

# POLICY RULES AND EXTERNAL SHOCKS

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The decade since 1990 has been a period of innovation in monetary policy. Around the world, many countries have adopted inflation targeting as their basic policy framework. Different countries have tried different techniques for achieving inflation targets, such as different choices of policy instruments. Most central banks use a short-term interest rate as their instrument, but some have experimented with monetary conditions indexes, which are based on both interest rates and exchange rates. A rapidly growing literature discusses the merits of these different approaches to policy.

Most recent research on monetary policy rules uses models of closed economies. In the real world, however, open-economy issues such as the behavior of exchange rates are central to monetary policy. The experience of the world economy since 1997 has reminded us of this fact. The major macroeconomic shocks hitting many countries have been external, originating in the Asian and Russian financial crises. Industrial countries such as Australia and New Zealand as well as developing countries such as Brazil and Chile have been buffeted by shifts in exchange rates, exports, and world commodity prices. Policy rules developed for closed economies are inadequate for responding to such shocks.

This paper discusses policy rules for open economies, and especially the appropriate responses to large external shocks. The starting point for my analysis is my previous theoretical work on open-economy policy rules (Ball, 1999). But I conclude that some of the analysis in that paper must be modified in light of recent events. I address several specific questions about policy rules. First, what

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variable should policymakers target? Closed-economy models support the practice of inflation targeting, but I argue that the target variable should be modified for open economies. Specifically, the inflation measure that is targeted should be adjusted to remove the transitory effects of exchange rate movements.

Second, what kind of reaction function should policymakers use to set policy instruments? Closed-economy models support the use of Taylor rules relating interest rates to inflation and output. In open economies such rules must be modified to give a role to the exchange rate.

Finally, what should policymakers use as their instrument? In other words, what variable should be on the left-hand side of the policy rule? I focus on the choice between an interest rate and a monetary conditions index. I examine this choice theoretically and use the results to interpret the recent experiences of countries that have used different instruments.

## 1. A SIMPLE MODEL

I base the analysis on my 1999 model and extensions of it. I therefore begin by summarizing the model, which is intended to capture the key interactions of macroeconomic variables. There are three equations:

$$y = \lambda y_{-1} - \beta U_1 - \delta H_1 + \varepsilon , \quad (1)$$

$$\pi = \pi_{-1} + \alpha y_{-1} - \gamma (H_1 - H_2) + \eta , \quad (2)$$

$$e = \theta r + v , \quad (3)$$

where  $y$  is output,  $\pi$  is inflation,  $r$  is the real interest rate,  $e$  is the real exchange rate (defined such that a higher  $e$  means an appreciation), and  $\varepsilon$ ,  $\eta$ , and  $v$  are shocks. All variables are defined as deviations from equilibrium levels, and all coefficients are positive.

Equation (1) is an open-economy IS curve. Output is decreasing in the real interest rate and the real exchange rate and depends on lagged output and a demand shock. Equation (2) is an open-economy, accelerationist Phillips curve. The change in inflation depends on output and the change in the real exchange rate, which affects inflation

through import prices. Equations (1) and (2) include time lags: it takes one period for interest rates and exchange rates to affect output, and it takes output and exchange rate changes one period to affect inflation.

Finally, equation (3) posits a positive relation between interest rates and exchange rates. The idea behind this equation is that higher interest rates encourage capital inflows, which lead to an appreciation. Other determinants of exchange rates, such as investor confidence and expectations, are captured by the error term  $v$ . Obviously equation (3) is at best a simple reduced form. Later I derive this equation from somewhat deeper foundations; this proves important for comparing alternative policy instruments.

## 2. WHAT VARIABLE SHOULD POLICYMAKERS TARGET?

There is a growing consensus worldwide that monetary policymakers should target inflation. More and more countries are adopting inflation targets, and recent theoretical research suggests that this policy is effective at stabilizing both inflation and output. However, many of the arguments for inflation targeting assume a closed economy either explicitly or implicitly. In open economies, inflation targeting is suboptimal unless it is modified in an important way.

My 1999 paper argues that policymakers should target “long-run inflation,” a measure of inflation that filters out the transitory effects of exchange rate fluctuations. In the notation of my model, this variable is defined as

$$\pi^* = \pi + \gamma e_{-1} \quad , \quad (4)$$

where again  $e$  is the real exchange rate and  $\gamma$  is the coefficient on the change in the real exchange rate in the Phillips curve. Using the model in equations (1) through (3), I show that targeting  $\pi^*$  leads to stable output and stable inflation. In contrast, targeting ordinary inflation,  $\pi$ , keeps inflation stable but produces much more output variability than is necessary.

Rather than repeat the formal derivation of these results, I will discuss the intuition of what the variable  $\pi^*$  measures and why it is a good target for policy. This variable can be interpreted as the level of inflation adjusted for the temporary effects of exchange rates. In the definition of  $\pi^*$ ,  $e$  is the deviation of the exchange rate from its

equilibrium level. If  $e_{-1}$  is positive, for example, the exchange rate has risen above its long-run level in the previous period. From the Phillips curve, this appreciation has directly reduced inflation by  $\gamma e_{-1}$ . Thus  $\pi^*$  is what inflation would be now if there had not been this direct exchange rate effect.

The variable  $\pi^*$  also tells us about the future path of inflation. If  $e_{-1}$  is above its equilibrium level, then at some point, either in the current period or in the future, it must fall by an amount  $e_{-1}$ . At this point the disinflationary effects of the appreciation will be reversed, and inflation will rise by  $\gamma e_{-1}$ . Thus  $\pi^*$  tells us where inflation will go in the long run. (More precisely,  $\pi^*$  is the level that inflation will approach if the output gap is held at zero. Inflation can go anywhere, of course, if there are large enough rises or falls in output.)

There are two reasons why it is better to target long-run inflation,  $\pi^*$ , than ordinary inflation,  $\pi$ . First, targeting  $\pi^*$  means that policy does not induce output contractions unless they are essential for long-run inflation stability. Increases in inflation often leave policymakers with a nasty job to do. Given the inertia in inflation, increases that arise when the economy overheats or there is an adverse supply shock will persist indefinitely if policy is accommodative. To prevent inflation from wandering away from its target, policymakers must tighten policy and slow down the economy. In an open economy, however, there is an exception to this rule: policy need not tighten to offset inflation rises to the extent they are caused by temporary exchange rate depreciation. Tightening is then not necessary because, as discussed above, the inflationary effects of exchange rate movements will eventually reverse themselves. Targeting  $\pi^*$  rather than  $\pi$  means that policymakers tighten only when there is an inflation increase that would otherwise be permanent. This approach allows some short-run volatility in inflation, but it keeps inflation stable over the longer run and greatly reduces output variability.

There is a second reason for targeting long-run inflation rather than current inflation. In open economies, a danger with pure inflation targeting is that policymakers will move exchange rates too aggressively to control inflation. The effect of exchange rates on import prices is the fastest channel from monetary policy to inflation, faster than the channel through speedups or slowdowns in output. As a result, if policymakers are given a mandate to keep inflation as close as possible to its target, they may respond by moving exchange rates aggressively to offset inflation movements. This in turn requires large

shifts in interest rates. The problem with large interest rate and exchange rate movements is that they cause large fluctuations in output. Targeting  $\pi^*$  rather than  $\pi$  avoids this problem and therefore keeps output more stable. By construction,  $\pi^*$  is unaffected by temporary exchange rate movements, so  $\pi^*$  targeters have no incentive to move exchange rates aggressively.

Targeting  $\pi^*$  means that it is important for policymakers to distinguish temporary from permanent shifts in exchange rates. So far my discussion has focused on deviations of the exchange rate from its long-run equilibrium—that is, on temporary changes. Policymakers can safely ignore the direct inflationary effects of these fluctuations. Exchange rates can also change, however, because fundamentals shift, changing the long-run equilibrium. Recall that the variable  $e$  is defined as the deviation of the exchange rate from its long-run level. If the actual exchange rate falls but the long-run equilibrium exchange rate falls by the same amount,  $e$  does not change. This implies that long-run inflation  $\pi^*$  rises by as much as actual inflation  $\pi$ . In this case policymakers cannot accommodate any of the increase in inflation; instead they must tighten policy and reduce output. Since the fall in the exchange rate reflects a change in fundamentals, it is not likely to be reversed in the future. There will be no disinflationary appreciation to take the place of a policy tightening.

Of course, it is not easy in practice to tell whether a change in exchange rates is permanent or temporary. To put it differently, it is not easy to measure the long-run equilibrium exchange rate. A disadvantage of  $\pi^*$  targeting is that it requires policymakers to estimate this unknown parameter. It also requires an estimate of the parameter  $\gamma$  in the Phillips curve. In contrast, pure inflation targeting is relatively easy to carry out, because measuring ordinary inflation does not require knowledge of equilibrium exchange rates or Phillips curve parameters. Defenders of pure inflation targeting can argue that moving to  $\pi^*$  targeting would reduce the simplicity and transparency of policy.

An important question for future research is whether the practice of  $\pi^*$  targeting can be simplified. Perhaps there is some target variable that is easier to measure than  $\pi^*$  but still avoids the problems with pure inflation targeting. One such variable mentioned by a number of authors is the inflation rate for prices of domestically produced goods. Targeting this inflation rate is not identical to targeting  $\pi^*$ , but it may be a good approximation: temporary exchange rate fluctuations have little direct effect on domestic price inflation.

And one can compute inflation in domestic goods prices without estimating the parameters in the  $\pi^*$  formula.

### 3. WHAT POLICY RULE?

Once policymakers have chosen a variable to target, they must also choose a strategy for meeting the target. Many economists advocate the use of a Taylor rule for adjusting short-term interest rates. Under this approach, a central bank raises interest rates when inflation rises above its target, or when output rises above its long-run level, and reduces interest rates in the opposite cases. The idea is that “leaning against the wind” in this way will keep output and inflation as stable as possible. So far no central bank has adopted a Taylor rule as a formal policy, but the data suggest that many move interest rates in a way that mimics such a rule.

The case for Taylor rules, like the case for inflation targets, is strong if one assumes a closed economy. But once again, the rule must be modified to account for openness. In particular, the Taylor rule must be extended to give a role to the exchange rate—a variable of central importance to policymakers that the basic Taylor rule ignores.

The model in equations (1) to (3) implies that a specific modification of the Taylor rule is desirable. Formally, the modified rule minimizes a weighted sum of the variances of output and inflation. The new rule is

$$\omega r + (1 - \omega)e = ay + b\pi^* . \quad (5)$$

This equation differs from the usual Taylor rule in two ways. First, on the right-hand side, inflation ( $\pi$ ) is replaced by long-run inflation ( $\pi^*$ ). This result is unsurprising given the earlier result that  $\pi^*$  is a better target variable than  $\pi$ .

Second, the variable on the left-hand side is no longer the interest rate, as in the basic Taylor rule. Instead, it is a weighted average of the interest rate and the exchange rate. Such an average is known as a monetary conditions index (MCI). The weights  $\omega$  and  $1 - \omega$  are roughly proportional to the effects of  $r$  and  $e$ , respectively, on aggregate spending—the coefficients  $\beta$  and  $\delta$  in the IS equation. For a number of small, open economies, this means weights in the neighborhood of 0.75 on the interest rate and 0.25 on the exchange rate.

The intuition for putting an MCI in the policy rule is straightforward. In the underlying macro model, monetary policy affects spending through both the interest rate and the exchange rate. The overall stimulus to spending depends on the average of these two variables, with weights given by the IS coefficients. Since this average measures the overall stance of policy, it is the variable that should be adjusted when inflation or output goes off track.

There has been much debate recently about whether MCIs should appear in policy rules. To some degree, this issue is merely semantic. Trivial algebra allows us to move the exchange rate from the left to the right side of equation (5), yielding

$$r = \left( \frac{a}{\omega} \right) y + \left( \frac{b}{\omega} \right) \pi^* - \left[ \frac{(1-\omega)}{\omega} \right] e . \quad (6)$$

Here the interest rate is on the left-hand side, as in the basic Taylor rule. The modification of the rule is that  $e$  is on the right-hand side: policymakers adjust interest rates in response to exchange rates as well as in response to output and inflation. Equation (6) may look like a less radical departure from the basic Taylor rule than equation (5), which introduces the concept of an MCI. But in substance, equations (5) and (6) are identical.

Later I discuss why, in the real world, the choice between rule (5) and rule (6) may be more than semantic. Here the point is just that  $e$  should appear somewhere in the rule—either on the left or on the right. If the rule simply ignores the exchange rate, policymakers will miss opportunities to adjust interest rates to offset the effects of exchange rates on spending. The result is unnecessarily large fluctuations in output and inflation.

#### 4. THE CHOICE OF POLICY INSTRUMENT: WHY DOES IT MATTER?

There has been much recent debate about the choice of an instrument for monetary policy, that is, the variable that central banks should adjust to influence output and inflation. In the model I have described, we can interpret the instrument as the variable on the left-hand side of the policy rule. Most central banks use an interest

rate as their instrument, but Canada and New Zealand have experimented with an MCI like the one in equation (5). Which instrument is best?

As discussed above, my simple model suggests that this question lacks substance. Policymakers who follow rule (5) use an MCI as their instrument, and those who follow (6) use an interest rate. But rules (5) and (6) imply identical responses to any event. Suppose, for example, that there is a shock to the exchange rate equation (3):  $e$  falls for a given  $r$ . If  $y$  and  $\pi^*$  are constant, both rule (5) and rule (6) imply that  $r$  should be raised. Policymakers using rule (5) will say they are keeping the policy stance constant: they are adjusting the  $e/r$  mix to maintain the same MCI. Policymakers using rule (6) will say they are tightening policy in response to the expansionary effects of depreciation. But these are just two ways of saying the same thing.

Despite this theoretical point, the choice of policy instrument does matter in practice. The difference between theory and reality is in policymakers' degree of flexibility in adjusting their instruments. My theoretical argument assumes that the instrument, whatever it is, moves instantly to the optimal level when a shock occurs. In practice, policymakers adjust their instruments slowly over time. As we will see, this fact breaks the equivalence of interest rate and MCI targets.

Why don't instruments adjust instantly? There are at least two reasons. One is the fact that central bankers reevaluate their policy stances periodically rather than continuously. In some countries, for example, the procedure for analyzing recent data and choosing a policy setting occurs once per quarter. That policy setting is then held constant between policy reviews. Thus, within a quarter, an interest rate target means the interest rate is constant, and an MCI target means the interest rate is adjusted to offset exchange rate movements. Therefore the rules produce different outcomes when there are shocks to the exchange rate.

Many discussions of instrument choice emphasize the intervals between policy resettings. But these intervals are not the most important reason why the choice matters. The intervals are fairly short: sometimes they last a quarter, as in New Zealand, and sometimes less, as in the United States, where the Federal Open Market Committee meets every six weeks. Given the relatively slow evolution of output and inflation, delaying the optimal instrument adjustment for such short periods is unlikely to add substantially to macroeconomic volatility. (And if it did, the frequency of adjustments could be

increased. If the Federal Reserve hired additional staff, it could redo its policy analysis every four weeks rather than every six.)

The most important reason why the choice of an instrument matters is that it affects policy for periods much longer than the interval between instrument adjustments. In principle, these adjustments are an opportunity to adjust policy flexibly in response to all new information. If this were truly the case, my earlier argument would apply, and the labeling of one variable as the instrument would be semantic. But the labeling matters in reality because, whatever the “instrument” is, policymakers are reluctant to change it by large amounts. This is true even for reviews when in theory the entire stance of policy is on the table.

In countries with interest rate targets, policymakers’ aversion to large instrument shifts has a common name: “interest rate smoothing.” According to most theories, optimal interest rate rules imply that news about output and inflation produces large, one-time adjustments in rates. But empirical work on many countries shows that such adjustments seldom occur. If the economy overheats, for example, policymakers usually respond slowly: they raise interest rates by a quarter of a percentage point at a time at a series of meetings, even if it appears likely from the beginning that a large change is needed. It can take a long time before the interest rate reaches its optimal level.

There is no consensus about the reasons for interest rate smoothing. I am sympathetic to the view that there are political incentives for smoothing, even though its economic effects are undesirable. For example, Lowe and Ellis (1997) suggest that policymakers are embarrassed by reversals in the direction of interest rate movements, because the public interprets these reversals as repudiations of previous actions. In contrast, a series of interest rate changes in the same direction looks like a well-planned program. If policymakers respond to a shock with the full interest rate adjustment they think is optimal, their next move is equally likely to be in the same direction or the opposite direction. A concern for appearances may lead policymakers to underreact to shocks initially, to make it more likely that future interest rate changes are in the same direction.

Whatever the explanation for interest rate smoothing, it is a fact of life. And I suspect that it is a special case of a more general phenomenon of instrument smoothing. Just as central banks with interest rate targets smooth interest rates, so do those with MCI targets smooth MCIs. This is less clear-cut empirically, because we have

observed fewer experiences with MCI targets. But as discussed below, the recent experience of New Zealand is consistent with the idea of MCI smoothing. And Lowe and Ellis's logic carries over to this case. A policymaker who announces a big instrument shift is going out on a limb regardless of whether he or she is announcing a large interest rate change or a large MCI change. Either way, the policymaker may be embarrassed if he or she later has to take back some of the adjustment.

With instrument smoothing, interest rate targeters and MCI targeters react differently to shocks. Recall my example of a shock that reduces the exchange rate for a given interest rate. This leads to a higher interest rate under either the MCI rule (5) or the interest rate rule (6). But instrument smoothing dampens the interest rate rise of the interest rate targeter. The behavior of the MCI targeter is not affected, because the full interest rate adjustment does not require a change in the MCI. Both policymakers may consider themselves "cautious" or "conservative," because they avoid large shifts in their instruments. But caution has different implications in the two cases. In this example, policy is tighter with an MCI target.<sup>1</sup>

## 5. A MODEL OF THE OPTIMAL INSTRUMENT

I now consider the choice of a policy instrument in a variation on my 1999 model. To focus on this issue, I simplify the model in two ways. First, I consider a static setting, thereby ignoring time lags in the effects of policy. Dynamics are crucial for some of the issues discussed earlier, but not for the issue of instrument choice. Second, I model only the real side of the economy and define the optimal instrument as the one that minimizes the variance of output; I do not explicitly consider inflation. This shortcut is possible because one can show that the instrument choice that minimizes output variability also minimizes inflation variability. Intuitively, the wrong choice causes unnecessary output fluctuations, which cause inflation fluctuations through the Phillips curve.

Having simplified the model along some dimensions, I now enrich the specification of how exchange rates are determined. Many commentators argue that the appropriate role of exchange rates in

1. David Gruen has made a similar argument about instrument smoothing with MCI and interest rate targets (personal communication with the author).

policy rules depends on the sources of exchange rate fluctuations. My 1999 model has a single exchange rate shock,  $v$  in equation (3). In the new model, two shocks affect exchange rates: a shock to exports and a shock to financial markets. The shock to exports also affects aggregate spending, so I modify the IS equation as well.

The new model starts with two accounting identities:

$$Y = D + X \quad , \quad (7)$$

$$X = F \quad , \quad (8)$$

where  $Y$  is output,  $D$  is domestic spending,  $X$  is net exports, and  $F$  is net foreign investment (that is, net capital outflows).

I assume the variables in equations (7) and (8) are determined by

$$D = -\beta U + u_1 \quad , \quad (9)$$

$$X = -\delta H + u_2 \quad , \quad (10)$$

$$F = -\phi U + \rho H + u_3 \quad . \quad (11)$$

Domestic spending thus depends on the real interest rate and on shocks such as shifts in fiscal policy or consumer confidence ( $u_1$ ). Net exports depend on the real exchange rate and on shocks such as shifts in trade policy or the strength of foreign economies ( $u_2$ ). Finally, net foreign investment falls when the interest rate rises (because domestic assets become more attractive) and rises when the currency appreciates (because this implies a future depreciation, raising the return on foreign assets). The shock  $u_3$  arises in financial markets. For example, if investors suddenly decide that a country's assets are risky, there is a capital outflow—a positive  $u_3$ .<sup>2</sup>

Substituting equations (10) and (11) into equation (8) yields a reduced-form relation between the interest rate and the exchange rate:

$$e = \left[ \frac{\phi}{(\delta + \rho)} \right] r + \left[ \frac{1}{(\delta + \rho)} \right] u_2 - \left[ \frac{1}{(\delta + \rho)} \right] u_3 \quad . \quad (12)$$

2. This model draws on the model of a “large open economy” in Mankiw’s (1999) intermediate macroeconomics text.

Like the exchange rate equation in my 1999 model, this equation gives a positive relation between  $e$  and  $r$ . This version of the equation makes it clear that the relation is shifted by two kinds of shocks.

I use the model in equations (7) through (12) to consider the choice between an interest rate and an MCI as policy instrument. I assume that the weights on  $e$  and  $r$  in the MCI are proportional to  $\delta$  and  $\beta$ , which give the variables' effects on aggregate spending. To capture the idea of instrument smoothing, I assume that the central bank must set its policy instrument in advance and can make no adjustment in response to shocks. With this assumption, I ask which choice of instrument keeps output more stable. This approach is similar to Poole's (1970) comparison of money and interest rate targets. The results would be similar if I allowed instruments to adjust partially in response to shocks.

Like Poole, I find that different instruments stabilize output depending on which shock hits the model. Specifically, there are three results:

*Result 1:* When there is a shock to domestic spending as in equation (9), output is the same under an interest rate or an MCI target. That is, when consumer confidence or fiscal policy shifts, it does not matter whether policy holds the interest rate or the MCI fixed. The explanation is simple. A domestic spending shock does not change the relation between the exchange rate and the interest rate:  $u_1$  does not enter equation (12). Thus a constant interest rate implies a constant exchange rate and hence a constant MCI. Fixing the interest rate and fixing the MCI are the same policy in this case.

*Result 2:* When there is a shock to net foreign investment as in equation (11), an MCI target keeps output more stable than does an interest rate target. To see this result, consider a rise in net foreign investment—a case of capital flight. In this case, the shock  $u_3$  is positive. A fixed-MCI policy fully insulates output from the shock, whereas a fixed interest rate does not.

Consider first a fixed interest rate. Under this policy, equation (12) implies that the positive  $u_3$  lowers  $e$ : capital flight causes a depreciation. Equation (10) implies that the depreciation raises net exports. Domestic spending does not change, because the interest rate is held fixed. Thus the rise in net exports implies a rise in aggregate output.

With a fixed MCI, by contrast, the interest rate is raised when there is capital flight, to prevent the MCI from falling. In equilibrium, the shock produces a higher  $r$ , a lower  $e$ , and no change in a weighted average of the two. Specifically, the assumed weights in the MCI imply that the sum  $\beta r + \delta e$  is unaffected by the shock. Equations (7) through (10) imply that this sum determines aggregate output; thus output is unaffected. Domestic spending falls because of the higher  $r$ , but this is offset by higher net exports caused by the lower  $e$ .

*Result 3:* When there is a shock to net exports as in equation (10), an interest rate target keeps output more stable than does an MCI target. Here suppose that net exports fall because of recession in a country's trading partners. This is a negative  $u_2$ . Output falls under either an interest rate rule or an MCI rule, but the fall is larger under the latter.

With a fixed interest rate, the negative  $u_2$  reduces net exports. It also reduces the real exchange rate, through equation (12), but the resulting rise in net exports is outweighed by the direct negative effect of the shock. Domestic spending does not change, so lower net exports imply lower output.<sup>3</sup>

Once again, a fixed MCI means that policymakers raise  $r$  to offset the fall in  $e$ . Thus  $r$  is higher than with a fixed interest rate, and  $e$  is also higher through equation (12). The higher  $r$  and higher  $e$  mean that both domestic spending and net exports are lower than with an interest rate target. Thus fixing the MCI magnifies the output loss from the negative net export shock.

To summarize, these results imply that the right choice of an instrument depends on the relative importance of shocks to net foreign investment and net exports. If different economies are susceptible to different kinds of shocks, different instruments may be appropriate. To illustrate these points, I now examine some recent country experiences.

## 6. SOME COUNTRY EXPERIENCES

In debating the choice of an instrument, many observers cite the recent experiences of Australia and New Zealand. The Asian financial

3. To see that net exports go down despite the lower  $e$ , recall that net exports equal net foreign investment. The combination of a lower  $e$  and a fixed  $r$  implies that net foreign investment falls by equation (11).

crisis of 1997 hit these two countries in broadly similar ways, yet in the aftermath of the crisis, New Zealand experienced a recession whereas Australia did not. At the time of the shock, New Zealand had recently adopted an MCI as an instrument, whereas Australia used an interest rate. Some commentators (such as *The Economist*, 1999) draw a connection between these facts: they interpret the Australasian experience as evidence that countries are better off with interest rate targets.

It is, of course, an oversimplification to attribute the experiences of Australia and New Zealand entirely to their choices of instruments. Other factors contributed to the recession in New Zealand. For example, policy in New Zealand was already tight when the Asian crisis began, because of inflationary pressures. In addition, a drought in 1998 reduced output in the country's large agricultural sector. On the other hand, the use of an MCI probably did make the recession deeper than it otherwise would have been. To explain why and to illustrate my model, I will tell a story about New Zealand and Australia that focuses on instrument choices.

My model implies that interest rate targets are the right choice in the presence of shocks to the net export function. This result is relevant because both Australia and New Zealand experienced large shifts in net exports during the Asian crisis. These countries trade heavily with East Asia, and so exports fell sharply when the region entered a recession.

This is not the whole story, however, because the East Asian crisis affected the Australasian countries through more than one channel. At the time of the crisis, investors fled countries that they deemed risky. Rightly or wrongly, these countries included New Zealand and Australia. Capital flight meant that these countries experienced a positive shock to net foreign investment as well as a negative shock to net exports.

Given this particular combination of shocks, Australia's policy of interest rate targeting worked brilliantly. Recall that a negative shock to net exports reduces output under interest rate targeting, although not as much as under MCI targeting. In Australia, the contractionary effects of the fall in net exports were offset by an additional depreciation resulting from the rise in net foreign investment. The stimulus from this additional depreciation was enough to leave total spending roughly constant. New Zealand suffered a recession after similar shocks because its policy was tighter: to maintain a constant MCI, it had to raise its interest rate.

The Reserve Bank of New Zealand recognized the contractionary effects of the Asian crisis and reduced its MCI target in late 1997 and 1998. However, the policy easing was not large or fast enough to prevent a recession. This experience is consistent with the practice of instrument smoothing: policy is adjusted slowly even though shocks make a large change optimal. It is easy to imagine the New Zealand central bank (like everyone else) being surprised by the Asian crisis and uncertain of the ideal response, and therefore erring on the side of adjusting its instrument “cautiously.” Australia was also cautious: there was almost no change in its instrument. The nature of the shocks determined which kind of caution was more successful.

Thus there was an element of luck behind the relative success of interest rate targets after the Asian crisis. If the contractionary shock to net exports had been smaller, or the expansionary shock to net foreign investment larger, output would have been higher in Australia. With a fixed interest rate, the economy might have overheated, causing inflation to rise. In such a scenario we would now be celebrating New Zealand’s wisdom in targeting an MCI: the higher interest rates implied by that policy would have prevented overheating.

Policymakers would like to know what instrument keeps output most stable on average, not just in particular episodes. Determining this requires more research on the relative importance of shocks to net exports and net foreign investment. The right choice of instrument may be different in different countries. It appears likely that an interest rate target is indeed best for Australia. Research by the Reserve Bank of Australia concludes that fluctuations in the Australian dollar are driven mainly by terms-of-trade shocks, which are less important in other countries. In my model, terms-of-trade shocks should be interpreted as shocks to the net export equation, since they change the value of exports for given physical quantities. These shocks are best handled through an interest rate target.

Are there countries that should use MCIs as instruments? One candidate is Canada, the country that pioneered their use. Research at the Bank of Canada suggests that fluctuations in the Canadian dollar—unlike the Australian dollar—are driven primarily by shocks to financial markets. In the terms of my model, these are net foreign investment shocks, which means they are best handled by an MCI target.

## 7. CONCLUSION

Monetary policy in open economies is different from that in closed economies. Open-economy policymakers should target a measure of inflation that filters out the transitory effects of exchange rate fluctuations. They should also include the exchange rate in their policy reaction function. Whether the exchange rate should appear on the left- or the right-hand side of the rule—that is, whether the policy instrument should be an interest rate or an MCI—is a question that requires further research.

I will conclude by mentioning another topic for further research: the benefits of stable exchange rates. In all the models I have discussed, optimal policy rules allow considerable variability in exchange rates. Real-world policymakers, however, seem averse to such variability. Rigid exchange rate pegs are becoming less popular, but many countries still seem to stabilize exchange rates more than is justified by current models. Is there some cost of exchange rate fluctuations that the models miss? One possibility is output fluctuations at the sectoral level. Exchange rate fluctuations cause reallocations of resources across the tradable and nontradable sectors, and these may be inefficient. Current models cannot capture this idea because they focus on aggregate variables. Progress might be made by evaluating policy rules in models that disaggregate output into tradables and nontradables.

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