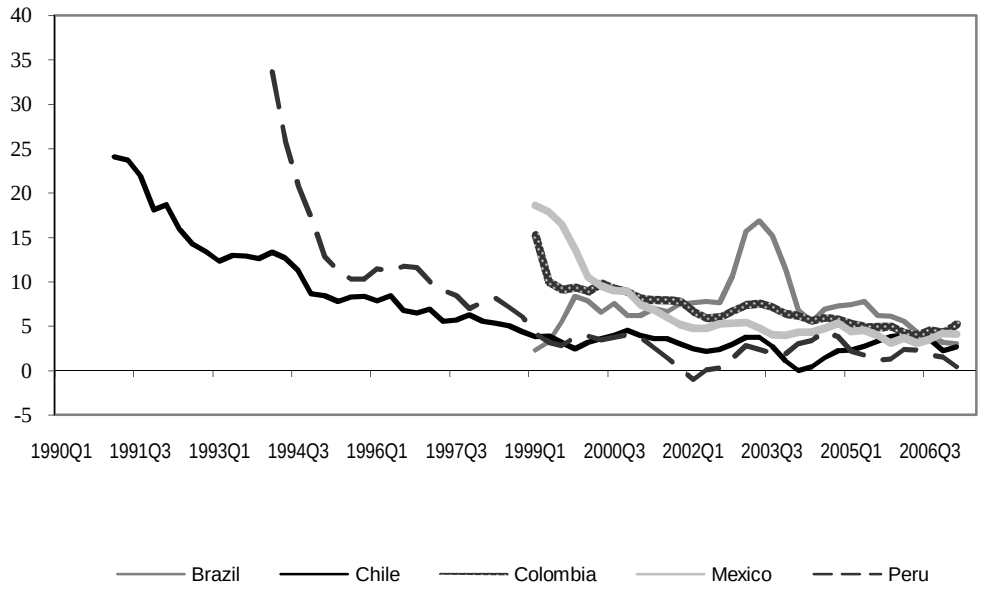
Figure 5. Inflation Rate (%) in Industrial Inflation Targeters



Source: Author's calculation based on World Bank: World Development Indicators (2007).

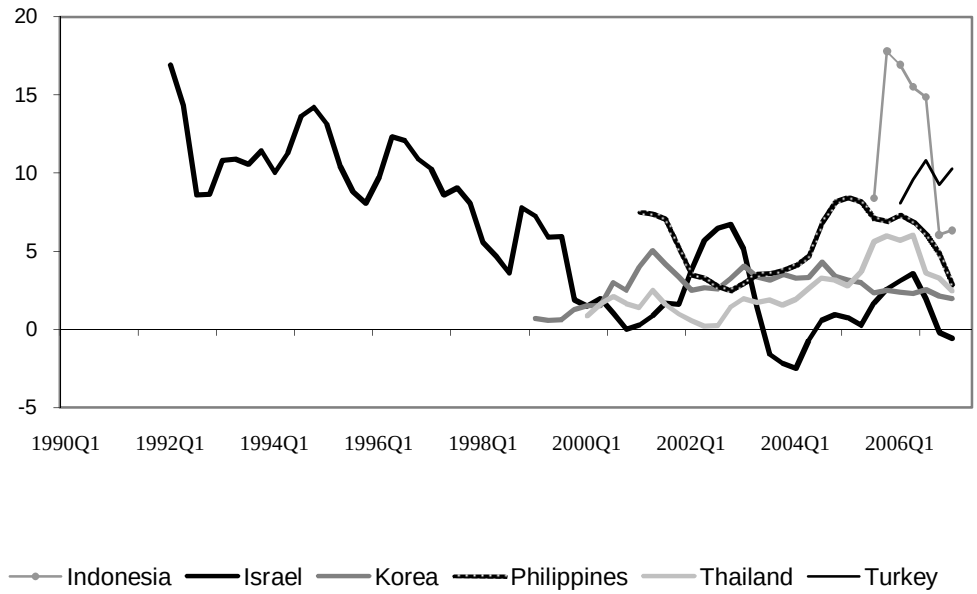
[4] Iceland is the exception in the last couple of years. While all industrial ITers' inflation rate was below 5 percent, Iceland's inflation rate was around 7 percent in the period 2005-2007.

Figure 6. Inflation Rate (%) in Latin American Inflation Targeters



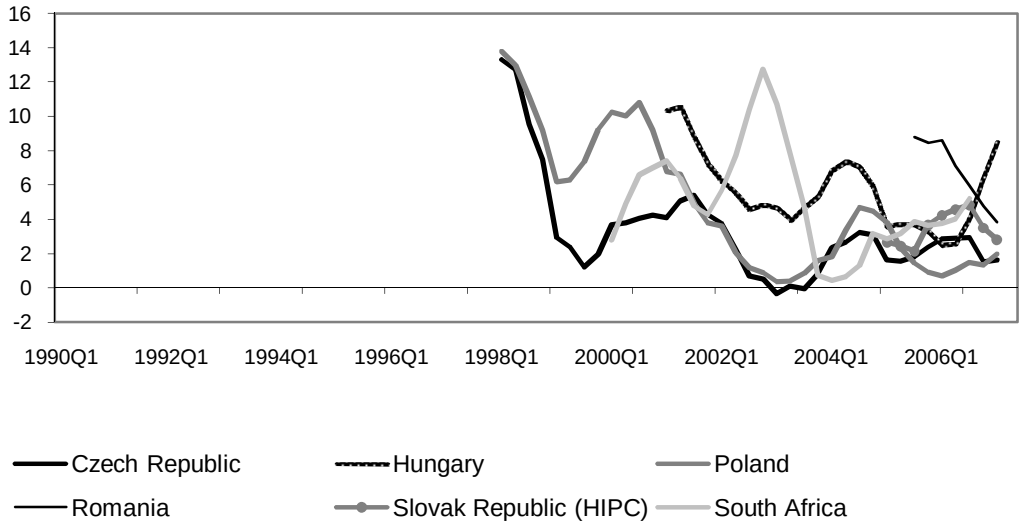
Source: Author's calculation based on World Bank: World Development Indicators (2007).

Figure 7. Inflation Rate (%) in Asian Inflation Targeters



Source: Author's calculation based on World Bank: World Development Indicators (2007).

Figure 8. Inflation Rate (%) in Central European and Other Emerging Market Economies Inflation Targeters

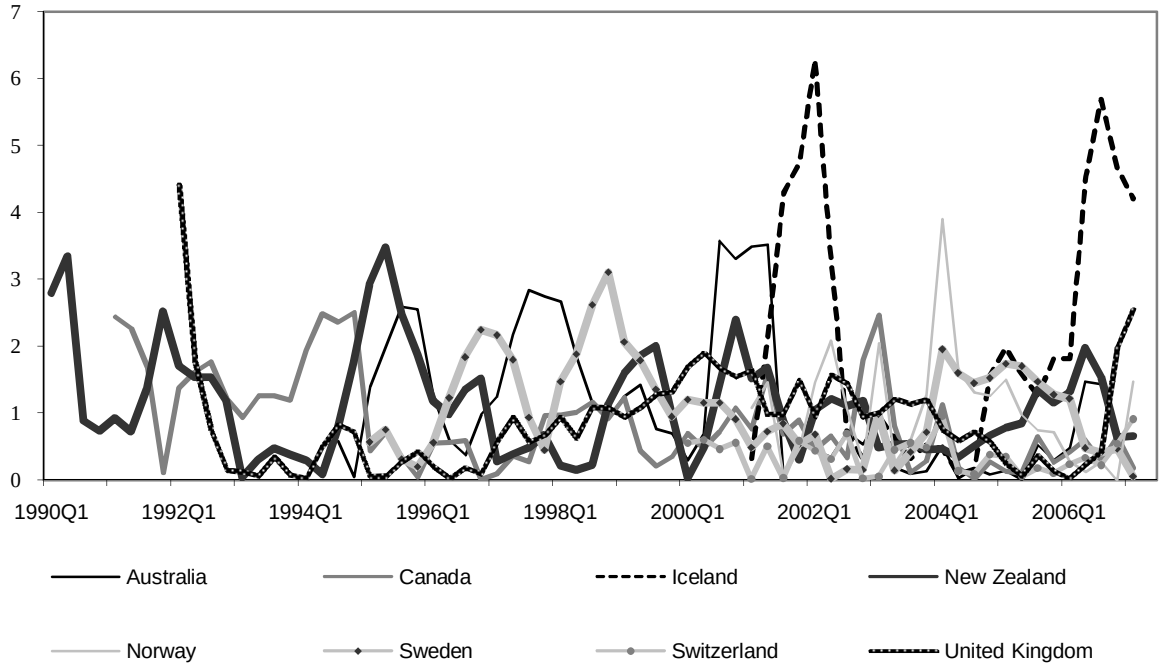


Source: Author's calculation based on World Bank: World Development Indicators (2007).

Inflation deviations from targets have been low and declining under IT. Figures 9 through 12 depict absolute inflation deviations from targets for the same groups of countries as shown above. Industrial ITers and Latin American ITers seem to be the best performers (Figures 9 and 10), with the smallest absolute deviations from their respective country-specific targets. Thus inflation performance seems to be enhanced after the adoption of IT, not only regarding the level but also the variability of inflation.

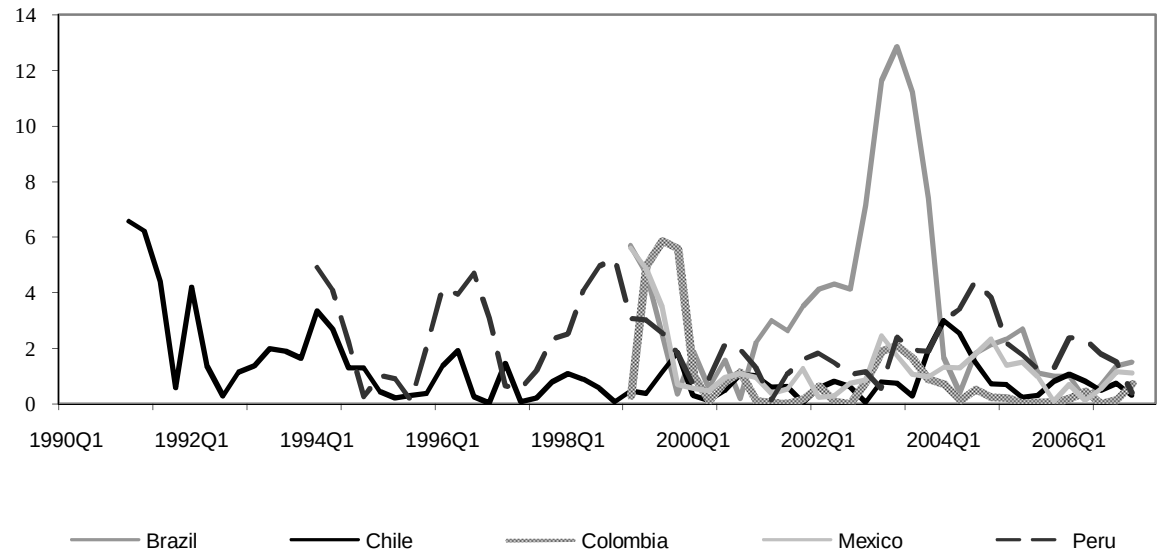
The rest of the paper goes beyond the descriptive analysis presented up to this point. It examines more carefully macroeconomic performance and monetary policy efficiency under IT, in comparison to non-IT experiences and controlling for the influence of factors other than the IT regime.

Figure 9. Absolute Inflation Deviation (%) in Industrial Inflation Targeters



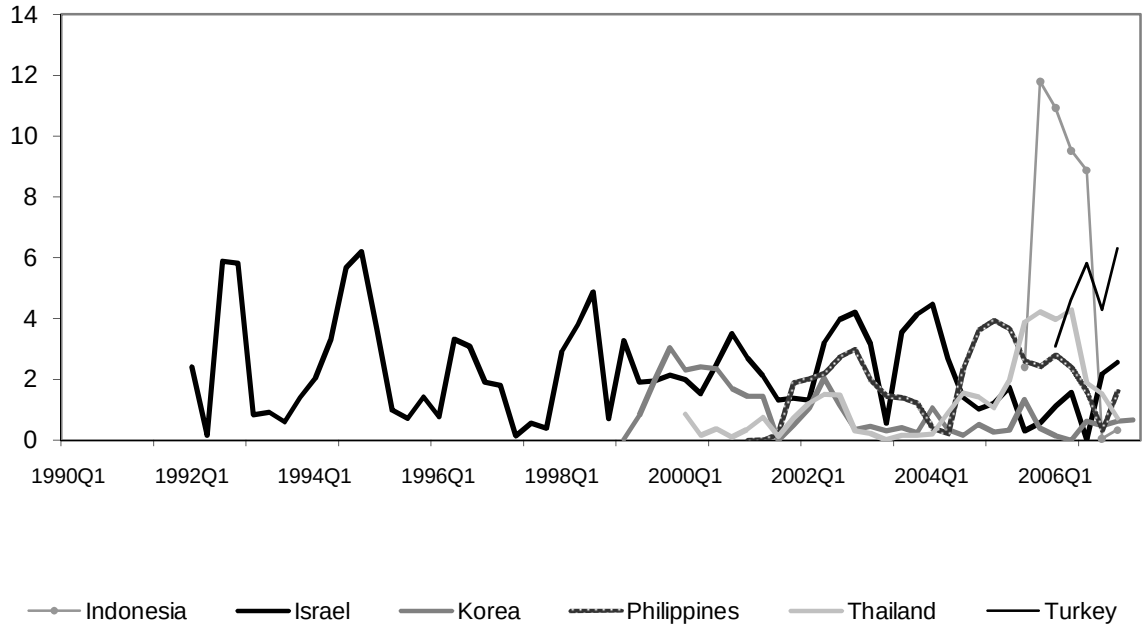
Source: Author's calculation based on World Bank: World Development Indicators (2007).

Figure 10. Absolute Inflation Deviation (%) in Latin American Inflation Targeters



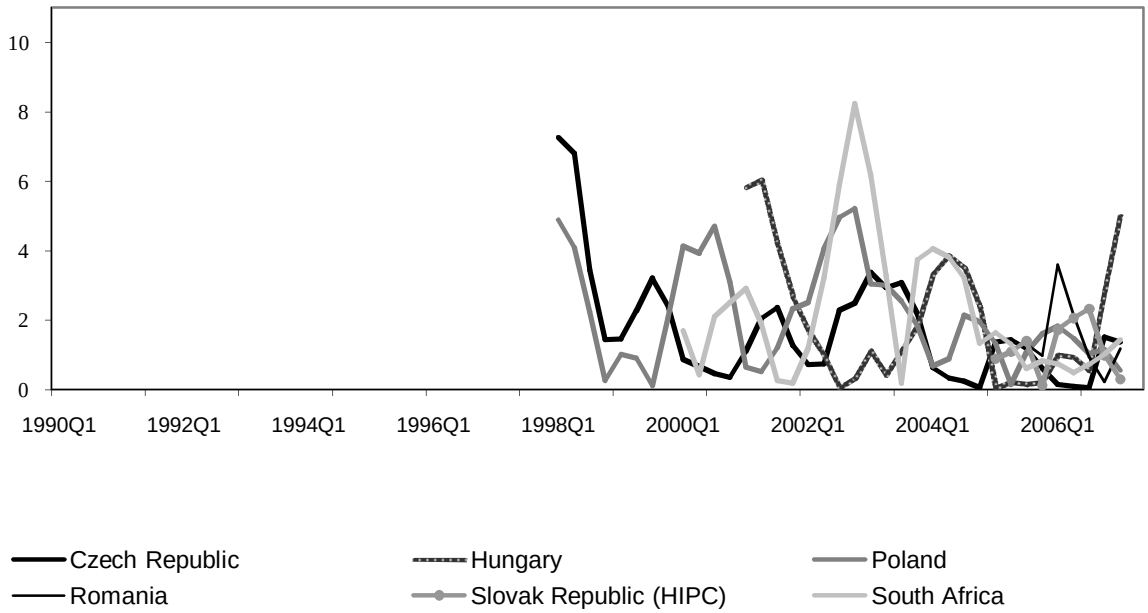
Source: Author's calculation based on World Bank: World Development Indicators (2007).

Figure 11. Absolute Inflation Deviation (%) in Asian Inflation Targeters



Source: Author's calculation based on World Bank: World Development Indicators (2007).

Figure 12. Absolute Inflation Deviation (%) in Central European and Other Emerging Market Economies Inflation Targeters

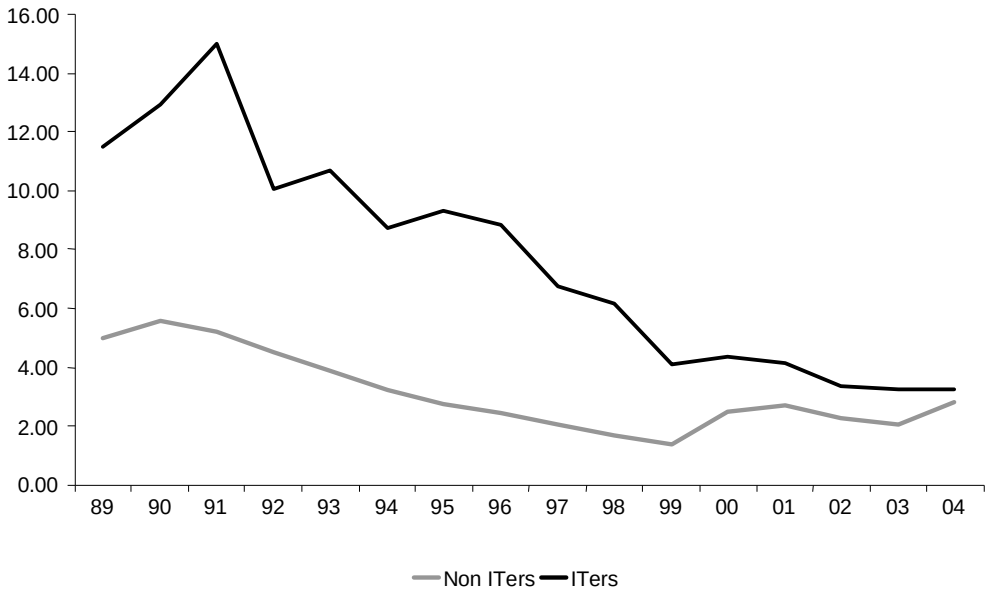


Source: Author's calculation based on World Bank: World Development Indicators (2007).

4. THE ROLE OF INFLATION TARGETING

This section draws heavily on the framework and empirical results presented in Mishkin and Schmidt-Hebbel (2007) on the outcomes of adopting IT. The first issue dealt with is the choice of the adoption date of IT. To avoid arbitrariness in this decision, two phases in IT experiences are distinguished: an initial converging period in which inflation targets are typically set annually on a declining path and a subsequent stationary inflation target period characterized by a constant target level. For a preliminary glance at the influence of IT on effective inflation in countries adopting it, Figure 13 depicts annual averages of inflation for 21 IT countries (all world ITers until 2005) and 13 high-performance NITers. Inflation levels are averages of four quarterly 12-month CPI inflation rates for the corresponding year. This figure suggests that IT helps reduce inflation toward NITers' levels.[5] However, more systematic tests are presented subsequently.

Figure 13. Average Annual CPI Inflation Rates in Inflation Targeting and Non-Inflation Targeting countries, 1989-2004



Source: Mishkin and Schmidt-Hebbel (2007).

4.1. Comparative Inflation Performance

Several previous studies have focused on comparing the performance of ITers and NITers. These studies were mainly based on cross-section evidence which limited the robustness of their conclusions. We extend these studies by considering alternative control groups in a panel data set which enables us to exploit the time-dimension information, as well as the differences between ITers and NITers. This approach also allows us to distinguish

[5] The control group of non-targeters comprises Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, Portugal and the United States.

between different stages in the adoption of IT (convergence and stationary period). To make results comparable with previous studies, we specify inflation as a weighted average of its long-term or underlying mean and its recent past represented by its lagged value, consistent with a standard partial adjustment specification. The unobserved long-term inflation rate is allowed to differ between ITers and NITers through a dummy variable, which is set equal to 0 for NITers and for ITers before adoption of IT and equal to one in other cases. This IT dummy variable, however, may be endogenous to the actual level of inflation, hence different estimation techniques are used to assess robustness of the results. Table 1 shows these results; specifically, it shows the long-term (LT) inflation difference between ITers and NITers. The chosen techniques are pooled OLS, panel IV and pooled IV with time and country fixed effects for the panel regressions. Different control groups are also used for these estimations; control group 1 includes all NITers and pre-ITers, control group 2 includes all NITers, and control group 3 includes pre-ITers. Using control group 1, all IT groups show statistically lower LT inflation levels with the exception of industrial ITers for which there is no statistically significant difference. Using control group 2 the opposite occurs. Only industrial ITers show statistically significant reduction of inflation. Finally, using control group 3 it can be seen that the adoption of IT is especially relevant for converging ITers (-8.2 percent LT difference) and EME ITers (-6.4 percent LT difference). Thus, in all cases, when statistically significant, IT comes along with a reduction on LT inflation level.

Table 1. Comparative Inflation Performance

Long-Term Inflation Level Difference

	Control Group 1	Control Group 2	Control Group 3
All ITers (OLS)	-1.9%	zero	-5.0%
All ITers (IV)	-4.8%	zero	-5.0%
Industrial (IV)	zero	-1.1%	zero
Emerging (IV)	-7.5%	zero	-6.4%
Stationary (IV)	-2.1%	zero	zero
Converging (IV)	-8.0%	zero	-8.2%

Source: Author's calculation based on Mishkin and Schmidt-Hebbel (2007).

Note: Control group 1 includes all NITers and pre-ITers; control group 2 includes all NITers; control group 3 includes pre-ITers.

4.2. Inflation and Policy Response to Shocks

As stated before, if somehow IT could diminish the impact of shocks on the economy, then it would be fundamentally wrong to give credit of this enhanced stability to smaller shocks, when these have not changed at all. If inflation targeting improves the credibility of monetary policy and helps anchor inflation expectations, then we

should expect inflation to respond less to oil price and exchange rate shocks. As a result of such effect, IT may also reinforce monetary policy independence, interpreted as a weakening of the reaction of domestic interest rates to shocks in foreign markets. To test such ideas, in this subsection we report the results of tests of dynamic response of inflation in IT and NIT country groups to oil prices and exchange rate shocks, and the response of domestic interest rates to international rates.

For this analysis, we use a panel VAR methodology[6] that allows us to use the larger data set on ITers and NITers. This technique combines a traditional VAR approach with panel data, allows for unobserved country heterogeneity and facilitates the exposition and analysis of aggregate results. Country heterogeneity is allowed by introducing fixed effects. These, however, are correlated with the regressors due to lags of the dependent variable (in line with the partial adjustment specification), therefore we use forward mean differencing to remove the mean of all the future observations available for each country. This technique supports the use of lagged regressors as instruments, and estimates the coefficients by system generalized method of moments (GMM). Finally, we identify the response of innovations in the system using the Choleski decomposition of the variance-covariance matrix of residuals, and we apply bootstrap methods to construct their confidence intervals. Confidence intervals for differences in impulse response functions are also calculated using bootstrap methods.

Our VAR system contains the following six variables: international oil price, international interest rate, output gap, inflation, interest rate, and nominal exchange rate.

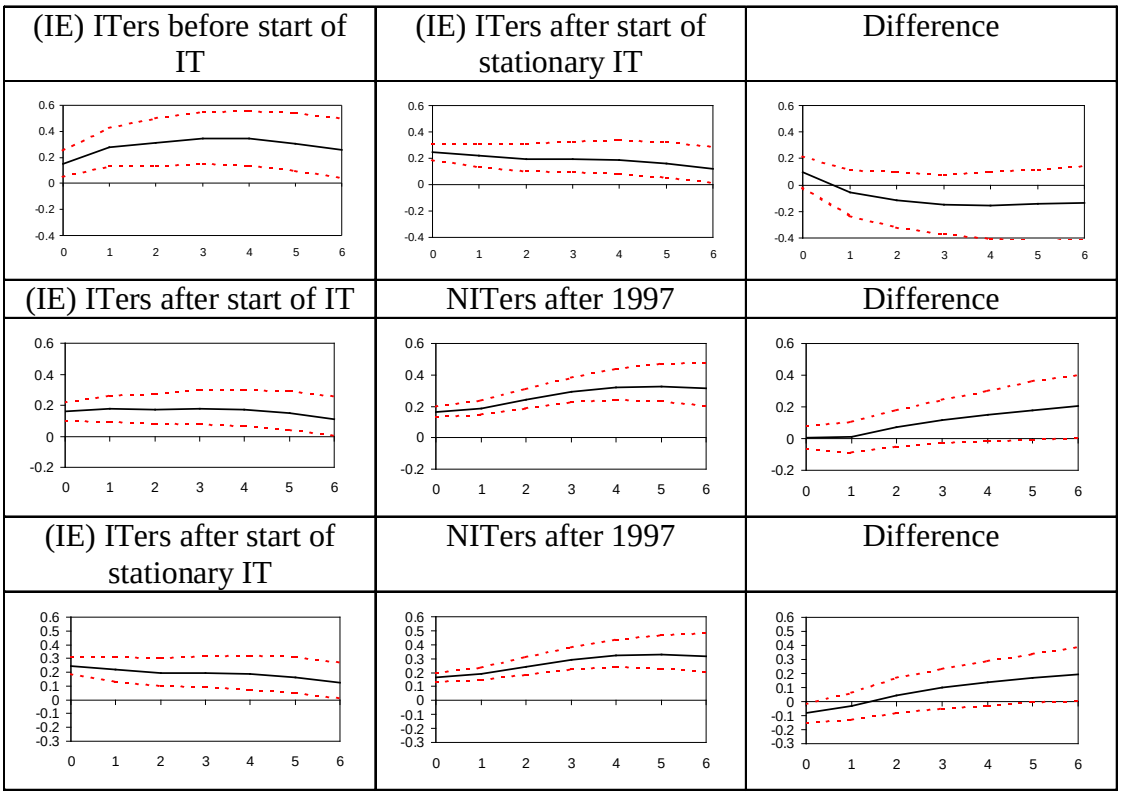
To take into account the sample heterogeneity in our full treatment group of inflation targeters, we divide the group first into industrial and emerging market ITers and then further into ITers before the start of inflation targeting and stationary-target ITers. Figures 14 and 15 depict the response of inflation to a shock in oil prices, separately for industrial and EME ITers, respectively. The first row of each figure reports the comparison of ITers before they adopted inflation targeting and after they achieved a stationary target. In both industrial countries and EMEs, inflation responds less to oil price shocks under a stationary target than before the adoption of IT, but the differences are not statistically significant. The comparison between ITers and NITers can be seen in the second and third rows of Figures 14 and 15. In all inflation-targeting treatment groups, inflation responds less to oil price shocks than it does in NITers (after 1997), and this difference is significant by the sixth quarter, at the latest. In the case of EME stationary ITers, this difference is larger, earlier, and more significant than in the other inflation-targeting treatment groups: it is significant from the fourth to the sixth quarters (last row in Figure 15).

This analysis leads us to two main conclusions. First, IT helps all ITers to reduce the domestic inflation response to an oil-price shock when comparing their performance to their own pre-IT experience, although this reduction is not statistically different from zero. Second, in all IT treatment groups, the inflation response to oil-price shocks is smaller than in NIT countries since 1997. The latter difference in favor of ITers is statistically

[6] For applied studies using panel VAR estimation, see Holtz-Eakin, Newey, and Rosen (1988); Love and Zicchino (2002); and Miniane and Rogers (2003).

significant, on average, at later quarters, reflecting smaller and less persistent effects of an oil shock on domestic inflation in IT than in NIT countries. Surprisingly, the latter result is particularly strong in emerging-market stationary ITers, where the inflation-to-oil-price response is the smallest and less persistent.

Figure 14. Response of Inflation to a Shock in Oil Prices, Splitting Treatment Group Sample: Industrial Economies

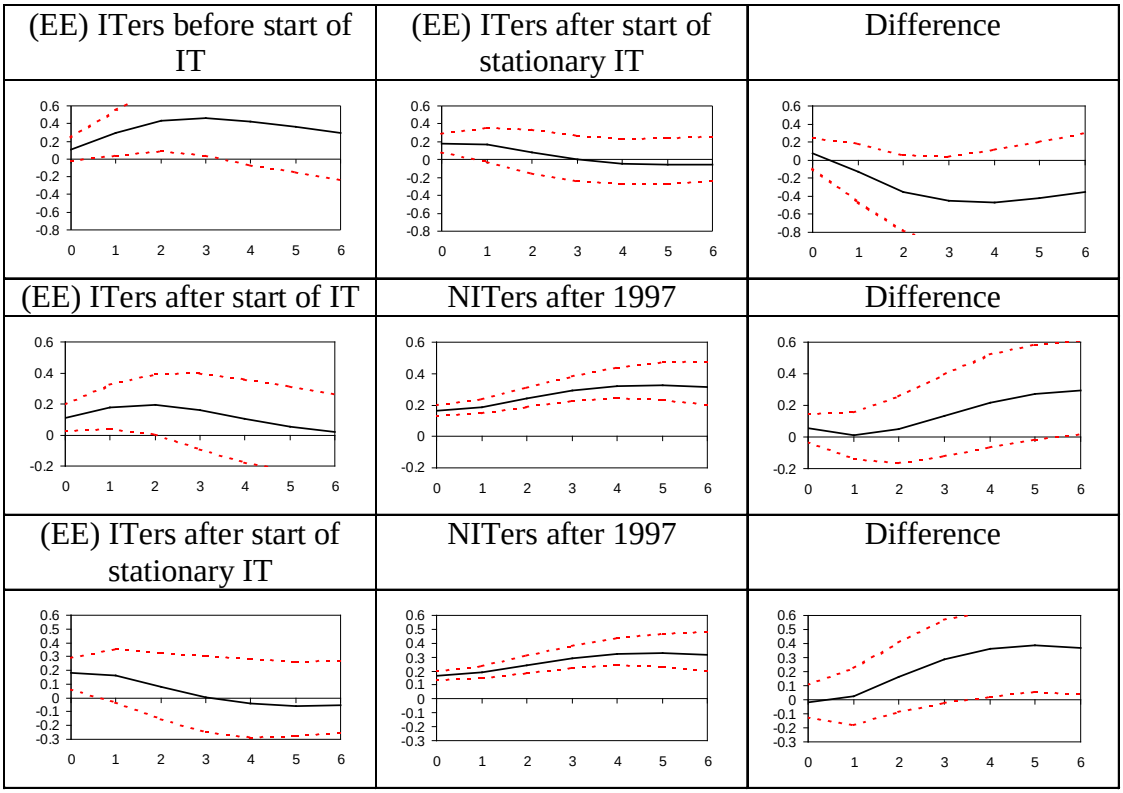


Source: Mishkin and Schmidt-Hebbel (2007).

Next we analyze the dynamic response of inflation to exchange rate shocks, which are depicted in Figures 16 and 17. Industrial ITers (after IT adoption) and industrial stationary ITers exhibit a significantly smaller inflation response to exchange-rate shocks than EME ITers (after IT adoption) and EME stationary ITers, respectively. While in both industrial economies treatment groups (ITers and stationary ITers) pass-through coefficients are close to zero and non-significant in all periods, in both emerging-market treatment groups pass-through coefficients are positive and significant. In industrial ITers, adoption of both IT and stationary-target IT has not made any difference to their pass-through coefficients, both in comparison to their own pre-IT experience and in comparison to NITers since 1997 (Figure 16). In emerging-market economies, however, the comparisons yield very different results (

Figure **17**). Short-term pass-through effects have declined after adoption of stationary targets, and the difference is significant in the first quarter after the exchange-rate shock. Nevertheless, this reduction has not been sufficient to bring pass-through coefficients down to zero, as is the case among NITers since 1997. In fact, emerging-market ITers and stationary ITers exhibit much larger pass-through coefficients than NITers.

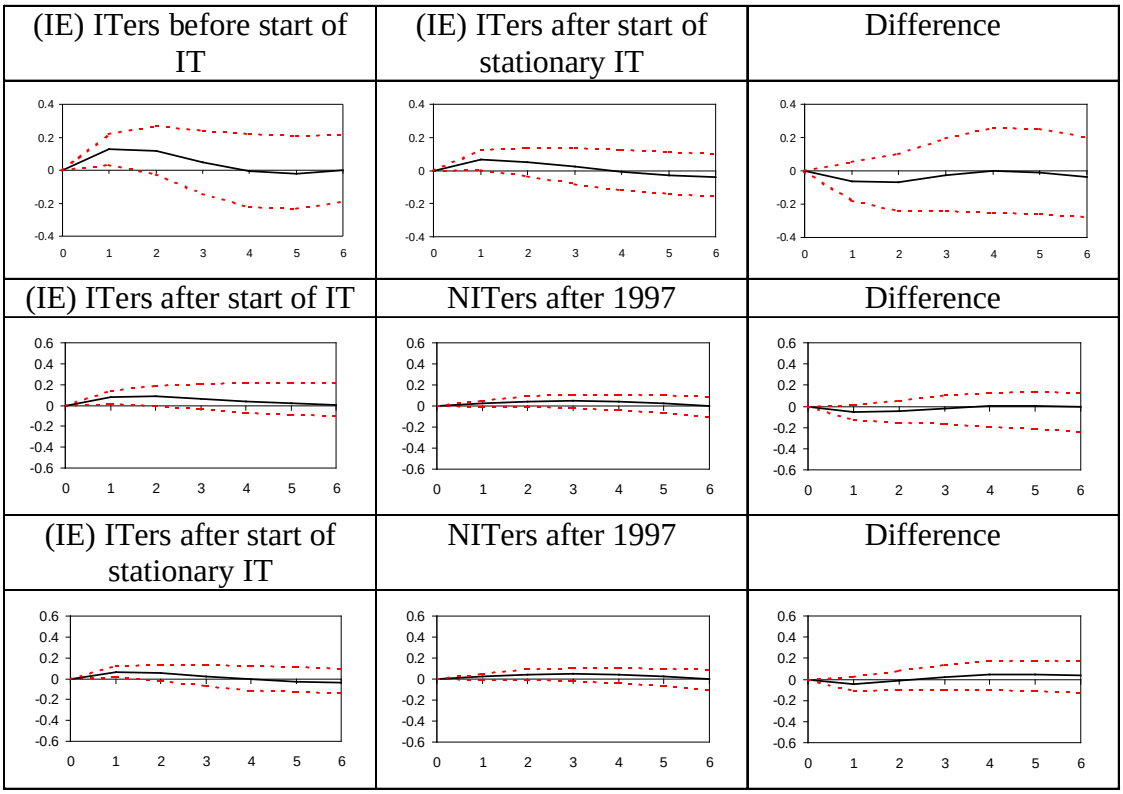
Figure 15. Response of Inflation to a Shock in Oil Prices, Splitting Treatment Group Sample: Emerging Market Economies



Source: Mishkin and Schmidt-Hebbel (2007).

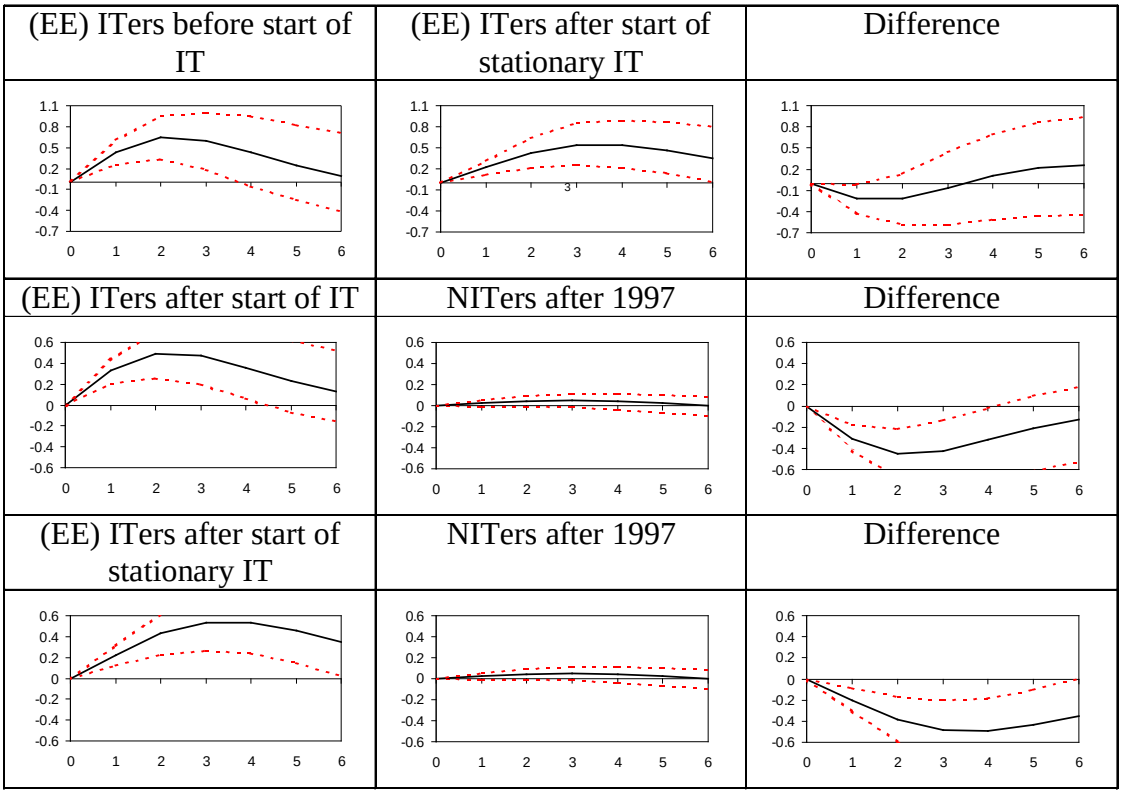
Finally, we consider the issue of comparative monetary independence, reflected by the response of domestic interest rates to shocks in international interest rates. Industrial and emerging-market ITers exhibit large and significant differences in monetary independence (Figures 18 and 19). The contrast in domestic interest rate reaction to foreign interest rate shocks is striking, when comparing industrial and emerging-market ITers before their adoption of IT. While the response is negative and significant in the first quarters after the shock in the industrial-country pre-IT experience, the response is positive, huge, increasing and statistically significant in emerging-market economies, suggesting a significant lack of monetary independence in the latter group before they adopt IT.

Figure 16. Response of Inflation to a Shock in the Exchange Rate, Splitting Treatment Group Sample: Industrial Economies



Source: Mishkin and Schmidt-Hebbel (2007).

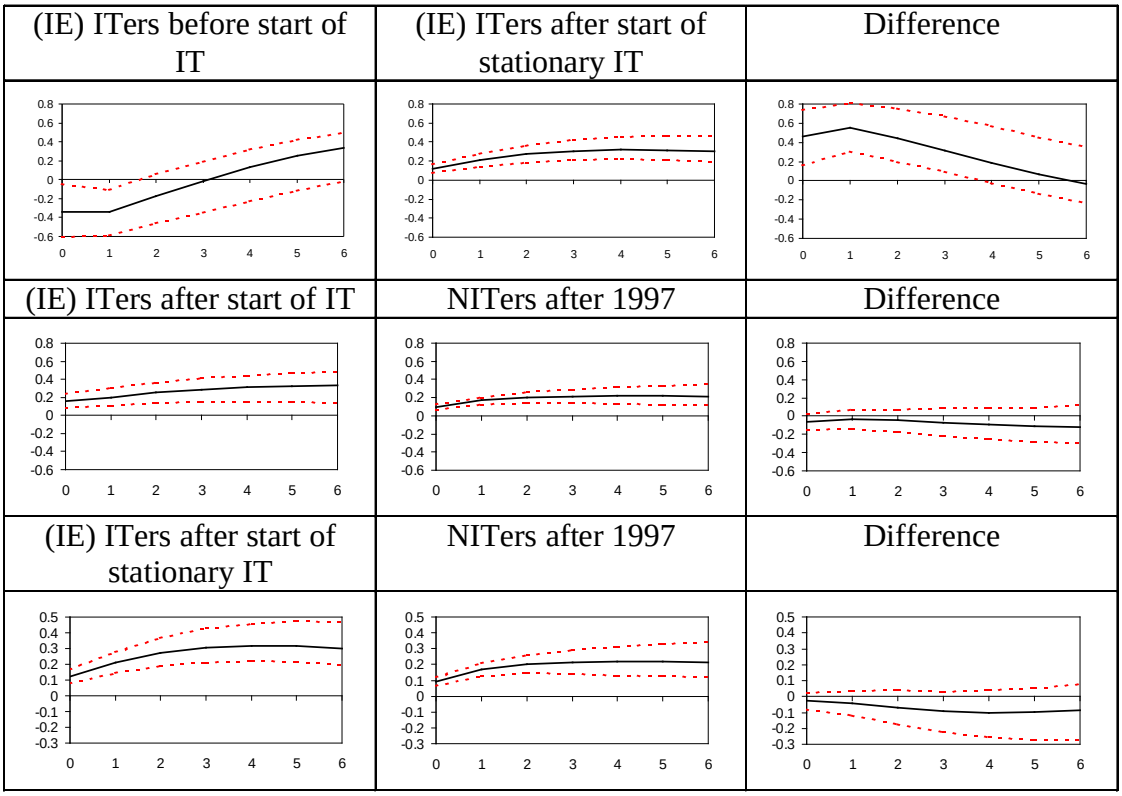
Figure 17. Response of Inflation to a Shock in the Exchange Rate, Splitting Treatment Group Sample: Emerging Market Economies



Source: Mishkin and Schmidt-Hebbel (2007).

However, after IT adoption the results are quite different. In industrial stationary ITers, domestic interest-rate sensitivity turns positive and is significantly larger in quarters 0 to 4 than before IT adoption. This makes industrial ITers more similar to NITers: there is no statistical difference in monetary independence between industrial ITers (and industrial stationary ITers) and NITers since 1997. In emerging-market ITers, however, adoption of IT reduces largely their interest rate sensitivity to foreign interest-rate shocks. The size of the interest-rate response declines by more than half after the start of IT but remains positive and significant from quarters 1 through 6. However, with adoption of stationary-target IT, emerging-market ITers attain a

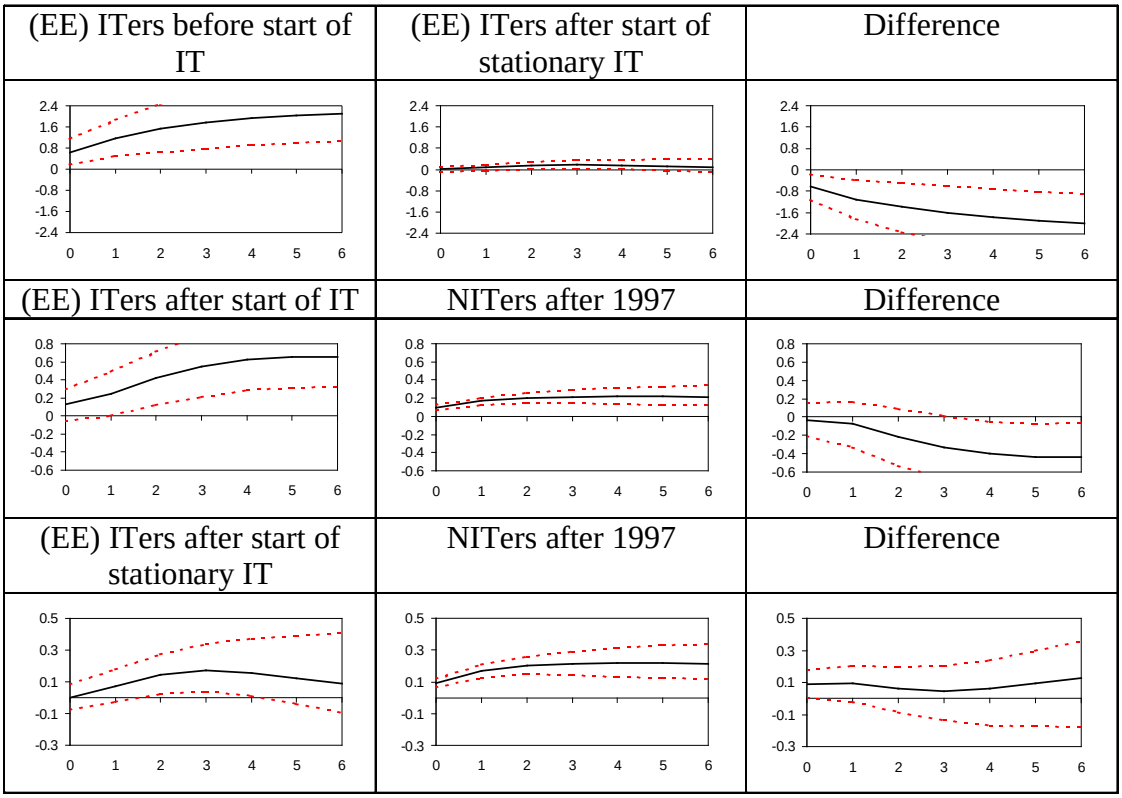
Figure 18. Response of the Domestic Interest Rate to a Shock in the International Interest Rate, Splitting Treatment Group Sample: Industrial Economies



Source: Mishkin and Schmidt-Hebbel (2007).

further reduction in interest-rate sensitivity, which is now barely positive and only significant in quarters 2 to 4 after the foreign interest-rate shock. Comparison of emerging-market ITers with NITers after 1997 yields a larger interest-rate sensitivity—that is significantly different from zero in quarters 3 to 6—in the former group. However, once emerging-market economies reach stationary targets, their interest rate sensitivity declines further to levels that are numerically smaller but statistically not different from those observed among NITers after 1997.

Figure 19. Response of the Domestic Interest Rate to a Shock in the International Interest Rate, Splitting Treatment Group Sample: Emerging Market Economies



Source: Mishkin and Schmidt-Hebbel (2007).

Thus, in industrial countries, interest rate sensitivity has increased from negative to positive and significant with IT adoption. In contrast, in emerging-market ITers, interest rate sensitivity has declined from huge before IT to moderate during converging-target IT and to small under stationary-target IT. Even more, the latter changes have made ITers more similar to NITers. While interest-rate sensitivity to foreign interest rate shocks is slightly larger in industrial stationary ITers than in NITers, and slightly smaller in EME stationary ITers than in NITers, the differences are not statistically significant. Hence our measures of monetary independence reflect a convergence of IT countries that have achieved stationary targets to the levels exhibited by—our high performance—NITers.

4.3. Inflation Volatility, Output Volatility and MP Efficiency

The performance of monetary policy can be assessed by examining the inflation and output variability trade-off faced by the monetary policymaker in the presence of supply shocks, which move output and inflation in opposite directions.[7] This trade-off allows us to construct an efficiency frontier known as the Taylor Curve which relates the

[7] We are concerned about supply shocks because they imply rising inflation and reducing output. Monetary policy that attempts to offset one effect can accomplish it only by further moving the other in opposite direction. The same

variance of output and inflation. This efficiency frontier is an indicator of the degree of optimality of monetary policy. When monetary policy is sub-optimal, the economy will exhibit large output and inflation volatility, and stand at a significant distance from the frontier. Movements toward the efficiency frontier indicate improved monetary policy. These features allow us to construct measures of economic and monetary policy performance in order to disentangle the contribution of policy efficiency and variability of shocks to the observed differences in macroeconomic performance between different samples of NITers and ITers.

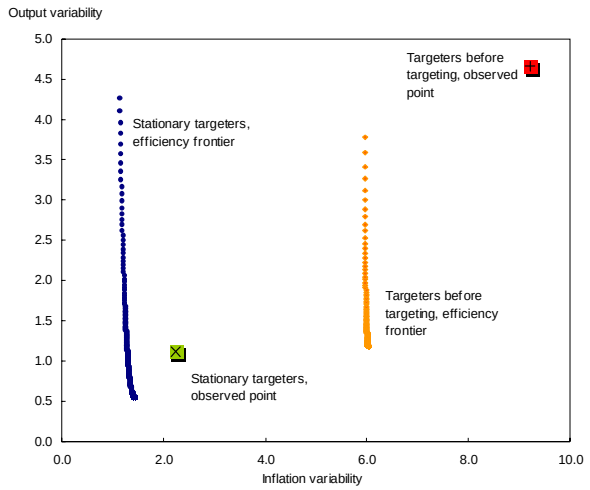
For such analysis, we follow closely the methodology derived by Cecchetti, Flores-Lagunes, and Krause (2006). However, in contrast with these authors, we do not apply it to individual countries but to IT and NIT country groups. The methodology is the following: We begin by estimating aggregate demand and supply curves for country groups; then, given such structure of the economy we solve the optimal control problem of the Central Bank by minimizing a quadratic loss function that incorporates a convex combination of inflation deviations from target and the output gap. Given this solution, we can compute the inflation-output volatility efficiency frontier varying the weight of relative importance to inflation and output in the authority's loss function. We decompose observed differences in macroeconomic performance (inflation and output volatility) into changes in supply shock variability and changes in monetary policy efficiency. Supply shock variability is assessed through changes in the efficiency frontier, whereas monetary policy efficiency can be assessed through the estimated distance from such frontier.

Results are presented next. Figure 20 shows the decomposition of macroeconomic performance (supply shock variability and changes in monetary policy), estimated efficiency frontiers and observed performance for all ITers before IT adoption and after they reach stationary IT. It can be seen that macroeconomic performance and monetary policy efficiency have increased significantly after reaching the stationary phase. A similar procedure is presented in Figures 21 and 22, which show the comparison of macroeconomic performance and efficiency frontiers between ITers (all ITers and stationary ITers, respectively) and NITers. In these figures, we can see that in general our set of NITers shows better macroeconomic performance and efficiency frontiers closer to the origin than IT countries. However, stationary inflation targeters are much closer to the performance and efficiency levels of non-targeters than is the full sample. Figures 23 and 24 show similar estimations for industrial stationary ITers and NITers after 1997 and EME stationary ITers and NITers after 1997. These two figures show that the poorer macroeconomic performance and efficiency exhibited by ITers, as compared to NITers, originate in EME ITers, which are rather further from NITers and industrial economies.

---

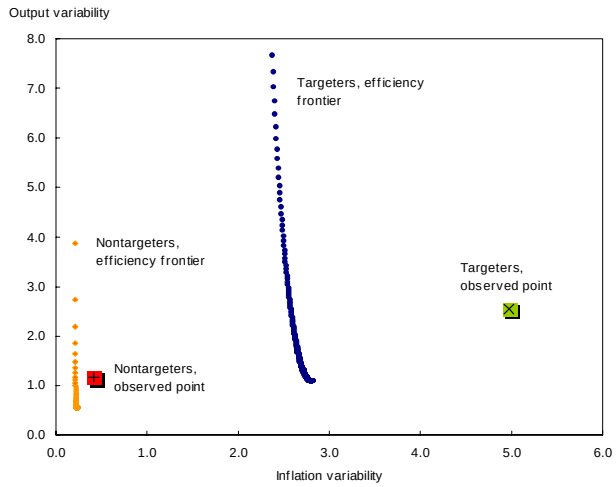
is not true with demand shocks, in which inflation and output move in the same direction and the policy response is clear, entailing no trade-off.

Figure 20. Estimated Efficiency Frontiers and Observed Performance Points: ITers and NITers Since 1997



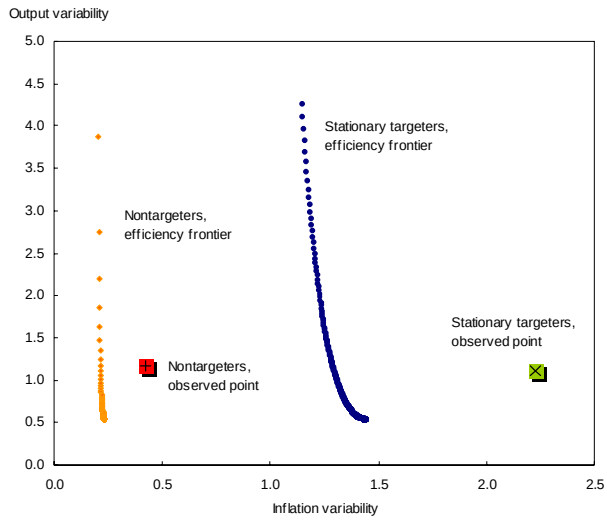
Source: Mishkin and Schmidt-Hebbel (2007).

Figure 21. Estimated Efficiency Frontiers and Observed Performance Points: ITers before IT and Stationary-Target ITers



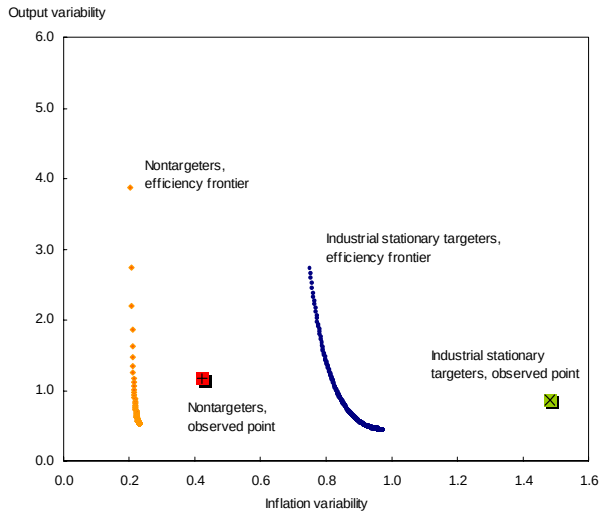
Source: Mishkin and Schmidt-Hebbel (2007).

Figure 22. Estimated Efficiency Frontiers and Observed Performance Points: Stationary ITers and NITers Since 1997



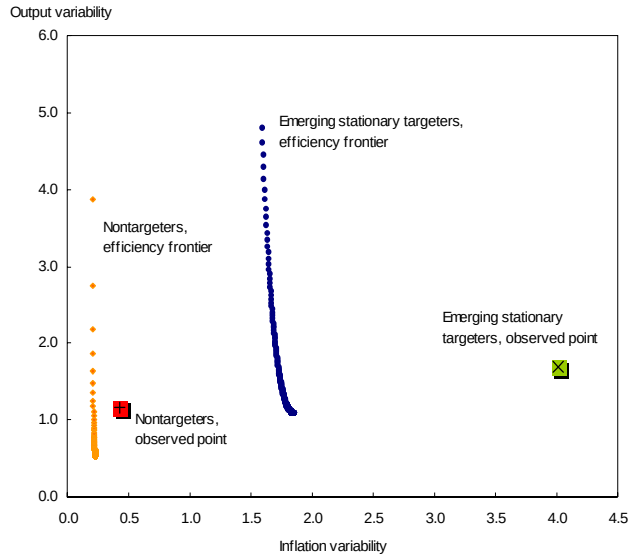
Source: Mishkin and Schmidt-Hebbel (2007).

Figure 23. Estimated Efficiency Frontiers and Observed Performance Points: Industrial Stationary ITers and NITers Since 1997



Source: Mishkin and Schmidt-Hebbel (2007).

Figure 24. Estimated Efficiency Frontiers and Observed Performance Points: Emerging Stationary ITers and NITers Since 1997



Source: Mishkin and Schmidt-Hebbel (2007).

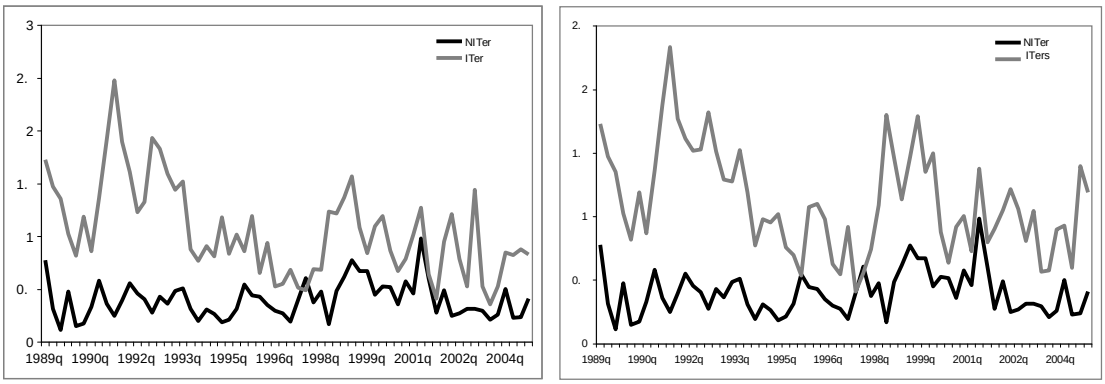
4.4. Inflation Accuracy

In this subsection we follow previous work by Calderón and Schmidt-Hebbel (2003) and Albagli and Schmidt-Hebbel (2005). We address the question of assessing how ITers' accuracy compares to the success of NITers in achieving a stable inflation rate. For this purpose, we compute absolute differences between inflation levels and observed targets (for ITers) or between inflation levels and unobserved inflation trends (for ITers and NITers). Figure 25 shows, for ITers, the difference that arises in data of absolute inflation deviation if (ID1) it is computed as the difference between effective inflation and the explicit inflation-target or if (ID2) it is computed as the difference between effective inflation and an HP filtered value. We use a panel data specification for the absolute value of deviations of inflation as a function of its own lag, a vector of relevant inflation-shock controls, an IT dummy variable that is set equal to one if the country has an inflation targeting regime in place and zero otherwise, and country and time fixed effects. The vector of control variables comprises two domestic shocks (absolute nominal exchange rate shocks and the output gap or the absolute deviation of output growth from trend) and two external shocks (the lagged absolute deviation of the Federal funds rate from trend and the absolute deviation of the international oil price from trend). This estimation procedure takes into account the endogeneity of the monetary regime (IT dummy) and the two domestic shocks using panel data IV estimation.

As can be noted in Table 2, we find evidence in favor of enhanced accuracy under IT. Results that include relevant controls suggest that absolute inflation deviations are smaller in IT countries than in NIT countries. These

results hold even after changing the definition used to compute absolute deviations (columns 2 and 3). The improvement in accuracy is found to be especially relevant for EME ITers and ITers that have reached the stationary inflation-target.

Figure 25. Absolute Inflation Deviation Computed as Difference of Effective Inflation with Inflation Target and Effective Inflation and HP Filtered Trend Inflation Value



Source: Author's calculation.

Note: The left figure shows (in gray) the values of absolute inflation deviations from explicitly announced inflation-target. The right figure shows (also in gray) the values of absolute inflation deviation from the HP de-trended inflation series.

Table 2. Inflation Targeters and Non-Inflation Targeters Long-Term Difference in Absolute Value of Inflation Deviation

	ITers – NITers long-term difference in absolute inflation deviation measured as:	
	Deviation from targets for ITers	Deviation from HP trends for ITers
All ITers	-0.4%	-0.6%
Stationary ITers	-0.3%	-0.6%
Converging ITers	-0.5%	-0.5%
Industrial ITers	zero	-0.5%
Emerging ITers	-0.5%	-0.6%

Source: Author's calculation based on Mishkin and Schmidt-Hebbel (2007).

Note: To assess the robustness of results we compute two measures of inflation deviations for inflation-targeting countries. The first, shown in the second column, computes the deviation of actual inflation from actual inflation targets. The second, shown in the third column, computes the deviation of actual inflation from HP trends for inflation-targeting countries.

5. CONCLUSION

The world economy has experienced wide-spread and vigorous economic growth for several years. Business cycles in major world regions seem to have become less pronounced and longer lasting, implying less volatile output growth. Inflation has also fallen significantly, both regarding its first and second moments. This Great Moderation is likely to reflect the influence of several forces at work. Among the latter are better institutions, stronger political and policy consensus on the benefits of macroeconomic stability; stronger, more accountable, and more sophisticated macroeconomic regimes and policies; structural improvements; and good luck.

Domestic improvements in the choice and implementation of macroeconomic regimes and policies are prime candidates to have contributed the most to the Great Moderation. This paper has focused on one major monetary regime and policy improvement: the conduct of monetary policy in a framework of IT. This regime is a key contributor to the improvement of macroeconomic performance, especially regarding inflation convergence, accuracy and stabilization. Inflation targeting (or inflation-forecast targeting) is a framework for monetary policy that, in contrast to alternative strategies—money growth or exchange-rate targeting—reflects a central bank's direct concern for its final policy objective, i.e., attaining a quantitative target for average inflation (or for the medium-term inflation forecast).

It has only been 17 years since New Zealand started the world trend toward IT, followed by 25 countries. Yet the world evidence gleaned from this relatively short time span is rather encouraging, while the literature on adverse effects of IT is non-existent. Not surprisingly, more and more countries are adopting such scheme or preparing their economies institutionally and technically to adopt it in the near future. During 2005 and 2006, five emerging-market economies have decided to adopt IT: Indonesia, Romania, Republic of Serbia, Turkey and Slovak Republic. And no country—other than new members of the Eurozone—has abandoned IT yet.

Supported by worldwide evidence, this paper shows that IT helps countries to attain lower inflation levels in the long run. IT has made countries more resilient to external shocks. Inflation targeters exhibit a smaller response of inflation to oil price shocks and pass-through effects from exchange-rate shocks. IT has also helped countries to enhance monetary policy independence. It has also contributed to improving monetary policy efficiency, and obtaining inflation outcomes closer to target levels. Some benefits of inflation targeting are larger when inflation targeters have achieved stationary inflation targets.

Despite these favorable results for IT, the evidence does not generally show that countries under IT have attained better macroeconomic outcomes and monetary policy performance relative to the control group of highly successful non-inflation targeters. However, IT does help countries to move all IT country sub-groups closer toward performance of the control group. Yet the performance attained by industrial-country inflation targeters generally dominates performance of emerging-economy inflation targeters and is similar to that of industrial non-inflation targeting countries.

REFERENCES

Albagli, E. and K. Schmidt-Hebbel. 2005. *By how much and why do inflation targeters miss their targets?* Santiago, Central Bank of Chile.

Bernanke, B.S. 2004. The Great Moderation. Remarks by Governor Ben S. Bernanke at the Meetings of the Eastern Economic Association, Washington, D.C.

Blanchard, O. and J. Simon. 2001. *The long and large decline in U.S. output volatility*. Brookings Papers on Economic Activity, 1:2001.

Calderón, C. and K. Schmidt-Hebbel. 2003. Macroeconomic policies and performance in Latin America. *Journal of International Money and Finance* 22(7): 895-923.

Cecchetti, S.G., A. Flores-Lagunes, and S. Krause. 2006. Has monetary policy become more efficient? A Cross-Country Analysis. *The Economic Journal* 116(511): 408-33.

Holtz-Eakin, D., W. Newey and H.S. Rosen. 1988. Estimating vector auto regressions with panel data. *Econometrica,* 56(6): 1971-95.

IMF (International Monetary Fund). 2007. *World Economic Outlook*, October. Washington, D.C.: IMF.

Love, I. and L. Zicchino. 2006. Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance* 46(2): 190-210.

Miniane, J. and J.H. Rogers. 2003. *Capital controls and the international transmission of U.S. money shocks.* International Finance Discussion Paper 778. Washington, D.C.: Board of Governors of the Federal Reserve System.

Mishkin, F.S. and K. Schmidt-Hebbel. 2002. One decade of inflation targeting in the world: What do we know and what do we need to know? In *Inflation targeting: Design, performance, challenges*, edited by N. Loayza and R. Soto, 171-219. Santiago: Central Bank of Chile.

Mishkin, F.S. and K. Schmidt-Hebbel. 2007. Does inflation targeting make a difference? In *Monetary policy under inflation targeting*, edited by F.S. Mishkin and K. Schmidt-Hebbel, 291-372. Santiago: Central Bank of Chile.

Summers, P. 2005. What caused the Great Moderation? Federal Reserve Bank of Kansas City *Economic Review*, Third Quarter.

PART II: DISCUSSION

GREAT MODERATION AND INFLATION TARGETING IN THE WORLD

Participants in the discussion that followed Klaus Schmidt-Hebbel's lecture included Sultan Abou-Ali (Zaqaziq University); Rania Al-Mashat (Central Bank of Egypt); and Hoda Selim (World Bank). The following is a summary of the discussion.

Moderator: Thank you for a very enlightening presentation. We now open the floor for discussion.

Participant: The prevailing perception about an inflation targeting country is that the central bank only pays attention to "price stability". So, would you please tell us about Chile's experience, since it has been implementing IT for a relatively long time, and how you were able to target inflation, but at the same time take into account employment and output? Similarly, how does the central bank accommodate or deal with exchange rate movements while it has only one anchor, i.e., the inflation target?

Speaker: Central banks under IT are concerned about inflation and output stability. What ITers do is that they look at the medium-term horizon of inflation and output, and they take decisions about interest rates accordingly. Rational central banks care about output as well as prices, and hence will base their decisions according to a country's circumstances when facing a supply shock.

Central banks are also not blind to exchange rate movements. They consider the exchange rate as one of the key variables through which monetary transmission takes place in open economies. An unanticipated interest rate hike is likely to reflect in exchange-rate appreciation, which may contribute to lower medium-term inflation. In addition to monetary policy objectives, central banks also tend to care about competitiveness, intervening at times of what they perceive as excessive real exchange-rate misalignment, preferably through sterilized intervention. Here the distribution of the world's central banks is very wide, ranging from banks that exhibit strong "fear to float" by intervening heavily and frequently to those that intervene rarely or never.

Participant: ITers use the short-term interest rates to curb inflation. However, transmission mechanisms in developing countries are slow or not very effective. What do you think of that?

Speaker: Your question is relevant to the issue of pass-through from short-term policy rates to medium-term activity and prices. While monetary transmission may be weak or imperfect in developing countries (because of imperfect transmission from policy rates to credit market conditions or to the exchange rate), it is strengthened over time with financial development, increased exchange-rate flexibility, and stronger monetary policy credibility.

Participant: There are certain facts that need to be taken into account regarding the Egyptian economy. Firstly, inflation might be due to structural reasons; in that case monetary policy alone will not be the only solution. Secondly, inflation should not be the only objective; other objectives of output and equity have also to be taken into

account. Thirdly, in Latin America, there were periods of extremely high inflation rates, but with high rates of growth, and people were better off compared to periods of lower inflation and lower rates of growth. Finally, rather than IT, good macroeconomic management might be more important for the Egyptian economy.

Speaker: Certainly, IT is not a panacea. There might be other fiscal or structural issues that could be more important in terms of a country's welfare. In my presentation, I talk about IT as a regime that would achieve low and stable long-term inflation, which is also important for the economy. Many other policies must be implemented in parallel to IT; i.e., IT must come only as a complementary policy. For example, it can't work without a proper fiscal policy.

With regards to inflation being a structural rather than a monetary phenomenon, in most Latin American countries, inflation is largely a monetary phenomenon, whereas structural reasons only explain short-term inflation dynamics. In terms of welfare, IT could help countries achieve higher consumer welfare through its effect on lower output volatility. Finally, with respect to the combination of unemployment and inflation, in the short term a trade-off exists. However, in the long run central bank policies cannot affect the natural rate of unemployment, the level of output or its rate of growth.