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Price-Level Targeting–A Real Alternative to Inflation Targeting?*

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Abstract
This paper reviews price-level targeting in the light of current theoretical knowledge and past practical experience. We discuss progress in the economic debate on this issue, starting with the traditional arguments discussed in the early 1990s and ending with the most recent literature from the beginning of the new millennium. We devote special attention to the issues of the zero interest rate bound, time consistency, and communication. Practical experience from Sweden in the 1930s and Czechoslovakia in the first few years after WWI is used to illustrate the advantages and disadvantages of price-level targeting. Finally, the similarities of price-level and inflation developments with hypothetical outcomes under price-level targeting are investigated in selected inflation-targeting countries.

1. Introduction

Academic discussions on price-level targeting have revived recently as some central banks have reached the zero interest rate bound. In the need to go beyond the limits of standard monetary policy instruments, central banks have turned to unconventional monetary policy tools, including the purchase of government bonds and private securities, and foreign exchange interventions. Besides these unconventional measures, the theory suggests another solution to the zero interest rate bound– the adoption of price-level targeting.

Under inflation targeting, after a shock hits an economy the central bank acts to bring inflation back to its target rate and abstracts away from the permanent effects of the shock on the price level. In contrast, under price-level targeting a central bank acts to return the price level to its original (targeted) path. This difference, although it might look small, has large implications for the formation of price expectations and the conduct, credibility, and communication of monetary policy, including the probability of hitting the zero interest rate bound.

Despite a substantial body of research on price-level targeting, central banks have very limited practical experience with this strategy. The Riksbank is considered to be the only central bank to have applied price-level targeting (in the 1930s). However, the experience of Czechoslovakia in the first few years after WWI also resembles price-level targeting.

In this paper, we review both the existing academic research and the practical experience with price-level targeting. We extend existing survey papers (e.g. Ambler,

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2009, and Bauducco and Caputo, 2010) in at least three aspects. First, we update the literature survey to include the most recent contributions. Second, we put this theoretical literature into contrast with practical experience. In addition to the widely known experience of Sweden we describe deflationary policy in Czechoslovakia as another example of price-level targeting. Third, we investigate how inflation targeting differs from price-level targeting in the light of actual price developments in inflation-targeting countries.

The rest of the paper is organized as follows. Section 2 describes the theoretical debate on price-level targeting. In this section, we first review the traditional arguments for and against price-level targeting. We then summarize Svensson's seminal 1999 paper, which initiated renewed interest in this strain of research. In Section 2 we also discuss price-level targeting from the perspective of deflation risk and the existence of a zero bound on nominal interest rates, the communication of price-level targeting, and time-inconsistency problems. Section 3 provides a historical excursion to inter-war Sweden and Czechoslovakia, whose monetary policy regimes resembled price-level targeting. Price-level developments in inflation-targeting countries are also discussed in this section. Section 4 concludes with a summary.

2. The Debate

2.1 Traditional Argumentation

Price-level targeting was advocated by Alfred Marshall (1887), Knut Wicksell (1898), and Irving Fisher (1922). Practical issues, however, were missing from their work. The pre-WWII literature saw price-level stability as a means of stabilizing economic activity. After WWII, discussions concerning monetary policy focused mainly on inflation.

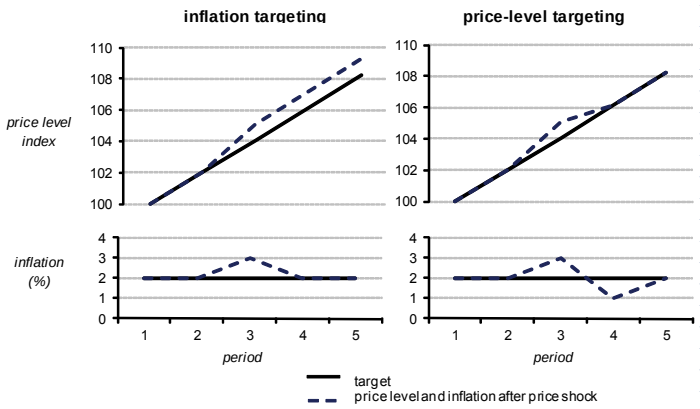
The debate on the issue of price-level targeting (constant or constantly increasing) was enlivened at the beginning of 1990s. The topic was pursued by, among others, McCallum (1990), Lebow et al. (1992), Fillion and Tetlow (1994), Goodhart (1994), Duguay (1994), Fischer (1994), and Haldane and Salmon (1995).

Most papers dating from this time period regard lower uncertainty about the future price level as the main benefit of price-level targeting. On the other hand, increased output variability (and–according to some authors–increased inflation variability) is considered the primary disadvantage of the regime.

In the case of inflation targeting, there is considerable uncertainty about the price level in the distant future. The price level in this regime is a random walk, which implies that its variability is linearly increasing with the distance from the present time. This regime thus allows price-level drift. The unit root in the price level arising from the inflation target is mentioned in Lebow et al. (1992), Fillion and Tetlow (1994), Duguay (1994), and Haldane and Salmon (1995). On the contrary, a price-level target path implies–according to these authors–that the price level moves around the target path (which can be constantly rising) without a trend. In the case of price-level targeting, the uncertainty about future prices is thus supposed to be limited, as the central bank aims to eliminate all deviations from the price-level path (*Figure 1)*.

Konieczny (1994) further notes that better predictability of the price level reduces the calculation costs of future consumption, improves the role of prices in

Figure 1 Illustration of Price-Level and Inflation Paths under Inflation Targeting and under Price-Level Targeting



the resource allocation process, and thus minimizes the risk of errors which could lead to a suboptimal consumption structure. Howitt (1994) adds inappropriate allocation of capital as another possible consequence of these errors. Ragan (1994) argues that better predictability of the price level reduces the probability of default and thus cuts the costs of financial intermediation.

Fisher (1994) primarily considers a zero inflation target, or a constant price-level target path. He also regards lower uncertainty about the future price level as the main advantage of price-level targeting. He sees drawbacks in the fact that in half of cases (when the price level deviates upwards from the target path) the monetary authority aims to achieve deflation, i.e., the inflation target is negative in the short run. He therefore believes that price-level targeting is an inappropriate regime which causes short-term fluctuations in the economy and more variability in the inflation rate. As it provides better predictability of prices in the long run, Fisher notes the often cited advantage of price-level targeting in the form of higher attractiveness of long-term contracts or savings on pensions. He argues, however, that stable real pensions can be more easily achieved by issuing inflation-indexed bonds. The uncertainty about the future price level will probably not be markedly higher if central banks target a small, positive rate of inflation. According to Fisher, in terms of uncertainty about the future price level there is no significant difference between a zero inflation target and a target of 2–3%. As Fisher concludes, inflation targeting with lower uncertainty about inflation in the short run is more convenient in spite of the higher uncertainty about the price level in the long run.

Besides commenting on the trade-off stemming from price-level targeting (i.e., the advantage of predictability of the price level in the long run and the disadvantage of increased output variability), Duguay (1994) also points out that costs related to the regime change need to be taken into consideration. There is a strong argument for prudence, seen by Duguay in uncertainty about the speed of adjustment of inflation expectations after switching to price-level targeting. Gaspar et al. (2007) run several simulations within a New Keynesian model with adaptive learning. Introducing price-level targeting leads to an initial increase in the loss, but after a few

periods, as agents learn about the new regime, the losses start falling and converge to those under commitment.

Haldane and Salmon (1995) used stochastic simulations from a small macromodel. In many respects the outcome of their work is parallel to the conclusions of Lebow et al. (1992) and Fillion and Tetlow (1994). The main disadvantage of price-level targeting is seen by these authors in the situation of an adverse supply shock. As a supply shock changes the equilibrium price level, attempts to put the price level back to its pre-shock level will most probably lead to significant real costs. An additional cost is the increased variability of inflation in the short run, as "correcting" deviations from the target path increases inflation variability.

Fillion and Tetlow (1994) argue, however, that there is a real possibility that price-level targeting could reduce inflation variability in comparison with inflation targeting. This would be so if prices are less prone to increase in the situation where economic agents understand that the central bank is committed to keeping the price level near the price target path. Black et al. (1997) came to the same conclusion using a stochastic model of the Canadian economy. This hypothesis was best illustrated by Svensson (1996), later published as Svensson (1999), which is described in detail in the next part.

Kiley (1998) compares monetary policy in models with different specifications of the Phillips curve. The first specification is consistent with the neoclassical models of price adjustment. The second specification is based on models with sticky prices, implying the new-Keynesian Phillips curve. When comparing price-level targeting and inflation targeting, Kiley affirms a trade-off between stability of prices and stability of output in the new-Keynesian model, but not in the neoclassical one. Given the empirical support for the new-Keynesian specification, Kiley concludes that the stability trade-off probably exists.

2.2 Svensson's "Free Lunch"

Svensson (1999) compares inflation targeting with price-level targeting in a model consisting of the Phillips curve and the central bank's loss function. The traditional Phillips curve (1) assumes short-term substitution between inflation π and the output gap y in the presence of output gap persistence and supply shocks ε_t:

$$y_t = \rho y_{t-1} + \alpha\left(\pi_t - \pi_{t|t-1}\right) + \varepsilon_t \tag{1}$$

Private sector inflation expectations are rational in the model, conditional on the information available in the given period, $\pi_{t|t-1} = E_{t-1}\pi_t$.

The central bank in the inflation-targeting regime stabilizes inflation at the long-term inflation target π^* and stabilizes the output gap at a desirable level y^*. The central bank's loss function is thus given by:

$$E_t\left[\sum_{\tau=t}^{\infty}\beta^{\tau-t}L_t\right], \text{ where } L_t = \frac{1}{2}\left[\left(\pi_t - \pi^*\right)^2 + \lambda\left(y_t - y^*\right)^2\right] \tag{2}$$

For the sake of simplicity the model assumes that the central bank has complete control over inflation (it has efficient instruments to achieve the desired level of inflation). Therefore, in every period after having observed the supply shock $\pi_{t+i} = -\lambda\left(y_{t+1} - y_{t+i-1}\right)$ $i > 0$ the central bank sets the optimum level of the inflation rate.

In the model, monetary policy is effective due to output persistence arising from imperfections in the labor market and sticky prices.

When using price-level targeting the central bank faces the same Phillips curve as mentioned above, but the loss function is defined in terms of the deviation of the output gap and the price level from the desirable level:

$$E_t\left[\sum_{\tau=t}^{\infty}\beta^{\tau-t}L_t\right], \text{ where } L_t=\frac{1}{2}\left[\left(p_t-p_t^*\right)^2+\lambda\left(y_t-y^*\right)^2\right] \tag{3}$$

Svensson shows that if output (output gap) persistence is higher than 0.5, a discretionary policy of the central bank results in lower inflation variability in the case of price-level targeting than in the case of inflation targeting. The reason is that the monetary authority targeting the price level sets inflation proportionally to changes in the output gap, while under inflation targeting the optimal level of inflation in response to a supply shock is proportional to the size of the output gap. If the output gap is sufficiently persistent, the variability of its first difference is less than the variability of its level and inflation has lower variability in the case of price-level targeting than in the case of inflation targeting.

Svensson further examines a situation where the society has a preference for inflation stabilization (i.e., the social loss function is defined as (2)) and the central bank has a choice between loss functions (2) and (3). Svensson raises the question of whether it is preferable for the society to assign an inflation or price-level target to the central bank. It turns out that even with social preferences for inflation stabilization it is optimal to define the loss function of the central bank as (3), i.e., in the form of price-level targeting.

The key assumptions of Svensson's model are an endogenous decision rule and the assumption of discretionary monetary policy. If the central bank was able to adopt a credible commitment to long-term optimal monetary policy (which in Svensson's model means that inflation is on target regardless of the size of the output gap), responding only to new information captured in the model by supply shocks, then the variability of output and inflation in the short run would be lower under inflation targeting than under price-level targeting. However, Svensson questions the feasibility and credibility of monetary policy under commitment even if conducted by an independent central bank.

2.3 Revisiting the Assumptions

In the same year that Svensson (1999) was published, Clarida et al. (1999) and Woodford (1999) reached the conclusion that in a forward-looking model, optimal monetary policy under commitment is characterized by stationary price levels. This has supported Svensson's findings that discretionary monetary policy should be focused on price level stabilization.

Clarida et al. (1999) came to this result using a different model than Svensson. The main difference is the use of a new-Keynesian Phillips curve, which contains current expectations of future inflation rather than past expectations of current inflation as they appear in the neoclassical Phillips curve.

Dittmar and Gavin (2000) also replaced the neoclassical Phillips curve used by Svensson with the new-Keynesian version. Their conclusion is that the use of

the new-Keynesian version highlights the benefits of price-level targeting because it is superior to inflation targeting even in the case of small or non-existent output persistence. However, it still holds true that the higher is the persistence, the bigger is the benefit from switching to price-level targeting.

To explain the empirically observed persistence in inflation (for example, inflation persistence in the euro area has been identified by Angeloni et al., 2006), some models assume that a fraction of economic agents set prices in a rule-of-thumb manner. Steinsson (2003) shows that as the fraction of rule-of-thumb price-setters increases, it becomes less optimal to offset cost-push shocks (i.e., to target the price level). On the contrary, with no rule-of-thumb price-setters in the economy it is optimal to offset cost-push shocks completely. Similar results were obtained by Gaspar et al. (2007).

Ball et al. (2005) explain inflation persistence using the concept of costly information. In their model, all agents can change prices in every period (in contrast to Calvo pricing), but only a fraction of agents possess complete information about the current state of the economy, including the central bank's behavior. The model leads to optimal monetary policy with a stationary price level as it minimizes agents' errors when they set prices using incomplete information.

The above-mentioned papers suggest that the extent to which economic agents are forward-looking is of key importance when judging between price-level targeting and inflation targeting. The more forward-looking agents are, the more persuasive are the arguments in favor of price-level targeting, because this regime is superior in anchoring price expectations. The degree of output persistence discussed in Svensson (1999) plays only a secondary role.

This point is best illustrated by Vestin (2006). He uses a new-Keynesian model with forward-looking agents and without cost-push shock persistence to show that with discretionary monetary policy with a loss function defined in price (not inflation) deviations and output deviations, the same level of social welfare can be achieved as with the optimal monetary policy under commitment by choosing an appropriate weight on output deviations. This is quite a strong result, since in standard models the social welfare that can be attained under discretion is lower than or equal to the welfare under commitment. If cost-push shock persistence is added to the model, social welfare becomes smaller than under commitment, but is still higher than under discretion with inflation deviations in the loss function.

If both forward-looking and backward-looking agents act in the economy, the highest social welfare can, under some circumstances, be attained by combining price-level and inflation targeting. Average-inflation targeting, where the central bank targets the moving average of inflation, can be considered such a combination. Nessén and Vestin (2005) in the new-Keynesian setup as used by Steinsson (2003) show that if the proportion of backward-looking agents is larger than one half, average-inflation targeting yields higher social welfare than price-level targeting. The bigger is the proportion of backward-looking agents, the smaller is the optimal window size for average-inflation targeting.

Another alternative way to merge inflation targeting and price-level targeting is called hybrid targeting, where the central bank's loss function is defined in both inflation and price-level deviations. The loss function is then a generalization of

either inflation targeting (with zero weight on price-level deviations) or price-level targeting (with zero weight on inflation deviations). Models with a hybrid loss function lead to similar results as in the case of average-inflation targeting (see, for example, Barnett and Engineer, 2001; Batini and Yates, 2003; and Cecchetti and Kim, 2005)–if forward- and backward-looking agents coexist in an economy, hybrid targeting dominates both inflation targeting and price-level targeting.

The majority of the models described above, including Svensson (1999), assume one good and one price only. The main disadvantage of these models is that it is impossible to analyze the evolution of relative prices. Ortega and Rebei (2006) use a DSGE model of the Canadian economy with two sectors (traded and non-traded). The model assumes nominal price rigidities on both markets and nominal wage rigidity. No clear advantage of price-level targeting over inflation targeting appears in this model.

Berentsen and Waller (2009) built a DSGE model with three markets–two goods markets and one credit market. All markets are fully flexible and money is necessary to trade on the markets. The central bank conducts monetary policy by controlling the supply of money. In this model setup, inflation targeting is ineffective and monetary expansion leads to higher price expectations and a higher nominal interest rate without any effect on the real economy, whereas price-level targeting efficiently anchors inflation expectations and monetary expansion has the desired impact on the real economy.

Gerberding et al. (2010) use a new-Keynesian model with two sectors. One sector is for intermediate goods with prices broadly corresponding to the producer price index (PPI). The other sector is for trading final goods with prices corresponding to the consumer price index (CPI). Both sectors have rigid prices and are subject to different productivity shocks. The authors come to the conclusion that optimal monetary policy should allow non-stationary prices in both sectors. Price-level targeting implies a higher welfare loss than inflation targeting and the difference is increasing in the length of the monetary policy horizon up to a horizon of approximately 10 years.

De Resende et al. (2010) built a multi-sector New-Keynesian DSGE model with several levels of production. The model economy consists of two final goods sectors, one of them traded and the other non-traded, two intermediate sectors, a sector producing basic domestic inputs for other sectors, and an import sector. Both nominal and real rigidities exist in the economy. In this more realistic model setup, inflation targeting and price-level targeting are virtually equivalent from a welfare perspective.

Another unrealistic assumption of Svensson (1999) and the majority of subsequent models is that all agents in the economy, or at least their forward-looking part, are rational and have a full information set and full confidence in the monetary authority. In the case of the transition from inflation targeting to price-level targeting, however, the learning process and credibility build-up can take several years. Gaspar et al. (2007) use a model with a constant-gain learning process to analyze the transition from inflation targeting to price-level targeting. They conclude that adaptive learning reduces the benefits of the switch, but the benefits remain positive unless learning is implausibly slow (the speed of learning coefficient is less than 0.02).

Kryvtsov et al. (2008) use a simple new-Keynesian model with gradual adjustment in expectations to a new monetary policy regime of price-level targeting. With

this model they reach similar conclusions as Gaspar et al. (2007). The transition yields higher welfare, but the gain is relatively small, of the order of hundredths of a percent.[1] Cateau et al. (2009) estimate approximately five times higher gains from the transition to an imperfectly credible new regime. The results are obtained from a DSGE model of the Canadian economy. Only if imperfect credibility prevails for 13 years or longer do the costs of introducing a new regime exceed its benefits.

Preston (2008) built a model with central bank uncertainty about the true behavior of economic agents. Households use adaptive learning to form their expectations, but the central bank might have a misspecified model and might wrongly assume rational expectations. In this situation, an inflation-targeting regime is likely to lead to instability in the economy. However, if the same wrong assumption is made in a price-level targeting regime, the economy remains stable for many empirically reasonable parameter values.

2.4 Risk of Deflation and the Zero Bound on Nominal Interest Rates

Price-level targeting is often discussed in association with the problem of reaching the lower (zero) bound on interest rates, a situation with which Japan has been confronted since the mid-1990s but which has also concerned the United States and many other countries during the recent financial and economic crisis. When the monetary policy rate is at or near the zero bound, the central bank's influence on inflation expectations and thus on real interest rates becomes an important stabilization tool. With a credible regime of price-level targeting, after the price level drops below the target path, short-term inflation expectations will increase above average inflation in the long run and real interest rates will decrease.

Duguay (1994) argues that the benefit of credible price-level targeting is its stabilizing effects on aggregate demand by raising real interest rates (through an expected price/inflation decrease) when the price level moves above the target, and by lowering them (via an expected price/inflation increase) when the price level falls below the target. Coulombe (1998) points out that credible price-level targeting can help limit the zero-bound problem, as it reduces the need to change nominal interest rates. This idea is also advocated by Berg and Jonung (1998), who believe that one important lesson to be drawn from the Swedish experience of the 1930s (see part 3.1.) is that the price-level target can be used to increase inflation expectations in a situation of serious concerns of deflation. Svensson (2001) suggests–as a possible way out of the liquidity trap–that Japan should temporarily introduce price-level targeting and at the same time the Japanese yen should be devalued and fixed. The view that price-level targeting can help avoid the zero-bound problem and lead an economy out of the deflation trap is also held by Eggertson and Woodford (2003) and Wolman (2005).

However, there are also studies emphasizing the higher probability of reaching zero interest rates and the possible risk of deflation in the case of price-level targeting in comparison to conventional cases. This concerns the situation where a marked overshooting of the target would require pushing the price level back to the target path, implying a need for a longer period of deflation, which could induce financial

[1] Kryvtsov et al. (2008) mention major problems with quantitatively assessing the benefits of price-level targeting, including the choice of welfare metric and the choice of policy rule.

instability. For example, Friedman and Gertler (2003) dispute the conclusions of Eggertsson and Woodford (2003), whose model does not include any of the mechanisms that make deflation harmful (e.g. debt defaults) and assumes perfect credibility of the central bank. Fear of deflation has been stressed in several studies (e.g. Mishkin, 2001). On the other hand, Ragan (2006) argues that sustained deflation, which would pose a threat to the financial system, is not probable in credible price-level targeting.

Nevertheless, the argument that price-level targeting can help avoid the zero bound problem and get the economy out of the deflation trap has gained more support recently. Mishkin (2006) mentions that arguments in favor of price-level targeting are very strong in cases of a deflationary environment mainly because of two facts: besides the effect of the expectations channel as described previously, price-level targeting has a positive impact on banks' and non-financial corporations' balance sheets which–after a prolonged period of deflation–are showing severe problems and increased non-performing loans that prevent the financial system from working properly and impair the efficient allocation of capital.

Amano and Ambler (2008) compare inflation targeting and price-level targeting in a situation of low trend inflation using a small calibrated DSGE model. They conclude that price-level targeting is more effective in keeping the economy away from the zero bound on nominal interest rates; and if the economy gets to the zero bound, it remains there for a shorter period of time. They also found that when the price level is targeted, the optimal rate of inflation is lower than under inflation targeting, thus yielding a higher level of economic welfare.

Coibion et al. (2010) compare the regimes in the new-Keynesian model and they conclude that the zero bound on nominal interest rates is less likely to be hit in the case of price-level targeting.

2.5 Communicating Price-Level Targeting and the Time-Inconsistency Problem

In contrast to inflation targeting, where communication is quite straightforward and focused on the inflation target, communicating price-level targeting is much more difficult (see, e.g., Kahn, 2009). If a central bank targets an upward-sloping path for the price level, it is not possible to present the target using a single number. Any communication of the initial value and targeted rate of increase of the price level would be difficult for the public to understand and remember. Also, for some economic agents and their decision-making, the rate of inflation might be of more importance than the price level, especially if they have long experience with an inflation-targeting regime.

Alternatively, it is possible to implement price-level targeting but to continue communicating inflation and leave an inflation target in place. However, the inflation target would have to be adjusted frequently depending on shocks hitting the economy (see, e.g., Ambler, 2009). Alternatively, an average inflation target over a longer time period could be communicated, ideally together with monetary policy being conducted in the average-inflation targeting manner (see the discussion of average-inflation targeting in Section 2.3.). Ambler argues that central banks that have explicit inflation targets are already implicitly using average-inflation targeting with a time window of one year, since they target the year-over-year rate of inflation. Moving

from a one-year average to an average defined using a longer time window would not entail a radical change in communication (e.g. the Reserve Bank of Australia communicates its target as average inflation over the business cycle, while the Reserve Bank of New Zealand targets average inflation over the medium term). But even then, communication would be more difficult compared to inflation targeting, for example when describing the forecast (should the central bank's reaction function be defined in terms of an inflation or price-level target?) or when assessing target fulfillment (which deviation is more relevant – deviation from the price-level target or deviation from the inflation target?).

At the same time, price-level targeting might make people think that the central bank puts too much emphasis on past economic developments and too little emphasis on future developments as captured in the forecast. The more backward-looking nature of the price-level targeting framework as compared to inflation targeting is discussed in more detail in Carlstrom and Fuerst (2002).

For all these reasons, price-level targeting poses a big communication challenge. Successful communication is the key prerequisite for achieving the major benefit of price-level targeting, namely, anchored price expectations. The importance of communication in price-level targeting is strengthened by the existence of the time-inconsistency problem,[2] which can put regime credibility to the test.

The time-inconsistency problem in the context of price-level targeting can be described in the following way. In the event of a positive cost-push shock, a central bank promises future inflation below its long-run average. This has a positive effect on inflation expectations and lowers the costs of absorbing the shock. However, as soon as the shock dissipates and inflation (not the price level) is back at its long-run level, it would be optimal for the central bank, and also for the economy as a whole, to renege on its announced policies, i.e., not to offset positive shocks to the price level by pushing inflation below its long-run average, as this would harm output. Then, the price level would not return to its targeted trajectory. However, it needs to be stressed here that in the short run the suboptimal policy of offsetting the shock is necessary to maintain the credibility of the price-level targeting regime in the long run. Masson and Shukayev (2011) show that if the public believes in the possibility of the central bank resetting the price-level target, switching to price-level targeting can have detrimental consequences for macroeconomic volatility.

All the models described in the previous parts of the paper assume time-consistent conduct of price-level targeting. However, in real life it might happen that both the public and professionals regard the short-run benefits of violating time consistency as appealing. In that situation, the central bank would be under strong pressure to break the time-consistency principle. In the end, the central bank might fail to resist public pressure and might abandon its efforts to return the price level to the targeted level.

[2] The time-inconsistency problem is one of the basic theoretical issues which have been in the focus of the new monetary policy paradigm since the late 1970s and which have led to the crystallization of inflation targeting as a "state-of-the-art" monetary policy regime. Inflation targeting, if conducted in a flexible manner, does not face this problem. In reaction to a positive cost-push shock, an inflation-targeting central bank allows inflation to rise temporarily above the target and tightens its policy only to the extent necessary to get inflation back to the target in a reasonable time horizon. It is not obliged to offset the shift in the price level, which gives rise to the inconsistency problem in price-level targeting.

The proposal of Evans (2010) to use price-level targeting only in certain, precisely defined situations represents a possible way out of the time-inconsistency problem. One such situation is a liquidity trap accompanied by a double-digit unemployment rate. Evans considers this a relatively rare event, with a frequency of twice a century or even lower. Temporary adoption of price-level targeting would enhance the credibility of the commitment to keep interest rates at zero for a sustained period and help the central bank to escape the liquidity trap.

Another possibility to subdue the time-consistency dilemma would be to adopt pre-defined escape clauses (exemptions from the obligation to achieve the price target). Several inflation-targeting central banks, particularly those in small open economies and facing abundant external shocks, define and publicly announce a set of situations (usually supply-side shocks) where attempts to keep inflation on target would cause undesirable volatility of output and employment. In these situations the bank does not respond to the primary impacts of the shock and allows inflation to deviate from the target. Similarly, a central bank targeting the price level might decide (and announce its decision) to ignore the price impacts of shocks that would require a strong monetary policy response with adverse effects on the real economy. However, in contrast to inflation targeting, this would require updating the target. The need to reset the target would inevitably reduce credibility in the regime. Thus, escape clauses might only reduce, not eliminate, the credibility loss stemming from the time-inconsistency problem in price-level targeting.

The time-inconsistency problem under price-level targeting, or exchange rate targeting as an alternative way to escape the liquidity trap, is also acknowledged in Jeanne and Svensson (2007). They start from the assumption that besides its standard monetary policy objectives a central bank also considers the capital of the bank and tries to avoid a situation in which capital falls below a certain minimum level. Economic agents know that the central bank will not accept future exchange rate appreciation because that would have a negative impact on the capital due to revaluation of the central bank's foreign exchange reserves. However, this line of reasoning falls short in light of the practical experience of central banks that have negative capital (including the Czech National Bank). These banks have not encountered any adverse effects of low or even negative capital on their decision-making or independence.

3. Practical Experience with Price-Level Targeting

3.1 Price-Level Targeting in Sweden 1931–1937

Even though price-level targeting is given significant academic attention, practical experience with this regime is limited. In the existing literature, the Riksbank is considered to be the only central bank in the world to have applied the regime in practice (Berg and Jonung, 1998).

Sveriges Riksbank adopted price-level targeting in 1931 after the Swedish krona faced speculative attacks on its convertibility to gold. As soon as the krona quit the gold standard the Swedish government declared a commitment to stabilize prices "using all means available". As a result of the economic crisis and price developments in Europe, consumer and producer prices in Sweden were declining from 1928 onwards. Appreciation of the krona exchange rate after the gold standard was abandoned put Swedish prices under additional downside pressure. Therefore, the aim of

monetary policy was to bring an end to declining prices and to ensure price stability in the future.

In the spring 1932, after eight months of work by several influential economists both from academia (Gustav Cassel, David Davidson, and Eli Heckscher) and from the Riksbank and after lively public discussion, the Swedish parliament adopted a monetary policy program for price stabilization. This program consisted of five major points:

1. The krona was to return to the gold standard or peg to the British pound in the future. For the time being, Sweden was to maintain a flexible exchange rate for the krona. Efforts to control the value of the krona were to start from the domestic price level and the needs of Sweden's economy.
2. Continued deflation was to be resisted as strongly as inflation.
3. Some recovery in prices was desirable, though not a return to a "too distant" price level. Price increases due to custom duties were to be accepted.
4. Monetary policy was not to be tied schematically to a particular price index.
5. Interest rates were to be kept as low as conceivably possible without jeopardizing the monetary policy objective.

In June 1933, the program was extended to include a sixth point giving the Riksbank a high degree of autonomy in the conduct of monetary policy, nowadays called instrumental independence. The Riksbank could choose the means of achieving the monetary policy objectives, but the objectives themselves were set by the parliament.

The Riksbank tried to return to a fixed rate as early as November 1931 by pegging the krona to the pound at the old gold parity rate. However, this attempt lasted for only three days. Between 1932 and 1933, the Riksbank accumulated foreign reserves and in July 1933 it established a successful peg of the krona to the British pound which lasted until the outbreak of WWII. This fixed exchange rate arrangement to the pound was viewed as being consistent with the program as long as prices in the United Kingdom moved in a moderate way consistent with the purpose of price stability. The only exception was the period 1936–1937, when British prices rose sharply.

Price-level targeting was definitively abandoned in 1937, when the Riksbank's mandate was extended to include stability of the economy and full capacity utilization. At the same time, the Riksbank's independence was weakened as the government pushed for stronger coordination between monetary and fiscal policies.

Not many robust conclusions can be deduced from the experience of the Riksbank. Price-level targeting in its pure form existed for only a short period of time (until 1933, when the exchange rate was fixed). Due to this short experience, the Riksbank's credibility was not put to the test and the Riksbank did not face the problem of time inconsistency. Also, the Riksbank did not produce economic forecasts and it set interest rates based on actual price developments (and later on the policy of the Bank of England). Cournède and Moccero (2009) find the Riksbank's policy difficult to gauge due to a lack of any commitment to a specific policy horizon. Straumann and Woitek (2009) argue that the Riksbank was striving for a fixed exchange rate rather than for stable prices. It can also be argued that the transition from the gold standard

to price-level targeting (and back) did not represent a significant change in monetary policy, as the gold standard was de facto price-level targeting determined by the price of a single commodity–gold.

3.2 Deflationary Policy in Czechoslovakia 1919–1923

Even though the Riksbank is mentioned as the first and until now the only central bank to have targeted the price level, the earlier experience of Czechoslovakia in the first years of its existence can be considered price-level targeting. Unlike in Sweden, where the regime was used to curb deflation, in Czechoslovakia it was introduced for the opposite and more painful purpose, to produce deflation with the aim of bringing the price level back down to its pre-war level. This experience is described in the following paragraphs, drawing upon Rašín (1920), Rašín (1922), Jíša (1993), Matoušková (2008), and Vencovský (2003).

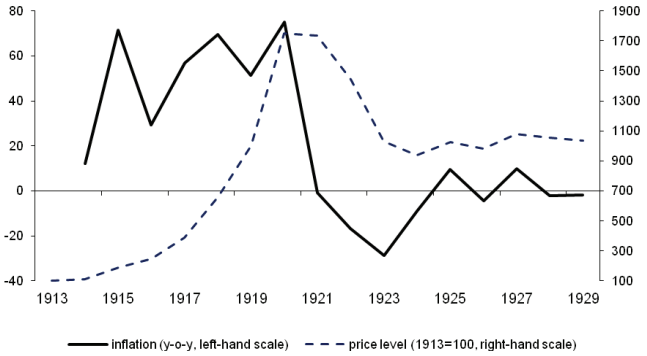
The deflationary policy was the second stage of a currency reform realized between 1919 and 1923 by Alois Rašín, then Czechoslovak Minister of Finance. The purpose of this policy was to offset price increases from the previous war years. Similarly to Sweden later on, Czechoslovakia planned to re-introduce the gold standard. The last stage of the currency reform was to be stabilization of the price level and the koruna exchange rate at stronger levels.

The first part of the currency reform–restriction of currency in circulation (during which the volume of currency in circulation dropped by roughly one third)–was carried out together with the currency separation of the Czechoslovak koruna from the Austrian krone. This restriction, however, did not prove to be very effective, as prices doubled in 1920 (see *Figure 2*). Although part of this increase in prices can be explained by an increase in indirect taxes and loose fiscal policy, it was obvious that reduction of the amount of money in circulation was not sufficient to achieve a lower price level. For that reason, in 1921 Rašín chose a different way–foreign exchange operations aimed at causing the koruna to appreciate, namely, foreign currency borrowing.

The impacts of the deflationary policy on the real economy were rather severe. Industrial production dropped markedly in the period of 1921–1923. Similar developments in agricultural production were prevented only by the post-war shortage of basic food in a market that stimulated demand for production of these products despite adverse price developments. Exports also slumped in this period. This was not surprising given the intentional koruna appreciation amid marked depreciation of the currencies of Czechoslovakia's main trading partners (Germany and Austria) against the Swiss franc and the strong protectionism applied in most countries. *Figure 3* depicts the koruna's exchange rate against the Swiss franc together with the exchange rates of the German mark and Austrian krone (schilling).

Despite this exchange rate appreciation, the balance of trade remained in surplus as imports slumped due to protectionist measures applied by the Czechoslovak government. Whereas gross domestic product grew by 8% in 1921, in 1922 it dropped by 3%. The falling economic performance raised unemployment, firms were caught in insolvency, and the banking sector, which had close relations with industry in the early years of the state, also encountered problems. However, the economy recovered surprisingly quickly and grew at a high pace (8% on average) in the rest of the 1920s, the year 1926 being the only exception (see *Figure 4*).

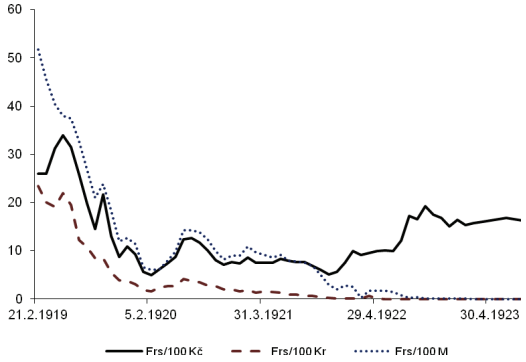
Figure 2 Inflation and the Price Level in Czechoslovakia 1913–1929



Note: From 1913 to 1920 unweighted index of adminstrated prices of 38 items, between 1921–1923 prices of food, fuels, petrol and soap, from 1924 food prices.

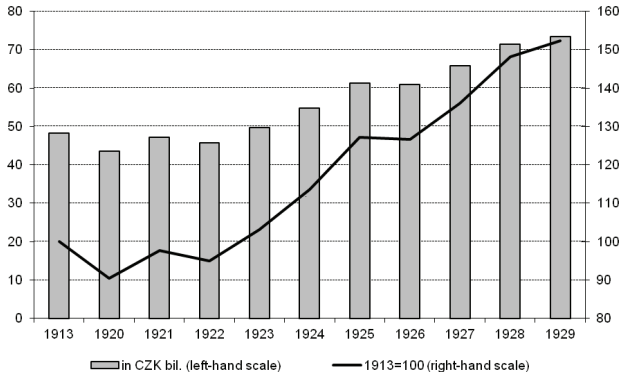
Sources: Ministry of Finance Report on Supplying People in Czechoslovakia, 1920; Statistical Handbook of Czechoslovakia, 1925; Price Reports of Statistical Office 1921–1929, Matoušková (2008).

Figure 3 Exchange Rate of the Czechoslovak Koruna 1919–1923



Source: Statistical Handbook of Czechoslovakia, 1925, Matoušková (2008)

Figure 4 GDP in Czechoslovakia 1913–1929



Source: Mitchell, 1981

The deflationary policy markedly worsened the economic position in the short run, but on the other hand it set up favorable conditions for the stabilization and long-run growth of the Czechoslovak economy. Simultaneously, it made the new Czechoslovak koruna a credible currency. At that time, the koruna was a freely convertible currency and in 1929 it even returned to the gold standard and stayed there for the next five years.

It is important to view Rašín's reform with a historical perspective. After WWI it was necessary to improve the gloomy post-war state of the Czechoslovak economy and re-orient its directive management and its structure stemming from the war period toward market principles. In doing that, it was necessary to establish an independent currency and rule out internal and external devaluation, as was observed, for example, in Germany. Despite its high openness, the post-war economy was self-sufficient in production of basic needs such as food and coal. At the same time, the domestic economy, like the economies of neighboring countries, was affected by various protectionist measures. That explains why the link between the exchange rate and the prices of goods for daily use was not strong. The question also remains as to whether the koruna appreciation and subsequent fall in prices reflected the steadier economic and political situation in Czechoslovakia compared to neighboring countries rather than foreign exchange interventions.

Similarly to Sweden, not many robust conclusions can be derived from the Czechoslovak experience. The reform was meant to be a temporary measure prior to a return to the gold standard. There was no independent central bank before 1926, monetary policy instruments were still developing, and the economy had been badly damaged by the war and heavily affected by protectionist policy both in Czechoslovakia and in neighboring countries. Therefore, it is hard to assess the role of the reform in subsequent economic developments. However, the reform did achieve its main objectives – the price level decreased and the gold standard was re-introduced.

3.3 Price-Level Developments in Inflation-Targeting Countries

Owing to the limited empirical experience it is worthwhile to analyze price-level developments in inflation-targeting countries, especially the deviation of the actual price level from the hypothetical price-level path computed from inflation targets. This would test the hypothesis made by some economists, among them Fischer (1994), that the difference between inflation targeting and price-level targeting is not substantial in practice.

Ruge-Murcia (2009) analyzes price-level developments in Australia, Canada, New Zealand, Sweden, and the United Kingdom and covers the time period between the introduction of inflation targeting in each country and September 2009. Ruge-Murcia found that in terms of actual price-level developments, inflation targeting was very similar to price-level targeting in Australia, Canada, and the United Kingdom. On the contrary, in the cases of New Zealand and Sweden the price level moved away from the price-level path implied by the inflation targets (upwards in New Zealand, downwards in Sweden).

In addition to graphical analysis, Ruge-Murcia ran unit root tests both on the price level and on the deviation of the price level from its hypothetical path. Under inflation targeting, both these variables should have a unit root, whereas under

price-level targeting the existence of a unit root should be rejected. The results of the statistical tests confirmed the findings from the graphical analysis – inflation targeting is highly similar to price-level targeting in the cases of Canada and the United Kingdom. However, no similarity was found for Australia, New Zealand, and Sweden. Ruge-Murcia presented a hypothesis that the similarity of inflation targeting to price-level targeting in terms of the actual price-level developments observed in Canada and in the United Kingdom could have been a result of different conduct of inflation-targeting policy in these countries.

Ruge-Murcia's results are quite surprising. The monetary policy regimes in Australia and New Zealand can be viewed as average-inflation targeting,[3] which is close to price-level targeting. Therefore, in contrast to Ruge-Murcia's results, one would expect high similarity of inflation targeting with price-level targeting in these two countries.

In the following paragraphs we build on the work of Ruge-Murcia, extending the analysis in two ways. First, we prolong the sample period to December 2010, which brings in more recent data affected by the financial crisis and the recent rise in commodity prices. Second, we also include the Czech Republic in the sample. Analogously to Ruge-Murcia, we do both graphical analysis and unit root testing.

Appendix 1 depicts the inflation and price-level developments in Australia, Canada, the Czech Republic, New Zealand, Sweden, and the United Kingdom. Inflation is shown in comparison with the inflation target, and the price level in comparison with the hypothetical price-level path computed from the inflation target(s). The price level is set to 100 at the beginning of the sample (the introduction of inflation targeting in the country concerned). The hypothetical price-level path is computed from this initial price level assuming that the hypothetical target growth rate of the price level is equal to the inflation target (which can change over time, as in the cases of the Czech Republic, New Zealand, and the United Kingdom). The figures in *Appendix 1* take into account the revisions of the targets in the Czech Republic, New Zealand, and the United Kingdom.

The most recent inflation data are in most cases in line with the inflation target, with the exception of the United Kingdom, where inflation exceeds the target from December 2009 onwards. Also, inflation in the Czech Republic since the introduction of inflation targeting in January 1998 has been mostly below the target(s). As a result, the price level has deviated significantly downwards from the hypothetical price-level target path, i.e., similarly as in Sweden (see above). If price-level targeting was conducted instead of inflation targeting, average inflation would have to be roughly double compared to actual inflation.

The table in the *Appendix 2* shows the unit root tests for all six countries in our sample. To make the results comparable, we conducted the tests with exactly the same settings as Ruge-Murcia. We test for unit roots both in the price level and in the deviation of the price level from its hypothetical target path. We use the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. The unit root tests for the price level take into account the intercept and the trend, whereas the tests for the deviation from the hypothetical price-level path are run without the trend and

[3] Australia targets inflation of between 2 and 3 percent on average over the cycle, while New Zealand targets CPI inflation outcomes of between 1 and 3 percent on average over the medium term.

with/without the intercept. The level of augmentation of the ADF test (that is, the number of lagged first differences in the OLS regression) was selected using recursive *t*-tests. The truncation lag of the PP test is set to three in all cases. Ruge-Murcia's estimates are also provided in *Appendix 2* for the sake of comparison.

The results using the extended data set confirm Ruge-Murcia's finding that in the cases of Australia, New Zealand, and Sweden the null hypothesis of a unit root cannot be rejected. However, the rejection of unit roots in the cases of Canada and the United Kingdom is not as unambiguous as in the shorter sample used by Ruge-Murcia. The results are strikingly different for the United Kingdom, where only one test out of the six is significant at the 10% significance level, whereas Ruge-Murcia found significance at the 5% level in four tests out of six. This shift in significance can be explained by inflation having been well above the target in 2010, as illustrated in *Appendix 1*.

The results for the Czech Republic are also surprising, as the unit root tests with the intercept reject a unit root in the deviation of the price level from its hypothetical path with 5% significance. This finding sharply contrasts with the figures in *Appendix 1*, where the actual price level lies far below the hypothetical path. However, it can also be seen from the figures that the deviation of the actual price level from its hypothetical path is steadily increasing in time. In the test, this deviation is absorbed by the intercept and the price level adjusted for this deviation reveals signs of stationarity. If the intercept is not included in the test, the unit root hypothesis cannot be rejected.

Overall, we conclude that in the Czech Republic the actual price-level developments reject the similarity of inflation targeting with price-level targeting. The same results are obtained for Australia, New Zealand, and Sweden. In the case of the United Kingdom, the PP tests reveal some similarity of inflation targeting with price-level targeting, but these results are not very significant. Only in Canada do the actual price and inflation developments resemble the hypothetical outcomes under price-level targeting. Given this observed similarity of inflation targeting with price-level targeting in Canada, it is not surprising that the Bank of Canada is considering switching to price-level targeting, possibly as early as 2012 (IMF, 2010).

4. Conclusion

Academic discussions on price-level targeting have revived recently as some central banks have reached the zero interest rate bound and been forced to use unconventional monetary policy tools. In this situation, voices calling for the temporary use of price-level targeting until the zero interest rate problem is resolved and the threat of deflation is over have gained in popularity.

A substantial body of research exists on price-level targeting. The main conclusion of the theoretical research is that reducing uncertainty about the future price level leads to better-anchored price expectations. Firmly anchored expectations then improve the inflation and output variability trade-off and social welfare. However, this conclusion is sensitive to assumptions. If, for example, a large proportion of economic agents are backward-looking, if the learning process for adapting a new regime lasts many years, or if there are significant real or nominal rigidities in the markets, the benefits of price-level targeting in comparison to inflation targeting are less clear.

The benefits of price-level targeting are manifest in models which allow for a zero interest rate bound, as anchored price expectations make it possible to achieve negative real interest rates despite nominal interest rates being bound by zero. These models also conclude that reaching the zero interest rate bound is less likely under price-level targeting.

Despite the efforts of academia to make the models of price-level targeting more realistic (e.g. by introducing micro-foundations, heterogeneous markets or a learning process), the models still hinge on questionable assumptions (e.g. i.i.d. supply shocks and a fully functional transmission mechanism) and therefore offer too simple a representation of a real economy. Thus, the question of whether it is possible, in practice, to exploit the theoretical benefits of price-level targeting remains unanswered.

The obvious disadvantage of price-level targeting is more complicated communication of monetary policy, either of the target or of day-to-day central bank decision making. It would be difficult to explain, for example, the intention to achieve low or even negative inflation in reaction to an inflationary shock. In this situation, the central bank encounters time-inconsistency problems, and, besides dealing with communication problems, it might be exposed to political pressures to opportunistically quit price-level targeting.

The experience of Sweden, whose monetary policy during the 1930s is often labeled as price-level targeting, does not bring much knowledge due to the short duration and rather vague settings of the regime. The experience of deflationary policy in Czechoslovakia in the first years after WWI, which could also be considered price-level targeting, is not very valuable for today's monetary policy considerations either.

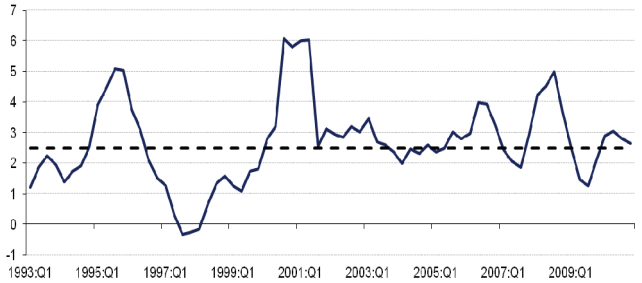
Currently, no central bank is using price-level targeting. The Bank of Canada is considering introducing this regime. In the case of Canada, a switch to price-level targeting would not necessarily mean a big change, since the actual results of inflation targeting there do not significantly differ from price-level targeting in terms of price-level developments. In other inflation-targeting countries, switching from inflation targeting to price-level targeting would represent a considerable change in the conduct of monetary policy.

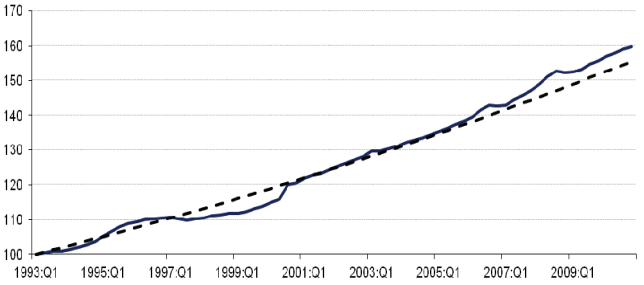
APPENDIX 1

Inflation and Price-Level Developments in Comparison with the Inflation Target and the Hypothetical Price-Level Path Computed from the Inflation Target

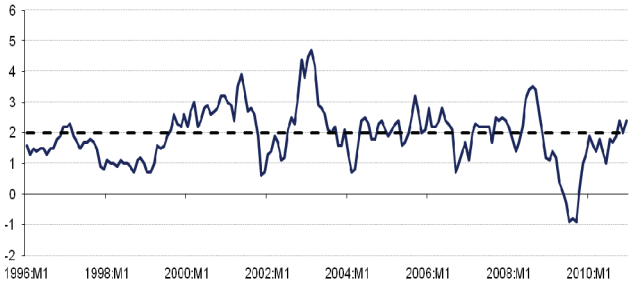
Selected Inflation-Targeting Countries

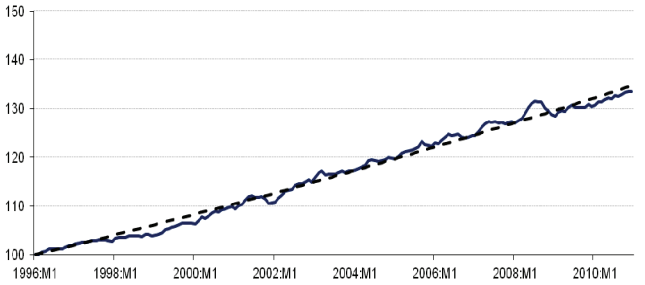
Australia

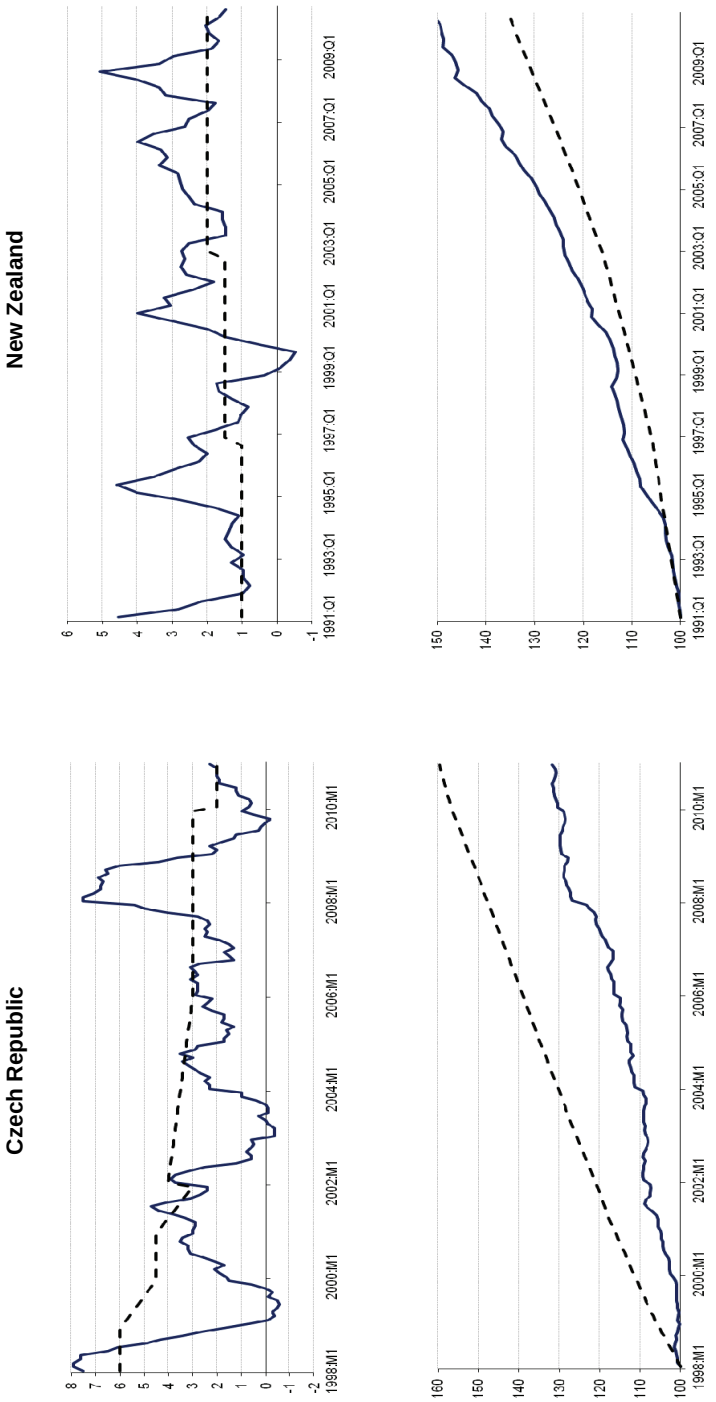


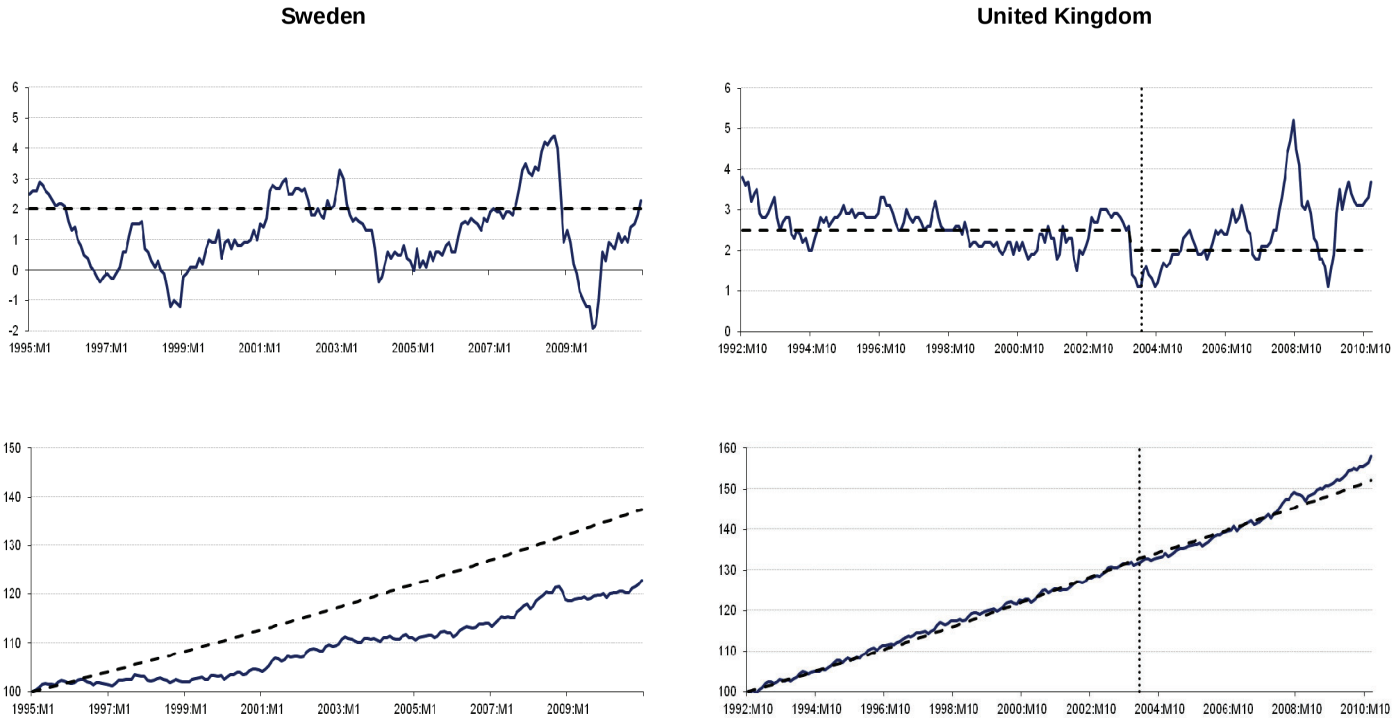


Canada






New Zealand
Czech Republic
1991:Q1
1993:Q1
1995:Q1
1997:Q1
1999:Q1
2001:Q1
2003:Q1
2005:Q1
2007:Q1
2009:Q1
1998:M1
2000:M1
2002:M1
2004:M1
2006:M1
2008:M1
2010:M1



Notes: In the upper graphs, inflation in per cent is drawn in black and the inflation target(s) in dashed. In the lower graphs, the price level is in black and the price-level path computed from the inflation target(s) in dashed. For the United Kingdom, RPIX inflation is used until December 2003, as it was initially targeted by the Bank of England. For the Czech Republic, so-called net inflation is used until December 2001, as it was targeted by the Czech National Bank in the first years of inflation targeting.

APPENDIX 2

Unit Root Tests of the Price Level and the Deviation of The Price Level from Its Hypothetical Target Path – Selected Inflation-Targeting Countries

	Time Span	Log of the Price Level		Deviation from Hypothetical Path			
				With Intercept		No Intercept	
		ADF	PP	ADF	PP	ADF	PP
Australia	1993:Q1–2010:Q4	-2.076	-2.091	-1.237	-1.196	-1.109	-1.077
Canada	1996:M1–2010:M12	**-3.163***	-2.956	**-2.988****	**-2.796***	**-2.988****	**-2.804*****
New Zealand	1991:Q1–2010:Q4	-0.916	-1.078	-	-	-	-
Sweden	1995:M1–2010:M12	-1.800	-2.169	-2.225	-1.630	-	-
UK	1992:M10–2010:M12	-2.930	**-3.274***	-0.804	-1.338	-0.289	-0.892
Czech Republic	1998:M1–2010:M12	-2.583	-2.301	**-3.418****	**-3.185****	-	-

Ruge-Murcia (2009) estimates

	Time Span	Log of the Price Level		Deviation from Hypothetical Path			
				With Intercept		No Intercept	
		ADF	PP	ADF	PP	ADF	PP
Australia	1993:Q1–2009:Q3	-1.956	-1.970	-1.214	-1.208	-1.158	-1.161
Canada	1996:M1–2009:M9	**-3.531****	**-3.175***	**-2.984****	**-2.714***	**-2.991****	**-2.719****
New Zealand	1991:Q1–2009:Q3	-1.109	-1.091	-0.198	-0.006	-	-
Sweden	1995:M1–2009:M9	-1.841	-2.173	-2.006	-1.386	-	-
UK	1992:M10–2009:M9	**-3.479****	**-3.718****	-2.353	**-2.940****	-1.472	**-2.513****

Note: *** significant at 1%, ** 5%, * 10%, positive test values are not reported in the table.

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http://chicagofed.org/webpages/publications/speeches/2010/10_16_boston_speech.cfm
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