PDP/00/5

IMF Policy Discussion Paper

The Role of MULTIMOD in the IMF's Policy Analysis

Peter Isard

INTERNATIONAL MONETARY FUND

 PDP/00/5

IMF Policy Discussion Paper

Research Department

The Role of MULTIMOD in the IMF's Policy Analysis

Prepared by Peter Isard[1]

June 2000

Abstract

This paper describes the basic structure, underlying philosophy, and key behavioral properties of MULTIMOD. It also focuses on several recent applications of macromodels in the IMF's policy analysis, emphasizing that most questions put forward for analysis with models like MULTIMOD are initially posed in ways that cannot be addressed by simply pushing a computer key. Meaningful macromodel-based policy analysis requires a sensibly structured and parameterized macromodel, but it also generally requires considerable probing of the nature of the policy issues in order to reformulate policy questions in terms of well-defined exogenous shocks.

JEL Classification Numbers: E1, E6

Keywords: MULTIMOD, macroeconomic policy analysis

Author's E-Mail Address: pisard@imf.org

---

[1] An earlier draft of this paper was presented at a conference on Macroeconomic Modeling and Public Policy organized by the Monetary Authority of Singapore. I am indebted to Douglas Laxton for sharpening my focus on many issues that arise in developing and applying macroeconometric models for policy analysis, and to Benjamin Hunt for valuable assistance and feedback on this paper.

I. INTRODUCTION

Since its development in the late 1980s, MULTIMOD—the International Monetary Fund's multi-country macroeconometric model—has been actively employed in the IMF's analysis of global and country-specific macroeconomic policy issues. This paper describes the key features of MULTIMOD and how it has been used in IMF policy analysis.[2]

The paper begins by distinguishing briefly between several broad classes of policy issues that are addressed with models by the Fund staff (Section II). It then provides an overview of MULTIMOD: its basic structure, the underlying philosophy, the key features of its behavioral equations, and the macroeconomic behavior that it generates in response to policy changes (Section III). This is followed with some specific examples of model applications at the Fund in recent years, focusing on how policy questions have been asked, discussing how those questions have been translated into issues that could be addressed formally with macromodels, and distinguishing between cases that led to MULTIMOD applications and cases that were addressed with other types of models (Section IV). The key points of the paper are summarized in the concluding remarks (Section V).

II. CATEGORIES OF MODEL-BASED POLICY ANALYSIS AT THE IMF

The IMF staff uses models to help address a wide range of policy issues. These include policy issues for individual countries as well as different types of global issues.

Much of the IMF's model-based global analysis is designed to explore alternative scenarios for the World Economic Outlook, which the IMF normally publishes twice a year.

---

[2]For a more complete description of MULTIMOD see Laxton and others (1998).

Often the focus is on the spillover effects of policy changes or other shocks in large economies. At other times the focus is on the macroeconomic implications of global shocks—such as changes in oil prices.

Another important global or multilateral issue that periodically calls for quantitative analysis by the IMF is the question of how much the exchange rates of major currencies differ from estimates of their medium-run equilibrium levels. Although such exercises involve a large element of judgment, a macroeconomic balance framework employing both a standard model of the trade balance and a simple model of the medium-run determinants of the saving-investment balance has provided useful inputs for assessments of these currencies by the IMF's staff and management.[3]

The IMF's model-based analysis also focuses on a variety of country-specific issues, such as the sustainability of a country's pension system and its fiscal policies more generally. Models are also used by the IMF staff in research on conceptual policy issues that have general applicability to many countries, such as stochastic simulation analysis of how well different types of monetary policy reaction functions would perform as guidelines for delivering macroeconomic stability.

As all this indicates, the IMF has a pluralistic approach to macroeconomic modeling, not only because its global membership gives rise to a focus on both global and country-specific policy issues, but also because different types of macroeconomic models are needed to address appropriately the different types of issues that surface in policy analysis for

---

[3]See Isard and Faruqee, eds. (1998) for a description of the IMF's macroeconomic balance framework.

individual countries. Some of the policy issues that arise at the IMF can be addressed with MULTIMOD—either the global model or one of its individual country component models. Other issues are more appropriately addressed with different types of models.

III. MULTIMOD

A. Basic Structural Features

The first principle of model design is that the basic structural features of any model should be commensurate with its intended use. MULTIMOD reflects a variation on this theme: its basic features have been influenced to a large extent by the fact that it is not intended to be used for forecasting.

MULTIMOD was developed in the late 1980s for the primary purpose of generating alternative scenarios for the World Economic Outlook (WEO). As such, it is based on annual data and takes the WEO forecast as an "exogenous" baseline. The WEO forecast is produced by combining forecasts for individual countries generated by the Fund's country teams, who have considerable country-specific expertise, including awareness of what national authorities and other forecasters are projecting for their countries. The process of putting together the WEO forecast imposes common assumptions about key global variables and involves a certain amount of iteration in pursuit of global consistency.

The construction of MULTIMOD has gone through several stages.[4] It grew out of a precursor model, MINIMOD, which was disaggregated into two regional blocks: the United

[4] See Masson and others (1988), Masson, Symansky, and Meredith (1990), and Laxton and others (1998).

States and the rest of the world.[5] By 1988 it was a seven region model, with individual country models for the United States, Japan, and Germany plus models for two groups of other industrial countries, a small group of high-income oil-exporting countries,[6] and the very large group of all other countries. With the publication of the Mark III version in 1998,[7] MULTIMOD included individual country models for each of the Group of Seven industrial countries, plus models for the group of all other industrial countries, the group of high-income oil exporters, and the group of all other countries. Today the main version of MULTIMOD includes individual country models for the United States, Japan, the United Kingdom, Canada, and the euro-area block, along with models for the groups of other industrial countries, high-income oil exporters, and all other countries.[8]

The country disaggregation of MULTIMOD reflects a number of considerations. These include the desire to concentrate first on countries whose policies tend to have the largest effects on the world economic outlook, as well as the fact that data are more readily available for industrial countries than for other countries. The limited attention to modeling the non-industrial world also reflects the fact that for countries that are relatively constrained

---

[5] See Haas and Masson (1986).

[6] The high-income oil exporters correspond to the subgroup of developing countries that the World Economic Outlook classifies as "net creditor countries."

[7] Laxton and others (1998).

[8] In addition, satellite models have been developed for most of the individual industrial countries. A paper updating the description of MULTIMOD is currently in preparation. Besides including a euro-area block and a more extended menu of monetary policy reaction functions, the Mark IV version of MULTIMOD will allow nominal variables to converge to different steady-state rates of inflation in different countries, consistent with countries choosing different target rates of inflation.

in their access to international capital markets, existing theoretical models do not provide a very coherent view of how the high degree of macroeconomic variability that we observe results from endogenous behavioral responses to well-defined shocks.

MULTIMOD can be regarded as a slight modification of a framework in which each industrial country produces a single differentiated product—its "main composite good"—which is perceived to be an imperfect substitute for other countries' main composite goods. The industrial country models disaggregate oil from total production and absorption, but oil production in these countries is treated as exogenous, as is the price of oil. The model for the large group of emerging market, developing, and transition economies distinguishes between oil, non-oil primary products, and a composite of other tradable goods—all of which are further distinguished from nontradable goods and services.

The Mark III version of MULTIMOD includes steady state analogue models. MULTIMOD can thus be perceived as having both a dynamic model and a steady-state model for each country, where each dynamic equation has a counterpart steady-state equation. The steady-state models are relied upon for determining model-consistent terminal conditions for the dynamic analysis. They can also be used to study the long-run effects of exogenous policy changes or other types of shocks.

The baseline path for MULTIMOD can be regarded as a judgmental forecast that coincides with the WEO projection over the medium run, which spans a 5-year horizon. This is implemented by imposing a set of residuals under which the estimated model generates the WEO projections over that horizon. The baseline is extended beyond the 5-year WEO horizon in a manner that converges smoothly to a steady-state growth path.

B. Philosophy

The fact that MULTIMOD is relied upon to clarify macroeconomic policy analysis and help shape judgments (i.e., generate plausible and consistent scenarios), rather than to forecast, has had a major influence on the philosophy that has governed its construction and its extensions over time. Among other things, freedom from forecasting has provided more scope to keep behavioral equations consistent with appealing theories and not sacrifice theoretical foundations for forecast accuracy. It has also permitted abstraction from many of the special factors that are often present in forecasting models—and that also have to be taken into account by the Fund's country desks in generating the "exogenous" baseline projections for MULTIMOD. This provides more scope to keep the structure of MULTIMOD "simple," so that macroeconomic behavior is transparent.

Because the model is used primarily for policy analysis over a medium-run horizon rather than for short-run forecasting, and because expectations in MULTIMOD have a forward-looking component, it is particularly important to make sure the long-run properties of the model are sensible. Prior to the introduction of the Mark III version in 1998, the long-run steady state in MULTIMOD was tied down by imposing the assumptions that primary fiscal and trade balances converged gradually to zero, and that the real rate of interest converged to the steady-state rate of growth. The latter condition, while convenient, had the undesirable feature of making fiscal policy a Ponzi game—governments could issue long-term debt with no apparent real costs, because such debt could always be rolled over at real interest rates that were no higher than the steady-state growth rate. The Mark III version includes both dynamic equations and steady-state analogue equations. The steady-state value

of the risk-free real short-term interest rate is specified exogenously, but at a level that exceeds the steady-state growth rate.[9]

Another element of the MULTIMOD philosophy is to impose broadly consistent structures on all of the component country models. This facilitates adapting individual country models for applications to other countries. Most of the parameters of MULTIMOD are estimated, and imposing consistent structures on the component country models also allows pooled estimation of equations and helps maintain transparency.

MULTIMOD treats inflation expectations as having both a backward-looking component and a forward-looking model-consistent component, while treating expectations about exchange rates (asset prices) as completely forward looking and model consistent. At the same time, and as another aspect of the philosophy, MULTIMOD has been coded to provide flexibility for exploring the implications of different behavioral assumptions. Differences of view on model structure, and additional uncertainties associated with imprecise parameter estimates, are common when confronting policy questions; so it makes sense to try to build in the flexibility to explore different choices. Among other things, the way MULTIMOD is coded allows us to study the implications of various policy changes or shocks under different relative weights on the backward-looking and model-consistent components of inflation expectations, and under different assumptions about exchange rate

[9] The steady-state real interest rate on short-term government debt (risk-free assets) is imposed to be 4.25 percent—the average real rate of return that accrued during 1987-96 on the short-term public debt of the Group of Seven countries. The steady-state long-term real interest rate is set 100 basis points higher. In addition, based on a catch-up model of productivity growth, it is assumed that growth in each country converges to a steady-state rate consistent with the WEO projection of potential output growth for the United States, the country with the highest level of per capita output.

expectations.[10] We have used a more general specification of exchange rate expectations in some of our work with smaller macro models[11] and see this as a direction that we may also want to explore with MULTIMOD.

Another philosophical point is reflected in the nonlinear specification of MULTIMOD's Phillips curves. In linear macro models, monetary policy affects the variances of output and inflation over time but does not influence the average levels of output, unemployment, or inflation. For the types of policy issues that are addressed with MULTIMOD, it is important to have a model in which monetary policy has first-order welfare implications—i.e., in which imprudent monetary policy reactions that "fall behind shifts in the curve" can result in higher average levels of inflation and unemployment over time, and not just influence the variances of inflation and unemployment. It would be appealing to incorporate this feature by defining and modeling policy credibility as an endogenous variable that has an important influence on inflation expectations, responds to the track record of the monetary authorities in a nonlinear way, and thereby gives monetary policy first-order welfare implications; but current work in modeling policy credibility is too

[10] As discussed at greater length by Laxton and others (1998, pp. 5-7), applications of MULTIMOD require an awareness of the Lucas critique. Mechanical applications of macro models that treat expectations as having backward- and forward-looking components with fixed weights can sometimes lead to nonsensical policy inferences, which makes it incumbent upon model users to reflect upon the appropriateness of the fixed-weight specification for the type of analysis that is being undertaken and perhaps to vary the weights (to capture regime changes or credibility effects) in certain policy experiments.

[11] See Isard and Laxton (1999, 2000).

primitive.[12] So for now MULTIMOD relies mainly on convex Phillips curves to provide some nonlinearity to macroeconomic behavior.

As a final point of philosophy, steps have been taken to make the model accessible for others. This is seen as a mechanism that is likely to elicit constructive criticism and help keep MULTIMOD evolving in useful ways over time.

C. Key Features of the Behavioral Equations

The key features of the behavioral equations of MULTIMOD (Mark III version) are as follows.[13]

Consumption-saving behavior is non-Ricardian, based on a model that treats consumers as having finite lives and as not being able to borrow against future labor income. Debt-financed increases in government spending lead to some reduction in private spending, other things equal, but not to dollar-for-dollar reduction.

Investment behavior is based on Tobin's q-theory, driven by the ratio of the market value of a marginal unit of capital to its replacement cost. In addition, it reflects an assumption that there are costs of adjusting the capital stock.

The trade equations reflect the standard approach of relating export and import volumes to real exchange rates and scale variables. The domestic scale variables that enter

---

[12] See Isard and Laxton (1999) and Isard, Laxton, and Eliasson (2000) for a crude but empirically-based representation of endogenous credibility.

[13] See Laxton and others (1998) for more extensive descriptions. Work is under way on an extended version of MULTIMOD that incorporates both population aging and an expanded menu of options for generating tax revenues; these innovations will facilitate the analysis of fiscal issues relating to demographic change and of alternative approaches for financing social security.

the import volume equations are constructed to recognize that different import propensities are associated with the different components of aggregate demand. The foreign scale variables that enter the export volume equations are constructed to reflect base-period trade shares. For each country, the price of (non-oil) exports is an average (with estimated weights) of the price of domestic output and the trade-weighted average (domestic-currency-equivalent) price of foreign output. Import prices are weighted averages of other countries' export prices.

Fiscal variables include: the stock of public debt, which is inherited; the level of fiscal spending, which is normally treated as exogenous; a basic tax rate on labor and capital income; and a wedge that differentiates the two tax rates. In most simulations the basic tax rate is governed by a feedback rule that prevents the level of debt from growing without bound relative to GDP.

The short-term interest rate in each country is determined by the monetary policy reaction function. MULTIMOD can be simulated under alternative monetary policy specifications corresponding to the alternative cases of money (or price-level) targets, fixed exchange rates, or as elaborated below, different formulations of inflation-forecast based rules (forward-looking Taylor rules).

The determination of interest rates and exchange rates is governed by several types of conditions: the expectations theory of the interest-rate term structure; the interest-rate parity conditions that link expected changes in exchange rates to international interest differentials; and the conditions that reconcile stocks and flows in the steady state, which tie down the long-run levels of real exchange rates and interest rates.

D. Effects of Fiscal Shocks Under Different Monetary Policy Regimes

To provide some impressions of the type of macroeconomic behavior that MULTIMOD generates, it is instructive to focus on exogenous changes in fiscal policy and to explore how the effects of such shocks depend on the nature of the monetary policy reaction function. To simplify the illustrations, the effects of the shocks are simulated in the model for a single economy, Canada.[14]

Consider two different fiscal shocks, each of which involves a permanent 10 percentage point reduction in the ratio of government debt to GDP. The first shock (approximately) achieves the debt reduction over a 5-year period with no change in the ratio of government spending to GDP; this involves increasing the basic tax rate by (approximately) 2 percentage points, maintaining the higher tax rate for 5 years, and subsequently reducing the tax rate back to (approximately) its initial level.[15] The second shock also (approximately) achieves the debt reduction over a 5-year period, but does so via a permanent 2 percentage point reduction in the ratio of government spending to GDP accompanied, after 5 years, by a permanent reduction in the basic tax rate.

---

[14] For the effects of similar shocks in the full multicountry model, see Laxton and others (1998), Boxes 2 and 4.

[15] The reduction in the basic tax rate after 5 years exceeds 2 percentage points since the lower long-run debt ratio implies a lower long-run level of the basic tax rate. Since the properties of MULTIMOD preclude the possibility of constraining both the basic tax rate and the debt ratio to remain strictly constant after 5 years, the simulations are designed to achieve smooth convergence to a long-run steady state, with the tax rate allowed to decline smoothly after 5 years to the neighborhood of its long run level and the debt ratio allowed to simply reach the neighborhood of its long-run level by the end of 5 years, such that it also converges smoothly to its steady-state value thereafter.

The simulations distinguish between three alternative monetary policy regimes: an inflation-forecast-based rule (or forward-looking Taylor rule), a money targeting regime (analogous to targeting the price level over the medium run), and a fixed exchange rate regime. Under the inflation-forecast-based (IFB) rule, the short-term nominal interest rate is adjusted, relative to its baseline setting, by an amount that—after subtracting a forward-looking model-consistent measure of the expected rate of inflation—makes the short-term real interest rate a positive function of both the deviation of observed inflation from target and the output gap (defined as observed output minus potential output).[16] Under the monetary targeting regime, the short-term nominal interest rate is adjusted as a simple positive function of the deviation of money from target. Under the fixed exchange rate regime, the nominal interest rate reacts to the deviation of the nominal exchange rate from its central parity, with the strength of the reaction calibrated to constrain exchange rate fluctuations to a relatively narrow band.

Figure 1 illustrates the effects of the first fiscal shock under the three alternative reaction functions for monetary policy. The individual panels plot (shock minus control) deviations between the simulated outcomes and the baseline timepaths for selected variables. The top three panels in the left column show the time paths of the basic tax rate, government spending, and the debt ratio, while the top three panels in the right column show the short-term interest rate (monetary policy instrument), the nominal exchange rate, and the consumer

[16] Isard, Laxton, and Eliasson (1999) refer to such specifications as IFB1 rules, as distinct from IFB2 rules that essentially adjust a forward-looking measure of the real interest rate as a positive function of both the output gap and the deviation of the inflation forecast from target.

price level. The simulations with the IFB rule are depicted by solid lines, with dashed lines corresponding to outcomes under money targeting and dotted lines associated with the fixed exchange rate regime.

Note that the fiscal contractions induce greater variation in the interest rate and the exchange rate under the IFB rule than under the money targeting regime. Note also that the interest rate remains essentially constant under the fixed exchange rate regime, the obverse of the fact that the fiscal policy shock does not put pressure on the exchange rate in the absence of interest rate changes. As is evident in the panels showing the price level, the inflation rate, and real GDP, under fixed exchange rates the absence of a stimulatory monetary reaction to the shock implies a relatively sharp initial contraction of real GDP and relatively strong downward pressures on prices and inflation. Furthermore, consistent with the different nature of the (implicit) policy objectives that underpin the IFB rule and the money targeting rule, the initial contraction of output is relatively smaller under the former regime, while the reverse is true for the decline in the price level and the transitory decline in the inflation rate.

The initial contractionary effects of the fiscal policy shock operate primarily through a decline in consumption in response to the higher tax rate, which is partially offset (except under the fixed exchange rate regime) by the positive response of investment to the fall in interest rates. This can be seen in the bottom two panels of Figure 1. After the first 5 years, the reduction in the tax rate to a level somewhat below its baseline induces consumption to rebound to a level somewhat above its baseline. Over the longer run, investment returns to its baseline path as the adjustment of inflation and the output gap (under the IFB rule) and money balances (under the money targeting regime) induce the monetary authorities to adjust interest rates back to their baseline settings.

Figure 2 shows the effects of reducing the debt ratio via a permanent reduction in government spending accompanied, after 5 years, by a permanent reduction in the tax rate. The main differences between Figures 1 and 2 can be seen in the panels on government spending, the tax rate, and private consumption. The lower levels of both government spending and the tax rate in Figure 2, compared with those in Figure 1, result in a smaller decline in private consumption in the short run and a larger increase in private consumption over the long run.

IV. Applications of Models in the IMF's Policy Analysis: Some Examples

A. Step One: Formulating the Policy Question for Model Analysis

As emphasized earlier, MULTIMOD has not been designed for purposes of generating macroeconomic forecasts. Rather, one of the main objectives in constructing and extending MULTIMOD has been to generate dynamic simulations that provide plausible and consistent descriptions of how an exogenously-constructed baseline forecast would be altered if certain policy changes or other shocks occurred.

Having a sensibly structured and parameterized macroeconomic model does not imply that relevant policy analysis can be generated by simply pushing a computer key. Before a macro model can be applied to analyze the effects of a policy adjustment, or of some other change in the macroeconomic environment, it is necessary to characterize the change as a set of exogenous shocks. This is a crucial step that generally requires considerable thought.

The need to translate many policy questions before addressing them with models can be appreciated by considering same examples of the issues that Fund staff have confronted in

recent years. One of the issues that called for analysis with MULTIMOD, for example, was posed as a question about how the global economy would be affected if capital flows to emerging market economies dried up by $100 billion more than was projected in the baseline forecast. Another request was for an analysis of the implications for Estonia of accession to the European Union. In neither case was the question initially worded in a manner that alluded to a well-defined set of exogenous shocks.

The process of translating policy questions in meaningful ways—and of reformulating them in terms of exogenous shocks—typically requires significant interaction between the modeler and the questioner to clarify the nature of the policy issue and make sure that the questioner is happy with the translation. In practice, applications of MULTIMOD have generally involved significant interactions between economists in the Research Department's Economic Modeling Division (which maintains MULTIMOD) and other economists engaged in preparing analysis either for the World Economic Output or for the IMF's consultations with member countries.

The remainder of this section briefly describes the first steps that were taken in a number of recent applications of models to policy analysis at the Fund.[17] It focuses initially on several applications of MULTIMOD and subsequently on a few examples involving applications of other models.

[17] The results of the model simulations are of secondary interest here and are not discussed; but references are provided for cases in which the simulation results have been described in publicly-available documents.

B. MULTIMOD Applications

Fiscal consolidation for Italy, 1995

Fiscal consolidation was a major issue for industrial countries in the early and mid-1990s, particularly in the United States and Europe. By the mid-1990s, experiences in several countries had focused economists on cases in which fiscal consolidation had significantly reduced uncertainty and market concerns about a country's macroeconomic outlook, and had thereby led to a significant reduction in the interest premiums on the country's debt, with expansionary effects on the economy. An annex to the October 1995 World Economic Outlook[18] reported MULTIMOD simulations that illustrated this possibility, emphasizing that when fiscal consolidation led to declines in interest premiums it could also give rise to exchange rate appreciation, in contrast with the standard Mundell-Fleming result.

At the time, there was particularly strong concern with the fiscal situation in Italy, and interest premiums on lira assets were quite large, reflecting uncertainties about whether the Italian political process would deliver the fiscal consolidation that was needed. In seeking to characterize the likely effects of fiscal consolidation under those circumstances, the analysis was constrained by the fact that most standard open economy macro models, including MULTIMOD, do not generate the behavior of the interest premium endogenously. Accordingly, the analysis was based on an educated guess about how much the interest premium would change, which was imposed exogenously as part of the shock. In particular, the shock was defined as fiscal consolidation that gradually reduced the public debt stock by

[18] Clark and Laxton (1995).

30 percent of GDP and was assumed to reduce the interest premium on Italian lira assets by 250 basis points.

Accession to European Union for Estonia

In a more recent application, MULTIMOD was used to provide a plausible description of the macroeconomic implications of Estonia becoming a member of the European Union (EU). The simulations that were generated helped focus discussion during the IMF's 1999 consultation with Estonia and have now been published as part of an IMF Working Paper.[19]

Part of the challenge was to adapt a small open economy model (specifically, the model for Switzerland) to Estonia. The other part of the challenge was to decide how to specify the shock in a meaningful way.

Both parts of the challenge required country-specific expertise and drew heavily on inputs from the IMF's Estonia team. It was assumed that EU accession would bring net transfer receipts from the EU amounting to 2 percent of Estonia's GDP, and that adopting the euro would also reduce the interest premium at which Estonia could borrow on international capital markets. The shock was characterized as a permanent increase in public spending of 2 percent of GDP,[20] accompanied by a decline in the interest premium.[21]

---

[19] Weber and Taube (1999).

[20] Phased in over 4 years; this was seen as corresponding to EU-related spending needs and domestic co-financing of infrastructure and environmental projects, and as being facilitated by the availability of significant EU transfers.

[21] By 100 basis points over 5 years.

Risks to the global economy in the wake of the 1997-98 Asian crises

To illustrate some of the risks and policy issues associated with the WEO projections at the end of 1997, MULTIMOD was used to generate an alternative scenario that might evolve if capital flows to emerging market economies dried up by $100 billion more than projected in the WEO baseline. The analysis was presented in the December 1997 WEO.[22]

This required constructing a model to represent the aggregate behavior of a group of 25 emerging market economies (EMEs). It also required devising a meaningful way to specify the exogenous shocks that would lead to an endogenous $100 billion decline in capital flows to the EMEs. The decision was to model the shock mainly as an exogenous increase in the interest premium for EMEs, but in part also as an exogenous decline in aggregate EME demand.[23] The latter component of the shock was seen as capturing the effects of weakening confidence and financial sector stress, which are not captured by the explanatory variables in MULTIMOD's behavioral demand equations.

A central part of the policy message conveyed in the WEO was that the risks to the global economy depended not only on the magnitude of the "shocks" to private sector behavior, but also on the response of macroeconomic policies throughout the world. To illustrate this point, an alternative scenario was simulated in which the drop-off in external

---

[22] International Monetary Fund (1997).

[23] The increase in the interest premium was assumed to dissipate gradually over 5 years. The effects during the first year were assumed to be cushioned to some extent by a drawdown of foreign exchange reserves, but with the EME trade balance in the second year essentially reflecting full adjustment to the $100 billion reduction in external financing.

financing flows to EMEs was smaller ($50 billion) and less prolonged. The alternative scenario involved more accommodative monetary policies in the industrial countries.

C. Applications of Smaller Models

The pension system in Italy

The 1999 consultation with Italy focused on the pension system and the long-term fiscal and macroeconomic implications of the aging population. The analysis of whether the current pension system was sustainable depended critically on the projected growth rate of potential output. Thus, the analysis did not call for simulations with MULTIMOD but rather required an appealing model for projecting the growth rate of potential output. This resulted in the specification and estimation of a simple catch-up model, in which the growth of GDP per worker in Italy gradually converged to that in a country with one of the highest prevailing levels of GDP per worker, the United States.

Inflation-forecast targeting in the United Kingdom

The most recent consultation with the United Kingdom focused on several issues relating to the Bank of England's monetary policy framework. One question was whether interest rates in the United Kingdom have been "too variable." Another issue concerned the merits of presenting the prospects for inflation using a conditional forecast of what the inflation rate would be if the policy interest rate was held constant for 8 quarters—a conditional forecast that is featured in the Bank of England's *Inflation Report*.

These issues were appropriately addressed through stochastic simulation analysis, and for that purpose a macro model of the UK economy was required. The UK component of MULTIMOD was not ideally suited for the analysis, among other things because it relied on

annual data and included more than a minimal set of behavioral equations. Accordingly, a small quarterly model of the UK economy was designed and estimated with an awareness of the key properties of the Bank of England's macro models. The simulation analysis illustrated that the optimal degree of interest rate variability (or the optimal value of the "interest rate smoothing" parameter in the monetary policy reaction function) depends, inter alia, on the channels through which monetary policy is transmitted to aggregate demand, the degree of openness of the economy, and the degree of policy credibility. Thus, the fact that interest rates had been significantly more variable in the United Kingdom than in the United States did not imply that interest rates had been "too variable" in the United Kingdom. The analysis also suggested that using a constant-interest-rate inflation forecast not only as a way of presenting the prospects for inflation but also as a mechanical basis for policy decisions would be time inconsistent and, other things equal, would imply that it actually would take much longer than 8 quarters to bring the inflation rate back to target following a shock.

V. Concluding Remarks

This paper has provided an overview of MULTIMOD and its use in model-based policy analysis at the International Monetary Fund. It has emphasized that the basic structure, philosophy, and behavioral properties of MULTIMOD have been influenced significantly by the purposes for which MULTIMOD is intended. In particular, the features of MULTIMOD to a large extent reflect the fact that the model has not been developed as a tool for generating baseline forecasts, but rather is primarily regarded as a framework for analyzing the macroeconomic implications of various policy changes or other shocks, and for generating plausible and globally-consistent alternatives to the baseline scenarios presented in the World Economic Outlook.

It should not be at all surprising that the Fund takes a pluralistic approach to macroeconomic modeling. Many global or country-specific policy issues can usefully be addressed with MULTIMOD or one of its component country models, but many other policy issues are appropriately addressed with other models.

One of the main themes of this paper is that relevant policy analysis cannot be generated by developing a sensibly structured and parameterized macroeconomic model and then simply pushing a computer key. Most policy issues are not initially posed in terms of a set of well-defined exogenous shocks that can be mechanically fed to a model. Translating policy questions in meaningful ways is crucial for generating relevant policy analysis, and the process of reformulating questions in terms of exogenous shocks typically requires significant interaction between the modeler and the questioner to clarify the nature of the policy issue and make sure that the questioner is happy with the translation.

References

Clark, Peter and Douglas Laxton, 1995, "Exchange Rate Effects of Fiscal Consolidation," *World Economic Outlook* (Washington: International Monetary Fund), October, Annex I, pp. 73-81.

Haas, Richard and Paul Masson, 1996, "MINIMOD: Specification and Simulation Results," *Staff Papers,* International Monetary Fund, Vol. 33 (December), pp. 722-67.

International Monetary Fund, 1997, "Alternative Scenarios," *World Economic Outlook: Interim Assessment* (Washington: International Monetary Fund), December, pp. 35-39.

Isard, Peter and Hamid Faruqee (eds.), 1998, *Exchange Rate Assessment: Extensions of the Macroeconomic Balance Approach*, IMF Occasional Paper No. 167 (Washington: International Monetary Fund).

Isard, Peter and Douglas Laxton, 1999, "Monetary Policy with NAIRU Uncertainty and Endogenous Policy Credibility: Perspectives on Policy Rules and the Gains from Experimentation and Transparency," in *Monetary Policy Under Uncertainty*, ed. by Benjamin Hunt and Adrain Orr, (Wellington: Reserve Bank of New Zealand), pp. 33-65.

Isard, Peter, Douglas Laxton, and Ann-Charlotte Eliasson, 1999, "Simple Monetary Policy Rules Under Model Uncertainty," in *International Finance and Financial Crises: Essays in Honor of Robert P. Flood, Jr.*, ed. by Peter Isard, Assaf Razin, and Andrew K. Rose, (Washington: International Monetary Fund and Boston: Kluwer), pp. 207-50.

Isard, Peter, Douglas Laxton, and Ann-Charlotte Eliasson, 2000, "Inflation Targeting with NAIRU Uncertainty and Endogenous Policy Credibility," *Journal of Economic Dynamics and Control*, forthcoming.

Laxton, Douglas, Peter Isard, Hamid Faruqee, Eswar Prasad, and Bart Turtelboom, 1998, *MULTIMOD Mark III: The Core Dynamic and Steady-State Models*, IMF Occasional Paper No. 164 (Washington: International Monetary Fund).

Masson, Paul R., Steven Symansky, Richard Haas, and Michael Dooley, 1988, "MULTIMOD: A Multi-Region Econometric Model," *Staff Studies for the World Economic Outlook* (Washington: International Monetary Fund), pp. 50-104.

Masson, Paul R., Steven Symansky, and Guy Meredith, 1990, *MULTIMOD Mark II, A Revised and Extended Model*, IMF Occasional Paper No. 71 (Washington: International Monetary Fund).

Weber, Rene and Gunther Taube, 1999, "On the Fast Track to EU Accession: Macroeconomic Effects and Policy Challenges for Estonia," IMF Working Paper WP/99/156 (November).

Figure 1. Debt Reduction With No Change in Government Spending

Solid - Inflation Forecast Based Rule
Dashed - Monetary Targeting Rule
Dotted - Fixed Exchange Rate Rule

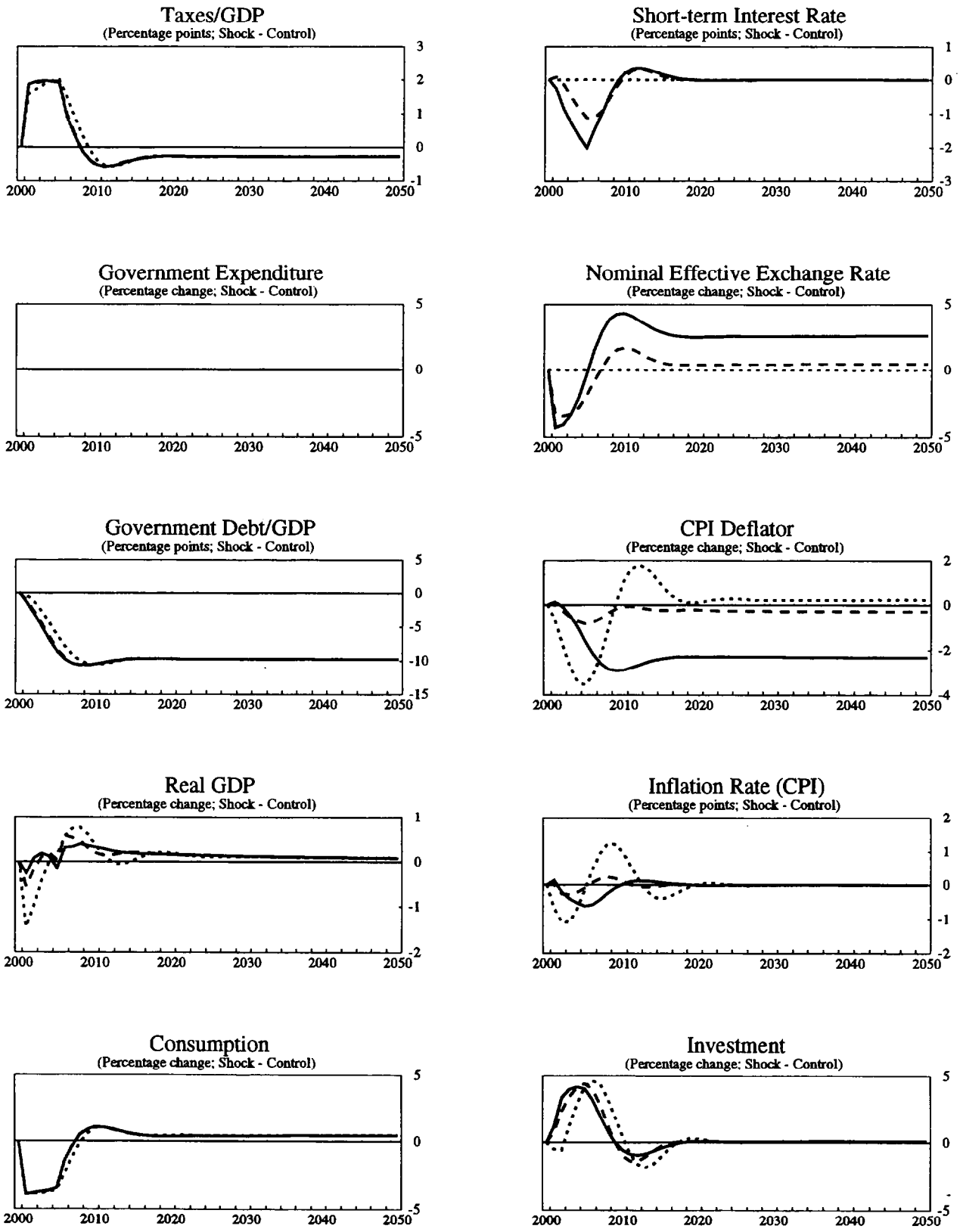

Figure 2. Debt Reduction Through a Permanent Decline in Government Spending

Solid - Inflation Forecast Based Rule
Dashed - Monetary Targeting Rule
Dotted - Fixed Exchange Rate Rule