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Discussion Paper

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On the Performance of Nominal Income Targeting as a Strategy for Monetary Policy in a Small Open Economy

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ABSTRACT

There is a great deal of support for nominal income targeting in the literature on strategies for monetary policy in a closed economy framework. Is nominal income targeting equally attractive in a small open economy? This paper compares nominal income targeting to alternative monetary policy rules in a stochastic macro model for a small open economy. We find that both, the weighting in the overall price level of the exchange rate and foreign prices and the elasticity of output supplied with respect to the real exchange rate, are important factors in assessing the attractiveness of nominal income targeting. In a small open economy where the size of both parameters is not negligible, a rule targeting the overall price level may actually be preferred to nominal income targeting.

JEL Classification Codes: E52, F41

Introduction

The adoption of inflation targets by a number of central banks during the past decade seems to run counter to the policy advice spelled out in the literature on monetary policy strategies. There appears to be a reasonably strong consensus in the literature that favours nominal income targeting as the most suitable monetary policy strategy.[1] Thus the decision by countries like Canada, New Zealand, Sweden, the United Kingdom and others to target inflation directly, and the long-standing implicit form of inflation targeting pursued by Germany, Switzerland, Japan, and arguably the United States, is surprising to readers of the academic literature, and in fact at odds with conventional wisdom. The divergence between what the literature hails as the most suitable object of monetary policy and actual practice highlights the need for reassessing the argument for nominal income targeting.

In our view, the argument for nominal income targeting must be reassessed for small open economies. Much of the existing literature has focused on relatively closed economies.[2] However, all of the economies that have adopted an explicit inflation target are (relatively) open economies. There is thus reason to believe that the attractiveness of nominal income targeting in a closed economy may not carry over in full force to a small open economy.

The evaluation of policy rules for closed economies has mainly focused on the attainment of domestic price and output stability. A small open economy has additional considerations. The stability of the exchange rate is important. Instability in the exchange rate leads to undesirable fluctuations in the pertinent price level, usually represented by a measure of prices of both domestic and foreign goods such as the Consumer Price Index. In addition, the degree of import penetration or openness is another factor that influences the choice of a strategy for monetary policy in a small open economy.

In the existing literature on nominal income targeting, a few contributions[3] do acknowledge the importance of the exchange rate in model specification and evaluation, but overall price level considerations and the degree of openness have not been addressed explicitly. In effect, this oversight has important implications for the accuracy of any assessment of the merits of nominal income targeting.

This paper seeks to redress this oversight by examining the properties of nominal income targeting vis-à-vis exchange rate, overall price level, and money supply targeting in the context of a small open economy. The role of the overall price level and other pertinent features such as openness and the sensitivity of aggregate supply to real exchange rate movements are emphasised in both model specification and evaluation. Doing so captures important aspects of small open economies that need to be recognized in the analysis of policy rules. Indeed, the findings reported in this paper provide an insight as to why small open economies may prefer inflation targeting to nominal income targeting. The appeal of inflation targeting is largely attributable to the fact that the strict adherence to a nominal income targeting rule may cause excessive fluctuations in the exchange rate and thus in the overall price level. These fluctuations become more pronounced under nominal income targeting as the degree of openness and the sensitivity of aggregate supply to swings in the real exchange rate increase.

The paper begins with a review of the arguments for nominal income targeting before discussing why such arguments may not necessarily apply to small open economies. Section III introduces the small open economy model used in the paper. Section IV discusses the criteria used in evaluating the performance of a particular monetary policy rule. This section also contains a graphical analysis of the properties of the different monetary policy rules

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[1] Hall and Mankiw (1994) argue that there exists a professional consensus that nominal income is the most suitable object of monetary policy, p77. This consensus is perhaps more evident in the United States, where economy is rather closed, than in other parts of the world.

[2] For example, Taylor (1985), McCallum (1988), Hall and Mankiw (1994).

considered in the paper. The last part of Section IV attempts to reconcile our findings with inflation targeting in practice. Section V concludes.

II. Nominal income targeting: closed vs open economy framework

Nominal income targeting has had an enduring popularity in the literature as the most appropriate policy target for monetary policy in a closed economy. Its support has spanned from the late 1970s, with early contributions from Meade (1978) and Tobin (1980), to the present day. At present, nominal income targeting has support from all branches of modern macroeconomics, from schools of thought espousing monetary neutrality to those favouring monetary non-neutrality.[4]

Advocates of nominal income targeting point out that it stabilises prices just as effectively as inflation targeting while offsetting cyclical shocks more effectively. The latter is due to the relative speed with which output adjusts to monetary policy actions compared to prices. The design of a nominal income target is arguably easier than that of an inflation target, as unlike inflation targeting, there is no need to extract from nominal GDP growth the relative inflation and real growth components.[5] Strong theoretical support for nominal income targeting in the closed-economy context has been given by Hall (1985), Frankel and Chinn (1995), and McCallum (1995).[6] There has been strong support from the empirical literature for nominal income targeting as well, including Taylor (1985), McCallum (1988), Henderson and McKibbin (1993), Bryant, Mann and Hooper (1993), and Hall and Mankiw (1994).[7]

Recent contributions by Frankel and Chinn (1995), Ratti (1997), and McCallum and Nelson (1999) claim that the merits of nominal income targeting carry over to the open

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[3] Such as Genberg (1989), Rodseth (1996), and Froyen and Guender (2000), to name a few.

[4] As pointed out by Hall and Mankiw (1994), p74, under full monetary neutrality, stable nominal income will result in stable prices (assuming stable real output). Under monetary non-neutrality, the targeting of nominal income is an intermediate solution to the question of how should monetary policy respond to a shock to the price level.

[5] The above merits of nominal income targeting are discussed by McCallum (1995).

[6] The theoretical literature has been generally in favour of nominal income targeting, although different model specifications have provided different degrees of support. The degree of support has been closely linked with a particular model's specification of aggregate supply, as demonstrated by Bean (1983), West (1986), Jansen and Kim (1993), and Ball (1997). The last two contributions, unlike Bean and West, aver that nominal income targeting may in fact be destabilising, not stabilising. See McCallum (1997) for a discussion of the robustness of nominal income targeting under different specifications of the aggregate supply relation.

[7] An exception is Fair and Howrey (1996) who use an optimal control technique to find a target for inflation outperforming a nominal income target in five different models.

economy. The latter find that nominal income targeting performs well in relation to inflation targeting and Taylor rules.[8]

However, nominal income targeting has its critics in policy circles inside and outside of academia. Svensson (1997) and Ball (1997) elaborate on a few important undesirable features of nominal income targeting in a dynamic framework. Reservations are also expressed by Poole (1980) who argues that nominal income targeting leaves too much discretion in the hands of authorities. Mayer (1990) comments on how nominal income targeting requires the assumptions that the central bank uses information efficiently and acts in the public interest, which are both issues of contention. Blinder (1997) emphasises practical difficulties in nominal income targeting, namely the timeliness of information on nominal GDP and the potential for misconstruing a nominal GDP goal as a real GDP goal. Nominal income targeting thus appears in a less favourable light if ease of implementation and interpretation are important criteria in the evaluation of different strategies for monetary policy. Froyen and Guender (2000) find that the case for nominal income targeting is not so clear-cut in a small open economy where the exchange rate has direct effects on both aggregate demand and aggregate supply. However, they do not consider overall price level targeting as an alternative strategy to nominal income targeting, a fact which motivates this paper.

III. A Small Open Economy Model

The model adopted in this paper builds on that proposed by Turnovsky (1983) and Froyen and Guender (2000). The model incorporates important features of a small open economy. Firstly, the exchange rate is incorporated into both the demand and supply side relations. Secondly, the model takes account of the fact that in a small open economy the general or overall price level serves as the measure underlying the calculation of the rate of

[8] It should be mentioned that McCallum and Nelson's favourable evaluation of the performance of nominal income targeting relative to inflation targeting derives from the choice of country and their definition of the rate of inflation. Firstly, their study is based on US data. Clearly, the United States is not a small open economy. Secondly, McCallum and Nelson define inflation as log changes in the domestic price level. In a small open economy, a more preferred measure of the rate of inflation is the log change in a more comprehensive price index (such as the CPI) that also includes the price of imported foreign goods and the exchange rate.

inflation. As a central bank is concerned primarily with stability in the *general* level of prices, the central bank's goal variable should not be solely the domestic price level but the measure of overall prices. That central banks are in fact concerned with stability in a comprehensive price index is evident from Table 1. All countries that have adopted inflation targeting measure inflation on the basis of changes in the overall price level, such as the CPI, and not the GDP deflator.

The model consists of the following five equations. All variables, apart from the nominal interest rate, are expressed in logarithms. All parameters are positive.

$$c_t = (1-\alpha)\, p_t + \alpha\,(x_t + p_t^f) \tag{1}$$

$$y_t = -a_1\,(r_t - (c^e_{t+1,\,t} - c_t)) + a_2\,(p_t^f + x_t - p_t) + v_{1t} \tag{2}$$

$$m_t - c_t = \gamma_1\,(y_t + p_t - c_t) - \gamma_2 r_t + v_{2t} \tag{3}$$

$$y_t = b_0 + b_1\,(p_t - x_t - p_t^f) + b_2\,(p_t - w_t) + u_t \tag{4}$$

$$r_t = r_t^f - x_t + x^e_{t+1,\,t} + \varepsilon_t \tag{5}$$

c_t = the overall price level

$c^e_{t+1,\,t}$ = the expectation of c_{t+1} formed at time t

p_t = the aggregate domestic price level

p_t^f = the foreign price level

x_t = the spot exchange rate

$x^e_{t+1,\,t}$ = the expectation of x_{t+1} formed at time t

r_t = the domestic nominal interest rate

r_t^f = the foreign nominal interest rate

y_t = real output

m_t = the nominal money supply

w_t = the money wage

v_{1t}, v_{2t},u_t, and ε_t are white noise disturbances with variance σ^2_{v1}, σ^2_{v2}, σ^2_u and σ^2_ε respectively.

Equation (1) defines the overall price level as a weighted average of the domestic

price level and foreign price level (after adjusting for movements in the exchange rate). Equation (2) defines the IS relation: real output demanded depends on the expected real interest rate and the real exchange rate. Equation (3) is the LM function for an open economy: the money supply and the value of nominal domestic output are deflated by the general price level.

Equation (4) is the aggregate supply (AS) relationship. Output is produced by profit maximising firms with the help of a labour input and an intermediate input imported from abroad. Output supplied responds negatively to the prices of the two factors of production.[9] Nominal wages are set in advance, at time t-1, by equating expected labour demand to expected labour supply, both parameterised by expectations of next period's price level. The presence of an intermediate good reflects the current trend towards vertical specialisation of production and underscores the importance of exchange rate effects on aggregate supply.[10]

Equation (5), the uncovered nominal interest parity condition, reflects the high level of integration of the financial sector of a small open economy with the rest of the world.

To close the model, we consider the following different strategies for monetary policy:

$$m_t = m^* + \lambda_1(x^* - x_t) \quad (6)$$

$$m_t = m^* + \lambda_2 (c^* - c_t) \quad (7)$$

$$m_t = m^* + \lambda_3(Y^* - (p_t + y_t)) \quad (8)$$

Equations (6), (7) and (8) allow the money supply to respond to deviations from target levels of the exchange rate, the overall price level and nominal income respectively. λ_1, λ_2, and λ_3 are policy rule parameters, the value of which determines the form of policy rule a central bank follows. A rule to target the exchange rate would see λ_1 tend to infinity while a rule to target the overall price level (nominal income) would let λ_2 (λ_3) approach infinity. A rule to target the money supply would see λ_i (i=1, 2, 3) tend towards zero.[11]

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[9] Notice that the (log) inverse of the two factor prices appears in equation (4). For a derivation of this equation, see Marston and Turnovsky (1984), Marston (1985) or Benavie and Froyen (1991). Notice also that we do not make a distinction between the price of the imported intermediate good and the imported consumption good; instead we use p^f_t to denote the price of the foreign good. The price of the foreign good is treated as a stochastic variable with mean zero and constant variance σ^2_{pf}.

[10] See Feenstra (1999) for a discussion of the changing pattern of international trade and the increasing importance of trade in intermediate goods.

[11] The distinction between using the money supply or the nominal interest rate as the instrument is of no relevance here. This is due to the assumption that a particular target is achieved without error. If this assumption

Model solution

To solve the model, first one of the policy rules and the uncovered interest rate parity condition are substituted into the LM equation. Then LM is solved for the exchange rate and the result substituted into IS, yielding aggregate demand. Next the exchange rate is substituted into aggregate supply. Setting aggregate demand equal to supply gives a solution for the domestic price level and output. Using the method of undetermined coefficients, trial solutions are postulated for y_t and p_t of the following form (not including constant terms):

$$y_t = \pi_{11}v_{1t} + \pi_{12}u_t + \pi_{13}v_{2t} + \pi_{14}\varepsilon_t + \pi_{15}r_t^f + \pi_{16}p_t^f \quad (9)$$

$$p_t = \pi_{21}v_{1t} + \pi_{22}u_t + \pi_{23}v_{2t} + \pi_{24}\varepsilon_t + \pi_{25}r_t^f + \pi_{26}p_t^f \quad (10)$$

That is, the domestic price level and output can be expressed as functions of all stochastic variables in the system. The resulting solutions for the domestic price level and output are then substituted into the exchange rate equation to solve for the equilibrium exchange rate in the following form:

$$x_t = \pi_{31}v_{1t} + \pi_{32}u_t + \pi_{33}v_{2t} + \pi_{34}\varepsilon_t + \pi_{35}r_t^f + \pi_{36}p_t^f \quad (11)$$

In order to investigate the relative merits of exchange rate targeting, nominal income targeting and overall price level targeting, we let λ_1, λ_2 and λ_3 tend towards infinity. For money supply targeting we set λ_i equal to zero.[12]

IV. Evaluating Policy Rules

To determine which policy rule should be the central bank's choice, we need to specify the framework underlying the evaluation of the policy rules. It is standard practice to assume that the central bank wishes to maintain stability in output and the price level. This motivates

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were dropped, then policy would have to be aimed at the forecast of the target variable, which would arguably reduce the merits of nominal income targeting.

[12] The solutions for the π_{ij}s in the respective equation for p_t and x_t under each policy rule appear in the appendix which is available from the authors upon request.

the specification of a loss function that includes deviations of real output and the general price level.[13]

In keeping with the accepted practice of modelling losses symmetrically, we adopt a loss function of the following form:

$$L_t = A\, c_t^2 + (y_t - y^*)^2 \qquad (12)$$

where

$$c_t = (1-\alpha)\, p_t + \alpha\, (x_t + p_t^f)$$

In the loss function A represents the relative weight assigned to the overall price level objective. The target price level has been normalized to zero. This normalisation is inconsequential as we have assumed a *static* framework where there is no distinction between inflation and price level targeting.[14] Output losses are defined as deviations from capacity output y^*.[15] The implied coefficient on y^* is one, which eliminates inflationary bias issues.[16]

Tables 2 and 3 give the coefficients of the equation for the level of real output and the overall price level, respectively. It is apparent that real output and the overall price level are not disturbed by money demand shocks under exchange rate, overall price level, or nominal income targeting. This is due to the money supply adjusting to maintain the target values, which in turn stabilises aggregate demand without changing the domestic interest rate or exchange rate. Therefore, the level of real output and the overall price level are unchanged.

In Table 2 one result is striking and deserves closer scrutiny. Under nominal income targeting the size of b_1 plays a pivotal role in stabilising the level of real output. The size of b_1

[13] The alternative method of evaluating policy rules is to use a representative household's utility function, an approach taken by Ireland (1998). Using this approach, he finds price level targeting outperforms nominal income targeting and money supply targeting.

[14] As we assume that the central bank hits the pre-determined target for the price level without fail, the distinction between price level targeting and inflation targeting becomes immaterial. See Rodseth (1996). For a comparison between price level and inflation targeting in a *dynamic* framework the reader is referred to Svensson (1999).

[15] One could argue that in the loss function the desired level of real output ought to vary in accordance with shocks to the real exchange rate or productivity. However, as the disturbances are temporary and as changing output is costly, we assume that the policymaker aims to hold the level of real output fixed.

[16] Though as an economy becomes more open, the inflationary bias decreases anyway, as noted by Hardouvelis (1992), and Guender and McCaw (1999).

reflects the sensitivity of output *supplied* to changes in the real exchange rate. In the event that $b_1 = 0$, nominal income targeting perfectly stabilises real output in the face of IS, UIP, and foreign price level disturbances. This is a standard result in models of the closed economy. Moreover, this result carries over to the open-economy framework provided that only *domestic* factors of production are combined to produce output. Once an intermediate input that is imported from abroad figures in the determination of output supplied, b_1 is greater than zero. As a consequence, output supplied becomes sensitive to changes in the real exchange rate. Open-economy models that ignore these exchange rate effects on aggregate supply thus tend to overestimate the ability of nominal income targeting to stabilise the level of real output (and the domestic price level) in the wake of IS, UIP, and foreign price shocks.

Otherwise, few concrete results emerge from comparing the coefficients of the shocks in either the output equation or the overall price level equation. Looking at Table 2 and abstracting from money supply targeting for the moment, we find that from the standpoint of output stabilisation nominal income targeting still dominates both exchange rate and overall price level targeting even if $b_1 > 0$ in the face of IS and UIP disturbances. In the case of an aggregate supply disturbance, exchange rate targeting insulates output better than overall price level targeting. No definitive rankings of the policy rules exist for foreign price level shocks.

By definition, overall price level targeting dominates both exchange rate and nominal income targeting from the standpoint of stabilising the overall price level. Again the size of b_1 is important. According to Table 3, the response of the overall price level under a strategy of nominal income targeting becomes more pronounced the greater the size of b_1 in the face of IS and UIP shocks. In contrast, the response of the overall price level becomes more muted under exchange rate targeting for IS and UIP shocks as b_1 increases in size. Larger values for b_1 cause larger displacements in the overall price level relative to target under both nominal

income targeting and exchange rate targeting in the face of foreign price shocks.[17]

By substituting the solutions for y_t and c_t into (12) for each policy rule, the loss function is evaluated. The expected values of the loss function for each stochastic shock are given in Table 4. Each row gives the coefficient on the variances of the stochastic disturbances that appear in the loss function.

A. Policy Frontiers

A quick glance at Table 4 will convince the reader that a straightforward ranking of the policy rules based on equation (12) is not immediately apparent. Further assumptions regarding the size of the parameters of the model have to be made.

Table 5 lists various studies that have estimated values for the demand-side elasticities a_1 and a_2. No reliable empirical estimates of the supply-side elasticities b_1 and b_2 are reported in the literature. A further unsettled issue concerns the size of A.[18]

To establish a ranking of the different policy rules, we proceed in the following way. For a given range of parameter values, we carry out pair-wise comparisons that pit nominal income targeting against one of the alternative rules. This is done sequentially for each stochastic shock that perturbs the economy. Each comparison involves establishing a particular combination of parameter values that results in the same value for the loss function for a specific stochastic shock. These combinations give rise to a policy frontier along which the two policy rules are equally preferred. The policy frontier divides the space of parameter values into regions where one policy rule is preferred to the other.

The assumptions initially made are that equal weights are attached to output and price level deviations in the loss function (A = 1) and that $a_2 = 0.2$ and $b_1 = 1$.[19] Table 6 provides a

[17] A similar response is evoked under both strategies by an increase in α, the weight on the foreign price level and the exchange rate in the overall price level. As α increases, the size of the coefficient on the foreign price shock increases. For the remaining disturbances, i.e. IS, AS, and UIP, an increase in α causes larger movements in the overall price level under nominal income targeting but smaller movements in the overall price level under exchange rate targeting.

[18] See Blinder (1997) for a discussion of the issues surrounding the determination of appropriate weightings.

[19] In considering the loss functions of money supply targeting, values for γ_1 and γ_2 must also be assumed. This paper assumes both to be 1, as estimated by Ghosh and Masson (1991). The effect of varying these parameters is the following, as noted by Froyen and Guender (2000). As γ_2 tends towards infinity, money supply targeting converges to exchange rate targeting for all shocks except UIP shocks. If γ_2 tends towards zero, then money

reasonable amount of evidence that a_2 is in the vicinity of 0.2.

In view of our objective to evaluate the performance of nominal income targeting relative to other monetary policy strategies in a small open economy framework, we have to discuss at greater length the meaning of *openness*. Furthermore, we have to clarify how we go about measuring varying degrees of openness. This is important as the outcome of the comparisons of the different monetary policy strategies depends on the degree of openness.

Typically openness in theoretical models is proxied by the weight (α) on the domestic currency price of the foreign good in a general price level such as the CPI. For instance, Romer (1995), Lane (1997), and Karras (1999) use α to denote the degree of openness of the economy. The greater α the more open the economy is thought to be.

Two different values of α are used to examine how a given policy frontier responds to an increase in the weight of the foreign price level and the exchange rate in the overall price level. Initially α is set at 0.1 to represent a fairly closed economy; then α is raised to 0.5 to represent a fairly open economy.[20] Throughout this exercise the value of b_1 remains fixed at 1. It is apparent though that the size of b_1 is very important in determining the performance of nominal income targeting vis-à-vis the other strategies. Recall from Table 2 that if b_1 equals zero, then nominal income targeting stabilises perfectly the level of real output and the domestic price level from IS shocks, UIP shocks, and foreign price level shocks.[21] Hence we also investigate to what extent the performance of nominal income targeting changes in our comparisons as the sensitivity of aggregate supply to the real exchange rate varies. With α being fixed at 0.5, values of b_1 are set at 0.5, 1, and 3 to investigate the behaviour of the policy rules.

The policy frontiers are drawn so as to compare exchange rate, overall price level, and money supply targeting to nominal income targeting. The attractiveness of nominal income

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supply targeting converges to nominal income targeting, except in the case of money demand shocks. If γ_2 equals zero, varying γ_1 would influence the slope and displacement of the aggregate demand schedule in the presence of shocks.

[20] Karras (1999) provides estimates for the ratio of imports to total consumption for various countries, which can be interpreted as measuring α. Based on this method, the value of α in the United States is approximately 0.1, while for the United Kingdom, Sweden, New Zealand and Finland it hovers between 0.35 and 0.5.

[21] Under (fixed) nominal income targeting, the domestic price level responds to a shock by the same amount as the level of real output albeit in the opposite direction. Hence the coefficients on the shocks in the equation for p and y are the same except for the sign.

targeting vis-à-vis the competing strategies is evaluated separately for each stochastic disturbance.

IS shock

Figures 1-6 illustrate the policy frontiers of comparing different policy rules to nominal income targeting under an IS shock. Figures 1-3 examine the properties of the policy frontiers by varying α while keeping b_1 fixed at 1. Figures 4-6 follow the same pattern except that b_1 is allowed to vary while α is fixed at 0.5.[22] All of the policy frontiers share the common characteristic of being downward sloping. As b_2 increases, a_1 must decrease for a particular policy rule to remain equally attractive to nominal income targeting. This trade-off is less pronounced as b_2 becomes larger, with a_1 decreasing at a decreasing rate. It is quite obvious that, all things equal, small parameter values detract from the appeal of nominal income targeting as the alternative strategies are preferred for combinations of the parameters that lie below the policy frontiers.

Increases in α also make nominal income targeting less appealing. This is evident in Figures 1-3. The areas where nominal income targeting is preferred decrease in size as α increases in size. With α increasing, $(1-\alpha)$, the weight on the domestic price level in the overall price level, decreases while the trade-off under nominal income targeting between the domestic price level and the level of real output remains fixed at one. With openness increasing, the attractiveness of nominal income targeting diminishes as it focuses solely on domestic variables, p and y. At the same time, due to the increase in α, displacements in the exchange rate take on greater significance and hence serve to aggravate the response of the overall price level relative to its target level.

Similarly, if the sensitivity of aggregate supply to real exchange rate movements increases, measured by an increase in b_1, the size of the relative areas where nominal income targeting is preferred is reduced. This is clearly a reflection of the fact that the stabilising properties of nominal incoming targeting for the domestic price level and the level of real

[22] We choose $b_1=1$ to ensure that changes in the real exchange rate have a noticeable effect on aggregate supply. Likewise we set $\alpha=0.5$ to ensure that changes in the price of foreign goods and the nominal exchange rate have a material effect on the overall price level.

output deteriorates as the size of b_1 increases. The monetary authorities' response to an IS shock leads to a change in the money supply, which in turn leads to a change in the nominal interest rate. The interest rate responds prompts the exchange rate to change. It is the latter change that induces the aggregate supply effect because it changes the cost of importing the intermediate input. The greater the size of b_1, the greater the displacement of the overall price level and real output from their desired levels in the loss function, and hence the more pronounced the losses under nominal income targeting.

LM Shock

From Tables 2 and 3 it is very clear that a money demand shock displaces the level of real output and the overall price level only if the money supply serves as the intermediate target. Under nominal income, overall price level, or exchange rate targeting, the money supply adjusts to offset completely the LM shock. If shocks to the economy are predominantly velocity shocks, money supply targeting will be dominated by any of the other three rules. This result is consistent with the demise of targeting a monetary aggregate in the early 1980s in the United States, at a time when velocity shocks became more common and more volatile.

AS Shock

The policy frontiers comparing overall price level, exchange rate, and money targeting to nominal income targeting under a supply shock are given in Figures 7-14. The policy frontiers can no longer be characterised by a simple curve. Rather, the parameter space is divided up by both a curve and a horizontal straight line in all but one illustration.

Comparing first nominal income targeting to the other targeting schemes for varying degrees of openness in Figures 7-11, we find that the shape of the policy frontier changes markedly as the size of α changes. Increases in the size of α now do not systematically detract from the appeal of nominal income targeting. It is also no longer true that all things equal combinations of low values for a_1 and b_2 automatically ensure the superiority of exchange

rate, overall price level, or money supply targeting over nominal income targeting.

In Figures 12-14 we vary the aggregate supply response parameter b_1. In all three comparisons there appears a straight horizontal line. This line gives the critical value for a_1 at which nominal income targeting and the respective alternative strategy for monetary policy are equally preferred regardless of the size of b_1. According to Figure 12, overall price level targeting dominates nominal income targeting for values of a_1 less 0.6 irrespective of the size of b_2. In contrast, the size of b_2 matters for values greater than 0.6, and the appeal of nominal income targeting diminishes as b_1 increases. From the comparisons involving exchange rate targeting and money supply targeting, depicted in Figures 13 and 14, no definitive conclusions emerge. Notice though that nominal income targeting becomes more attractive as the size of b_1 increases provided that a_1 is less than the respective critical value.

UIP Shock (or Foreign Interest Rate Shock)

A UIP shock, like a change in the risk premium or a sudden change in the foreign interest rate, is transmitted into the small open economy model through changes in the domestic interest rate, which enters the IS equation. This fact is reflected in Tables 2 and 3, where for nominal income, overall price level, and exchange rate targeting, the coefficients on output and the overall price level for a UIP shock are identical to the coefficients for an IS shock, except that the UIP shock coefficient is multiplied by $-a_1$.

However, a UIP shock has a very different impact on output and the overall price level compared to an IS shock under money supply targeting. Under the latter strategy, a UIP shock causes the exchange rate to depreciate, which, combined with upward pressure on the domestic price level as a consequence of rising aggregate demand and declining aggregate supply, induces the overall price level to increase. The overall effect of a UIP shock on output is uncertain, as aggregate demand and aggregate supply move in opposite directions in the wake of a UIP shock under money supply targeting.[23]

[23] In general, under money supply targeting, the coefficients on the shocks in the equations for output and the overall price level become more complex as they also depend on γ_1 and γ_2, the parameters of the money demand function. Neither parameter figures in the determination of the coefficients on the shocks under nominal income, price level, or exchange rate targeting as a result of λ_1 tending towards infinity. The money demand parameters

The policy frontiers for a UIP shock appear in Figures 15-20. While the attractiveness of overall price level targeting vis-à-vis nominal income targeting clearly improves with α increasing in size, as seen in Figure 15, the comparisons of exchange rate and money supply targeting with nominal income targeting yield far less definitive results. The complex shape of the policy frontier in Figure 16 for different values of α illustrates the fact that the relative attractiveness of exchange rate and nominal income targeting depends very much on the size of a_1 and b_2. Figure 17 shows that money supply targeting improves vis-à-vis nominal income targeting as the size of α increases from 0.1 to 0.5. Nevertheless, for money supply targeting to be preferred to nominal income targeting when $\alpha = 0.5$, a_1 must be rather large.

The results that emerge from the analysis of the strategies for monetary policy when b_1 is allowed to vary while α is kept fixed are shown in Figures 18-20. The comparisons of nominal income targeting to overall price level targeting and exchange rate targeting, depicted in Figure 18 and 19, respectively, reveal that the attractiveness of nominal income targeting diminishes as the size of $b_1$increases from 0.5 to 1, and finally to 3 as either the policy frontiers shift upward or downward. Just the opposite conclusion holds in the comparison of nominal income targeting to money supply targeting. According to Figure 20, an increase in the size of b_1 serves to enhance the appeal of nominal income targeting. Notice that in Figures 19 and 20 nominal income targeting is preferred in two areas of the parameter space: for combinations of small values of a_1 and b_2 that lie in an area close to the origin and for combinations of rather large values of a_1 and b_2 in the centre or the top right-hand corner of the respective figure. In sharp contrast, nominal income targeting is preferred only for combinations of a_1 and b_2 that lie in the area above the policy frontier if the alternative strategy is overall price level targeting, as illustrated in Figure 18.

Foreign Price Shock

Figures 21 and 22 give the pair of policy frontiers that are based on the comparisons of nominal income targeting with exchange rate targeting for a foreign price shock. There are

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then become irrelevant to the analysis. Not so under money supply targeting, when λ is set equal to zero.

only two policy frontiers to consider, as the losses sustained under overall price level and money supply targeting, respectively, vis-a-vis nominal income targeting for a foreign price shock are the same as for a UIP shock.

It is evident from inspection of Figure 21 that the performance of exchange rate targeting becomes more favourable relative to nominal income targeting as α increases from 0.1 to 0.5. A more complex result obtains when b_1 is allowed to vary. According to Figure 22, both the upper and the lower portions of the policy frontier shift up as b_1 increases in size. Thus increases in the value of b_1 do not necessarily imply that exchange rate targeting becomes more attractive relative to nominal income targeting. Instead, the size of a_1 is of critical importance. For relatively small values of a_1, increases in b_1 make nominal income targeting more attractive. For larger and a much broader range of values for a_1, however, exchange rate targeting becomes superior to nominal income targeting as the size of b_1 increases.[24,25]

B. Ranking the Rules

Having studied the properties of nominal income targeting and the competing strategies for monetary policy in the context of a small open economy framework, we now have to make an attempt at ranking the policy rules. Based on the pair-wise comparisons presented in part A of this section, we find the case for nominal income targeting less compelling in a small open economy. Indeed, a case can be made that overall price level targeting has better stabilizing properties than nominal income targeting in a small open economy.

The argument in favour of targeting the general price level instead of nominal income derives from two sources. Firstly, for small parameter values (i.e. for a_1, b_2) overall price level targeting tends to dominate nominal income targeting. All the parameter estimates reported in

[24] Inspection of the coefficients on the foreign price shock in Table 3 reveals that if a_1 is small, increases in b_1 result in a much more pronounced effect on the overall price level under exchange rate compared to nominal income targeting.

[25] Notice the stark contrast between Figures Figure 19 and Figure 22. In the former, nominal income targeting becomes less attractive compared to exchange rate targeting as b_1 becomes larger. The area between the two policy frontiers where exchange rate targeting is preferred increases in size as b_1 rises from .5 to 3.

Table 5, especially the estimated values for a_1, are indeed rather small. All of them are less than one, which in view of the location and shape of the policy frontiers, generally favours overall price level targeting over nominal income targeting. The apparent dominance of overall price level targeting applies to all disturbances except perhaps aggregate supply disturbances. Secondly, as the foreign price level and the exchange rate take on a greater weight in the overall price level, a strategy targeting the overall price level becomes more attractive relative to nominal income targeting. The same can be said for increases in the size of b_1: as the elasticity of output supplied with respect to the real exchange rate increases, the case for overall price level targeting becomes stronger.

Less definitive results emerge from the comparisons that evaluate the performance of nominal income targeting against exchange rate and money supply targeting. The relative size of the parameters, either alone or in combination with other parameters, takes on much greater significance. In addition, the source of the disturbance becomes a far more important criterion in judging the performance of a given policy strategy. As a consequence, the comparisons involving nominal income targeting and exchange rate or money supply targeting produce no clear-cut results which would suggest that nominal income targeting systematically outperforms the other two strategies.

Despite this ambiguity, certain properties of the strategies do stand out and hence deserve mentioning. For IS disturbances, increases in α and b_1 make exchange rate and money supply targeting more attractive relative to nominal income targeting. But nominal income targeting appears to dominate money supply targeting for reasonable parameter values even as the values for α and $b_1$increase in the wake of a UIP shock. Nominal income targeting also seems to dominate exchange rate targeting for a given foreign price shock, especially for small values of a_1, but its attractiveness wanes as α, the proxy for openness, increases in size.[26, 27]

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[26] We have also examined the properties of the different policy rules under a different specification of the loss function. Instead of using equation (12) where the overall price level is an argument in the loss function, we employed a loss function where only domestic variables matter. More specifically, we specified the loss function as

$$L_t = A\, p_t^2 + (y_t - y^*)^2 + B\, x_t^2$$

The values of A and B are assumed to be 1. In sharp contrast to equation (12), this alternative loss function does

C. Inflation Targeting in Practice

A number of countries are currently engaged in targeting inflation explicitly. According to Table 1, the CPI serves as the underlying measure of inflation in all but one country.[28] Yet, there are subtle differences in the way inflation targeting is carried out in these countries. These differences range from the methods used to calculate the CPI to the circumstances under which the inflation target may be breached. Contingencies for breaching the inflation target include items such as indirect taxes, food and energy prices, and mortgage interest. For instance, New Zealand targets a measure of the CPI excluding credit services, commodity prices, and government-controlled prices, while Canada excludes food, energy, and the effect of indirect taxes in the calculation of the relevant CPI.

Several of these contingencies are essentially supply-side considerations. In this paper, we have seen that overall price level targeting performs better than a nominal income rule in a small open economy for all stochastic shocks, apart perhaps from supply shocks where more information is needed on the size of the structural parameters. If a central bank, which has a mandate to target inflation explicitly, is not held accountable for missing the inflation target in the wake of a supply shock, then a big potential disadvantage concerning overall price level targeting will be eliminated. A strategy to target the overall price level will then prove to be even more appealing.

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not automatically adjust the weighting on the exchange rate and foreign prices that appear in the overall price level. The results based on the alternative loss function weakens the case for nominal income targeting even more, particularly for IS, AS, and UIP disturbances. It is only for a foreign price shock that the policy frontiers based on the two different loss functions differ markedly. For instance, comparing price level targeting to nominal income targeting based on the loss function that appears in equation (12), we find that if a_1 takes on a value of less than one, overall price level targeting was preferred to nominal income targeting. However, under the alternative loss function, nominal income targeting is preferred if a_1 is less than one, regardless of the value of b_2. Analysing the merits of money supply or exchange rate targeting strategies vis-à-vis nominal income targeting by means of policy frontiers for a foreign price shock is also more complicated under the alternative loss function. The findings based on the alternative loss function appear in the appendix to the paper and are available from the authors upon request.

[27] Other factors, specifically the advantages and disadvantages of following each specific monetary policy rule, need to be considered. For example, it is generally accepted that exchange rate targeting goes hand in hand with giving up control over an independent course for monetary policy and, given unfavourable circumstances, may provoke speculative attacks on the currency. Money supply targeting relies on a strong relationship between the goal variable and the measure of money. Inflation targeting allows for an independent monetary policy but may be unstable under prolonged supply shocks.

[28] The Retail Price Index targeted in the United Kingdom also includes the prices of foreign goods.

V. Concluding Remarks

This paper has compared the stabilising properties of nominal income targeting to those of other strategies of monetary policy in a stochastic macro model for a small open economy. We find that the choice of the preferred policy rule depends on the source of uncertainty and the size of the parameters of the model, a standard result in the literature on monetary policy under uncertainty, which goes back to Poole (1970).

In view of the difficulty in ranking the policy rules a priori, we evaluate the attractiveness of nominal income targeting vis-à-vis the alternative policy rules with the help of policy frontiers. We find that overall price level targeting may be preferable for a small open economy. This conclusion emerges after

i. studying the effects on the performance of competing policy rules of the various disturbances that strike a small open economy and

ii. assessing the effects on the performance of the competing policy rules of changes in the size of parameters deemed important in small open economies: the weight on the domestic currency price of imported goods in the overall price level and the elasticity of output supplied with respect to the real exchange rate.

Taken altogether, the findings reported in this paper imply that the theoretical case for nominal income targeting is weaker within the framework of a small open economy. The benefits of domestic price and output stabilisation are offset by the cost of the displacement of the exchange rate in achieving stability in output and the general price level. Coupled with practical implementation problems and transparency issues, the notion that nominal income targeting would prove to be the preferred policy for a small open economy is questionable.

Table 1: The Basic Ingredients of Inflation Targets

Country	Inflation Objective	Index Targeted	Contingencies for Breaches of the Target
Australia	2-3%	CPI	Mortgage interest Government controlled prices Energy prices
Canada	1-3%	CPI	Indirect taxes Food and energy prices
Finland	2%	CPI	Housing capital costs Indirect taxes Government subsidies
New Zealand	0-3%	CPI	Commodity Prices Government controlled prices Interest, credit charges
Spain	2%	CPI	Mortgage interest
Sweden	1-3%	CPI	Conditional on indirect taxes, subsidies
United Kingdom	2.5%	Retail Price Index	Mortgage interest

Source: Siklos, Pierre, (1998)

Table 2: Coefficients for the Output Equation

Shock	Exchange Rate Target $\lambda_1 \to \infty$	Overall Price Level Target $\lambda_2 \to \infty$	Nominal Income Target $\lambda_3 \to \infty$	Money Supply Target $\lambda_i \to 0$
IS (v_{1t})	$\frac{b_1+b_2}{b_1+b_2+a_1(1-\alpha)+a_2}$	$\frac{b_2\alpha+b_1}{b_1+b_2\alpha+a_1(1-\alpha)+a_2}$	$\frac{b_1}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{b_1\gamma_2+b_2\gamma_2+b_1+b_2\alpha(1-\gamma_1)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
LM (v_{2t})	0	0	0	$\frac{-b_2(a_1(1-\alpha)+a_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
AS (u_t)	$\frac{a_1(1-\alpha)+a_2}{b_1+b_2+a_1(1-\alpha)+a_2}$	$\frac{a_1(1-\alpha)+a_2}{b_1+b_2\alpha+a_1(1-\alpha)+a_2}$	$\frac{a_1(1-\alpha)+a_2}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{(1+\gamma_2)(a_1(1-\alpha)+a_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
UIP (ε_t or r_t^f)	$\frac{-a_1(b_1+b_2)}{b_1+b_2+a_1(1-\alpha)+a_2}$	$\frac{-a_1(b_2\alpha+b_1)}{b_1+b_2\alpha+a_1(1-\alpha)+a_2}$	$\frac{-a_1b_1}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{\gamma_2(b_2a_2-a_1b_1)-a_1\alpha b_2(1-\gamma_1+\gamma_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
FP (p_t^f)	$\frac{b_2(a_2-a_1\alpha)-b_1a_1}{b_1+b_2+a_1(1-\alpha)+a_2}$	$\frac{-a_1(b_2\alpha+b_1)}{b_1+b_2\alpha+a_1(1-\alpha)+a_2}$	$\frac{-a_1b_1}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{\gamma_2(b_2a_2-a_1b_1)-a_1b_1-a_1\alpha b_2(1-\gamma_1+\gamma_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$

Table 3: Coefficients for the Overall Price Level Equation

Shock	Exchange Rate Target $\lambda_1 \to \infty$	Overall Price Level Target $\lambda_2 \to \infty$	Nominal Income Target $\lambda_3 \to \infty$	Money Supply Target $\lambda_i \to 0$
IS (v_{1t})	$\frac{1-\alpha}{b_1+b_2+a_1(1-\alpha)+a_2}$	0	$\frac{b_1+\alpha(1+b_2)}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{\gamma_2(1-\alpha)-\gamma_1\alpha(1+b_2)-b_1\gamma_1}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
LM (v_{2t})	0	0	0	$\frac{-(a_1+a_2+b_1)+\alpha(a_1-b_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
AS (u_t)	$\frac{-(1-\alpha)}{b_1+b_2+a_1(1-\alpha)+a_2}$	0	$\frac{\alpha-(a_1(1-\alpha)+a_2)}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{-\gamma_2(1-\alpha)-\gamma_1(a_1+a_2-(1+a_1)\alpha)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
UIP (ε_t or r_t^f)	$\frac{-a_1(1-\alpha)}{b_1+b_2+a_1(1-\alpha)+a_2}$	0	$\frac{a_1b_1+\alpha a_1(1+b_2)}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{\gamma_2(a_2+b_1)+a_1b_1\gamma_1+\alpha(a_1\gamma_1+(a_1y_1+\gamma_2)b_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$
FP (p_t^f)	$\frac{a_2+b_1+\alpha b_2}{b_1+b_2+a_1(1-\alpha)+a_2}$	0	$\frac{a_1b_1+\alpha a_1(1+b_2)}{b_1+(1+b_2)(a_1(1-\alpha)+a_2)}$	$\frac{\gamma_2(a_2+b_1)+a_1b_1\gamma_1+\alpha(a_1\gamma_1+(a_1y_1+\gamma_2)b_2)}{b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1)}$

Table 4: Coefficients of the Expected Loss Functions

Shock	Exchange Rate Target	Overall Price Level Target	Nominal Income Target
IS (v_{1t})	$\frac{A(1-\alpha)^2+(b_1+b_2)^2}{(b_1+b_2+a_1(1-\alpha)+a_2)^2}$	$\frac{(\alpha\ b_2+b_1)^2}{(b_1+b_2\alpha+a_1(1-\alpha)+a_2)^2}$	$\frac{A(b_1+\alpha(1+b_2))^2+b_1^2}{(b_1+(1+b_2)(a_1(1-\alpha)+a_2))^2}$
LM (v_{2t})	0	0	0
AS (u_t)	$\frac{A(1-\alpha)^2+(a_1(1-\alpha)+a_2)^2}{(b_1+b_2+a_1(1-\alpha)+a_2)^2}$	$\frac{(a_1(1-\alpha)+a_2)^2}{(b_1+b_2\alpha+a_1(1-\alpha)+a_2)^2}$	$\frac{A(\alpha-(a_1(1-\alpha)+a_2))^2+(a_1(1-\alpha)+a_2)^2}{(b_1+(1+b_2)(a_1(1-\alpha)+a_2))^2}$
UIP (ε_t or r_t^f)	$\frac{A(1-\alpha)^2a_1^2+a_1^2(b_1+b_2)^2}{(b_1+b_2+a_1(1-\alpha)+a_2)^2}$	$\frac{a_1^2(\alpha\ b_2+b_1)^2}{(b_1+b_2\alpha+a_1(1-\alpha)+a_2)^2}$	$\frac{A(a_1b_1+\alpha a_1(1+b_2))^2+a_1^2b_1^2}{(b_1+(1+b_2)(a_1(1-\alpha)+a_2))^2}$
FP (p_t^f)	$\frac{A(b_1+a_2+\alpha b_2)^2+(b_2(a_2-a_1\alpha)-b_1a_1)^2}{(b_1+b_2+a_1(1-\alpha)+a_2)^2}$	$\frac{a_1^2(\alpha\ b_2+b_1)^2}{(b_1+b_2\alpha+a_1(1-\alpha)+a_2)^2}$	$\frac{A(a_1b_1+\alpha a_1(1+b_2))^2+a_1^2b_1^2}{(b_1+(1+b_2)(a_1(1-\alpha)+a_2))^2}$

Table 4 cont.
Coefficients of the Expected Loss Functions

	Money Supply Target
IS (v_{1t})	$\frac{A(\gamma_2(1-\alpha)-\gamma_1\alpha(1+b_2)-b_1\gamma_1)^2+(b_1\gamma_2+b_2\gamma_2+b_1+b_2\alpha(1-\gamma_1))^2}{(b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1))^2}$
LM (v_{2t})	$\frac{A(b_1+\alpha b_2+(a_1(1-\alpha)+a_2))^2+(b_2(a_1(1-\alpha)+a_2))^2}{(b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1))^2}$
AS (u_t)	$\frac{A(\gamma_2(1-\alpha)+\gamma_1(a_1+a_2-(1+a_1)\alpha))^2+(1+\gamma_2)^2(a_1(1-\alpha)+a_2)^2}{(b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1))^2}$
UIP (ε_t or r_t^f)	$\frac{A(\gamma_2(a_2+b_1)+a_1b_1\gamma_1+\alpha(a_1\gamma_1+(a_1\gamma_1+\gamma_2)b_2))^2+(\gamma_2(b_2a_2-a_1b_1)-a_1b_1-a_1\alpha b_2(1-\gamma_1+\gamma_2))^2}{(b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1))^2}$
FP (p_t^f)	$\frac{A(\gamma_2(a_2+b_1)+a_1b_1\gamma_1+\alpha(a_1\gamma_1+(a_1\gamma_1+\gamma_2)b_2))^2+(\gamma_2(b_2a_2-a_1b_1)-a_1b_1-a_1\alpha b_2(1-\gamma_1+\gamma_2))^2}{(b_2(\gamma_1(a_1(1-\alpha)+a_2)+\gamma_2+\alpha(1-\gamma_1))+(1+\gamma_2)(a_1(1-\alpha)+a_2+b_1))^2}$

Table 5: Empirical Estimates of Parameters of the Model

Author(s)	Country	a_1	a_2
Ericsson et al (1997)	Canada	0.648	0.181
	New Zealand	0.155	0.089
	Norway	0.349	0.163
	Sweden	0.154	0.076
Nadal-De Simone et al (1995)	New Zealand	0.03	0.52
Duguay (1994)	Canada	0.77	0.2
Alexis (1993)	Sweden	0.5	0.2
Ghosh and Masson (1991)	World excluding USA	0.378	0.167

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Policy Frontiers for IS Shocks - Varying α
For a_2=0.2, b_1=1, A=1

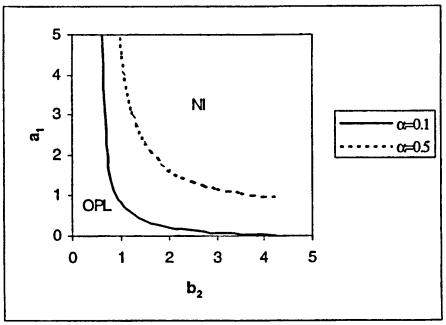

Figure 1: Overall Price Level Targeting

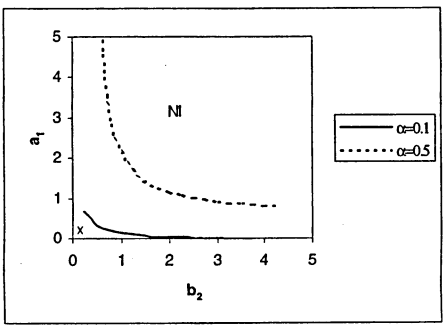

Figure 2: Exchange Rate Targeting

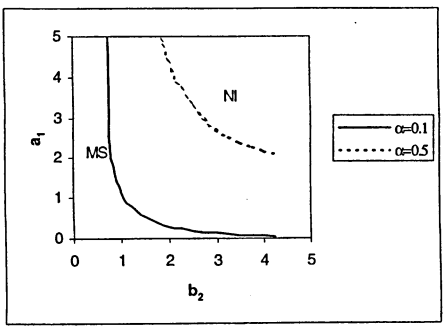

Figure 3: Money Supply Targeting

Policy Frontiers for IS Shocks - Varying b_1
For a_2=0.2, α=0.5, A=1

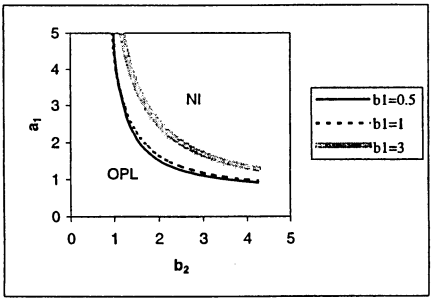

Figure 4: Overall Price Level Targeting

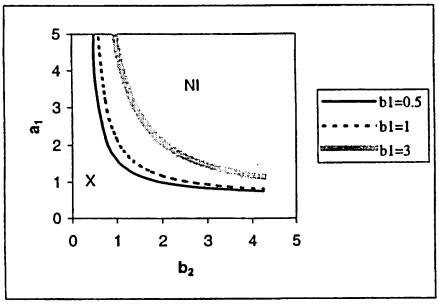

Figure 5: Exchange Rate Targeting

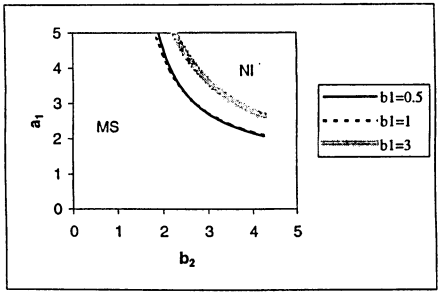

Figure 6: Money Supply Targeting

Policy Frontiers for AS Shocks - Varying α
For a_2=0.2, b_1=1, A=1

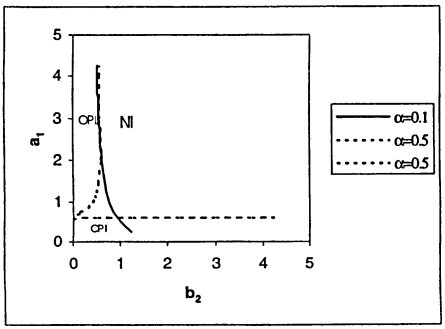

Figure 7: Overall Price Level Targeting

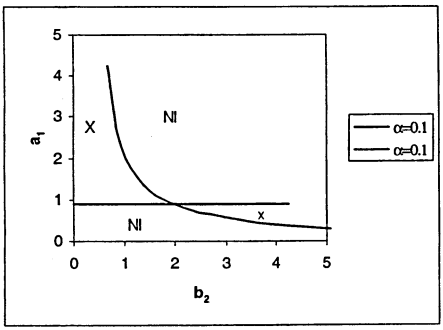

Figure 8: Exchange Rate Targeting, α=0.1

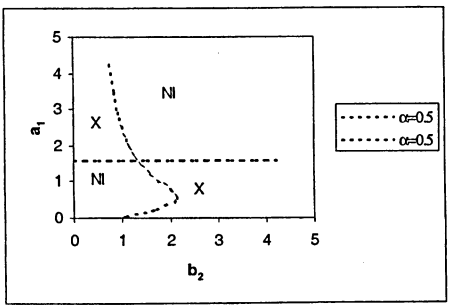

Figure 9: Exchange Rate Targeting, α=0.5

Policy Frontiers for AS Shocks - Varying α
For a_2=0.2, b_1=1, A=1

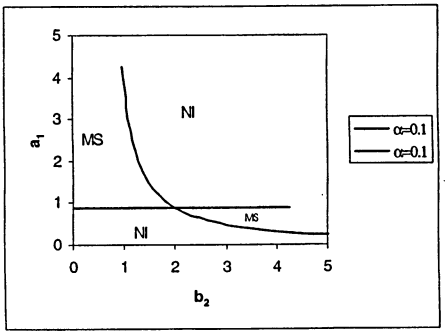

Figure 10: Money Supply Targeting, α=0.1

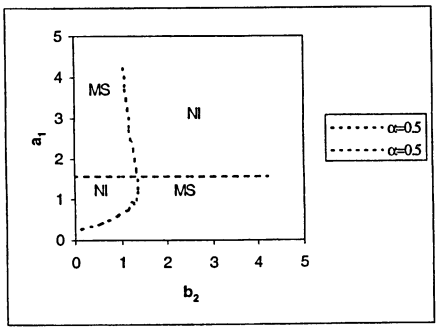

Figure 11: Money Supply Targeting, α=0.5

Policy Frontiers for AS Shocks - Varying b_1
For a_2=0.2, α=0.5, A=1

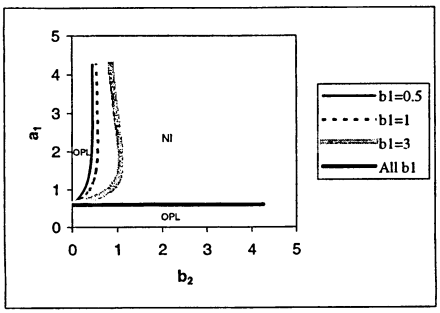

Figure 12: Overall Price Level Targeting

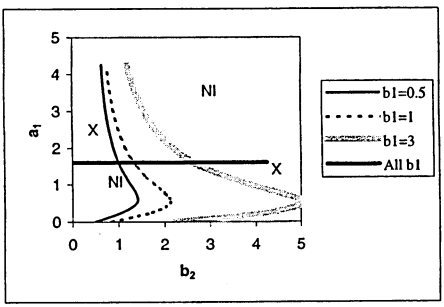

Figure 13: Exchange Rate Targeting

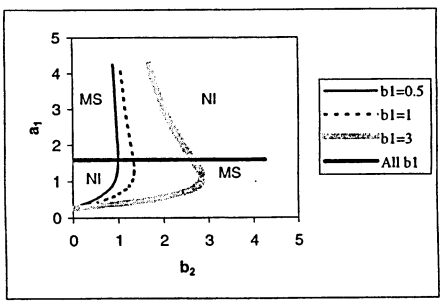

Figure 14: Money Supply Targeting

Policy Frontiers for UIP Shocks - Varying α
For a_2=0.2, b_1=1, A=1

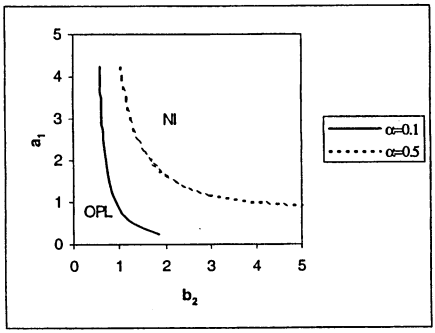

Figure 15: Overall Price Level Targeting

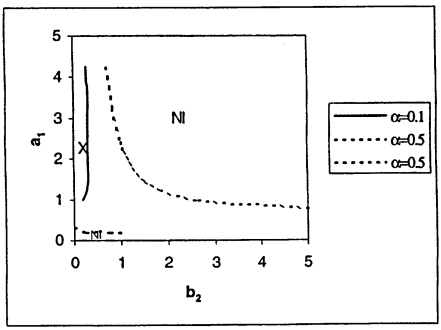

Figure 16: Exchange Rate Targeting

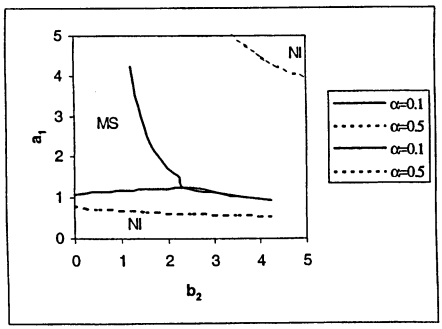

Figure 17: Money Supply Targeting

Policy Frontiers for UIP Shocks - Varying b_1
For a_2=0.2, α=0.5, A=1

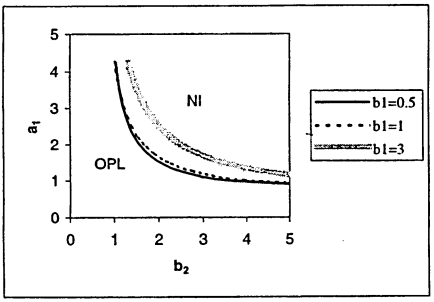

Figure 18: Overall Price Level Targeting

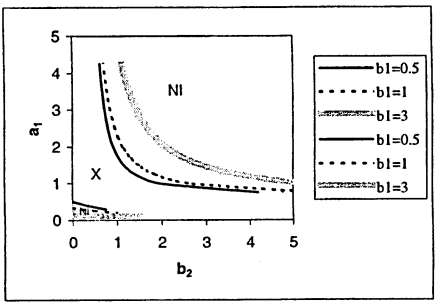

Figure 19: Exchange Rate Targeting

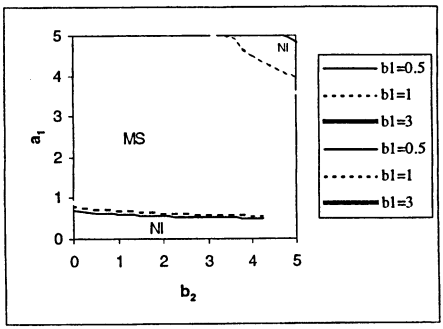

Figure 20: Money Supply Targeting

Policy Frontiers for FP Shocks - Varying α

For a_2=0.2, b_1=1, A=1

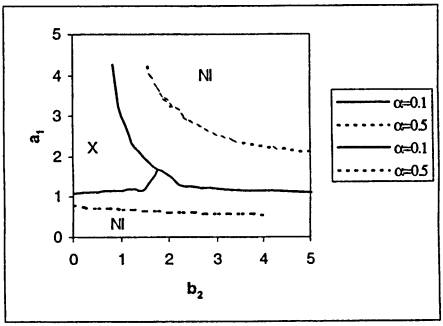

Figure 21: Exchange Rate Targeting

Policy Frontiers for FP Shocks - Varying b_1

For a_2=0.2, α=0.5, A=1

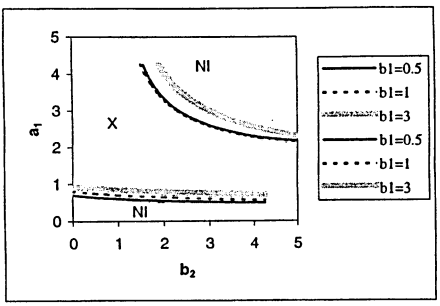

Figure 22: Exchange Rate Targeting

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