Monetary Policy under Inflation Targeting: An Introduction

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With the end of intermediate exchange rate regimes, countries are either abandoning domestic monetary policy (by choosing super-hard pegs or relinquishing their national currencies altogether) or strengthening independent monetary policymaking (by adopting floating exchange rates, of either the clean or dirty variety) (Fischer, 2001; Calvo and Mishkin, 2003). Among monetary regimes, inflation targeting has become the natural complement of flexible exchange rate regimes. Many countries—which differ in size, structural features, and development level—have selected inflation-targeting-cum-floating as their preferred framework for pursuing a more independent and effective monetary policy. This choice is often made by instrument-independent central banks in open economies with a history of inflation, which need to establish a credible monetary anchor to promote price stability (Mishkin and Schmidt-Hebbel, 2002). Therefore, since New Zealand first adopted inflation targeting in 1990, a steadily growing number of industrial and emerging economies have implemented an explicit inflation

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target as their nominal anchor. Eight industrial countries and seventeen emerging economies currently have full-fledged inflation targeting in place, and many more emerging economies are planning to adopt inflation targeting in the next few years.

The theory and practice of monetary policy under inflation targeting have evolved hand in hand, with mutually beneficial effects. Academic researchers and central bankers are collaborating in analyzing monetary theory and policy results, as well as improving policy design and conduct, in both inflation-targeting and nontargeting central banks. This collaboration gives rise to joint academic–central bank research, conferences, and publications, like the one for which this introduction is written.

Several volumes have been published on the theory, design, implementation, and performance of inflation-targeting regimes, including Haldane (1995), Leiderman and Svensson (1995), Lowe (1997), Bernanke and others (1999), Bank of Thailand (2000), Carson, Enoch, and Dziobek (2002), Loayza and Soto (2002), Truman (2003), Reserve Bank of Australia (2004), and Bernanke and Woodford (2005). These works typically combine the study of theoretical questions on monetary theory and policy design under inflation targeting with new empirical evidence on policy and macroeconomic performance, based on the growing body of data pertaining to the rising number of inflation-targeting countries.

In the following section, we selectively review the literature on inflation targeting. We then discuss the new research on monetary policy under inflation targeting introduced here (in this volume) and summarize its main findings.

1. A Selective Review of Research on Inflation Targeting

A large and growing literature focuses on monetary theory, monetary policy, and macroeconomic performance under an inflation-targeting regime. This is part of a much larger analytical and empirical literature on monetary theory and policy outcomes. The boundaries between the general research and that referring specifically to inflation targeting are sometimes blurred, as is clear in this review. Considering the latter fact and the sheer size of the current research, we focus selectively on six issues of monetary policy design and practice that are of central relevance to the inflation targeting debate.

1.1 Practice and Optimality of Inflation-Targeting Regimes

A growing literature addresses the optimal choice of the parameters that define an inflation-targeting regime. While all countries have formally chosen inflation over price-level targeting to date, the debate about the optimality of inflation versus price-level targeting has not been closed. Inflation targeting dominates price-level targeting in riding out temporary inflation shocks and in avoiding costly contractionary policy offsets and excessive inflation variability (Fischer, 1996). Price-level targeting, however, may do a better job than inflation targeting in avoiding a random drift in the price level and reducing price-level uncertainty (Fischer, 1996); in delivering lower output and inflation volatility (Svensson, 1999; Chadha and Nolan, 2002); in allowing relative prices to allocate resources and reducing distortions and unintended wealth transfers (Barnett and Engineer, 2000); and in lessening the problems associated with the zero nominal interest floor (Eggertsson and Woodford, 2003; Svensson, 2003). Hybrid rules that combine inflation and price-level targeting may be superior to either of the two extremes (Cecchetti and Kim, 2005; Nessén and Vestin, 2005).

Most countries have chosen the headline consumer price index (CPI) as their target measure; alternative measures based on core inflation measures are exceptions. While there are good practical arguments for choosing the headline CPI as the official measure (including its status as a widespread and trusted measure of overall inflation and its use for indexation), the literature identifies several reasons that alternative price-level measures are potentially a better choice. Central banks are more likely to have stronger and quicker effects on core inflation than headline inflation and on nontradable than tradable goods inflation. When the production of final consumption goods involves different stages of processing, it may be optimal for monetary policy to react not only to output and CPI variability, but also to producer price inflation variability (Huang and Liu, 2004). Countries have not chosen nominal income as their target measure for a variety of reasons, including the lack of readily available high-frequency data on gross national income and the equal weight attached to inflation and output in nominal income. Nevertheless, nominal-income targeting may be superior to inflation targeting under certain conditions (McCallum and Nelson, 1999).

Another design dimension of an inflation-targeting regime is the monetary policy horizon—that is, the time targeted by the central

bank to return inflation to the target level after an inflation shock. The optimal horizon will depend on the nature and persistence of the shock, the structure of the economy (including the extent of nominal and real rigidities), and central bank preferences (Batini and Nelson, 2001). The discussion of the optimal horizon is also linked to the choice between inflation and price-level targeting (King, 1999; Cecchetti and Kim, 2005).

1.2 Inflation Targeting and Optimal Monetary Policy

Recent research follows the advice of McCallum (1988) and investigates the robustness properties of alternative monetary policy rules by evaluating them in a variety of models. However, the dichotomy between economic structure and policy objectives could be inappropriate. First, the central bank's quadratic loss function can be interpreted as an approximation of the welfare of the representative agent (Woodford, 1993). Second, loss functions are endogenous to model structure; for example, increased price rigidity raises the relative weight of the inflation objective in the optimal loss function that an inflation-targeting central bank should use (Walsh, 2004).

Researchers generally agree that inflation targeting has led to major progress in the practice of monetary policy (see, for example, Woodford, 2004). The early literature that describes inflation targeting as a regime of constrained discretion (Bernanke and others, 1999) underscores its potential benefit of allowing sufficient discretion (as required in the face of policy uncertainty) within a rule-based framework that is consistent with Kydland and Prescott's rules versus discretion paradigm (see Kydland and Prescott, 1977).

Yet is monetary policy as currently practiced by inflation-targeting central banks optimal? Many authors point to the suboptimality of implicit policy rules and weakness in communicating policy rules, internal evaluations, and projections of future policy and performance variables to the public. The optimal targeting rules derived by Giannoni and Woodford (2005) imply forecasts for interest and inflation paths several years into the future, which are inconsistent with assumptions of constant future interest rates and constant medium-term policy horizons, as still practiced by several inflation-targeting central banks. Other authors call for clear central bank communication of point and density forecasts for their policy instrument and objectives, as well as their likely course of policy under alternative or risk scenarios (Svensson, 1997; Faust and Henderson, 2004; Woodford, 2004).

1.3 Uncertainty, Learning, and Monetary Policy under Inflation Targeting

Central bankers face different types of uncertainty that may affect monetary policy decisions, such as uncertainty about current (real-time) and future data, the most appropriate model (including specification, parameters, and the dynamics that govern monetary policy transmission), and preferences (of the representative consumer and even of the central banker). Brainard (1967) was the first to explore how a (monetary) policymaker should respond to uncertainty, showing that if uncertainty is additive, a policymaker with a quadratic objective function should display certainty equivalence. A more cautious policy is optimal, however, if uncertainty is multiplicative (Brainard's conservative principle). If uncertainty is Knightian—that is, when probability distributions over possible events are unknown—robust control methods lead policymakers to minimize the loss that arises when uncertainty turns out to be most unfavorable (Hansen and Sargent, forthcoming).

Early work on inflation targeting under uncertainty suggests that parameter and lag uncertainty should have little effect on policy behavior, while uncertainty about the nature of shocks tends to raise interest rate smoothing (Srour, 1999). For the case of parameter uncertainty, and in the framework of the Svensson (1999) model, forward-looking expectations imply that a more aggressive monetary policy yields greater stability than interest rate smoothing (Demertzis and Viegi, 2004). Uncertainty about key natural rates (namely, natural unemployment and interest rates) can result in persistent monetary policy errors (Orphanides and Williams, 2002; Cukierman and Lippi, 2005) and propagate macroeconomic disturbances, with first-order implications for monetary policy (Gaspar and Smets, 2002; Orphanides and Willliams, 2004a). Inflation targeting can be particularly successful in reducing the latter risks by better anchoring inflation expectations under imperfect knowledge of key variables and private perception of monetary policy behavior.

The signal extraction problem that accompanies imperfect knowledge of key input or target variables causes both central banks and the private sector to learn gradually about the realization of shocks. This form of bounded rationality—a departure from rational expectations—provides a plausible framework for modeling the behavior of central banks and private agents (Evans and Honkapohja, 2001) and seems to be empirically reasonable

(Orphanides and Williams, 2004b). Adaptive learning on the part of central banks implies that they will have a relatively muted response to cost-push shocks (Smets, 1999; Orphanides and Williams, 2002; Gerali and Lippi, 2002). When private sector expectations are determined by adaptive behavior, optimal monetary policy responds more persistently to cost-push shocks. The higher the private sector's initially perceived inflation persistence, the stronger and more persistent is the optimal policy response (Gaspar, Smets, and Vestin, 2006).

When the central bank's uncertainty about potential output leads to central bank learning behavior, the optimal choice of whether to target output growth, the price level, or inflation will depend on the weight of inflation stability and the degree of learning efficiency (Yetman, 2005). The interaction between private sector uncertainty about the central bank's inflation target level (in other words, the central bank's lack of credibility) and the central bank's uncertainty regarding the private sector's uncertainty about the inflation target can have serious implications for monetary policy, leading to policy errors and raising inflation persistence (Aoki and Kimura, 2005).

1.4 Transparency, Communication, and Accountability under Inflation Targeting

Transparency, communication, and accountability are key to successful inflation targeting. This belief has motivated inflation-targeting central banks to undertake ongoing efforts to upgrade these three features of their policy framework (Roger and Stone, 2005). The recent analytical literature focuses increasingly on these features and their relation to monetary policy uncertainty and optimality.

Optimal inflation targeting balances the need for accountability with monitoring capabilities (Walsh, 2003). If the central bank has little information about inflation shocks or if policy is transparent, then more weight should be placed on the inflation objective. Multiplicative uncertainty leads to more cautionary monetary policy (Brainard, 1967), but it also raises the value of central bank accountability for achieving the inflation target (Walsh, 2003). If the private sector has diverse information about aggregate shocks, and if this information is less accurate than the central bank's, then full transparency is generally optimal for inflation targeters, unless they are inflation nutters or put an excessive weight on output gap stability (Amato, Morris, and Shin, 2002; Walsh, 2005).

1.5 Asset Prices and Monetary Policy under Inflation Targeting

A heated debate has taken place in recent years regarding the optimality of monetary policy—whether under inflation targeting or alternative monetary regimes—to react to asset prices or perceived asset price misalignment. Cecchetti and others (2000) argue that reacting to asset prices, in addition to inflation and the output gap, is likely to achieve superior performance and a smoother inflation path by reducing the likelihood of an asset price bubble. (This view was restated by Cecchetti, Genberg, and Wadhwani, 2002, in their response to some of the counterarguments presented next.) Much of the academic and policy literature reacted with skepticism to their proposal. Bernanke and Gertler (2001) contend that reacting to equity prices is counterproductive (over and above its effects on inflation and the output gap), while Batini and Nelson (2000) state that reacting to the exchange rate is not optimal (over and above its effects on inflation and the lagged interest rate). A related argument holds that since inflation-targeting central banks focus on inflation expectations, they need not target asset prices directly, but rather can use them to improve their prediction of the path of future inflation (Bean, 2003).

Most inflation-targeting (and other) central banks have thus far sided with the skeptical view on monetary policy reaction to asset prices. Reasons for skepticism include the difficulty of measuring asset price misalignment, the difficulty of anticipating future asset price booms and busts or the future effects of preventive nonmonotonic policy actions, the difficulty in discriminating among different asset prices (such as housing prices, equity prices, and the exchange rate), and the possible dilution of the inflation objective.

1.6 Economic Performance under Inflation Targeting and in Comparison with Nontargeting Regimes

Empirical evidence on the links between inflation targeting and particular measures of economic performance generally supports the view that inflation targeting is associated with an improvement in overall economic performance (Bernanke and others, 1999; Corbo, Landerretche, and Schmidt-Hebbel, 2002; Neumann and von Hagen, 2002; Hu, 2003; Truman, 2003; Mishkin, 2006). In one of the few empirical papers critical of inflation targeting, Ball and Sheridan

(2005) argue that inflation targeting does not make a difference in industrial countries; rather, the apparent success of inflation-targeting countries simply reflects regression toward the mean. Ball and Sheridan's findings are heavily disputed by Hyvonen (2004), Vega and Winkelried (2005), and IMF (2005), who present evidence—generated with different specifications and estimation techniques and based on samples that include emerging economies—that inflation levels, persistence, and volatility are lower in inflation-targeting countries.

Output volatility has not worsened after the adoption of inflation targeting; if anything, it has improved (Corbo, Landerretche, and Schmidt-Hebbel, 2002). Evidence on inflation targeting's impact on sacrifice ratios is also mildly favorable. Bernanke and others (1999) do not find that sacrifice ratios in industrialized countries fell with the adoption of inflation targeting, while Corbo, Landerretche, and Schmidt-Hebbel (2002) conclude, based on a larger sample of inflation targeters, that inflation targeting did lead to an improvement in sacrifice ratios.

Bernanke and others (1999) and Levin, Natalucci, and Piger (2004) do not find that inflation targeting leads to an immediate fall in expected inflation, but Johnson (2002, 2003) does find some evidence that expected inflation falls after the announcement of inflation targets. However, inflation expectations appear to be better anchored for inflation targeters than nontargeters: inflation expectations react less to shocks to actual inflation for targeters than nontargeters, particularly at longer horizons (Gürkaynak, Levin, and Swanson, 2006; Levin, Natalucci, and Piger, 2004; Castelnuovo, Nicoletti-Altimari, and Rodríguez Palenzuela, 2003).

Finally, the evidence increasingly indicates that inflation targeters are successful in meeting their targets. A virtuous circle seems to be at work here, with inflation targeting being adopted in conjunction with institutional improvements that help strengthen monetary policy credibility. Central bank independence, fiscal policy credibility, overall institutional strength, and financial sector development all contribute to reducing the size of inflation target misses (Calderón and Schmidt-Hebbel, 2003; Albagli and Schmidt-Hebbel, 2004; Gosselin, 2006). While inflation targets are never met exactly, the success and resilience of the regime—no country has dropped inflation targeting to date—are attributed to its flexibility and its improvements in monetary policy formalization and transparency (Roger and Stone, 2005).

2. Overview of the Volume

Our selective review of the literature on inflation targeting suggests a significant number of open issues. Which further challenges are faced by economists and policymakers to lock in the benefits of low world inflation and minimize the transition costs toward inflation targeting in currently nontargeting countries? Is inflation targeting still optimal when considering real-world features of fiscal policy, like distortionary taxation and nonguaranteed intertemporal solvency? Which features of inflation targeting could be key when private knowledge of central bank goals and reactions is imperfect, raising the risk of endogenous drift of private expectations away from the central bank's inflation goal? How is the Ramsey-optimal inflation level affected by the degree of price stickiness and the zero bound on the nominal interest rate—and which variables determine the Ramsey-optimal policy rule? How can central banks improve their current communication practice to raise the efficiency of monetary policy under inflation targeting? If the private sector has diverse information that is generally inferior to that of the central bank, what determines the optimal degree of policy transparency?

How does output persistence affect the optimal weights of price-level and inflation targeting, and what does cross-country data reveal about how close inflation targeters are to price-level targeting? What have been the benefits of inflation targeting for the world sample of targeting countries, in terms of macroeconomic performance and monetary policy efficiency, both over time and in comparison to successful nontargeters? What is the evidence on the pass-through of exchange rate devaluation to inflation, exchange rate volatility, and the role of the exchange rate in policy rules under inflation targeting? Are inflation expectations better anchored in inflation-targeting countries than in the United States? Has inflation targeting improved the anchoring of inflation and inflation expectations and reduced volatility in emerging economies—and are the results sensitive to a country's having met preconditions at the start of inflation targeting? How important are real and nominal rigidities in explaining monetary policy and macroeconomic dynamics in Chile, and has the weight attached to inflation relative to output declined since the adoption of full-fledged inflation targeting in 1999? Finally, has Chile experienced changes in price rigidity, price indexation, devaluation-inflation pass-through, and the policy rule since attaining full-fledged inflation targeting and stationary inflation?

The papers in this volume address these thirteen questions. The introductory essay by Anne Krueger assesses the benefits of a low-inflation environment for the world economy. The author starts by reviewing the main costs of inflation—namely, how it distorts the calculus of profitability, encouraging short-term projects at the expense of longer-term investment and diminishing the value of relative price signals. She then reviews the progress that most countries have made in recent years toward achieving low inflation. The new low-inflation environment has brought noticeable gains—faster global growth, increased stability, and reduced vulnerability. The role of the IMF in helping foster a low-inflation environment is also discussed, highlighting the Fund's important support for policy reform efforts in its member countries. To conclude, Krueger identifies future challenges for economists and policymakers: locking in the benefits of low inflation, identifying how far policies should go toward lowering inflation further, and expanding the knowledge frontiers on the transition toward adopting inflation targeting.

Pierpaolo Benigno and Michael Woodford extend the theoretical literature on inflation targeting by focusing on the fiscal consequences of committing to an inflation target. They analyze the nature of an optimal monetary policy commitment under alternative assumptions about fiscal policy, ranging from distorting revenue to deviations from intertemporal insolvency. While the fiscal policy regime has important consequences for the optimal conduct of monetary policy, a suitably modified form of inflation targeting will still be a useful approach to optimal monetary policy. Benigno and Woodford show that the optimal targeting rule for monetary policy, which applies to the alternative fiscal regimes considered, involves commitment to an explicit target for an output-gap-adjusted price level. The optimal policy allows temporary deviations from the long-run target rate of economic growth in the gap-adjusted price level in response to disturbances that affect the government budget. However, such a policy also requires a commitment to return quickly to normal growth following these disturbances, so that medium-term inflation expectations remain firmly anchored despite the occurrence of fiscal shocks.

The paper by Athanasios Orphanides and John Williams reexamines the role of the key elements of the inflation-targeting framework in the context of an economy with imperfect knowledge. In their model, private agents attempt to infer the central bank's goals and reactions through past actions. The novelty of the approach is that inflation expectations can endogenously drift away from the

central bank's inflation goal. Using an estimated model of the U.S. economy, Orphanides and Williams show that monetary policy rules that would perform well under the assumption of rational expectations do very poorly when imperfect knowledge is introduced. The authors then examine the performance of an easily implemented policy rule that incorporates three key features of inflation targeting—namely, transparency, commitment to price stability, and close monitoring of inflation expectations—and find that all three play important roles in ensuring success. Their analysis suggests that simple difference rules excel at tethering inflation expectations near the central bank's target and, in doing so, achieve superior stabilization of inflation and economic activity in an environment of imperfect knowledge.

Stephanie Schmitt-Grohé and Martín Uribe study the characterization and implementation of optimal monetary policy in the context of a medium-scale macroeconomic model that has been estimated to fit postwar U.S. business cycles. The main finding of the paper is that mild deflation is Ramsey-optimal in the long run. However, the optimal inflation rate appears to be highly sensitive to the assumed degree of price stickiness. This sensitivity disappears when lump-sum taxes are unavailable, in which case mild deflation is robustly optimal. In light of the result that the optimal inflation rate is negative, Schmitt-Grohé and Uribe find it puzzling that inflation-targeting countries pursue positive inflation goals. They also argue that the zero bound on the nominal interest rate, which is often cited as a rationale for a positive inflation target, is of no quantitative relevance in their model. Finally, the authors characterize operational interest rate feedback rules that best implement optimal stabilization policy and find that the optimal interest rate rule is sensitive to price and wage inflation, insensitive to output growth, and moderately inertial.

Lars Svensson claims in his paper that while inflation-targeting central banks have made impressive achievements, there is still ample room for progress in the development and effectiveness of this new regime. He explains that inflation-targeting central banks can improve their aim by being more specific, systematic, and transparent about their operational objectives (by using an explicit intertemporal loss function), their forecasts (by deciding on optimal projections of the instrument rate and the target variables), and their communication (by announcing optimal projections of the instrument rate and target variables). According to Svensson, further progress can be made by systematically incorporating central bank judgment and model uncertainty into the forecasting and decisionmaking process. In

particular, incorporating model uncertainty would lead central banks to engage in a more general "distribution forecast targeting" rather than the usual, more restrictive form of "mean forecast targeting" under the assumption of approximate certainty equivalence.

Carl Walsh extends the literature on central bank transparency under inflation targeting by exploring two dimensions of transparency that are typically overlooked: the quality of the information the central bank provides and how widely that information is publicized. Employing a simple new Keynesian framework with private and diverse information, Walsh finds that announcements about short-run targets allow price setters to distinguish policy actions designed to offset demand shocks from those designed to partially offset the inflation effects of cost shocks. Announcements can thereby prevent demand shocks from affecting inflation, but private sector decisions become more sensitive to central bank forecast errors, raising inflation variability. It may then be advantageous for the monetary authority to make partial announcements. Walsh shows that the optimal degree of partial announcements depends on the persistence of cost and demand shocks, the relative weight of inflation and output gap objectives, and the information asymmetry between the central bank and the public. Full transparency is optimal for a central bank that has reasonable preferences (a central bank that is neither an inflation nor an output gap nutter) and has more accurate information than the private sector.

The paper by Stephen G. Cecchetti and Stefan Krause revisits the relative merits of price-level targeting and inflation targeting. According to the authors, whether the optimal approach is pure inflation targeting, pure price-path targeting, or some hybrid depends on the country's output persistence. Furthermore, any hybrid rule can be optimal once policymakers realize that the horizon for target evaluation can vary. For example, a rule that heavily weights inflation targeting but is evaluated over a long horizon will be equivalent to a rule that heavily weights price-path targeting but is evaluated over a shorter horizon. The authors confront these ideas empirically with data drawn from a large panel of countries. Their evidence shows that output and price-level persistence vary significantly across countries. Inflation targeters show a distinctly lower degree of price-level persistence than nontargeters. More generally, output persistence did not change much between the 1980s and the 1990s, whereas price-level persistence declined—possibly a result of inflation targeting—and the optimal horizon for target evaluation grew shorter.

Cecchetti and Krause conclude that countries may be closer to price-path than to inflation targeting.

Frederic S. Mishkin and Klaus Schmidt-Hebbel revisit the issue of whether inflation targeting is associated with an improvement in overall economic performance. They extend the previous empirical literature on this ongoing debate by focusing on a panel of data comprising the world population of inflation-targeting countries and a control group of high-achieving industrial economies that do not target inflation. The authors find that inflation targeting has helped inflation-targeting countries reduce their long-run inflation levels, diminish the inflation response to oil-price and exchange rate shocks, strengthen monetary policy independence, improve monetary policy efficiency, and lower the deviations of inflation outcomes from inflation goals. Many of these benefits increase once inflation targeters attain stationary target levels. Despite the improvements obtained by inflation targeters relative to their past performance, the evidence generally rejects the notion that inflation-targeting countries perform better than the control group of nontargeters. Mishkin and Schmidt-Hebbel show, however, that inflation targeting helps all country groups move toward control-group performance—and industrial inflation targeters' performance is at the level of the control group.

Sebastian Edwards analyzes core issues on the relation between exchange rates and the inflation-targeting regime. He uses a dataset for two advanced and five emerging inflation-targeting economies to empirically address three issues: the relation between devaluation-inflation pass-through and the effectiveness of the nominal exchange rate as a shock absorber (that is, the extent to which a nominal devaluation causes a real exchange rate depreciation); the effects of inflation targeting on exchange rate volatility; and the role of the exchange rate in monetary policy rules. Edwards finds that countries that have adopted inflation targeting have experienced a decline in the pass-through from the exchange rate to inflation—for both producer and consumer price (nontradables) inflation. He finds no evidence, however, of changes in the degree to which the nominal exchange rate acts as a shock absorber. Adoption of inflation targeting has not led to higher nominal or real exchange rate volatility, although adoption of exchange rate floats has increased the volatility of exchange rates in three out of five countries. Finally, Edwards reports a wide range of estimates of the effects of the exchange rate on central banks' interest-setting behavior, ranging from nil (Chile) to high (Mexico).

The paper by Refet Gürkaynak, Andrew Levin, Andrew Marder, and Eric Swanson investigates the extent to which long-run inflation expectations are well anchored in three Western Hemisphere countries—namely, Canada, Chile, and the United States—based on a high-frequency event study. Their contribution to the literature consists in empirically verifying the success of inflation-targeting regimes in helping to anchor long-term inflation expectations. The authors use daily data on long-run forward inflation compensation measures—that is, the difference between forward rates on nominal and inflation-indexed bonds—as an indicator of financial-market perceptions of inflation risk and the expected level of inflation at long horizons. For the United States, Gürkaynak, Levin, Marder, and Swanson find that far-ahead forward inflation compensation reacts significantly to macroeconomic data releases, suggesting that long-run inflation expectations are not strongly anchored. In contrast, Canadian and Chilean inflation compensation data do not exhibit significant sensitivity to either domestic or external macroeconomic news, which is consistent with the view that inflation targeting in these two countries has succeeded in anchoring long-run inflation expectations.

Nicoletta Batini and Douglas Laxton analyze the effects of inflation targeting in emerging-market economies. They conducted a detailed survey of central banks, which they use to show that inflation targeting in emerging economies brings significant benefits compared with countries that adopt alternative nominal anchors (namely, monetary growth and exchange rate targets). They report that inflation targeters, unlike countries that pursue alternative monetary regimes, attain significant improvements in anchoring both inflation and inflation expectations, with no adverse effects on output performance; in reducing the volatility of interest rates, exchange rates, and international reserves; and in lowering the risk of currency crises. Batini and Laxton also find that countries do not have to meet a stringent set of institutional, technical, and economic preconditions before adopting inflation targeting for the subsequent success of this regime. In fact, most countries build up these conditions gradually after inflation targeting is in place. They show that the feasibility and success of inflation targeting instead depends on policymakers' commitment and ability to plan and drive institutional change after introducing the new regime.

Rodrigo Caputo, Felipe Liendo, and Juan Pablo Medina develop a dynamic stochastic general equilibrium (DSGE) model to analyze the extent to which nominal and real rigidities play a role in explaining

the behavior of aggregate data in Chile. This issue is particularly important from a central banker's perspective, since the existence (or absence) of certain rigidities may have important implications for the trade-off between output and inflation stabilization. Unlike previous DSGE models for Chile, their specification features habit formation, sticky prices and wages, price and wage indexation, and imperfect pass-through from the exchange rate to domestic prices of imports. Caputo, Liendo, and Medina use Bayesian techniques to estimate the model. Their main finding is that adding price and wage rigidities, wage indexation, and imperfect pass-through improves the fit of the model. Real rigidities, such as habit formation, also deliver a better account of aggregate data, although their effects are quantitatively small. Finally, their subsample analysis indicates that monetary policy has reacted less aggressively to inflation relative to output since 2000, suggesting a lower sacrifice ratio—a result they attribute to the increased credibility of full-fledged inflation targeting.

Luis Céspedes and Claudio Soto's paper revisits the argument that inflation targeting in Chile has made a major contribution to lowering inflation to around 3 percent per year by enhancing the credibility of monetary policy. The authors use a new Keynesian Phillips curve to show that price rigidity has intensified in the past few years, while the degree of indexation in the economy has declined and the exchange rate pass-through to traded-goods inflation has fallen. They also find that the monetary policy rule has become more forward-looking in terms of inflation and more resolute in fighting inflation deviations from target. Céspedes and Soto's findings are consistent with the notion that monetary policy credibility in Chile has been strengthened over time. As monetary policy has become more credible, costly price adjustments are undertaken less frequently, indexation based on past inflation has become less widespread, and the central bank has been able to fight inflation deviations from target more strongly and at lower output costs.

We end this introduction by summarizing selectively the main lessons drawn from our preview of the new findings on monetary policy and inflation targeting reported in this volume.

Countries considering adoption of inflation targeting should not wait to meet the stringent preconditions identified in older research and policy recommendations—the evidence shows that most countries build up these conditions gradually after adoption. Instead the success of inflation targeting depends on central banks' commitment and ability to adopt institutional changes after introducing the new regime.

On the optimal design of inflation-targeting regime parameters and rules, this volume presents novel analytical results. When fiscal regimes are considered, the optimal targeting rule for monetary policy involves commitment to an explicit target for an output-gap-adjusted price level. Then the optimal policy allows deviations in the gap-adjusted price level in response to fiscal disturbances, which need to be temporary in order to allow medium-term inflation expectations to remain firmly anchored. Regarding the choice of the inflation-target level, mild deflation is Ramsey-optimal, but this inference depends on the degree of price stickiness and the availability of lump-sum taxes.

The choice between price-path, inflation-level targeting, or a hybrid rule depends on the degree of output persistence and the horizon for target evaluation. The optimal policy horizon is determined by the persistence of the shocks faced by central banks, the volatility of output, and the preferences of central bankers. The cross-country evidence suggests that the horizon for target evaluation has become shorter and that countries may be closer to price-path than to inflation targeting.

Macroeconomic performance has improved significantly and by large measures in inflation-targeting countries. After adopting the new regime, the level, persistence, and volatility of inflation have improved, output volatility has declined, monetary policy efficiency has improved, and inflation outcomes are closer to target levels. The response of inflation to oil-price and exchange-rate shocks is smaller and monetary policy rates are less responsive to international interest rates. Some of the latter benefits are larger when countries achieve stationary inflation targets. Most of the gains have been larger for emerging-economy targeters, although industrial-country targeters by-and-large perform better than emerging-economy targeters. However, macroeconomic performance of inflation targeters is generally not better than that of nontargeters like the United States, the Eurozone, and Japan. The one exception to the latter is on long-term inflation expectations, which seem to be better anchored in inflation-targeting countries (specifically in Canada and Chile) than in nontargeting countries (specifically the United States).

Inflation targeting and nontargeting central bankers alike face the challenge of dealing adequately with data and model uncertainty. Uncertainty implies that learning about data and models is key to understand the behavior of economic agents and central banks, as reflected in a growing body of theoretical and empirical research on monetary policy. This work shows that both monetary policy efficiency and consumer welfare increase when uncertainty and learning are explicitly considered in agents' and central banks' decisionmaking.

Monetary policy rules that would perform well under the assumption of rational expectations do poorly when imperfect knowledge is introduced. Transparency, commitment to price stability, and close monitoring of inflation expectations play a key role in monetary policy under imperfect knowledge. In particular, simple difference rules are better in guiding expectations toward inflation target levels, reducing inflation and output volatility.

Transparency and communication are another areas where central banks—both inflation targeters and nontargeters—should aim at further improvements. Incorporating central bank judgment and model uncertainty explicitly into the forecasting and decisionmaking process—for example, engaging in "distribution forecast targeting" rather than the usual "mean forecast targeting"—would improve monetary policy efficiency further. Yet the optimal degree of central bank transparency is also shown to depend on the quality of information provided by the central bank and how widely that information is publicized. Full transparency is optimal under reasonable central bank preferences and when the central bank has more accurate information than the private sector.

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