

Output Volatility and Exchange Rate Considerations Under Inflation Targeting : A Review

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ABSTRACT: The objective of the paper is to offer a critique on the theoretical and empirical literature on inflation targeting (IT). It seems to exist a consensus in the theoretical literature that this monetary regime reduces both inflation and output volatility, mainly through building monetary policy credibility. When the role of the exchange rate is discussed, while there are some arguments that, as an instrument, it should not be explicitly stated in the central-bank loss function, theoretical arguments and evidence are still mixed as regards the effectiveness of exchange-rate management under IT. On the empirical front, the paper concludes that despite the fact that the work on IT in the last two decades has been immense in quality and quantity, still there is no quantitatively-credible study for the developing world, let alone a study that appropriately measures the regime switch from one monetary strategy to another.

Keywords: Inflation targeting; Output volatility; Exchange rate; Trade-off; DSGE

JEL Classifications: E42; E52; E58

1. Introduction

Inflation targeting (IT) is a monetary strategy which commits to a numerical target for achieving medium-term price stability and uses an inflation forecast over a horizon as an intermediate target of the monetary policy (Batini et al., 2006). More precisely, the central bank decides upon a monetary-policy instrument, usually an interest rate, which is envisaged to meet the inflation target, through the means of intermediate targeting of the inflation forecast. However, in the real world, inflation targeters are not “inflation nutters” (King, 1996) but, rather, demonstrate the needed flexibility in order not to sacrifice too large a proportion of output in order to quickly return inflation to target when a shock hits the economy. Furthermore, monetary authorities observe exchange-rate developments and by foreign-exchange interventions prevent large exchange-rate fluctuations, but without the aim of preventing the exchange rate reaching its market equilibrium over the longer horizon. In essence, by introducing inflation targeting, countries: i) provide an anchor for inflation expectations (Svensson, 1999); ii) put a positive weight on output stabilization (Svensson, 2000; Debelle, 1999); and iii) introduce a managed-floating exchange rate in order to prevent large exchange-rate volatility (Goldstein, 2002; Gersl and Holub, 2006). The aim of this paper is to critically review the latter two aspects of the IT regime. The crucial question is if IT, in the manner in which it is defined, amends the theoretical consensus and empirical findings on the existence of a short-run trade-off between inflation volatility and output volatility.¹ Since inflation and inflation volatility dwindled after IT was introduced (Nadal-de-Simone, 2001), and since both ERT and IT anchor inflation expectations, we aim to highlight the aspects in which these two monetary regimes are different – output volatility and exchange-rate issues. However, this does not mean that our discussion will not include issues related to inflation.

¹ For a summary discussion on the inflation/output volatility trade-off, see Clarida et al. (1999).

The paper is organized as follows. Section 2 focuses on theoretical analysis of the trade-off between output and inflation volatility under IT. Section 3 discusses the role of the exchange rate. Section 4 provides a critique of the empirical literature on IT. The last section concludes the chapter.

2. Theoretical Analysis of Output Volatility and Its Trade-Off with Inflation Volatility Under Inflation Targeting

In the real world, IT is designed to bring inflation on target while reducing the sacrifice ratio. In mathematical terms, this means that the central bank's loss function - set in the quadratic form commonly found in the literature - explicitly considers the output gap and attaches to it a weight, which reflects the extent to which the central bank wants to "fight" for output:

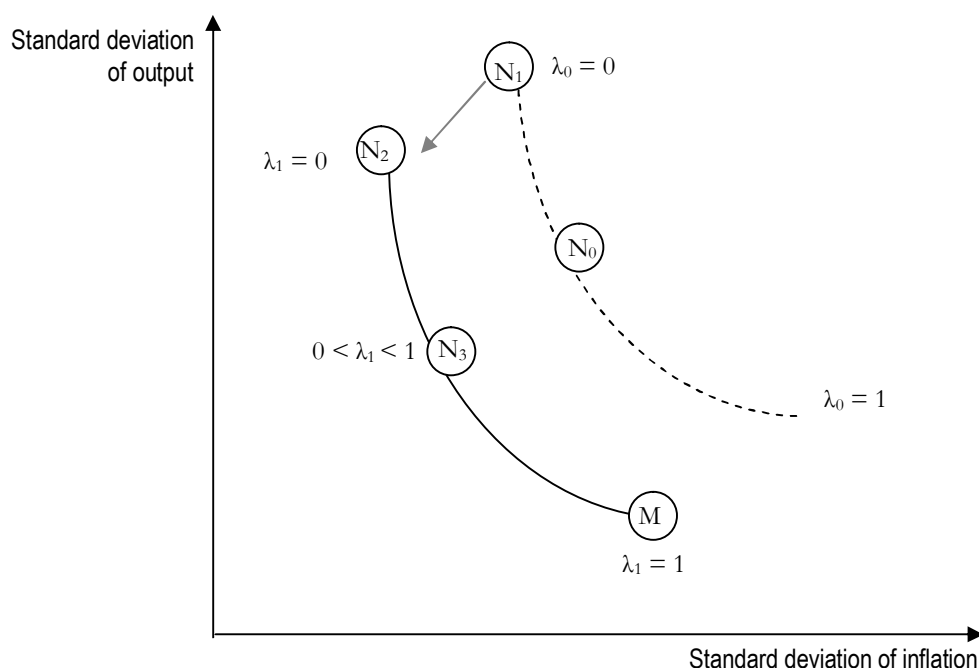
$$L_t = \frac{(\pi_t - \pi^*)^2}{2} + \frac{\lambda(y_t - y_t^*)^2}{2} \quad (1)$$

Whereby, π_t refers to actual inflation, π^* is the targeted inflation rate, while $(y_t - y_t^*)$ refers to the output gap. λ refers to the relative weight on stabilizing the output gap. In terms of the loss function, an inflation targeter will attempt to minimize deviation of actual inflation from the inflation target contained by the first term of (1). However, while output stabilization has a clear role to play within IT, the weight put on it (noted with λ) is an empirical question (Debelle, 1999). The general approach in the literature has been to stochastically simulate an intertemporal general equilibrium model. Namely, it consists of aggregate demand and supply relations derived under the intertemporal optimizing behaviour of private agents with nominal rigidities in price and wage setting. They give an explicit account of the short-term interest rate as a core instrument and of the lags in the monetary transmission mechanism. In such models, the weight put on output stabilization (λ) is changed and a variability frontier is then established for an optimal policy response.

Stevens and Debelle (1995) establish a convex relationship (Figure 1, solid curve) between inflation and output volatility using a model of the form described above (with inflation volatility around a given inflation target measured along the horizontal axis and output volatility measured along the vertical axis)². They argue that as the weight the central bank puts on output increases, this elevates the variability of inflation and reduces the variability of output. When the central bank is an "inflation nutter" ($\lambda=0$; point N2), the relative disregard of output will lead to a low level of inflation volatility but a high level output volatility. For values of λ different from but close to zero, a small increase of inflation volatility leads to a very large portion of output saved (upper-left part of the curve). Then, a large range of values for λ deliver very similar outcomes for inflation and output volatility and are concentrated in the middle of the curve (around point N3). As values of λ approach unity, a large increase of inflation volatility leads to a very small portion of output saved (lower-right part of the curve). The other extreme, let us call it an "output nutter" central bank ($\lambda=1$; point M), refers to a situation when the central bank targets the output gap exclusively, there is no monetary anchor, a situation that is not observed in practice (Svensson, 2003).

The curve presented on Figure 1 is called the Taylor curve (Taylor, 1979) and is a type of volatility trade-off frontier depicting the gains that a central bank could achieve and the cost it would pay. Namely, although theoretically IT favours both lower inflation and output volatility, and some empirical studies (Batini and Haldane, 1998; Bean, 1998 and others) found that IT is capable of smoothing both volatilities, still central banks must choose a point to position themselves on the trade-off frontier. A stable trade-off between inflation and output volatility would require that inflation volatility increases as output volatility decreases, and vice versa.

² Points above and to the right of the curve correspond to inefficient monetary policy, where either inflation variability or output-gap variability, or both, could be reduced by better monetary policy. Points below and to the left of the curve correspond to outcomes that are infeasible. See further details in Svensson (2003).

Figure 1. Inflation and output volatility trade-off

Source: Drafted by the author based on the arguments and figures in Stevens and Debelle (1995); Debelle (1999); and Svensson (2003).

Albeit defined in the manner to optimize the behaviour of inflation vis-à-vis output in the short run, IT is, however, criticised in the literature as being associated with increased output volatility (Arestis et al. 2002), especially in comparison to non-IT countries. For instance, Cecchetti and Ehrmann (1999) observe that while inflation volatility fell more in IT countries than in non-ITers, output volatility fell by far less in the former than in the latter. The conventional view is that when prices are sticky, IT leads to slow adjustment of output to its natural level. A supply shock will be combated with increasing interest rates, which will reduce inflation but will depress real activity. Such difficulty does not arise when a demand shock hits; a monetary policy that tries to offset the effect of those shocks on demand helps to stabilize both inflation and output. Policy is capable of moving output and inflation in the same direction, as the aggregate demand shock does. “It is the aggregate supply movements that create the essential dilemma for policy, because they force a choice” (Cecchetti and Ehrmann, 1999, p.9). The choice is where to position on the trade-off curve, while the extent of the policy response to a supply shock will depend on the economic structure as represented by the aggregate demand and supply curves³ and the weight put on output stabilization.

Erceg et al. (1998) demonstrated the existence of an inflation-output volatility trade-off under IT, assuming optimizing agents behaviour and staggered nominal wages and prices. They argue that only when prices are sticky and wages perfectly flexible does the trade-off disappear. However, this combination of assumptions is rather strong, making the case unrealistic. They show that when nominal wages are sticky, there exists a variance trade-off between price inflation and an output gap, regardless of the degree of price stickiness. In this case, the equilibrium real wage moves in response to preference and technology shocks, while the nominal wage only moves in response to changes in the output gap. Thus, if monetary policy maintains a constant price inflation rate, output must temporarily deviate from its potential to induce nominal wage adjustment, so that the real wage can move toward its new equilibrium value. Hence, in the real world, it is infeasible to simultaneously

³ More specifically, the positioning on the trade-off frontier will depend on the slope of the aggregate supply curve and the slope of the aggregate demand curve. Whereas the shape of the trade-off curve depends on the inverse of the slope of the aggregate supply curve. The flatter the aggregate supply curve, the more the trade-off curve looks like the solid curve on Figure 1. The steeper the aggregate supply curve, the closer the trade-off curve to the axes.

stabilize price inflation, wage inflation and output gap. A model incorporating reasonable wage inertia produces increased output volatility when inflation volatility increases.

Another strand of the literature (see Cecchetti and Ehrman, 1999; Clarida et al. 1999; and Bernanke and Mishkin, 1997), however, argues that it is possible that a shift to an IT regime acts as a commitment device, and through increasing the credibility of the central bank, facilitates the achievement of lower inflation volatility and lower output volatility. The central bank improves in anchoring inflation expectations on the inflation target by attaining credibility. Svensson (2003) argues that with an explicit inflation target, the credibility of an IT regime can be measured as the degree of proximity between private-sector inflation expectations and the inflation target. Shocks to inflation expectations are historically an important source of volatility in inflation and output, since shifts in inflation expectations have independent effects on future inflation (the direct expectations channel). Shifts in inflation expectations also cause additional indirect disturbances to output and inflation by affecting real interest rates and exchange rates. As a result, volatility in inflation expectations shifts the curve in Figure 1 up and to the right and worsens the variability trade-off (dashed curve). Conversely, more stable inflation expectations, anchored on the inflation target, improve the trade-off and shift the curve down and to the left, allowing inflation volatility, or output volatility, or both to fall. This is also because inflation expectations anchored on the inflation target create a strong tendency for actual inflation to revert to the inflation target and, everything else equal, mean that monetary policy needs to be less active. Interest rates and output need to move less to counter unfavourable movements in inflation expectations. "The economy is, to some extent, put on autopilot. This situation is every IT central banker's dream" (Svensson, 2003, p.270).

Practical experience though shows that credibility cannot be granted by law but instead has to be earned over time. In most new IT regimes, especially when the initial inflation is high and a period of disinflation is required, inflation expectations are high and credibility is low (Mishkin, 2000). Hence, the central bank should initially put more weight on reducing and stabilizing inflation in order to achieve credibility more quickly. According to the earlier discussion, the cost would be more output volatility at the beginning of the regime, while the benefit - an improved trade-off and, hence, lower volatility of both inflation and output - would occur later on, when credibility has improved and the central bank can afford to be a more flexible ITer. As an illustration using Figure 1, suppose, because of low initial credibility, that the economy initially is at a point to the upper-right of the efficient frontier (solid curve), i.e. on the dashed curve, implying higher volatility of both inflation and output and has some positive λ , but not too far from zero (point N_0). Suppose the central bank implements strict IT - this would correspond to a move up along the dashed trade-off curve (point N_1). If credibility improves, the trade-off curve would shift to the down-left; the more credibility is achieved, the more the curve approximates the efficient frontier (solid curve); ultimately, the solid curve is achieved, i.e. the economy will operate at point N_2 . If the central bank then implements flexible IT, the economy could move to point N_3 . Compared to the initial situation (N_0 vis-à-vis N_3), the economy benefits from lower volatility of both inflation and output. Hence, under an IT umbrella it has been doubted the existence of a volatility trade-off is so straightforward, suggesting that a shift can occur, making IT conducive to output volatility besides inflation volatility. This view, which in the jargon of Goodfriend and King (1997) became known as the new neoclassical synthesis, however, does not negate the thesis of vital trade-offs among the mentioned macroeconomic indicators. The models of King and Wolman (1996, 1998) and Goodfriend and King (1997), for instance, consider economies with completely flexible wages, while prices are set by monopolistically competitive firms according to a staggered price-setting rule à la Taylor (1979), and conclude that IT should be adopted because it smoothes inflation and output simultaneously.

3. The Role of the Exchange Rate Under Inflation Targeting

Several contributions within the so-called New Keynesian synthesis have shown that, under quite general conditions, a simple, inward-looking, interest rate rule can be regarded as an optimal policy response for a closed economy (Taylor, 1999). Less attention has been paid to the choice of monetary policy objectives in an open-economy context, given that an open economy is comparable to a closed economy whenever the exchange rate pass-through to import prices is complete, which is a strong assumption (Galí and Monacelli, 2005). In other words, under complete exchange-rate flexibility, policymakers in open economies should also be focused uniquely on domestic targets.

Unfortunately, there is extensive evidence that, in reality, departures from the law of one price for traded-goods are large and pervasive (Rogoff, 1996; Engel, 2002). Under these circumstances, policy choices are not independent of exchange-rate dynamics and monetary conduct is liable to focus on more than just domestic stabilization. Plainly put, the question in the literature is not whether to account for exchange-rate volatility under IT, but whether to explicitly include it in the loss function. For instance, Agénor (2002) argues that exchange-rate-volatility management (a managed floating regime) under IT should be explicitly considered in the policy loss function. Hence, the loss function should be:

$$L_t = \frac{(\pi_t - \pi^*)^2}{2} + \frac{\lambda(y_t - y_t^*)^2}{2} + \frac{\varphi(\Delta e_t - \pi_t^N)^2}{2}, \lambda > 0; \varphi > 0 \quad (2)$$

where notation is the same as in (1) and exchange-rate volatility is defined through the movements of the real exchange rate, i.e. through the difference between the nominal-exchange-rate changes and non-tradables inflation. However, at this point, two questions arise: i) is the exchange rate an instrument towards achieving price and output gap objectives or it is an objective of the policy itself?; and ii) why, then, is the interest rate, which is the prima-facie instrument under IT, not explicitly included in the loss function? Cecchetti and Ehrmann (1999) oppose the arguments and formulation of Agénor (2002), suggesting that the exchange rate should not be a part of the loss function. The rationale for this is the belief that domestic inflation and output are the fundamental concerns of policymakers, while the exchange rate is only a vehicle to achieve these basic objectives. Namely, as long as there exists a positive pass-through from the exchange rate to prices, exchange-rate changes will affect inflation; if real exchange-rate changes reflect situations of misalignment, they will also affect the output gap (Edwards, 2006). Hence, an optimal policy would be to consider how exchange-rate developments impinge on these two components of the loss function, rather than include the exchange rate in it directly. Moreover, the decision to focus on the exchange-rate path in the formulation of policy would be a choice of an intermediate target, which, in turn, is not a desirable option under IT. Policymakers are not concerned with the behaviour of intermediate targets per se, but with the domestic inflation and output outcomes produced by their use. Ultimately, intermediate targets under direct IT would lead to conflicting policy goals and might throw bewilderment on the financial markets. This argument also gives the reason why interest rates should not be included in the loss function. However, this reasoning does not say that exchange-rate behaviour should be chaotic or left to chance but, rather, that the exchange-rate should be considered as an instrument to achieve the goals specified in (1).

Still, although exchange-rate management under IT emerges as possibly important, Svensson (2003) argues that it is difficult to find good reasons for stabilizing either the exchange rate or the interest rate at the expense of increased inflation and/or output-gap variability. In practice, flexible IT, with a longer horizon to meet the inflation target and concern for output volatility, will normally mean a more gradual approach and a less activist policy and, hence, reduced interest-rate volatility. Because interest-rate changes lead to exchange-rate changes, everything else equal, this also reduces exchange-rate volatility. Gersl and Holub (2006) argue that, ideally, IT would operate with a free-floating exchange-rate regime, so that the only instrument in the hands of the central bank would be the short-run interest rate. To the extent that the exchange-rate volatility affects the targeted inflation rate and the output gap, interest rates are used to respond to an exchange-rate shock. In that respect, credibility is also important because increased credibility and increasingly stable inflation expectations will reduce a major source of shocks to both interest rates and exchange rates. Thus, successful and credible flexible IT is likely to contribute to less volatility of interest rates and exchange rates. However, exchange rates are, by nature, volatile asset prices and are affected by a number of shocks beyond inflation expectations and interest-rate changes and/or a "fear of floating" (Calvo and Reinhart, 2002). Such shocks will continue to cause unavoidable exchange-rate volatility.

At that point, the central bank still has the foreign-exchange reserves to prevent large exchange-rate fluctuations and to achieve a goal as specified in equation (1). Hence, exchange-rate management through foreign-exchange interventions is important under IT (Bofinger and Wollmershaeuser, 2003; Goldstein, 2002). Though, the extent to which the central bank would be committed to prevent exchange-rate fluctuations would differ from case to case and remains an empirical question. In general, for a small, open economy, foreign-exchange interventions will reduce

the harmful effect of large supply-side shocks coming from abroad and this will, in turn, improve the overall performance of the IT, because it will facilitate a more favourable positioning of the trade-off frontier. Some of the IT countries do use foreign-exchange interventions more or less frequently in practice (Gersl and Holub, 2006). This group includes Australia, Chile, South Korea, Sweden (in 2001), Hungary, and Slovakia, to name just a few. Most recently, the Reserve Bank of New Zealand, a pioneer of IT, has been given a formal mandate to use direct foreign-exchange interventions as a monetary-policy instrument. There is thus not a general consensus on the "fall of foreign-exchange market intervention as a policy tool" (Schwartz, 2000).

The use of foreign-exchange interventions under IT faces several challenges, though. Among these, the most important is the lack of consensus on the effectiveness of such interventions (which is closely related to the effectiveness and completeness of exchange-rate pass-through). Most of the empirical analyses that were carried out during the 1980s did not support the quantitative importance of the interventions (Almekinders, 1995). On the other hand, there are some more recent econometric studies, which benefited from better data availability since the 1990s and the new methodologies applied, supporting the effectiveness of interventions (Disyatat and Galati, 2007; Fatum and Hutchison, 2006; and the references therein). New studies focused also on the effect of intervention on exchange-rate volatility (Egert and Komarek, 2006). Moreover, some authors have argued that the effectiveness of the interventions may be greater in the emerging economies compared with the advanced countries, whose data have been typically used in the empirical analyses (Canales-Kriljenko, 2003). The evidence in this respect is still rather scarce, but there are papers that do indeed find some evidence on the effectiveness of interventions in emerging economies under specific conditions (e.g., Guimaraes and Karacadag, 2004). However, the link between this policy instrument and its effects is much less clear than for the interest rates, which makes its use as a systematic monetary-policy tool challenging. In summary, while there are some arguments that, as an instrument, the exchange rate should not be explicitly stated in the loss function, theoretical arguments and evidence are still mixed as regards the effectiveness of exchange-rate management under IT.

4. Empirical Evidence: Scope and Critical Analysis

Since its "invention" in the early 1990s until nowadays, IT has spurred a tremendous body of research, part of which evaluates the macroeconomic outcomes of, and/or central-bank policy responses under, this monetary regime. Some of this literature is primarily based on theoretical arguments, while empirics by and large give comparisons of macroeconomic behaviours pre- and post-IT introduction (see Angeriz and Arestis, 2007, for a summary). In general, this part of the literature concludes that after IT was introduced inflation and its volatility fell, but that these countries did not reach better performance than non-ITers with a similar starting point (mostly taken as an equal initial level of inflation). In other words, the environment of the 1990s was, in general terms, a stable economic environment, "a period friendly to price stability" (Neumann and von Hagen, 2002, p. 129). The results on output volatility remained mixed, thus not giving support for the claim that IT is a superior strategy. In that respect, the FED and the ECB continue to show scepticism towards IT adoption (Duisenberg, 2003). IT proponents (Bernanke et al. 1999) have argued in its favour, though without empirical support. This (descriptive) part of the literature is not subject to critical analysis in this paper, since it does not reveal causal relationships. There is a need for deeper quantitative analysis, which at present appears scarce.

Notwithstanding this general impression, a major part of the studies with systematic quantitative assessment are based upon structural models of conditional volatilities, Friedman's (1993) model of conditional and unconditional volatility, unrestricted VAR models allowing for structural breaks and others. A minor, but growing part gives sensitivity analyses within dynamic stochastic general equilibrium (DSGE) models, which is a recent innovation (see de Mello and Moccero, 2008). However, the analysis of IT within DSGEs in advanced economies is only marginally analysed. This could be due to these economies already possessing strengthened monetary credibility and sufficiently developed financial markets and institutions, hence, making the analysis of monetary policy more general (in terms of transmission channels and their effectiveness), rather than specifically focused on IT effects, per se. In addition to this, the analysis of regime switch has been almost absent. In the words of Nadal-de-Simone (2001), this is "an issue virtually ignored in the literature" (p.4). This could

be due to the previously observed evidence that developed economies embarked on IT from an implicit nominal (inflation) target, hence making the switch smooth.

Nadal-de-Simone (2001) assesses output volatility before and during IT in two models. Friedman's (1993) "plucking model" assumes that output cannot exceed a ceiling level determined by the resources and the technology available to the economy, but it is occasionally plucked down by a recession. The model assumes asymmetry in the shocks hitting the trend or cyclical component of output. Clark's model is a restricted version of the former, assuming that there is no asymmetry in output behaviour at all. Both models are a type of time-varying-parameter model, which allows for the variance of the shock to the cyclical and trend component of output to depend on the state of the economy, and are used to estimate output-conditional variance for a sample of 12 countries. The study opts to utilize a regime switch between normal and recession time by modelling a Markov process, but does not resolve how output reacts to a change of the monetary regime, or explicitly consider the role of the exchange rate. A sample of six non-ITers and six ITers in the period 1976-2000 is used, in order to compare the former with the latter and the latter before and after IT was established. However, since the study is conducted in the period when EMEs started to establish IT, the sample is restricted to developed economies. As a digression, many studies base their assessment on a comparison with non-IT economies, either neighbouring or the most successful ones (Vega and Winkelried, 2005), but the concern that different economies are exposed to different (domestic or regional) shocks suggests that these should be treated with caution. The study finds that although inflation volatility dwindled after the introduction of IT, it was not accompanied by a significant increase in conditional output volatility, with the single exception of Canada. The results suggest that by introducing IT, these countries succeeded in delivering a combination of both lower inflation volatility and lower, or similar, output volatility. However, it is also possible that there were fewer supply shocks in the late 1980s and 1990s, so that the general reduction in the variability of inflation has not been generally accompanied by an increase in output volatility.

Contrary to the studies based on DSGE models, which consider the volatility trade-off as a long-run issue, but similarly to the previous study, Arestis et al. (2002) use a model of stochastic, conditional, time-varying volatilities, with the expectation of extracting more information from the short-run dynamics. First, the study compares the economic performance of six IT economies in the 1980s and 1990s, focusing on inflation and output volatility following a supply shock. However, the switch from the previous regime to IT and the IT regime itself, is not considered. The findings suggest that in the 1990s, after IT was established, there was markedly lower output volatility for an unchanged level of inflation volatility, with the exceptions of Australia and Finland. Again, though, the sample is comprised of developed countries only, and hence the results are restrictive. Considering that the 1990s were relatively shock-free, the study, in a second stage of analysis, compares the ratio of output to inflation volatility in the 1990s, between six ITers and six non-ITers, similar to the study of Nadal-de-Simone (2001). It was found that if IT was not adopted, a worsening of this ratio is observed, which suggests that IT regime delivers successful smoothing of inflation and output volatility. This conclusion is attributed to the acquired monetary credibility, which is a characteristic of developed economies, and to the flexibility of the monetary regime, which implicitly refers to the direct accounting for the output stabilization and exchange-rate developments within the monetary-policy loss function.

The relatively shock-free period observed in the 1990s, raised as an issue in Cecchetti and Ehrman (1999), is further advanced in Lee (1999). He observes three IT countries: New Zealand, Canada and the UK and analyses an unrestricted VAR system of inflation, output, long-term and short-term interest rates over the period 1975-1996. Although important, the exchange-rate is omitted from the analysis, hence neglecting the discretion that the authorities (especially former exchange-rate targeters) gained with the introduction of IT. From today's viewpoint, the study is dated but it still encompasses some features in its quantitative approach not present elsewhere in the literature. First, the series are examined for containing structural breaks and, in almost all cases, particularly for the output series, a break is found to be associated with the switch to IT. Hence, in the simulation analysis, the period from 1975 until the introduction of IT is taken separately for each country and forecasts are generated. The objective of these is to provide a counterfactual for the situation without a regime switch in the economy. The comparison with the actual data reveals that, in general, inflation and output volatility under IT have been lower than compared to the simulated path (non-IT). However,

Lee (1999) argues that these findings, also present in other studies, might be deceptive, given the generally observed more stable economic environment in the time when IT was established. To check for this, in a second stage, he uses the common-trend-and-cycle approach for the three countries with three counterparts (their biggest trading non-IT partners: Australia, US and Germany). Under his framework, common stochastic trends are characterised by the existence of cointegrating vectors among the variables (long-run movements), and common cycles by serial correlation of common features among the residual stationary components of these variables (short-run movements). The possibility that the cointegration vector could be affected by a structural break (Nadal-De Simone, 2001) is captured by estimating Sup-F and Mean-F statistics. However, no such breaks were found to be associated with the introduction of IT. Modelled in such a way, the data reveal that the volatility of inflation and output did not decrease; instead, the series became slightly more volatile. These differences in the results could be ascribed to the process of synchronisation of economic activity rather than to the monetary regime itself; and hence, depict IT as instrument ineffective, i.e. a regime whose results could have been achieved without embarking on a new regime. In general, albeit that the study is, from the econometric approach, alone in the literature, it makes a genuine approach towards assessing IT performance. Still, the regime switch is not explicitly modelled; also, the results are valid for the developed world only. The absence of the exchange rate from the analysis might appear as the main drawback of the study if a similar approach was applied to developing IT countries.

5. Conclusion

The objective of the paper has been to offer some critique on the theoretical and empirical literature on inflation targeting. It seems to exist a consensus that this monetary regime reduces both inflation and output volatility, mainly through building monetary-policy credibility. When the role of the exchange rate is discussed, while there are some arguments that, as an instrument, it should not be explicitly stated in the central-bank loss function, theoretical arguments and evidence are still mixed as regards the effectiveness of exchange-rate management under IT. On the empirical front, the paper concludes that despite the fact that the work on IT in the last two decades has been immense in quality and quantity, still there is no quantitatively-credible study for the developing world, let alone a study that appropriately measures the regime switch from one monetary strategy to another. The studies for emerging markets are primarily based on theoretical arguments, while the empirical studies amount to descriptive analysis of the macroeconomic performance and/or policy responses since IT introduction, but do not model or reveal causal relationships. Moreover, the majority of developed countries that adopted official IT previously relied on an implicit nominal anchor, which is the closest strategy to IT, the only difference being that the target is not officially announced.

References

- Agénor, P.R. (2002). Monetary Policy under Flexible Exchange Rates: An Introduction to Inflation Targeting. In: and Loayza, N. and Schmidt-Hebbel, K. (Editor) (eds.) *Inflation Targeting: Design, Performance, Challenges*. 1(5), chapter 3, p.79-170.
- Almekinders, G. J. (1995). *Foreign Exchange Intervention: Theory and Evidence*. Aldershot, UK: Edward Elgar.
- Angeriz, A. and Arestis, P. (2007). Inflation Targeting: Assessing the Evidence. Chapter in: McCombie, J.S.L. and Gonzalez, R.C. (eds.) *Issues in Finance and Monetary Policy*. Palgrave Macmillan.
- Arestis, P., Caporale, G.M., Cipollini, A. (2002). Is There a Trade-off Between Inflation and Output Gap? *The Manchester School*, 70(4), 528-545.
- Batini, N., Haldane, A. (1998). Forward Looking Rules for Monetary Policy. Bank of England Discussion Paper, 91.
- Batini, N., Breuer, P., Kochhar, K., Roger, S. (2006). Inflation Targeting and the IMF. IMF Staff Paper, Washington DC.
- Bean, C. (1998). The New UK Monetary Arrangements: A View from the Literature. *Economic Journal*, 108, 1795-1809.
- Bernanke, B., Mishkin, F.S. (1997). Inflation Targeting: A New Framework for Monetary Policy? *Journal of Economic Perspectives*, 11(2), 97-116.

- Bernanke, B.S., Laubach, T., Mishkin, F.S. and Posen, A. (1999). *Inflation Targeting: Lessons from the International Experience*. Princeton University Press: Princeton.
- Bofinger, P., Wollmershaeuser, T. (2003). Managed Floating as a Monetary Policy Strategy. *Economics of Planning*, 36(2), 81-109.
- Calvo, G. and Reinhart, C.M. (2002). Fear of Floating. *Quarterly Journal of Economics*, 117, 379-408.
- Canales-Kriljenko, J.I. (2003) Foreign Exchange Intervention in Developing and Transition Economies: Results of a Survey. IMF WP, 03/95.
- Cecchetti, S.C., Ehrmann, M. (1999). Does Inflation Targeting Increase Output Volatility? An International Comparison of Policymakers' Preferences and Outcomes. NBER WP, 7426.
- Clarida, R., Galí, J. and Gertler, M. (1999). The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature*, 37, 1661-1707.
- De Mello, L., Moccero, D. (2008). Monetary Policy and Macroeconomic Stability in Latin America: The Cases of Brazil, Chile, Colombia and Mexico. In: De Mello, L. (eds.), *Monetary Policies and Inflation Targeting in Emerging Economies* (edited volume). OECD (Paris).
- Debelle, G. (1999). Inflation Targeting and Output Stabilization. Research Discussion paper, 1999-08, Reserve Bank of Australia, p.1-25.
- Disyatat, P., Galati, G. (2007). The Effectiveness of Foreign Exchange Intervention in Emerging Market Countries: Evidence from the Czech Koruna. *Journal of International Money and Finance*, 26(3), 383-402.
- Duisenberg, W. (2003). Introductory Statement, and Questions and Answers. ECB Press Conference, 8 May, Frankfurt: Germany.
- Edwards, S. (2006). The Relationship Between Exchange Rates and Inflation Targeting Revisited. NBER Working Paper, 12163.
- Egert, B., Komarek, L. (2006). Foreign Exchange Interventions and Interest Rate Policy in the Czech Republic: Hand in Glove? *Economic Systems*, 30(2), 121-140.
- Engel, C. (2002). The Responsiveness of Consumer Prices to Exchange Rates: A Synthesis of Some New Open Economy Macro Models. *Manchester School*, 70, 1-15.
- Erceg, C., Henderson, D.W., Levin, A.T. (1998). Trade-offs between Inflation and Output Gap Variances in an Optimizing Agent Model. *International Finance*, 627.
- Fatum, R. and Hutchison, M. M. (2006). Effectiveness of Official Daily Foreign Exchange Market Intervention Operations in Japan. *Journal of International Money and Finance*, 25(2), 199-219.
- Friedman, M. (1993). The 'Plucking Model' of Business Fluctuations Revisited. *Economic Inquiry*, 31(2), 171-177.
- Galí, J. and Monacelli, T. (2005). Monetary Policy and Exchange Rate Volatility in a Small Open Economy. *Review of Economic Studies*, 72(3), 707-734.
- Gersl, A., Holub, T. (2006). Foreign Exchange Interventions under Inflation Targeting: The Czech Experience. *Contemporary Economic Policy*, 24(4), 475-491.
- Goldstein, M. (2002). *Managed Floating Plus*. Washington DC: Institute for International Economics, Policy Analyses in International Economics.
- Goodfriend, M., King, R. (1997). The New Neoclassical Synthesis and the Role of Monetary Policy. NBER Macroeconomics Annual 1997, MIT Press, p.233-283.
- Guimaraes, R.F., Karacadag, C. (2004). The Empirics of Foreign Exchange Intervention in Emerging Market Countries: The Cases of Mexico and Turkey. IMF WP, 123.
- King, M. (1996). How Should Central Banks Reduce Inflation? Conceptual Issues. In: *Achieving Price Stability*, FRB of Kansas City, p.53-91.
- King, R.G., Wolman, A.L. (1996). Inflation Targeting in a St. Louis Model of the 21st Century. Federal Reserve Bank of St. Louis Quarterly Review, May Issue, 83-107.
- King, R.G., Wolman, A.L. (1998). What Should Monetary Authority Do When Prices are Sticky? In: Taylor, J. (eds.) *Monetary Policy Rules*. Chicago, IL, University of Chicago Press.
- Lee, J. (1999). Inflation Targeting in Practice: Further Evidence. *Contemporary Economic Policy*, 17(3), 332-347.
- Mishkin, F.S. (2000). Inflation Targeting in Emerging Market Countries. *American Economic Review*, 90(2), 105-109.
- Nadal-De Simone, F. (2001). An Investigation of Output Variance before and during Inflation Targeting. IMF Working paper, 215.

- Neumann, M.J.M., von Hagen, J. (2002). Does Inflation Targeting Matter? FRB St. Louis Review, 84(4), 127-148.
- Rogoff, K. (1996). The Purchasing Power Parity Puzzle. *Journal of Economic Literature*, 34(2), 647-668.
- Schwartz, A.J. (2000). The Rise and Fall of Foreign Exchange Market Intervention. *Journal of Financial Services Research*, 18(2-3), 319-339.
- Stevens, G., Debelle, G. (1995). Monetary Policy Goals for Inflation in Australia. In: Haldane, A. (eds.) Targeting Inflation. Bank of England, p.81-100.
- Svensson, L.O. (1999). Inflation Targeting as a Monetary Policy Rule. *Journal of Monetary Economics*, 43, 607-654.
- Svensson, L.O. (2000). Open-Economy Inflation Targeting, *Journal of International Economics* 50, 155-183.
- Svensson, L.O. (2003). Monetary Policy and Real Stabilization. NBER WP, 9486.
- Taylor, J.B. (1979) Estimation and control of a macroeconomic model with rational expectations. *Econometrica*, 47(5), 1267-86.
- Taylor, J.B. (1999). The Robustness and Efficiency of Monetary Policy Rules as Guidelines for Interest Rate Setting by the European Central Bank. *Journal of Monetary Economics*, 43, 655-679.
- Vega, M., Winkelried, D. (2005). Inflation Targeting and Inflation Behaviour: A Successful Story? *International Journal of Central Banking*, 1(3), 153-175.