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## Fundamental Determinants of the Effects of Fiscal Policy

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**Abstract**

**This Working Paper should not be reported as representing the views of the IMF.**

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We explore the underlying determinants of the macroeconomic effects of fiscal policy and tax and social security reform using the Global Fiscal Model (GFM). We show that the planning horizon of consumers, access to financial markets, and the elasticity of labor supply, as well as the characteristics of utility and production functions, and the degree of competition are all critical for determining the impact of fiscal policy. Four topical fiscal policy issues, for a representative large and small economy, are examined: the effects of changes in government debt; higher government spending; tax reform; and privatization of retirement savings.

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## I. INTRODUCTION

With the advent of the New Open Economy Macroeconomics (NOEM), a new paradigm has emerged to analyze the effects of macroeconomic policies and of international interdependence. NOEM models are general equilibrium models rooted in rigorous microfoundations allowing for the consideration of underlying or “fundamental” factors that affect the qualitative effects of macroeconomic policies while providing an opportunity to bring theory closer to the data. These models have so far mostly been applied to monetary policy issues, and this paper applies the general NOEM approach, as implemented through the recently developed IMF’s Global Fiscal Model (GFM), to analyze the effects of fiscal policy in one consistent and rigorous framework.

Specifically, the paper undertakes simulations using the GFM to revisit the fundamental determinants of four recurrent topics in fiscal policy: (i) the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries; (ii) the effects of higher current government spending on private consumption; (iii) the distortions created by alternative forms of taxation and the resulting macroeconomic benefits of revenue neutral tax reform; and (iv) the macroeconomic implications of proposals to privatize the pension system where such a reform can take place in either a compulsory or a voluntary manner.<sup>2</sup>

GFM is a multicountry dynamic general equilibrium model that is rooted in the NOEM tradition, but is specifically designed to explore fiscal policy issues. This paper allows for an extension of the previous work on the above topics as a result of four complementary features:

- GFM features a richer non-Ricardian structure as it incorporates overlapping generations in the spirit of Blanchard-Weil, allows for distortionary taxation, and includes the realistic assumption that not all consumers have full access to financial markets. As a result, we can assess to what extent such fundamental factors as consumer myopia, the sensitivity of workers to the real wage, the flexibility of the production structure, and the extent of nonparticipation in financial markets have a bearing on the effects of fiscal policy.
- The explicit microeconomic structure of the model allows for the consideration of a number of key factors that are not often given adequate attention when assessing the effects of fiscal policy. These include, for example, the sensitivity of consumption to changes in the real interest rate, which we will show is an important determinant of the macroeconomic effects of fiscal policy and tax and pension reform. Also, as in NOEM models, GFM incorporates the assumption of monopolistic competition. This assumption implies that output is partly demand determined in the short term—with

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<sup>2</sup> For applications of the model in the context of fiscal reform in respectively Canada and the United States see Bayoumi and Botman (2005), Bayoumi, Botman, and Kumar (2005), Kumhof, Laxton, and Muir (2005), and Botman and Laxton (2004).

important implications for the effects of fiscal policy—and this setup allows us to consider the effects of price markups for the distortionary effects of taxation.

- The multi-country dimension of GFM allows for additional channels through which fiscal policy operates and points to the degree of trade openness as another fundamental determinant of fiscal policy effects.
- Contrary to previous studies, which use a variety of modeling strategies and assumptions, GFM provides one uniform framework to study policy issues.

The remainder of the paper is organized as follows. Section II highlights the key features of GFM, while Section III discusses calibration of the model to a large and a small open economy, respectively, and includes a discussion of the baseline parameters. Section IV studies the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries. Section V examines the fundamental factors that influence the relationship between government spending shocks and private consumption, including the timing and type of tax policy changes needed to prevent higher government debt. Section VI analyzes the distortions caused by respectively labor, personal, and corporate income taxation. Given that these taxes imply different degrees of distortions, we also study the benefits of revenue-neutral tax reform, and the extent to which these benefits depend on behavioral assumptions. Section VII addresses the effects of pension reform, specifically the privatization of pension saving in either a compulsory or voluntary manner. Section VIII concludes.

## II. KEY FEATURES OF THE GLOBAL FISCAL MODEL

It should be emphasized at the outset that if the Ricardian equivalence hypothesis holds fully, many of the fiscal policy questions posed in this paper and in the real world would be virtually irrelevant. Generally speaking, complete Ricardian equivalence, on which there is scant empirical evidence, will hold in case consumers are homogenous and have an infinite planning horizon, if taxation is lump sum, if access to financial markets by all agents is complete, and if government debt is riskless. In such a setting, temporary changes in tax policy that increase government debt will affect the composition of national saving, but not its level. Any increase in the government deficit will be matched by higher private savings as agents anticipate having to make higher future tax contributions, with no effect on interest rates, consumption, investment incentives, or output. Also, any real effects of a temporary increase in government spending—followed by a contraction in spending in the future—will be offset by an equal reduction in private consumption. Furthermore, since there is only lump-sum taxation, there are no benefits from tax reform.

It should also be noted that traditional NOEM models do not depart from the Ricardian equivalence hypothesis enough to allow detailed consideration of fiscal policy issues.<sup>3</sup>

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<sup>3</sup> See Obstfeld and Rogoff (1995, 1996), Betts and Devereux (2001), Caselli (2001), Corsetti and Pesenti (2001) and Ganelli (2003a). In a recent paper, Erceg, Guerrieri, and Gust (2005) add rule-of-thumb consumers to a model based on the representative agent paradigm and then use the model to study the effects of recent U.S. fiscal deficits on the current account deficit. Not surprisingly, they find much smaller effects than in models that

(continued...)

Instead, since these models feature a representative agent framework with lump-sum taxation, the analysis is restricted to the effects of balanced budget fiscal policies.

The IMF's Global Fiscal Model (GFM) extends the NOEM framework to incorporate sufficient degree of non-Ricardianity to allow for an analysis of the effects of fiscal policy and of interdependence.<sup>4</sup> There are three reasons why full Ricardian equivalence does not hold in GFM. First, the model features overlapping generations in the spirit of Blanchard-Weil. The use of overlapping generations allows the assumption of Ricardian equivalence to be relaxed, implying that government debt is perceived as net wealth. Essentially, consumers have short planning horizons, which implies that even temporary changes in fiscal policy affect their incentives to consume and work as they discount any future fiscal policy reaction. Second, GFM incorporates the assumption that some consumers do not have sufficient access to financial markets to smooth their consumption over time. This is consistent with overwhelming evidence that even in the advanced economies up to a third of the consumers are liquidity constrained. Liquidity-constrained agents consume their entire disposable income every period and therefore any change in fiscal policy that affects this disposable income will have real effects. Third, GFM allows labor supply and capital accumulation to be endogenous and respond to changes in incentives related to the after-tax real wage or the after-tax rate of return of capital. This in turn allows the model to incorporate the assumption of distortionary taxes, and analyze the consequences of changes in these taxes.

One further difference between traditional NOEM models and GFM is the absence of nominal rigidities in the latter. In the current setup, it is still assumed that wages and prices are fully flexible. This assumption implies that the central bank follows money targeting, which limits the analysis of the interaction between monetary and fiscal policy. Also, short-term multipliers will be smaller than is the case for models with nominal rigidities. In this context, it should also be noted that capital mobility in GFM is perfect implying that interest rates are set in world markets. As a result, especially for small open economies, the crowding-out effects of government debt via higher interest rates will tend to be smaller than would be the case if there were impediments to capital flows and international trade. These features nonetheless provide a useful benchmark for the analysis, especially regarding the medium- and long-term effects of fiscal policy.

NOEM models have been extended over the past two-three years to allow for an analysis of fiscal policy issues. An overlapping generations setting has been brought into NOEM framework by Ghironi (2003a and 2003b), and by Ganelli (2003a and 2003b).<sup>5</sup> The former does not consider the effects of government debt, but shows that an overlapping generations structure following Blanchard (1985) and Weil (1989) ensures the existence of a well-defined

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allow for the possibility that permanent increases in government debt can have permanent consequences for the stock of net foreign liabilities and the world real interest rate.

<sup>4</sup> GFM is described in more detail in Botman and others (2006).

<sup>5</sup> See Frenkel and Razin (1992) for a diagrammatic exposition of a two-country overlapping-generations model without distortionary taxation.

steady state for net foreign asset holdings (for an early analysis of this, see Buitier, 1981). Ghironi, Iscan, and Rebucci (2005) describe how differences in agents' discount rates across countries gives rise to nonzero net foreign asset positions in the long run.

Ganelli (2003b) is the first attempt to analyze alternative fiscal policies in a NOEM model with finite lives. Apart from including endogenous labor supply and liquidity-constrained consumers, GFM extends this approach in four other major directions:

- The utility function is less restrictive, permitting the analysis of alternative values for the intertemporal elasticity of substitution. This parameter affects the sensitivity of consumers to changes in the real interest rate. Although it is not given sufficient attention, as shown below, it has important implications for an assessment of the impact of fiscal policy.
- At the same time, the production structure is extended to include endogenous capital formation, which provides an additional channel through which government debt can potentially crowd out economic activity and allows for the consideration of corporate and personal income taxation. In GFM, investment is driven by a Tobin's Q relationship, with firms responding sluggishly to differences between the future discounted value of profits and the market value of the capital stock. In addition, the supply of labor is made endogenous and consequently labor income taxes will be distortionary.
- The model features both traded and nontraded goods, which allows us to consider the terms of trade effects of changes in fiscal policy and potentially the implications of various degrees in home bias in either private or government consumption.
- Compared to other fiscal models, GFM features a richer menu of taxation. The taxes included are a labor income tax levied on wage compensation paid by workers, a corporate income tax levied on accounting profits of firms, and a personal income tax levied on labor income, accounting profits, government transfers, and interest income (on government bonds and net foreign assets). Each of these taxes has a single, albeit different, marginal rate, which coincides with the average tax rate. While at present GFM does not incorporate a sales tax or VAT, it should be noted that a consumption tax in many ways is identical to labor income taxation in the sense that both taxes affect the consumption-leisure decision in a similar manner.<sup>6</sup>

GFM also has a stylized financial sector block, with two kinds of assets, namely government debt (which can be traded internationally) and equity (which is held domestically). Changes in the outstanding stock of debt have direct implications for long-term interest rates through a variety of channels that are discussed below.

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<sup>6</sup> Nevertheless, since increasing a VAT also taxes accumulated savings, it is likely to be less distortionary than a tax on labor income, which partly explains its popularity in many countries as an important source of revenue.

### III. CALIBRATING THE MODEL

For the purposes of analyzing the issues noted earlier, the key macroeconomic parameters of the model are based on two sets of values reflecting respectively features of a large open economy and a small open economy (Table 1).<sup>7</sup> The calibration reflects in particular only the key aspects of the macroeconomic and fiscal structure of these economies. The macroeconomic aspects include the ratios to GDP of consumption, investment, wage income, and income from capital. The fiscal aspects include tax revenue from labor income, corporate income, and personal income in GDP as well as the ratios of government debt and government spending to GDP.

The size of the large economy is posited to be 30 percent of that of its trading partners, which essentially constitute the world economy, while the corresponding value for the small economy is assumed to be around 5 percent of that of its trading partners. Given the specification of the GFM as a “two-country model”, the spillover effects of any policy change can be assessed vis-à-vis the “foreign” economy.<sup>8</sup>

The discount rates for both economies are computed residually to generate a steady-state real interest rate of 3 percent. The effective discount rate is the product of the resulting pure rate of time preference and of average longevity. Following the Blanchard-Weil setup, this is parameterized as the probability of living. The discount rate constitutes one of the key underlying parameters of the economy. Indeed, differences in discount rates across countries have a significant bearing on whether in the steady state a country is a net debtor or net creditor vis-à-vis the rest of the world. In general, the more impatient country will optimally run a trade balance deficit with corresponding accumulation of net foreign liabilities. In addition to giving rise to a non-Ricardian framework, this was another important reason why several modelers adopted the Blanchard-Weil OLG framework and incorporated it into both small open-economy models as well as multi-country models.<sup>9</sup>

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<sup>7</sup> The calibration of the model broadly replicates the United States as the large economy, and the Czech Republic as the small economy, although it should be emphasized that the calibration is not intended to capture all the key characteristics of these two economies, but rather to provide an illustrative benchmark for the large and the small economies.

<sup>8</sup> Although the version of the model discussed here features a two-country setup, a multi-country version exists (see Kumhof, Laxton, and Muir 2005 for an application of a four-country version).

<sup>9</sup> For a collection of early models with these features, see Buiter (1981), Blanchard (1985), Weil (1989), McKibbin and Sachs (1991), Black and others (1994, 1997), Faruqee, Laxton, and Symansky (1997), Laxton and others (1998), and Faruqee and Laxton (2000).

Table 1. Key Macroeconomic Variables in the Initial Steady State

	Large economy	Foreign	Small economy	Foreign
<b>Country size</b>	30.0	70.0	5.0	95.0
% share of world real income	29.4	70.6	4.0	96.0
<b>National expenditure accounts at market prices</b>				
Consumption	62.4	65.4	50.6	64.6
rule-of-thumb	9.3	9.3	7.7	9.3
forward-looking	53.2	56.1	43.0	55.3
domestic	45.5	57.6	24.8	63.3
imported	17.0	7.8	25.9	1.3
Investment	15.5	15.4	21.9	15.5
for tradables	5.6	5.3	9.1	5.4
for non-tradables	9.9	10.2	12.8	10.1
domestic	11.3	13.6	10.7	15.1
imported	4.2	1.9	11.2	0.3
Government expenditures	20.0	20.0	26.0	20.0
Exports	23.2	8.8	38.6	1.6
of consumption goods	18.8	7.1	31.1	1.1
of investment goods	4.4	1.8	7.4	0.5
Imports	21.2	9.7	37.1	1.6
of consumption goods	17.0	7.8	25.9	1.3
of investment goods	4.2	1.9	11.2	0.3
<b>Tradable/nontradable split</b>				
Tradables	32.7	30.8	40.6	31.3
domestic	9.8	22.1	3.7	29.8
imported	20.8	9.5	35.5	1.6
Nontradables	67.4	69.2	59.4	68.7
<b>Factor incomes</b>				
Capital	37.8	37.7	46.9	37.8
Labor	62.2	62.3	53.1	62.2
<b>Interest rates and inflation</b>				
Nominal short-term interest rate	5.1	5.1	6.1	5.1
Real short-term interest rate	3.0	3.0	3.0	3.0
CPI inflation	2.0	2.0	3.0	2.0
<b>Government</b>				
Deficit	0.9	0.9	0.7	0.9
Debt	45.0	45.0	24.0	45.0
<b>Tax rates</b>				
On total income (effective)	20.5	20.5	25.8	20.5
gross rate	26.2	26.1	30.8	26.2
transfer rate	5.7	5.7	5.0	5.7
On labor income (effective)	15.0	14.0	33.2	14.3
as a % of income	7.1	6.6	16.2	6.8
gross rate	27.0	25.9	43.4	26.2
transfer rate	12.0	11.9	10.2	11.9
On capital income	11.0	11.0	9.0	11.0
as a % of income	1.9	1.9	2.2	1.9
On dividend income (profits)	11.0	11.0	9.0	11.0
as a % of income	4.1	4.1	2.6	4.1
On personal income	8.5	8.5	6.0	8.5
as a % of income	7.4	7.9	4.8	7.8

Source: GFM simulations.

The behavioral parameters are based on microeconomic estimates and set equal across the two benchmark economies (Table 2).<sup>10</sup> This includes the parameters characterizing real rigidities in investment, the sensitivity of workers to changes in the real wage, the elasticity of substitution between labor and capital, the share of liquidity-constrained consumers, and the elasticity of intertemporal substitution. However, price markups and depreciation rates, as well as the shares of labor and capital in national income, are set to reflect the differential estimates for the two economies.

The fact that we set most of the parameters equal indicates that there is little comparable empirical evidence about these fundamental factors across countries or large and small economies. This is a lacuna as we will argue that these parameters have a fundamental bearing on the effects of fiscal policy and it is likely that these parameters will in reality vary across countries—not only between small and large economies, but also between open and more closed economies, developed and less developed economies, and countries with large versus those with small social protection systems.

Table 2. Behavioral Assumptions and Key Parameters in the Initial Steady State

	Large economy	Small economy	Foreign
<b>Behavioral assumptions subject to sensitivity analysis</b>			
Planning horizon of consumers	10 years	10 years	10 years
Labor disutility parameters	0.96	0.96	0.96
Fraction of rule-of-thumb consumers	0.25	0.25	0.25
Intertemporal elasticity of substitution	0.33	0.33	0.33
Elasticity of substitution between capital and labor	0.80	0.80	0.80
<b>Other key parameters</b>			
Effective discount rate	0.87	0.87	0.92
Depreciation rate on capital	0.10	0.20	0.10
Capital adjustment cost parameters	2.0	2.0	2.0
Elasticity of substitution between varieties			
Tradables sector	6.0	10.0	6.0
Price markup over marginal cost	1.2	1.1	1.2
Nontradables sector	3.5	7.5	3.5
Price markup over marginal cost	1.4	1.2	1.4
Capital share in production tradables sector	0.50	0.55	0.50
Capital share in production nontradables sector	0.50	0.55	0.50
Utility from real money balances	0.02	0.02	0.02
Price stickiness parameters	0	0	0
Home bias in government consumption	yes	yes	yes
Home bias in private consumption	no	no	no
Elasticity of substitution between traded and nontraded goods	0.75	0.75	0.75
Bias towards domestically produced tradable over nontradables	0.40	0.54	0.40

Source: GFM simulations.

<sup>10</sup> See Laxton and Pesenti (2003) for a more detailed discussion of evidence on parameter values.

Apart from the size of the economy, the paper explores the following five main fundamental determinants of the effects of fiscal policy, with the first three reflecting consumption and saving decisions and the last two the production framework:

- *The consumers' "degree of impatience"*. This parameter is proxied by the wedge between the rate of time preference and the yield on government bonds. This parameter has not been subject to much microeconomic analysis. The baseline value of the wedge is set to 10 percent—which translates into a planning horizon of 10 years—with an alternative simulation using values consistent with a longer planning horizon. In GFM, owing to the overlapping generations structure, the parameter guiding the planning horizon is the probability of living. The baseline value is obviously much lower than the probability of survival for most of the population, but it is a simple way of introducing a form of myopia into the model that many others have emphasized is necessary to generate plausible dynamics.<sup>11</sup>
- *Limited participation in financial markets*. This is the fraction of consumers that does not have access to credit markets and hence cannot smooth consumption over time. In the baseline, 25 percent of the population is assumed to be liquidity constrained (empirical evidence suggests that the proportion may be as high as 33 percent), with the consumers spending their entire disposable income every period. This combined with a planning horizon of 10 years generates plausible dynamics and correlations between consumption and disposable income.<sup>12</sup> To investigate the importance of this assumption, an alternative simulation assumes that all consumers can use credit markets to smooth their consumption over time. It should be noted that despite the fact that liquidity-constrained consumers represent a quarter of the population in the baseline, they account for a much smaller share of total private consumption because their incomes are lower and they do not have any wealth.
- *The sensitivity of consumers to changes in the real interest rate*. Lower values of the intertemporal elasticity of substitution will result in larger increases in real interest rates when government debt increases. The baseline value for this parameter is -0.33, which is consistent with the upper end of the range of empirical models without habit persistence.<sup>13</sup> The parameter value in the alternative simulation, -0.20, is consistent with the lower end of microeconomic estimates for models without habit persistence.
- *The sensitivity of labor supply to the real wage (Frisch elasticity)*. The absolute value of this elasticity in the baseline (-0.04) is at the mid-range of values found in micro-

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<sup>11</sup> Other studies, for example, McKibbin and Sachs (1991) assume an even shorter planning horizon. However, since GFM also incorporates liquidity-constrained consumers who essentially have a one-year planning horizon we use a longer planning horizon for optimizing agents.

<sup>12</sup> Models without finite planning horizons, such as infinitely-lived representative agent models, sometimes assume a much larger share of liquidity-constrained consumers to generate a more plausible correlation between disposable income and consumption—see Erceg, Guerrieri and Gust (2005), who use a value of 0.5.

<sup>13</sup> Patterson and Pesaran (1992) and Attanasio and Weber (1993) argue that the elasticity of intertemporal substitution falls between 0.1 and 0.3 in models with habit formation.

economic studies. Such a value can be characterized as a moderately elastic labor supply: most empirical studies indeed find a modest elasticity for males and a somewhat more elastic labor supply for females. The elasticity of labor supply is a key determinant of the crowding-out effects of government as it affects the distortion created by labor income taxes. To illustrate this, alternative simulations assume values consistent with more elastic labor supply respectively inelastic labor supply.

- *The elasticity of substitution between labor and capital in the production function.* The ease with which firms can substitute between factors of production is an indication of the flexibility of the production structure of the economy, with the elasticity likely to exhibit large variation between different sectors in the economy. The baseline value is -0.8, with an alternative simulation using a higher value of -1 which is the value for a Cobb-Douglas production function.

#### **IV. THE MACROECONOMIC EFFECTS OF GOVERNMENT DEBT**

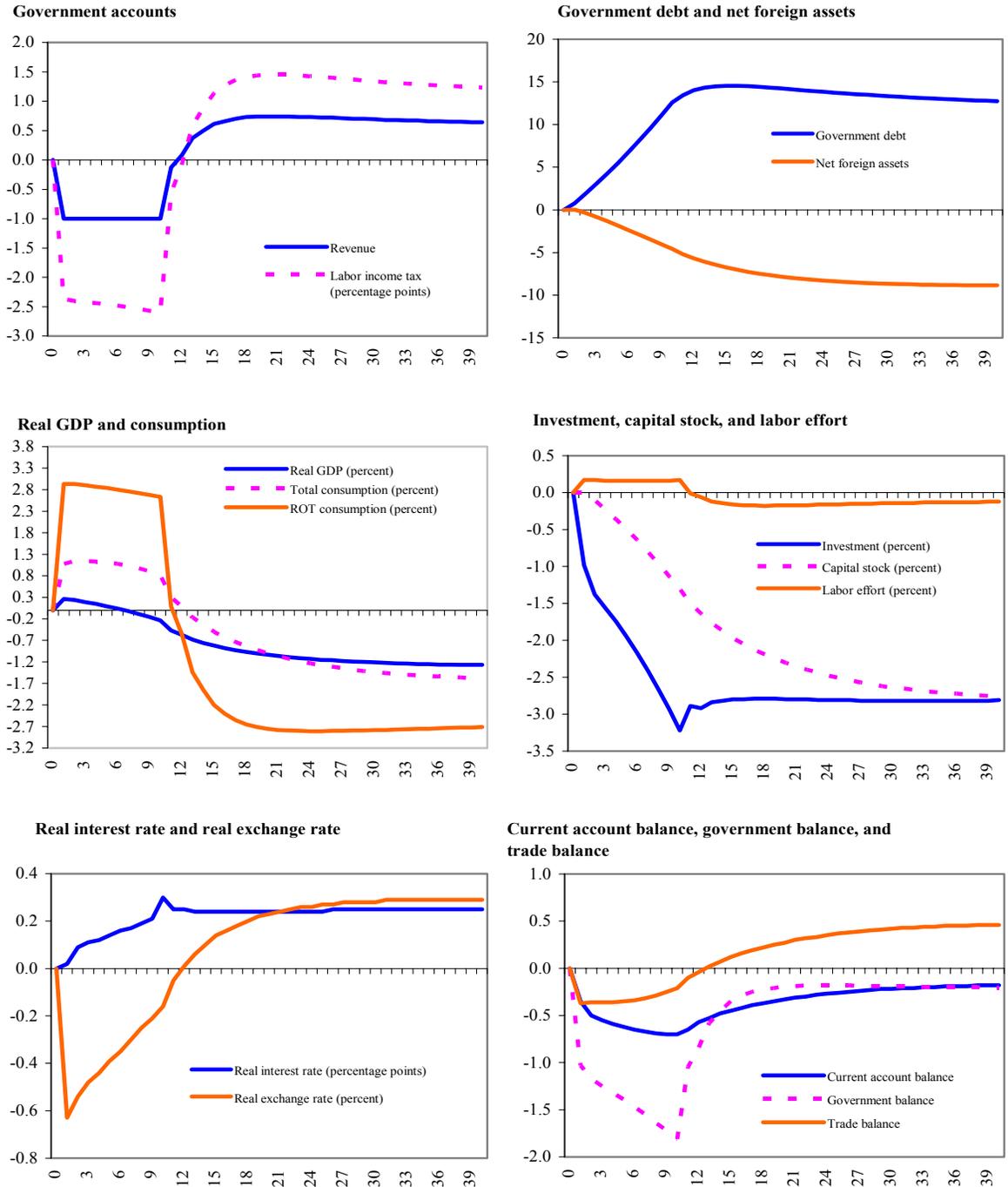
This section studies the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries, and in the process illustrates some of the key properties of the model. We draw a distinction between, on the one hand, a reduction in labor income taxes that results in permanently higher government debt and, on the other, temporary higher government debt resulting from a reduction in labor income taxes but followed by a fiscal consolidation.

##### **A. Tax Cut Causing Permanently Higher Debt**

This simulation assumes a debt-financed temporary reduction in labor income taxes by the equivalent of 1 percent of GDP for 10 years. The macroeconomic effects of such a tax cut are depicted in Figures 1 and 2 for the large and the small economy respectively.

Consider first the large open economy. A 1 percent of GDP reduction in revenue corresponds to roughly a 2.5 percentage point cut in the labor income tax rate. Such a cut in taxes leads to an increase in government deficits, which are then reflected in an increase in government debt. There are a variety of other economic developments that accompany this temporary change in tax policy. A decline in taxes leads to an increase in labor effort as agents substitute work for leisure to take advantage of temporary lower tax rates and higher labor demand by firms. The combination of lower taxes and higher labor effort leads to an increase in after-tax wage income, which in turn leads to an increase in private consumption. This is despite the fact that the reduction in taxes is temporary, and it highlights the non-Ricardianness of the model. Specifically, the increase in consumption is particularly strong for liquidity-constrained consumers who consume the entire increase in disposable income. Optimizing agents, with access to credit markets, on the other hand do save part of their temporary higher income, although not the full amount, to anticipate for the possibility that they will face a higher future tax burden. Higher aggregate demand, given the assumption of monopolistic competition, increases GDP in the short term. As expected given the absence of nominal rigidities, the short-term multipliers are small, with GDP increasing by less than a fifth of a percent in the first five years.

**Figure 1. Macroeconomic Effects of Permanently Higher Government Debt: Large Economy 1/**  
(Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

1/ The effects of a 1 percent of GDP cut in labor income taxes for 10 years.

A decline in government savings is associated with an increase in real interest rates compared to the rest of the world, and an appreciation in the real exchange rate. The currency appreciation in the near term implies a positive wealth effect for consumers, which further

stimulates aggregate demand, and initially supports higher GDP. The real interest rate increases by about 30 basis points in the long run. This is broadly consistent with evidence from reduced-form empirical evidence concerning the increase in world interest rates during the 1980s in countries with integrated capital markets (see Ford and Laxton, 1999). Higher interest rates have an adverse effect on investment and the capital stock, which pulls down potential growth in the medium and long run.

Given the real appreciation of the currency, and the fact that some of the additional consumption falls on imports, the trade balance moves into a deficit. Thus, twin deficits—government and the current account—emerge as a result of the expansionary fiscal policy. The deterioration in the current account is about half the size of the decline in the revenue-to-GDP ratio, during the entire period of fiscal loosening, which is consistent with the evidence reported in Kumhof, Laxton, and Muir (2005) for the United States. Put differently, the magnitude of this response highlights the potentially important contribution fiscal adjustment in a large open economy suffering from twin deficits could make to reduce the external (and global) imbalances. These estimates are considerably larger than those obtained in another recent model-based analysis of this topic (see Erceg, Guerrieri, and Gust, 2005). The model developed by Erceg, Guerrieri, and Gust is based on the representative agent framework and the only source of non-Ricardian behavior is the presence of rule-of-thumb consumers. As such, the impact of government debt on the net foreign asset position is muted and this divergence of results highlights the critical role of short planning horizons in GFM.

Since the economy needs to run primary surpluses to finance the higher interest spending, after the ten-year period, labor income tax rates will be permanently higher by about 1 percentage point, where we assume that the increase in taxes after 10 years takes place in a gradual manner. As a result, consumption and labor effort over the medium term decline. These declines, together with the crowding out of investment as a result of higher interest rates noted above, causes a permanent decline in output.<sup>14</sup> Moreover, over the medium and long run, a permanent real exchange rate depreciation will be needed in order to run trade balance surpluses to service the stock of accumulated net foreign liabilities.<sup>15</sup>

Next consider the results for a small open economy (Figure 2). There are a number of distinct differences compared to those for the large economy. First, the increase in consumption and output is greater and of somewhat longer duration—this is due primarily to a higher sensitivity of the real exchange rate to interest rate differentials. Second, compared to an increase in government debt in the large economy, the increase in interest rates in the long term is considerably smaller as fiscal policy in the small economy has a negligible effect on global saving and investment. Third, given the negligible effect on interest rates, there is a significantly smaller impact on investment and the capital stock, and hence on potential

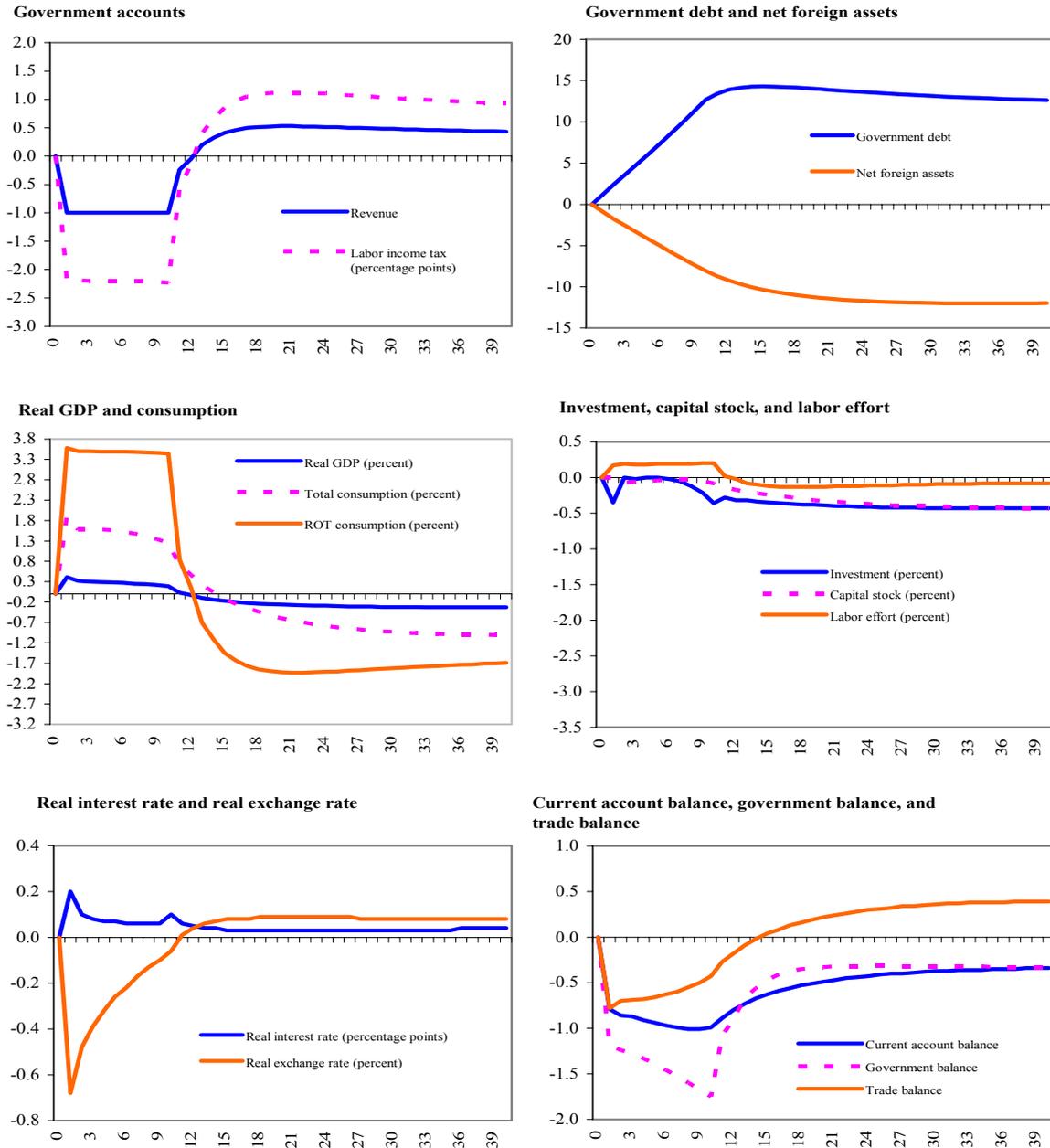
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<sup>14</sup> Consumption and labor effort are negatively correlated in the long term since leisure is a normal good.

<sup>15</sup> By contrast, a model with Ricardian equivalence posits that net foreign liabilities and real interest rates do not depend on the level of government debt in the long run. Lane and Milesi-Ferretti (2002) find empirical support that the stock of public debt is an important determinant of the net foreign asset position in both industrial and developing countries.

output in the long term. Notice also that the small open economy considered here has a relatively large share of exports and imports and therefore is more affected by the global trade and investment relationship. Therefore, in all there are marked differences in the macroeconomic consequences of higher debt for a small open economy compared to a large one. Also, the response of the current account is almost equal to the decline in government revenue as a share of GDP.

**Figure 2. Macroeconomic Effects of Permanently Higher Government Debt: Small Economy 1/**  
(Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

1/ The effects of a 1 percent of GDP cut in labor income taxes for 10 years.

To highlight the importance of the behavioral assumptions, Table 3 reports the long-term effects of higher government debt on real GDP and real interest rates under alternative parameterizations. The crowding-out effects of government debt, for both the large and small open economy cases, depend in particular on the planning horizon of consumers as well as the sensitivity of consumption to changes in the real interest rate. The presence of rule-of-thumb consumers, the sensitivity of workers to changes in the real wage, and the substitutability between factors of production matter less for the long-term crowding-out effects of government debt.

A longer planning horizon for optimizing agents implies that a higher fraction of the temporary cut in taxes will be saved to prepare for higher future tax liabilities. As a result, national saving declines by less, as reflected in a smaller accumulation of net foreign liabilities. This in turn implies a considerably smaller increase in long-term real interest rates and smaller crowding out of investment. A lower intertemporal elasticity of substitution implies that consumption is less responsive to changes in the real interest rate. Since both types of economies need to run trade balance surpluses to service foreign liabilities, this implies that real interest rates need to increase by more to induce lower domestic consumption. As a result, crowding-out effects will be stronger.

Table 3. Sensitivity Analysis: Long-Term Effects of Permanently Higher Government Debt on Real GDP and Real Interest Rates Under Alternative Parametrizations

	Large economy	Foreign	Small economy	Foreign
Baseline 1/				
Real GDP	-1.25	-0.89	-0.33	-0.13
Real interest rate	0.25	0.25	0.03	0.03
Longer planning horizon 2/				
Real GDP	-0.23	0.02	-0.18	0.00
Real interest rate	0.01	0.01	0.00	0.00
Inelastic labor supply 3/				
Real GDP	-1.24	-0.88	-0.30	-0.13
Real interest rate	0.25	0.25	0.04	0.04
All consumers have access to financial markets 4/				
Real GDP	-1.11	-0.78	-0.29	-0.11
Real interest rate	0.21	0.21	0.03	0.03
Lower intertemporal elasticity of substitution 5/				
Real GDP	-2.63	-2.13	-0.48	-0.32
Real interest rate	0.58	0.58	0.08	0.08
Cobb-Douglas production function 6/				
Real GDP	-1.67	-1.28	-0.36	-0.18
Real interest rate	0.25	0.25	0.03	0.03

Source: GFM simulations.

1/ See Table 2 for parameter values in the baseline; long term refers to the new steady state value.

2/ Planning horizon is 100 years.

3/ The absolute value of the elasticity of labor supply is -0.001.

4/ The share of rule of thumb consumers is 0.

5/ The intertemporal elasticity of substitution is -0.20.

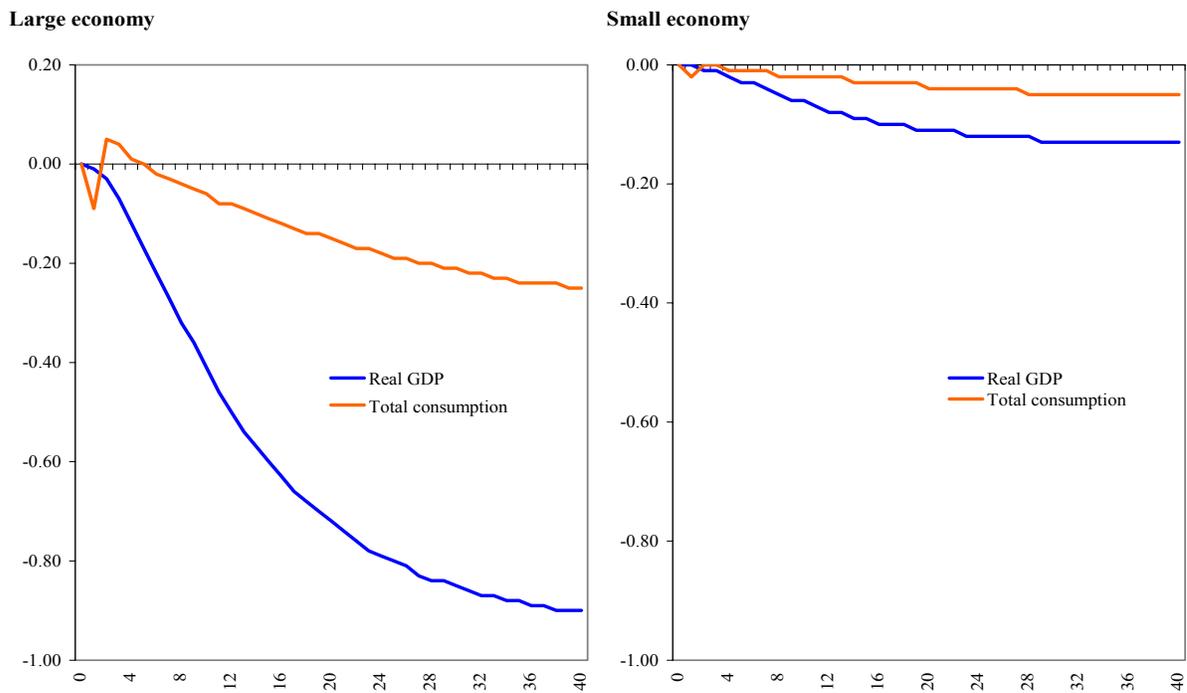
6/ The elasticity of substitution between capital and labor is 1.

Simulation results (not reported) also indicated that for a less open small economy, the interest rate would increase by more in the short term for the same policy change, with a correspondingly much larger real exchange rate appreciation. Further note that a corollary of the results above is that crowding-out effects of government debt are larger for economies that are relatively closed to international trade.

### B. International Spillover Effects of Government Debt

The above differences between the large and small economy are reflected in the spillover effects to the rest of the world of the change in tax policy. The exchange rate and interest rate movements, together with trade linkages, are the main channels through which such spillover effects occur (Figure 3). The initial real appreciation of the exchange rate in the home economy and the corresponding depreciation in the rest of the world imply a negative wealth effect for the rest of the world, although the magnitude of this varies significantly between the large and the small economies. The adverse effect on output that this entails is accompanied by the higher demand for the foreign economy's imports that provides a positive stimulus to rest-of-the-world output. For both the large and the small economy case these effects more or less balance in the short term, implying modest changes in output and consumption. However, over the long term higher government debt in the larger economy crowds out economic activity abroad as well via higher interest rates and lower demand for its exports, with an increasingly adverse effect on potential output. As might be expected, in the case of the small open economy, the spillover effects are small, even in the long term.

Figure 3. Spill-Over Effects From Fiscal Policies in Large and Small Economies  
(Deviation from initial steady state in percent)



Source: GFM simulations.

### **C. Temporary Tax Cut Followed by Fiscal Consolidation**

The above analysis is based on the assumption that labor income tax rates only increase to stabilize government debt. As a result, government debt remains permanently higher. An alternative scenario is where the policymakers cut taxes in the short term, but after a while change policy direction and instead focus on reducing government debt by increasing taxes. In other words, how do the above results change if instead the rise in debt is expected to be temporary? As Figures 4 and 5 indicate, for both types of economies, in contrast to a permanent increase in debt, the labor income tax rate needs to increase for a prolonged period for government debt to gradually decline so that in the long run it is back to the original level.

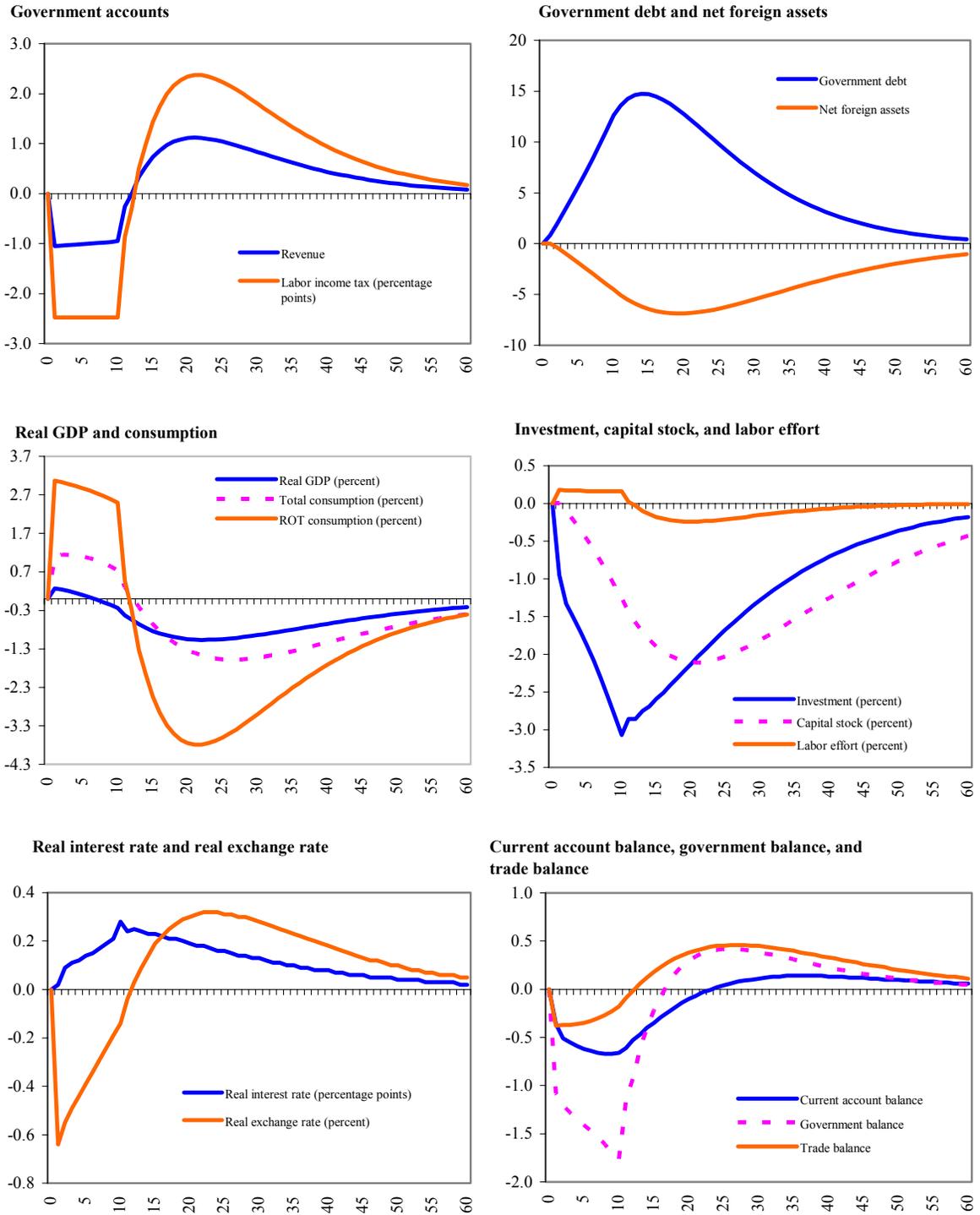
The macroeconomic consequences during the period of fiscal expansion reflecting a tax cut are similar to the scenario studied above, but the medium- and long-term effects are quite different. The decline in consumption and output is more marked in the medium term, but in contrast, there is no permanent loss to potential output. More importantly from a policy perspective, the medium-term output losses following fiscal adjustment exceed by a wide margin the short-term output gains associated with a fiscal stimulus. This is particularly the case for the large open economy and follows from the need to finance the interest burden on transition deficits.

### **D. Fundamental Determinants of the Effects of Temporary Fiscal Stimulus**

The above results are sensitive to the key structural and behavioral assumptions in the model. For instance, the extent to which consumption increases following the cut in labor income taxation depends on whether consumers expect to pay higher future taxes. This in turn is critical for the extent of medium-term consumption and output losses once taxes are increased. As such, the assumptions regarding the planning horizon of optimizing agents, together with the fraction of liquidity-constrained or “rule-of-thumb” consumers is critical. Furthermore, the results are materially affected by the extent to which labor effort responds to the initial decline, and subsequent increase, in taxes, as well as the substitutability between factors of production at the level of the firm. The extent to which the real exchange rate needs to depreciate in the long term depends on the sensitivity of consumers to changes in the real interest rate.

In order to evaluate the importance of these assumptions, Figures 6 and 7 report the macroeconomic effects of higher government debt on real GDP and real interest rates under alternative parameterizations.

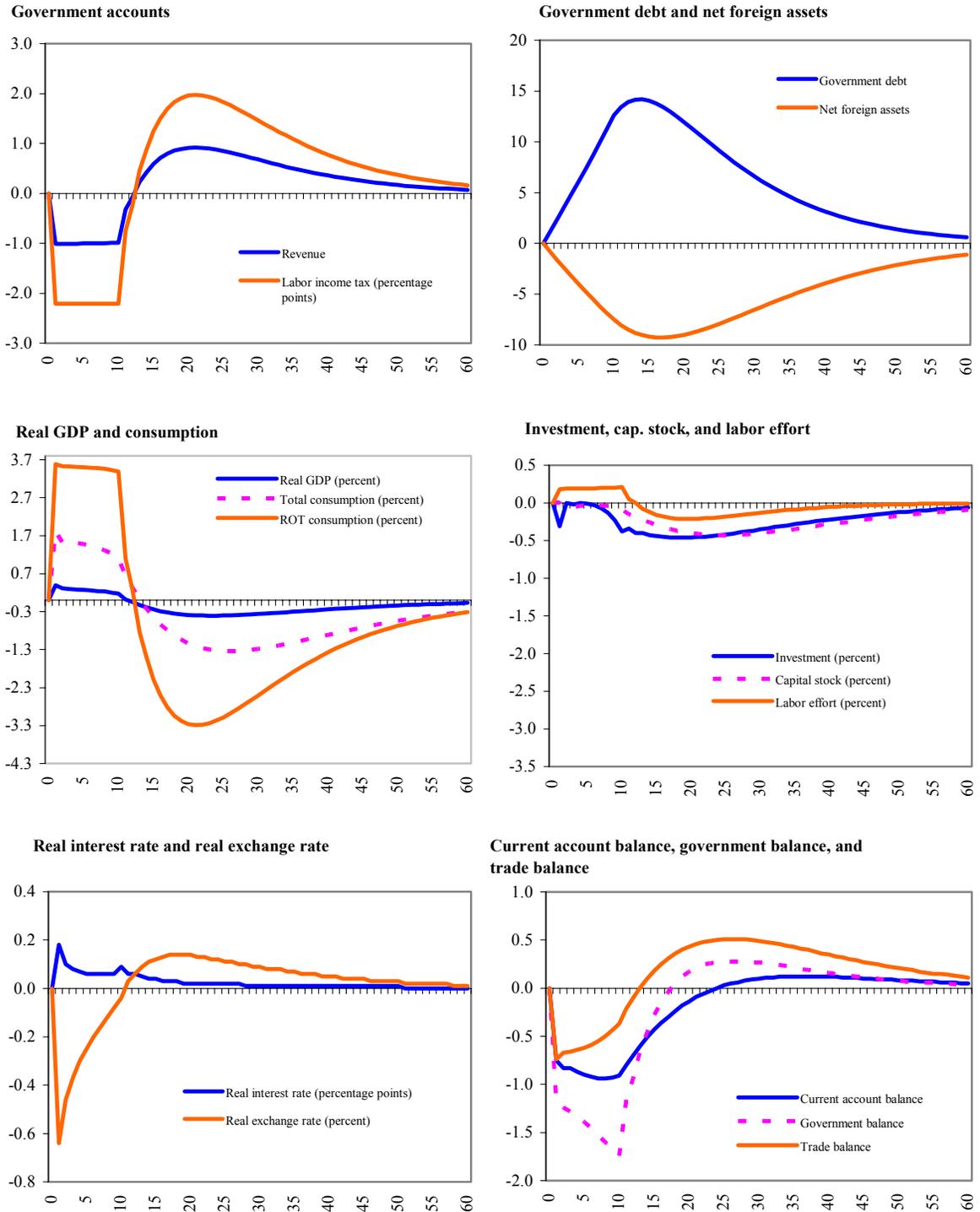
**Figure 4. Macroeconomic Effects of Temporary Higher Government Debt: Large Economy 1/**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

1/ The effects of a 1 percent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt in the long term.

**Figure 5. Macroeconomic Effects of Temporary Higher Government Debt: Small Economy 1/**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)

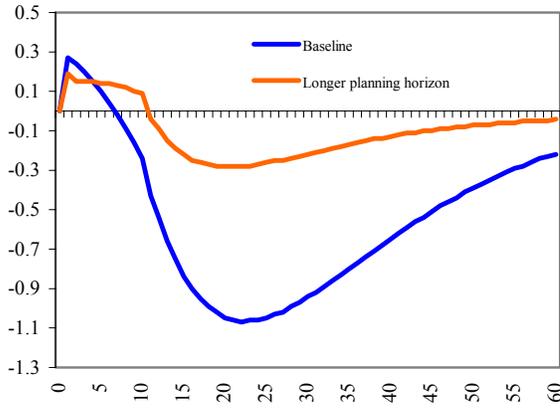


Source: GFM simulations.

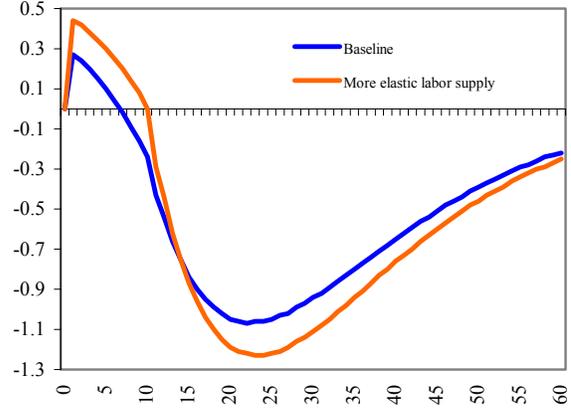
1/ The effects of a 1 percent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt in the long term.

**Figure 6. Effects on GDP in a Large Economy of Temporary Higher Government Debt:  
An Analysis of the Fundamental Determinants 1/**

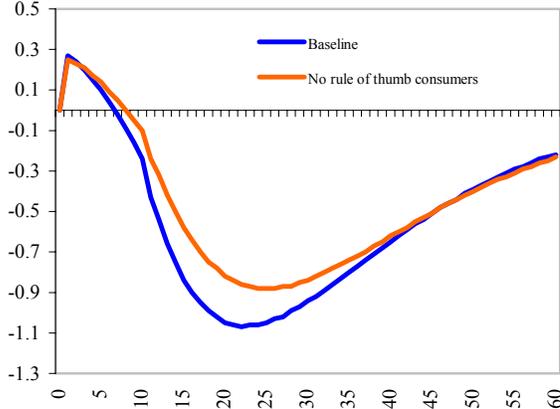
**Planning horizon of 100 years**



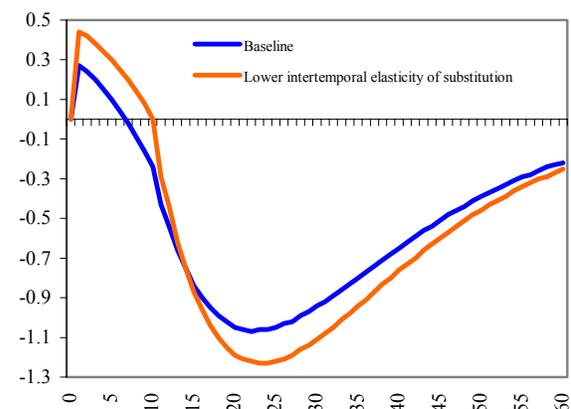
**Absolute elasticity of labor supply is 0.90**



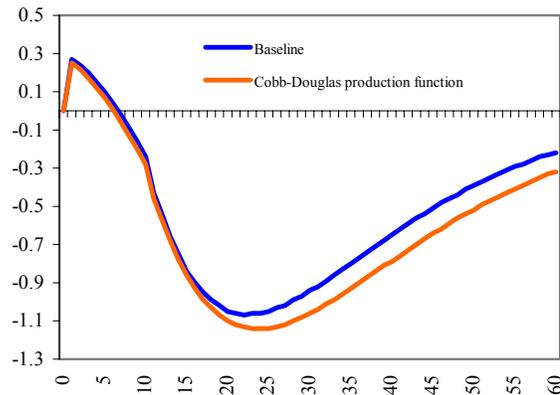
**No rule of thumb consumers**



**Lower intertemporal elast. of substit.**



**Cobb-Douglas production function**

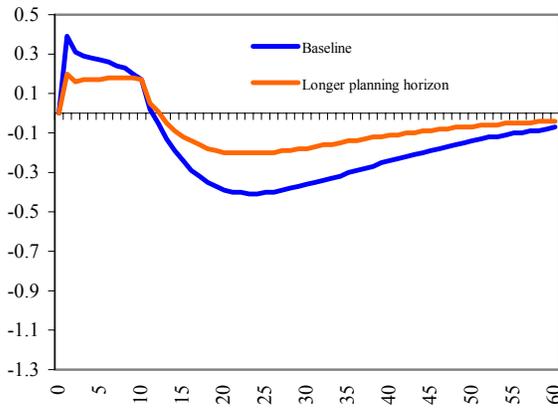


Source: GFM simulations.

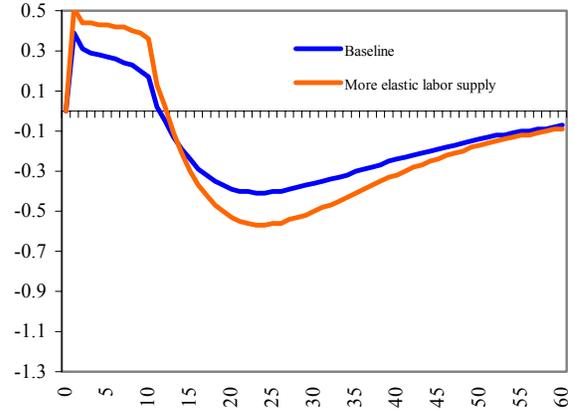
1/ The effects of a 1 percent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt. For baseline parameter values, see Table 2.

**Figure 7. Effects on GDP in a Small Economy of Temporary Higher Government Debt:  
An Analysis of the Fundamental Determinants 1/**

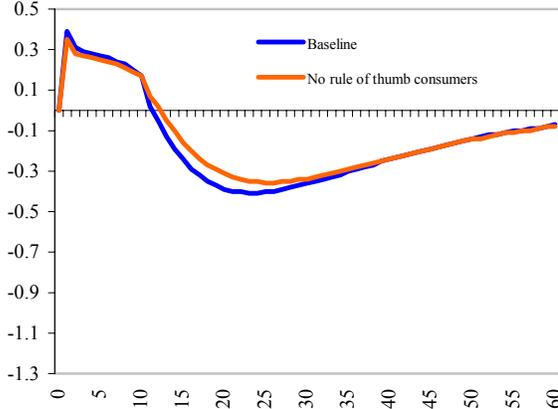
**Planning horizon of 100 years**



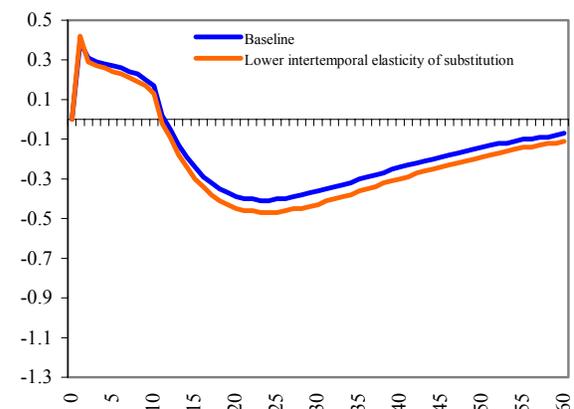
**Absolute elasticity of labor supply is 0.90**



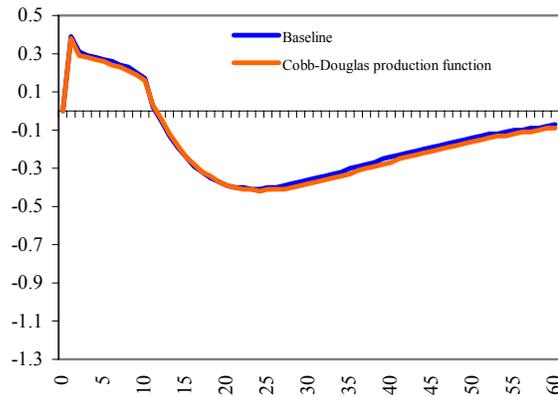
**No rule of thumb consumers**



**Lower intertemporal elast. of substit.**



**Cobb-Douglas production function**



Source: GFM simulations.

1/ The effects of a 1 percent of GDP cut in labor income taxes for 10 years, after which labor income taxes adjust to prevent higher government debt. For baseline parameter values, see Table 2.

**The simulations illustrate the following:**

- The crowding-out effects of government debt, for both the large and the small open economy case, depend in particular on the *planning horizon of consumers*. A longer planning horizon for optimizing agents implies that a higher fraction of the temporary cut in taxes will be saved to prepare for higher future tax liabilities. As a result, national saving declines by less, as reflected in a smaller accumulation of net foreign liabilities. This in turn implies a considerably smaller increase in long-term real interest rates and smaller crowding out of investment. Essentially, a longer planning horizon offsets the short-term gains from a fiscal expansion and correspondingly mutes the medium-term costs in terms of foregone output once the fiscal contraction occurs. This smoothing effect is particularly pronounced for the large economy.
- The presence of *liquidity-constrained or rule-of-thumb consumers* has a similar effect as a longer planning horizon, although to a much smaller extent. Essentially, with all agents optimizing, the crowding-out effects and the output decline in the medium-term is somewhat smaller. The fact that non-participation in financial markets matters less than consumer myopia is directly related to the fact that liquidity-constrained consumers account for only a small fraction of aggregate consumption.
- A *lower intertemporal elasticity of substitution* implies that consumption is less responsive to changes in the real interest rate. Both the large and the small economy need to run trade surpluses to service the transitory stock of net foreign liabilities. As a result, domestic consumption needs to decline, which implies that real interest rates need to increase to provide the incentive for additional saving. As consumption becomes less sensitive to changes in the real interest rate, the real interest rate needs to increase by more. As a result, crowding out of capital accumulation in the medium term will be stronger, and there will be a larger adverse effect on GDP growth. As such, the open-economy dimension of GFM underlines the important role for decision making by consumers in assessing the effects of fiscal policy.
- Increasing *the sensitivity of workers to changes in the real wage* implies a stronger increase of hours worked in the short term following the decline in labor income taxation. Similarly, in the medium term, labor effort declines by more when taxes increase as the emphasis of fiscal policy changes to reducing the stock of debt.
- For changes in tax policy centered on labor income taxation, the *substitutability between factors of production* does not appear to have a marked impact on the crowding-out effects of government debt.

## **V. GOVERNMENT SPENDING SHOCKS AND PRIVATE CONSUMPTION**

### **A. The Effects of Higher Government Spending on Private Consumption**

Keynesian theories and neoclassical real business cycle theories predict an opposite response of private consumption to higher government spending. In the IS-LM model, all consumers essentially behave in a rule-of-thumb fashion, which, together with sticky prices, implies that higher government spending financed through higher government debt increases private consumption. Conversely, in real business cycle models with infinitely lived representative

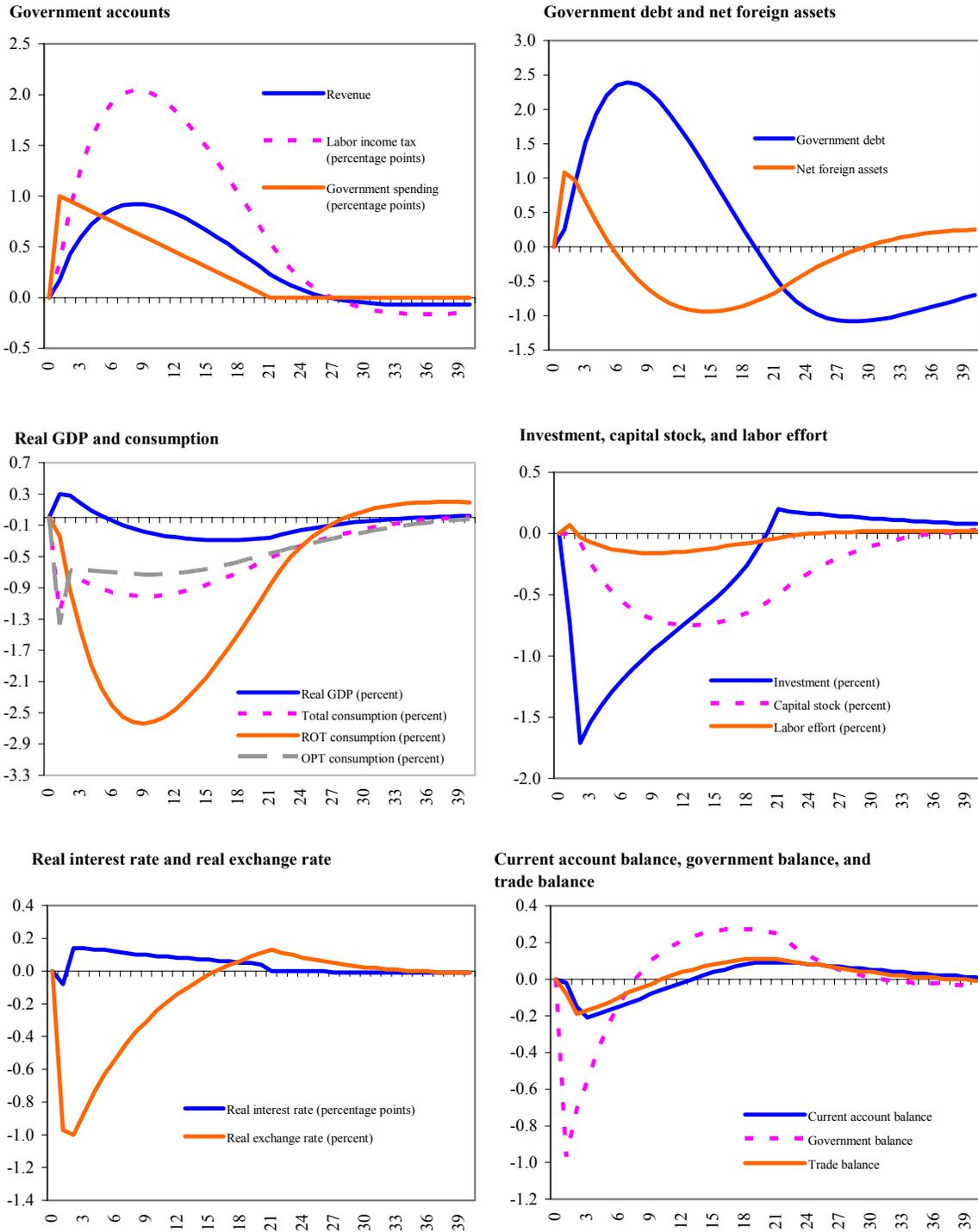
agents, consumers anticipate the higher future tax burden and, therefore, to smooth their consumption over time, save more. As a result, private consumption is expected to decline after a positive government spending shock.

Most of the empirical evidence finds a positive correlation between government spending and private consumption, thus supporting the Keynesian rather than the neoclassical view (see Gali, López-Salido, and Vallés 2005, for a recent overview of the empirical evidence; also see Fatás and Mihov, 2001; Blanchard and Perotti, 2002; and Perotti, 2004 for earlier analysis). Gali, López-Salido, and Vallés construct a model in the spirit of NOEM models to account for this empirical finding. Similar to GFM, in their framework, investment is determined by a Tobin's Q relationship with capital adjustment costs as well as monopolistically competitive firms. However, contrary to GFM, their model incorporates sticky wages and prices and monetary policy follows a Taylor rule. In combination with a significant proportion of rule-of-thumb consumers this can explain the observed positive correlation between government and private consumption. Indeed, it is the combination of nominal rigidities and the presence of non-Ricardian consumers that gives rise to this positive correlation.

Apart from sticky wages and prices and rule-of-thumb consumers, there is little in the existing literature about the fundamental factors that affect the correlation between government and private consumption. There are four key areas of interest where our analysis diverges from that of Gali, López-Salido, and Vallés. First, in Gali, López-Salido, and Vallés agents are infinitely lived while one would expect that the planning horizon is a key determinant of the response of private consumption to government spending shocks—as evidenced by the critical role of rule-of-thumb consumers. Second, Gali, López-Salido, and Vallés posit lump sum taxation. As a result, changing the composition and timing of higher taxation following the rise in government spending cannot be analyzed, but is likely to be an important determinant for the response of consumers. Third, unlike the setup in Gali, López-Salido, and Vallés, GFM is an open-economy model allowing for wealth effects operating through the real exchange rate to affect private consumption as well as to study whether the response is different for large and small economies. Finally, we will analyze the extent to which the production technology and sensitivity of consumers to changes in the real interest rate affect the response of private consumption to government spending shocks.

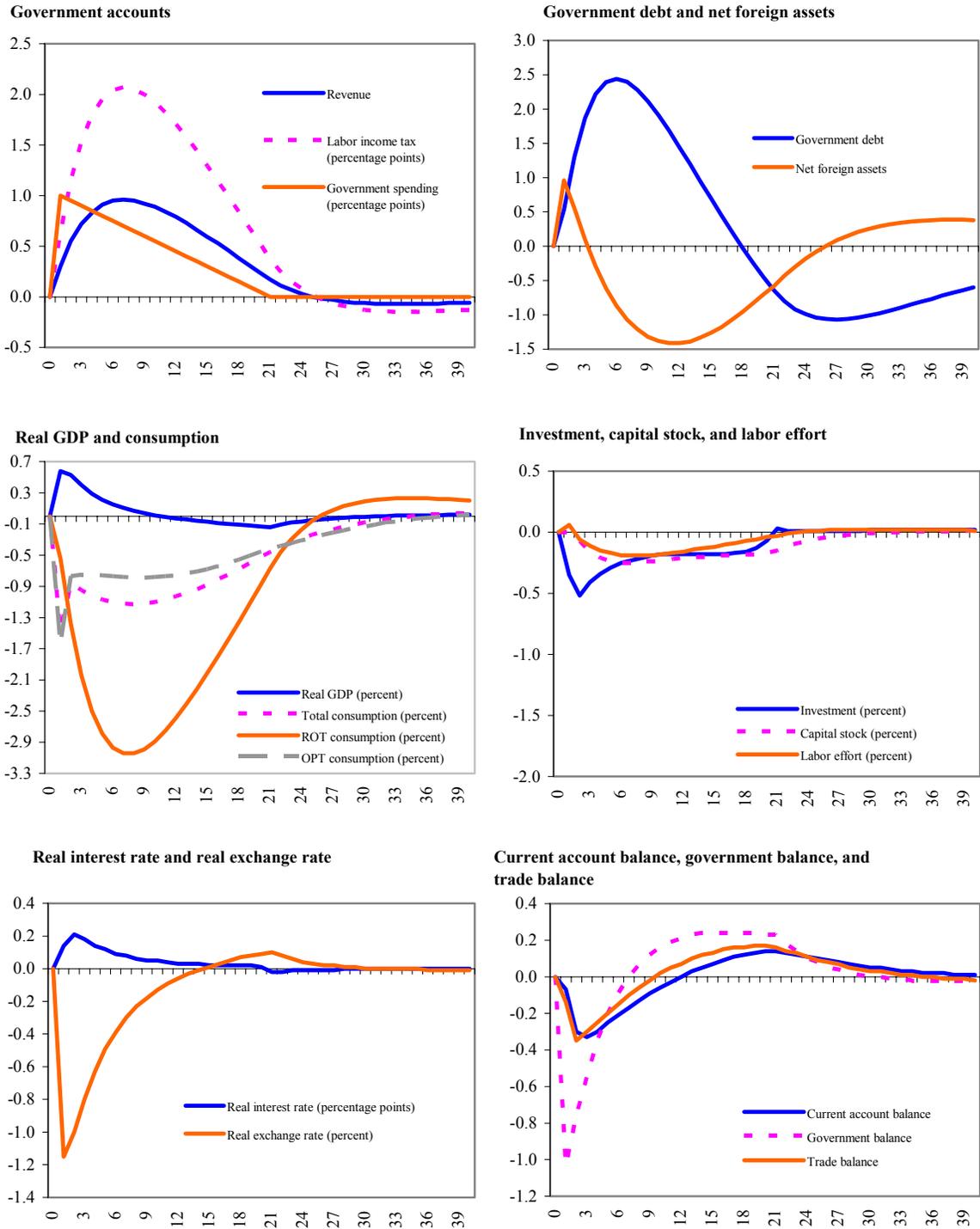
The effects of a temporary shock to current government spending for the large and small open economy are illustrated in Figures 8 and 9, respectively. Real government spending is assumed to increase by 1 percent of real GDP after which the shock gradually wanes off during a period of 20 years—similar to the shock investigated in Gali, López-Salido, and Vallés. Labor income taxes are assumed to adjust immediately, although gradually, to mitigate the increase in government debt.

**Figure 8. Macroeconomic Effects of a Temporary Government Spending Shock: Large Economy**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

**Figure 9. Macroeconomic Effects of a Temporary Government Spending Shock: Small Economy**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

Higher government spending increases output in the nontraded goods sector given complete home bias in government spending. Since labor income taxes are increased, however, private consumption declines. On impact, the consumption of optimizing and liquidity-constrained consumers declines, closely following the path of higher taxes in light of the limited response of hours worked. Consumption by optimizing agents initially declines by more as they anticipate the gradually increasing path of labor income taxation and start to save more in response. In the medium term, the consumption decline is substantially greater for liquidity-constrained consumers as they are unable to take similar contingency measures. The maximum decline in the consumption for this group occurs when taxes reach their maximum. Overall, the decline in aggregate private consumption is about equal to the increase in government consumption. Note that the deterioration of the current account in response to higher government spending is smaller compared to the case in which taxes are reduced. This follows from the fact that government spending is characterized by a high degree of home bias and implies that consolidation measures aiming to increase government revenue can contribute relatively more to reducing external (and global) imbalances.

Investment declines quite quickly as a result of higher interest rates following the temporary increase in government debt. Labor effort and (pre-tax) real wages increase on impact, but decline during the period of rising taxes. In fact, labor effort increases in the nontradeables sector, while it declines in the tradables sector. Output increases as a result of the wealth effect of real exchange rate appreciation with the increase in nontradables production more than offsetting the decline in production in tradables sector.

In the case of the small open economy, while some of the effects are similar, there are two notable differences. First, output initially increases substantially more, and subsequently declines less as the real exchange rate is more responsive due to the higher trade openness. Second, the decline in investment is muted as the path of real interest rates is more benign.

## **B. Determinants of the Government-Private Consumption Correlation**

As in the first exercise, sensitivity analysis was undertaken to assess the extent to which the above results regarding the impact of government spending shocks on private consumption are affected by different behavioral assumptions and parameter values (Table 4).

The planning horizon of consumers is the only fundamental determinant that affects the correlation between government and private consumption. Optimizing agents reduce their consumption by less as they take into account the fact that the increase in taxation is only temporary. Overall consumption declines by less on impact (ROT consumers respond the same way as in the base case as their disposable income declines to the same extent). The result is similar across both the large and the small economies, although it is somewhat more pronounced in the latter. The other fundamental determinants that were shown to play an important role in the previous section for changes in tax policy matter little for the short-term effect of government spending shocks.

Changes in the *composition of fiscal adjustment as well as its timing* substantially affect the correlation between government and private consumption. In this context, increasing corporate income taxes rather than labor income taxes has two implications. First, that

liquidity-constrained consumers reduce their consumption by less as they are not affected by this increase in taxes. In fact their consumption increases slightly as a result of higher labor effort and real wages increase. Second, since higher corporate income taxation reduces the incentives for capital accumulation, optimizing agents substitute savings for consumption, mitigating the decline in their consumption. The net result is a significantly smaller initial impact on aggregate private consumption compared to higher labor income taxes. This is particularly so in the case of the small economy and reflects a more muted effect on interest rates. The differential impact persists, albeit in a much reduced manner, especially in the large economy. Regarding increasing personal income taxes, since the tax base consists of both capital and labor income—as well as some other components—the effect on consumption is in between that resulting from the effect of higher labor respectively higher corporate income taxation.

The adverse effects on consumption are substantially reduced if the increase in taxes is postponed. The effects then depend in a marked way on the types of taxes that are increased. Delaying adjustment also implies that the negative correlation between government and private consumption is delayed.

Table 4. Sensitivity Analysis: Effect of Government Spending on Private Consumption: Alternative Parametrizations and Types and Timing of Consolidation

	Large economy					Small economy				
	1	2	3	4	5	1	2	3	4	5
<b>Immediate adjustment through higher labor income taxes 1/</b>										
Baseline	-1.2	-0.7	-0.8	-0.9	-0.9	-1.5	-0.9	-1.0	-1.0	-1.1
Longer planning horizon	-0.9	-0.8	-0.9	-0.9	-1.0	-1.1	-0.9	-0.9	-1.0	-1.0
Inelastic labor supply	-1.2	-0.7	-0.8	-0.8	-0.9	-1.5	-0.8	-0.9	-1.0	-1.0
Less consumers have access to financial markets 2/	-1.1	-0.7	-0.8	-0.9	-1.0	-1.3	-0.8	-1.0	-1.1	-1.1
Lower intertemporal elasticity of substitution	-1.1	-0.7	-0.8	-0.9	-0.9	-1.4	-0.8	-0.9	-1.0	-1.1
Cobb-Douglas production function	-1.3	-0.7	-0.8	-0.9	-0.9	-1.6	-0.9	-1.0	-1.1	-1.1
Higher mark-up in the traded goods sector 3/	-1.1	-0.7	-0.8	-0.9	-0.9	-1.4	-0.8	-0.9	-1.0	-1.0
<b>Alternative types of immediate fiscal adjustment</b>										
Corporate income taxes	-0.4	-0.6	-0.7	-0.8	-0.8	-0.3	-0.5	-0.6	-0.7	-0.8
Personal income taxes	-0.9	-0.8	-0.9	-0.9	-0.9	-1.0	-0.9	-1.0	-1.0	-1.0
<b>Alternative timing of fiscal adjustment</b>										
<i>Taxes adjust after 5 years</i>										
Labor income taxes	-0.9	-0.3	-0.3	-0.3	-0.4	-0.8	-0.1	-0.1	-0.1	-0.2
Corporate income taxes	-0.6	0.0	0.0	0.0	0.1	-0.3	0.3	0.3	0.3	0.3
Personal income taxes	-0.7	-0.1	-0.1	-0.1	-0.1	-0.5	0.1	0.1	0.1	0.1
<i>Taxes adjust after 10 years</i>										
Labor income taxes	-0.8	-0.2	-0.2	-0.2	-0.2	-0.4	0.1	0.2	0.2	0.1
Corporate income taxes	-0.7	0.0	0.0	0.1	0.1	-0.2	0.4	0.4	0.4	0.4
Personal income taxes	-0.7	0.0	0.0	0.0	0.0	-0.3	0.3	0.3	0.3	0.3

Source: GFM simulations.

1/ See Table 2 for alternative parameter values unless otherwise noted.

2/ 40 percent rule of thumb consumers.

3/ Mark-ups in the traded goods sector are doubled.

## **VI. TAX DISTORTIONS AND THE BENEFITS OF TAX REFORM**

### **A. The Distortionary Effects of Taxation**

The previous section indicated that labor and corporate income taxation can have qualitatively distinct macroeconomic effects. To analyze this topic further we consider the impact of a permanent increase in lump-sum transfers by one percent of GDP. To prevent an increase in government debt, labor, corporate, or personal taxes adjust. Since this simulation is revenue neutral, the main implication of this policy change is that tax distortions in the economy increase as the size of the government expands in a nondistortionary manner.

Given that labor supply is relatively inelastic in the baseline, the distortions created by increasing labor income taxation are relatively small as reflected by the small decline in potential output in the long term (Figure 10). These long-term output costs are considerably larger for corporate income taxation, confirming the traditional view that corporate income taxation affects the returns to capital, which is a reproducible factor of production. The effect of personal income taxation is in between that of the corporate and the labor income tax.

It is evident that initially consumption increases more when corporate income taxes are increased than when labor income taxes are increased. The reason is that higher lump-sum transfers increase disposable income for liquidity-constrained consumers. Optimizing agents smooth their consumption over time, implying a more subdued response of their aggregate demand in the short term. In essence, this is a policy of redistribution from optimizing agents that own all the assets in the economy to poorer agents, albeit entailing a distortion of the tax system.

In the case of the small economy, for corporate income taxes, savings increase by less as interest rates increase by less. The latter mitigates the decline in investment while the former implies that the increase in consumption is larger. The overall effect is thus a somewhat larger expansion in the short term, with a more muted decline in output compared to the large economy case in the longer term.

### **B. The Macroeconomic Effects of Revenue-Neutral Tax Reform**

Given that taxes create distortions to different degrees, we next consider the effects of a particular type of tax reform that has received considerable attention in recent years: that of eliminating the double taxation of dividends. Essentially, the current setup in many countries is that profits are taxed at the level of the firm and again when the after-tax profits are paid out in the form of dividends when they become subject to personal income taxation. As such, eliminating the double taxation of dividends is a form of tax reform aimed at stimulating incentives to save. Here we consider this reform to take place in a revenue-neutral manner, that is, the elimination of this double taxation is accompanied by an increase in labor income taxes. If the tax bases are broadly the same, the increase in labor income taxes would be broadly equal to the decline in personal income taxation of dividend income. It should be noted that GFM reflects the traditional view that taxation of dividends negatively affects

capital accumulation.<sup>16</sup> Narrowing the personal tax base to labor and interest income and transfers—thus eliminating the personal income taxation of capital—should therefore reduce economic distortions.

Eliminating the personal income taxation of capital in a revenue-neutral manner has significant long-term positive effects in the large economy (Figure 11). In the short run, narrowing the personal income tax base while raising rates on labor income to prevent revenue losses causes a small decline in real GDP as higher labor taxes dampen consumption as this policy is essentially regressive—as reflected in the large decline in consumption by liquidity-constrained consumers. Over time, however, national saving increases substantially, the interest rate declines, and increased capital accumulation results in output increasing about 2¾ percentage points above the baseline.<sup>17</sup> As such, this particular type of tax reform also contributes to improving the current account balance in a sustained manner.

In the small economy, the long-term benefits are less pronounced—with about 1 percentage point less gain in potential output compared with the large economy (Figure 12). This is so since the increase in investment is not as marked, following a smaller reduction in real interest rates as the increase in savings in the small open economy has a smaller effect on world savings. Savings in this economy, however, increase by more, leading to a large increase in the current account balance.

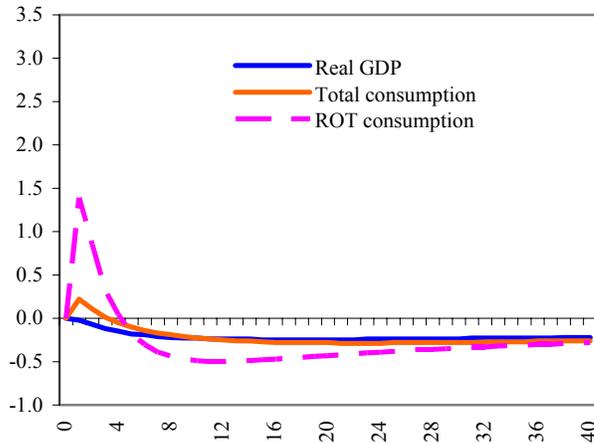
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<sup>16</sup> The new view argues that borrowing by debt issuance rather than equity issuance is the main form of financing of investment. Since debt financing is tax deductible, capital income is effectively taxed only once, and hence there is no need to reduce the personal income taxation of capital. This has little impact on the simulations in this paper, which focus on the macroeconomic consequences of reducing the taxation of personal capital income, rather than on the welfare implications of taxation across factors of production.

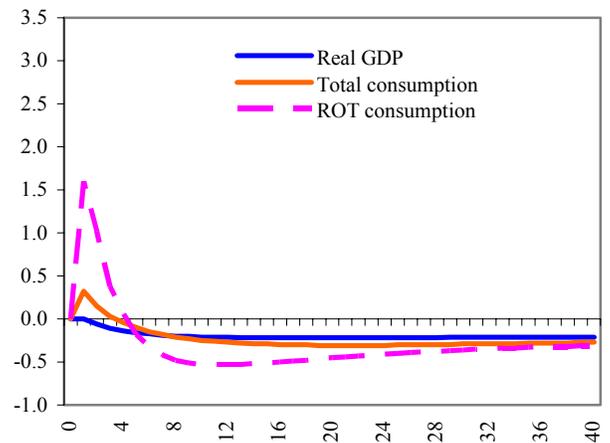
<sup>17</sup> If tax reform results in a reduction in the taxation of overall savings, instead of capital income only, the benefits are smaller. The reason is that increasing labor income taxes to reduce taxes on interest income increases distortions in the economy. Also, see Bayoumi, Botman, and Kumar (2005) for a discussion of the implications of non-revenue-neutral tax reform.

**Figure 10. The Distortionary Effects of Alternative Forms of Taxation 1/**  
(Deviation from initial steady state in percent)

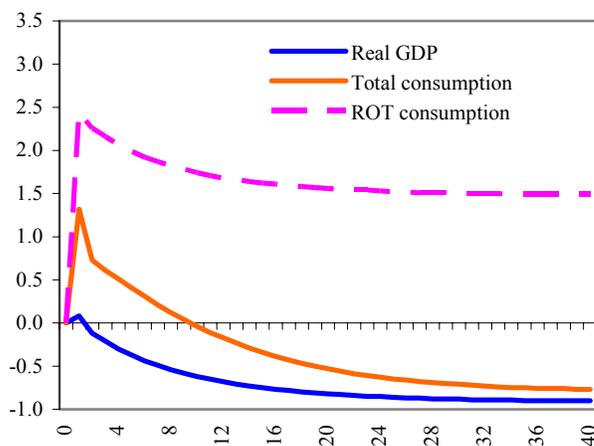
**Labor income tax: large economy**



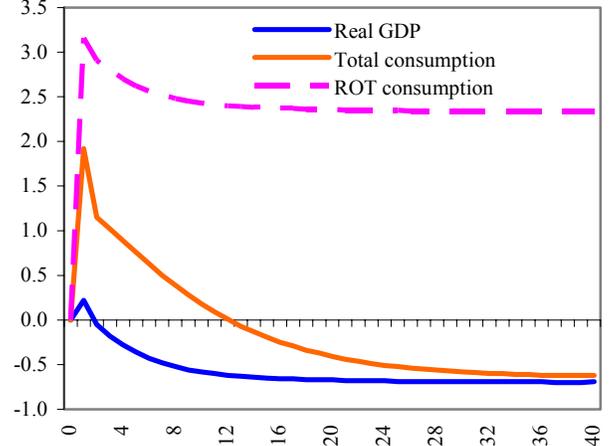
**Labor income tax: small economy**



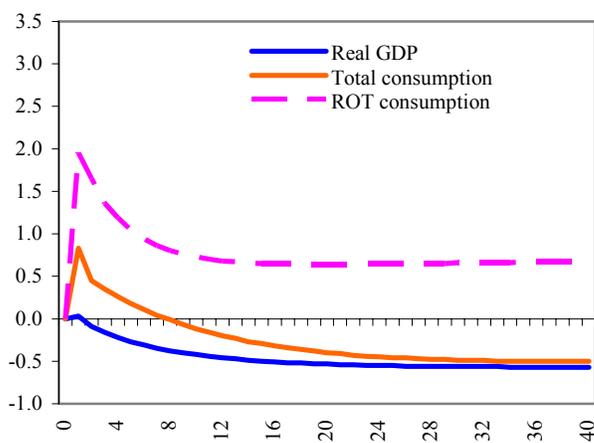
**Corporate income tax: large economy**



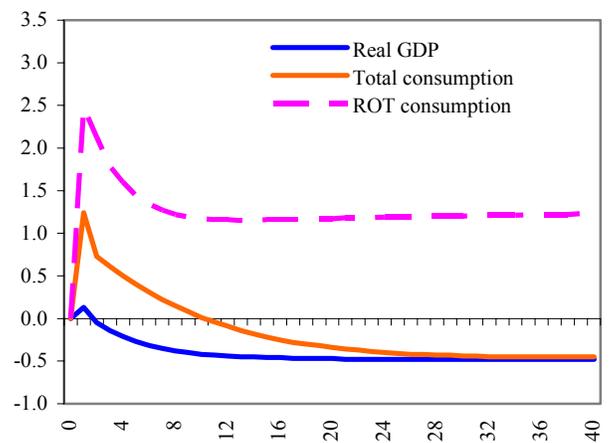
**Corporate income tax: small economy**



**Personal income tax: large economy**



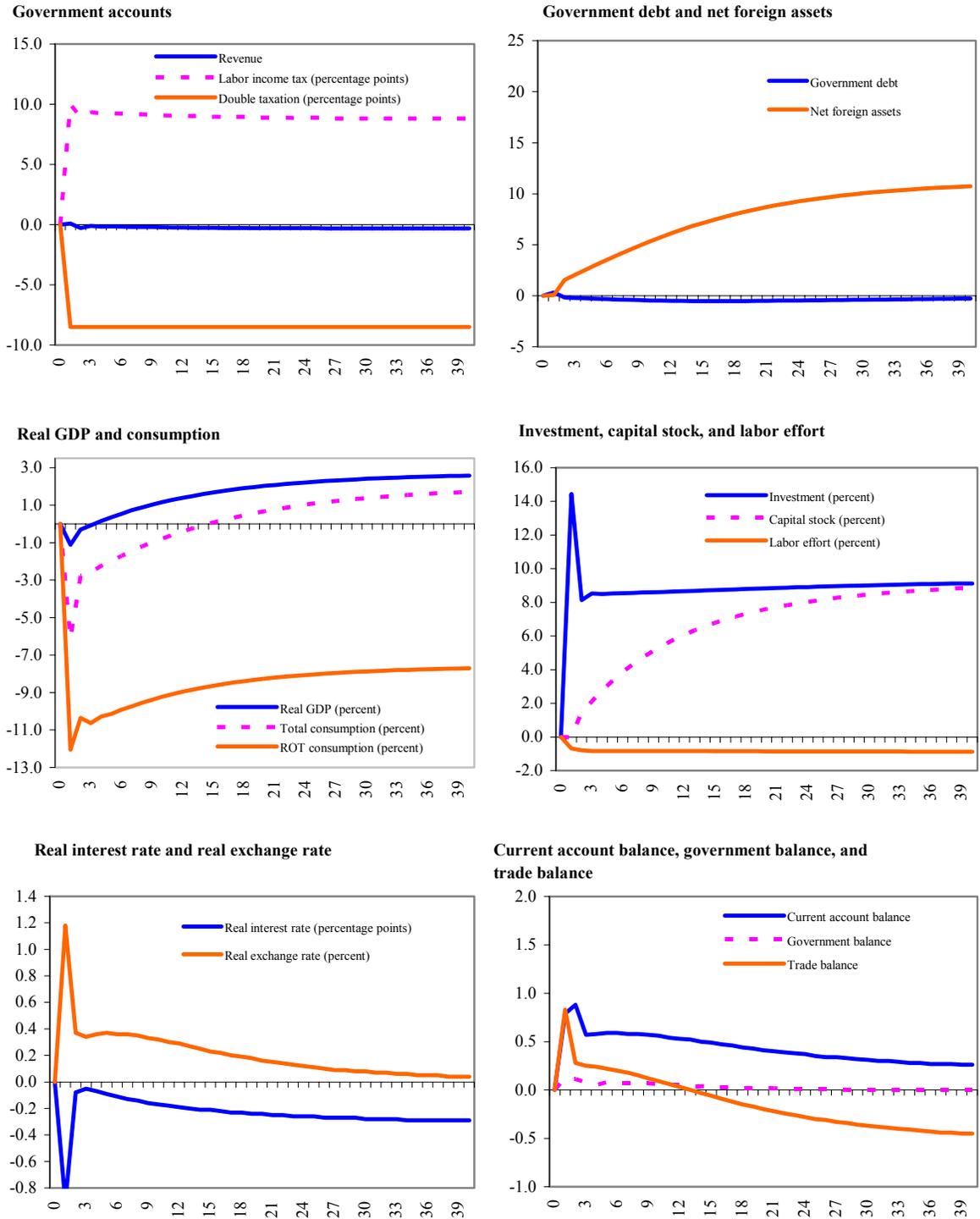
**Personal income tax: small economy**



Source: GFM simulations.

1/ Lump-sum transfers permanently increase by 1 percent of GDP. Labor, corporate, or personal income taxes adjust to prevent an increase in government debt.

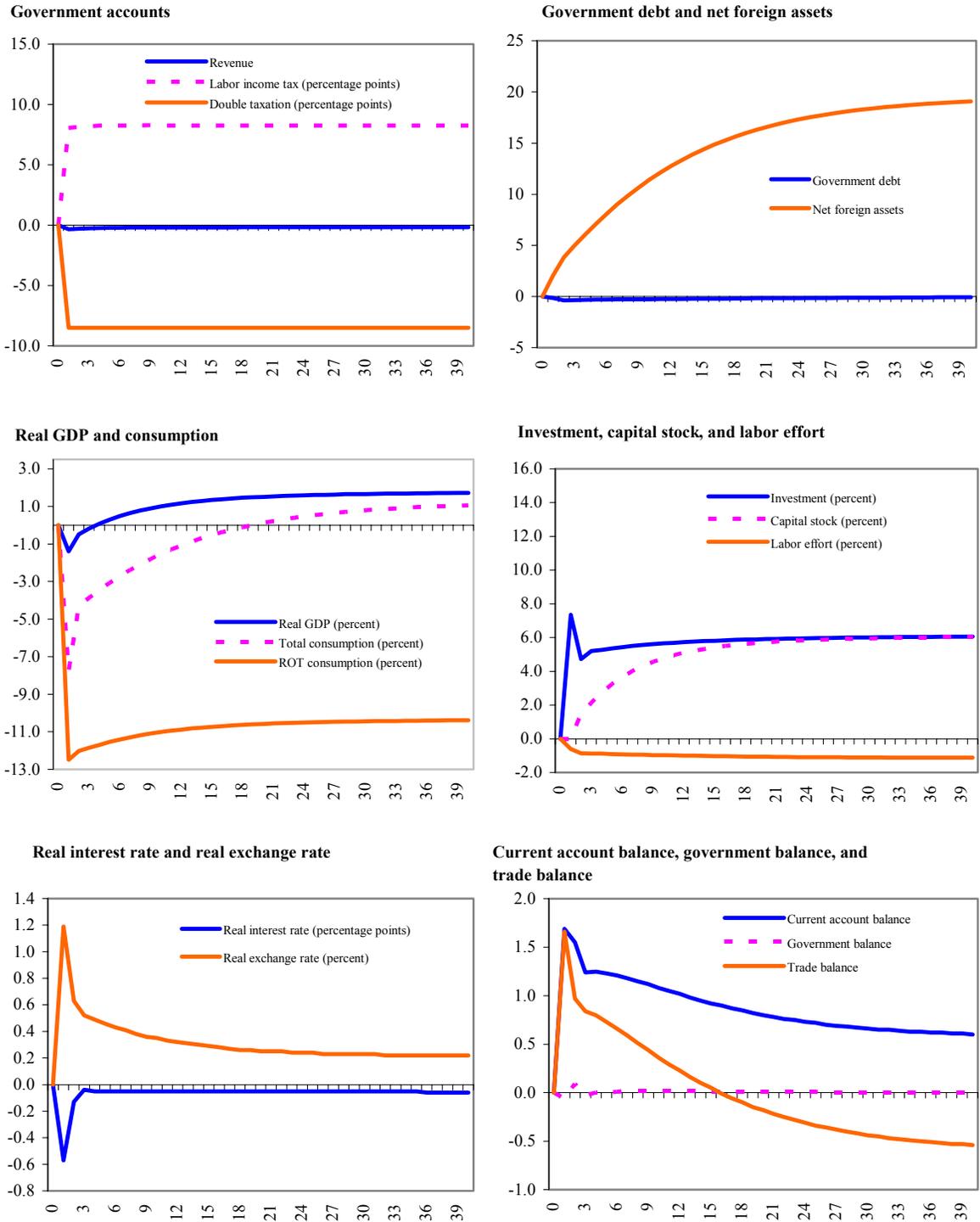
**Figure 11. Macroeconomic Effects of Tax Reform: Large Economy 1/**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

1/ The effects of eliminating the personal income taxation of dividend income in a revenue-neutral manner by adjusting labor income taxes.

**Figure 12. Macroeconomic Effects of Tax Reform: Small Economy 1/**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)



Source: GFM simulations.

1/ The effects of eliminating the personal income taxation of dividend income in a revenue-neutral manner by adjusting labor income taxes.

### C. Sensitivity Analysis of the Benefits of Tax Reform

The benefits of tax reform, as well as its spillover effects depend on several factors. First, if consumers have a longer planning horizon, the decline in initial consumption is smaller as optimizing agents capitalize on their anticipation of lower corporate income taxation and therefore higher returns on investment in the future (Table 5). The counterpart of this result is that saving does increase by more in the medium term. However, overall investment increases by less in this case even though savings in the long term increase much more with longer planning horizons.

Table 5. Sensitivity Analysis: Long-Term Effects on Real GDP of Revenue-Neutral Tax Reform Under Alternative Parametrizations 1/

	Large economy	Foreign	Small economy	Foreign
Baseline	2.72	1.26	1.76	0.25
Longer planning horizon 2/	2.34	0.74	1.87	0.15
More elastic labor supply 3/	1.48	1.27	0.56	0.23
All consumers have access to financial markets	2.49	1.07	1.72	0.21
Lower intertemporal elasticity of substitution	4.34	2.75	2.04	0.56
Cobb-Douglas production function	4.17	2.07	2.21	0.36
Higher mark-up in the traded goods sector	2.55	1.33	1.62	0.27

Source: GFM simulations.

1/ See Table 2 for alternative parameter values unless otherwise noted.

2/ Planning horizon equal to 20 years

3/ The absolute value of the elasticity of labor supply is -0.100.

Second, a more elastic labor supply implies more distortionary labor income taxation, and therefore smaller benefits from shifting the tax burden from capital to labor. The benefits are particularly muted for the smaller economy. If all consumers are optimizing and have access to financial markets, the results move in the same direction as for an extension of the planning horizon although to a much smaller degree.

Third, a lower intertemporal elasticity of substitution has a substantial effect on the benefits of tax reform, particularly for the large economy. Following the increase in national savings, the current account turns positive, and trade deficits are needed to stabilize the current account in the long term. As a result, interest rates need to decline to stimulate higher consumption and mitigate the increase in saving. If consumers are less responsive to changes in the real interest rate, it needs to decline by more to induce the required increase in consumption. This in turn stimulates capital accumulation and produces significantly larger long-term output gains. The effect in the small economy is much more muted, however, given smaller effects on the world real interest rate.

Fourth, a Cobb-Douglas production function implies greater substitutability between capital and labor compared with the baseline and therefore a stronger response of investment and somewhat larger decline in labor effort following this policy change. This again implies substantially larger long-term output gains in the larger economy. In the smaller economy,

the effects are less marked as the increased after-tax return of capital interacts with the decline in the real interest rate.

Finally, higher markups reduce the distortionary effects of dividend taxation as a larger share falls on rents rather than capital accumulation. As a result, the benefits of tax reform are somewhat smaller for both economies.

## VII. THE EFFECTS OF PRIVATIZING RETIREMENT SAVING

### A. Compulsory Pension Reform

This section explores the macroeconomic effects of (partially) privatizing saving for retirement. This privatization can take place through either a compulsory or a voluntary reform. Given the rising concerns about the solvency of the public funded pension systems and adverse demographics, such schemes have been proposed or are under consideration in a variety of industrial as well as emerging market countries, including the United States and the Czech Republic. The modalities of such schemes vary widely, and in part are related to the considerable divergence of views regarding what the consequences of such a reform would be. To explore this issue in a systematic way, the simulations discussed below are based on the following characteristics of the reform. (i) It is assumed that workers can divert 4 percentage points of social security contributions into Personal Retirement Accounts (PRAs).<sup>18</sup> (ii) Accumulation of assets into PRA's matures after 45 years. It is assumed that workers up to the age of 45 can participate and that they retire at 65, so that PRAs start paying benefits after 20 years. However, aggregate contributions to PRAs exceed benefit payments for a further 25 years, when the youngest workers that participated at the start of the program (assumed to be 20 years old) reach retirement. (iii) Withdrawals from PRAs result in equal reductions in government transfers.<sup>19</sup>

The simulations suggest a significant increase in federal deficits and debt over several decades (Figure 13). As payroll contributions are diverted from the Social Security system to PRAs, government revenue declines markedly, falling by 2 percentage points of GDP relative to the baseline. As a result, government debt starts rising quickly and is about 50 percent of GDP above baseline after 20 years, and reaching a peak of almost 60 percent after another 5 years. This is when the benefit payments from PRAs start, and as they do so, "traditional" Social Security payments decline by a corresponding amount, which allows government deficits and debts to begin to decline. Nonetheless, in the long run, government debt still exceeds the baseline by 50 percentage points of GDP.

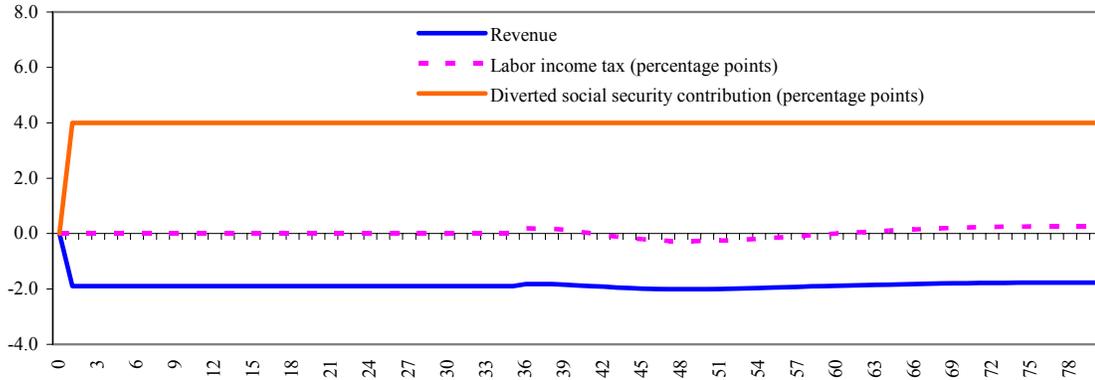
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<sup>18</sup>A more gradual introduction of PRAs in the context of the United States was assumed in Bayoumi, Botman, and Kumar (2005).

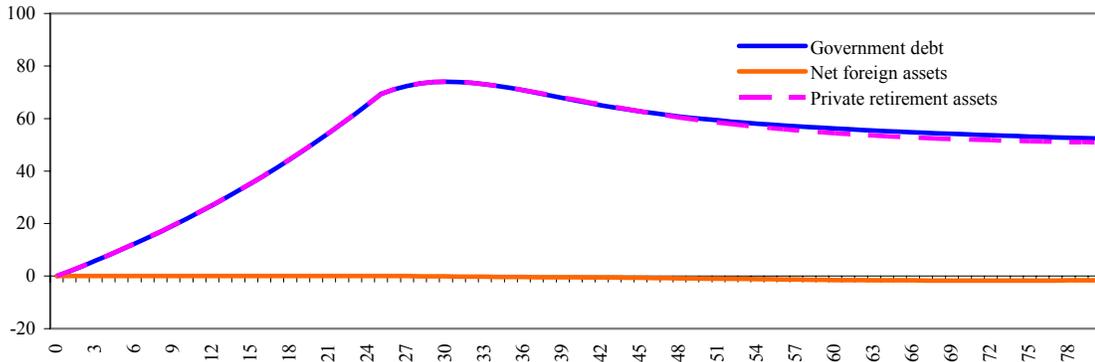
<sup>19</sup> Reflecting the stylized nature of financial markets in the model, there is no equity premium to be exploited by owners of PRAs.

**Figure 13. The Effects of Introducing Compulsory Personal Retirement Accounts 1/**  
 (Deviation from initial steady state in percent of GDP unless otherwise noted)

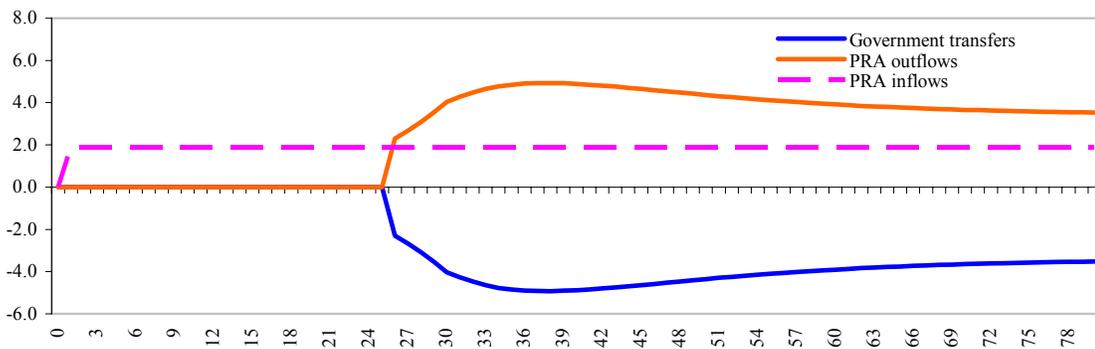
**Government accounts**



**Government debt, net foreign assets, and savings in personal retirement accounts (PRA)**



**Government transfers and PRA inflows and outflows**



Source: GFM simulations.

1/ The effects are the same for a small and large open economy. Workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts (PRAs). Workers withdraw from these accounts after 25 years; i.e., workers up to age 40 can participate and the retirement age is 65. The reduction in social security transfers from the government is equal to outflows from PRAs.

In this simulation we assume compulsory saving for retirement. As a result, private saving through PRAs offsets government dissaving and there is no impact on national saving. Real interest rates are virtually unchanged and there is little effect on investment. Hence, there is no significant impact from privatizing retirement saving in a compulsory manner on GDP, national saving, and financial markets. However, it should be emphasized that these results follow from the stipulation that workers cannot borrow against accumulated savings held in their PRAs. In this case, a shift from government to private saving does not affect perceived wealth, and there is no change in consumer behavior. These results hold for both a large and a small open economy.

Introducing PRAs could, however, lead to perceptions of higher future transfer payments. Survey evidence suggests that workers, especially younger ones, are skeptical about the value of their future Social Security benefits, possibly reflecting the underfunded nature of the Social Security system. Placing contributions into individual accounts could be interpreted as a reducing the likelihood of a default on future benefit payments. Workers could perceive this as an effective increase in their permanent income. However, if workers currently assume that the government will not fully meet its promises, this also implies that workers correspondingly should expect a smaller increase in future government debt or taxes in the absence of PRAs. (Bayoumi, Botman, and Kumar, 2005, discuss this possibility and offer an illustrative simulation for the case of the United States).

It should be noted that financial markets may also expect PRAs to lead to an additional increase in government debt. Financial markets may underestimate implicit liabilities in anticipation of future reforms of benefits that reduce payment obligations of Social Security. If PRAs increase the estimated size of future liabilities by making implicit debt explicit, the risk premium on government bonds may increase.

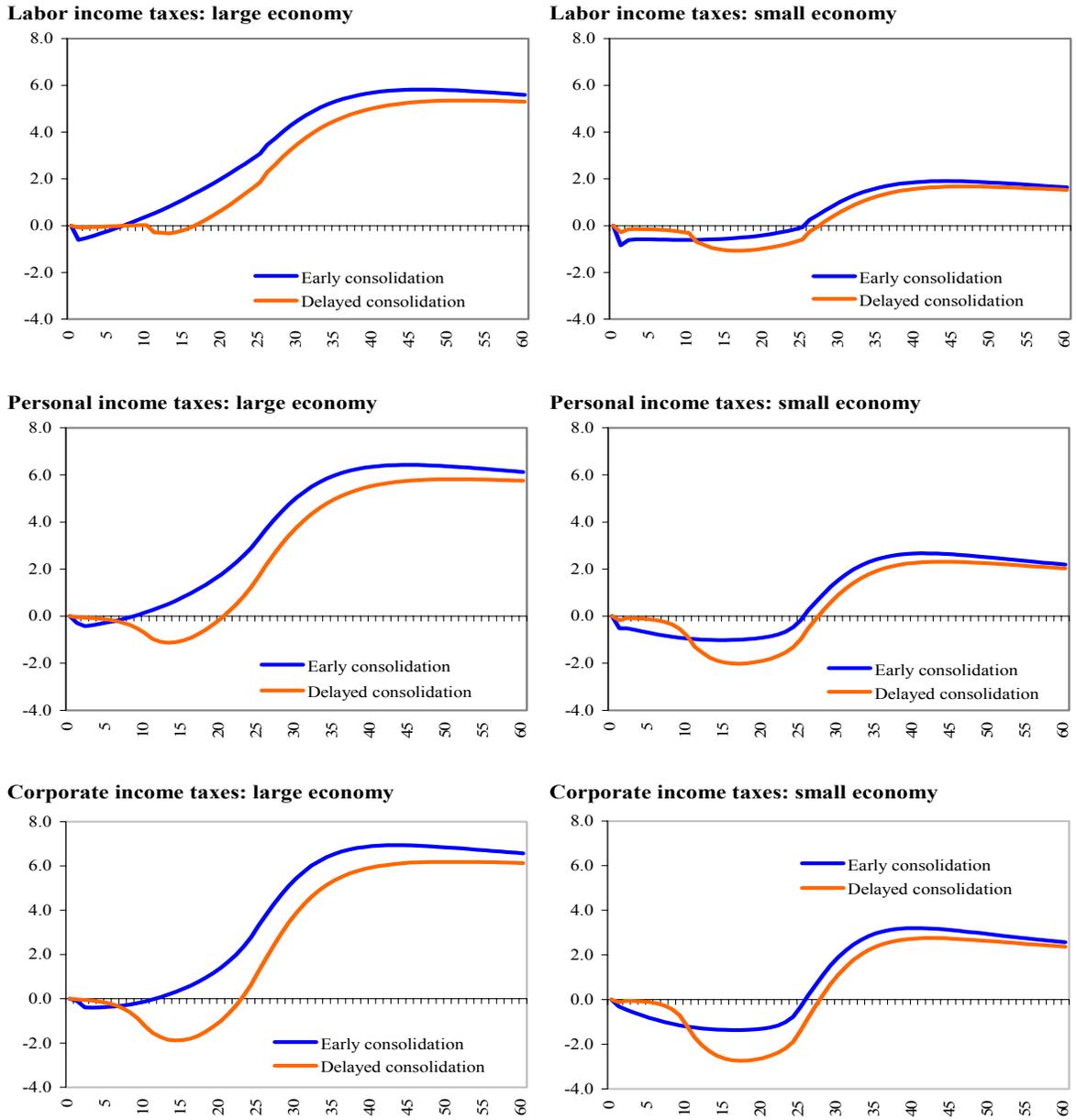
### **B. Compulsory Reform with Fiscal Consolidation**

Contrary to the above case, model simulations suggest that significant macroeconomic benefits may accrue when PRAs are accompanied by greater fiscal discipline that prevents PRA-related increase in government debt. In essence, such a policy amounts to prefunding higher future pension liabilities. By making future liabilities explicit, PRAs could lead to greater public awareness, and lead to both public and as well as financial market pressure to offset the resulting increase in government debt. If such deficit reduction can be achieved, the question is whether there is any significant difference with regard to whether it is achieved through higher labor income, corporate income, or personal income taxes.

Simulation results suggest that the short-run effects are broadly invariant to the type of tax increase. In general, output falls modestly below the baseline over the short run. Over the longer run, higher government saving and lower government debt reduces the real interest rate and boosts investment (Figure 14). This is particularly the case for a large open economy. Nonetheless, there are some differences, with labor income tax-based consolidation yielding quicker but somewhat smaller long-run benefits. The reason is that labor income taxes are less distortionary compared to personal and corporate income taxes given the relatively low elasticity of labor supply. Fiscal consolidation through higher corporate income taxes provides larger long-term output and consumption gains when these

taxes can be reduced after traditional benefit payments decline. The results for personal income taxation are in between the two, since its base combines both labor and corporate income. Delaying consolidation by 10 years provides modest short-term output gains, but at considerable medium-term costs.

**Figure 14. Introducing Personal Retirement Accounts with Alternative Forms of Fiscal Consolidation: Effects on Real GDP 1/**



Source: GFM simulations.

1/ Introduction of personal retirement accounts; labor, personal, or corporate income taxes adjust either immediately (early consolidation) or after ten years (delayed consolidation) to prevent an increase in government debt.

### C. Voluntary Opt-Out

The absence of a consumer's net wealth effect on mandatory personal retirement accounts hinges on the fact that workers who contribute into private accounts are not allowed to borrow against these savings. If this constraint is not binding, the simulation essentially transforms into a permanent tax cut—social security contributions decline—followed by lower future public pension outlays. One could thus consider the above scheme whereby workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts, but can opt out.

Contributions to private pension funds are voluntary, while the rate of exit from the public pension system is assumed to be the same as in the baseline simulation above. Given the resulting incentives—whether to save for future retirement or to consume—consumers who are liquidity constrained and the optimizing ones that are impatient or myopic do not fully save the surplus that accrues from the reduction in social security taxes. Effectively, the myopic consumers discount the lack of traditional social security benefits in the future. Consumption and output increase in the short run at the expense of a long-run decline. In the long run, consumption falls due to a decline in the social security benefit payments and an increase in taxes required to stabilize debt (Figure 15).

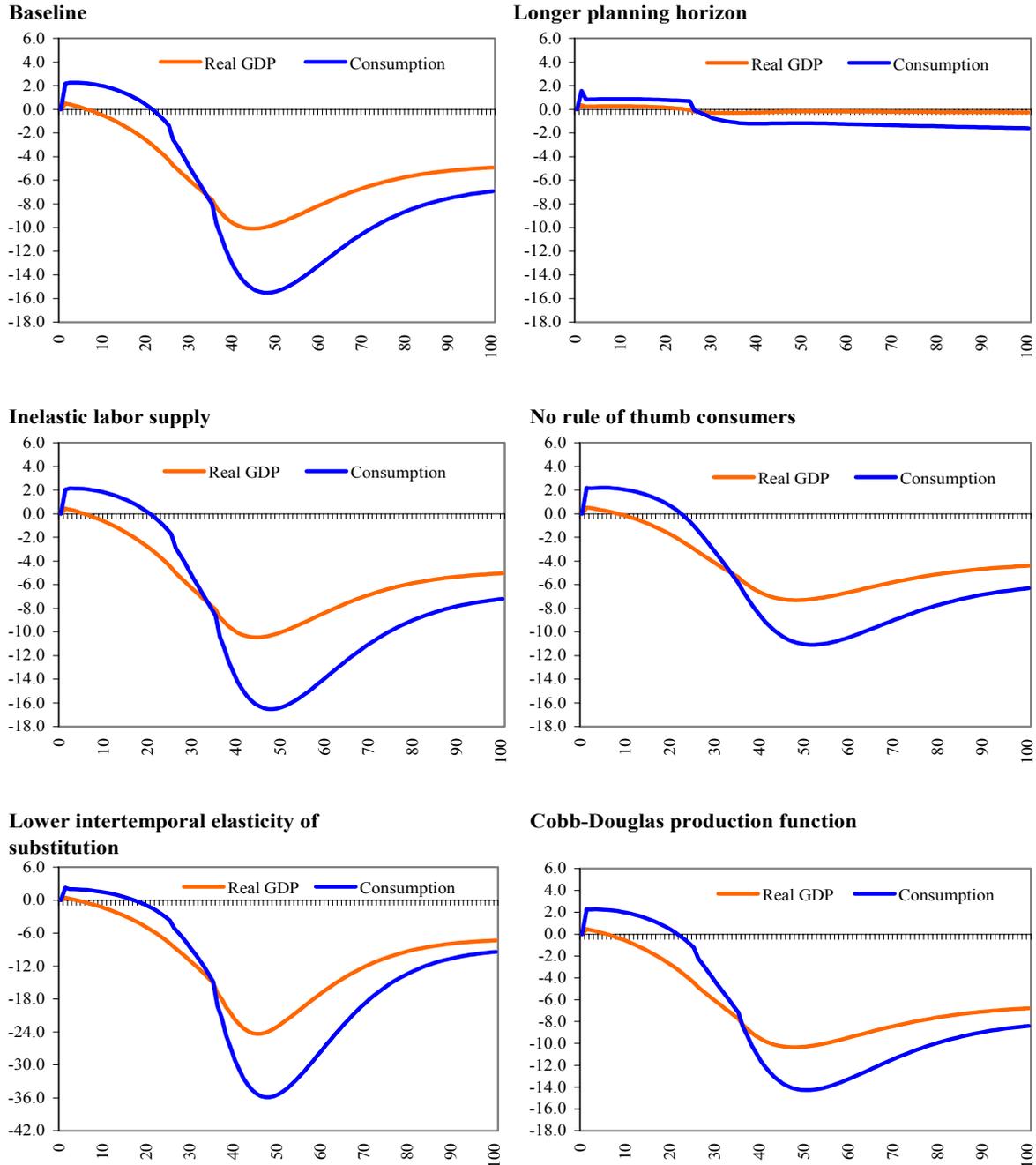
The macroeconomic impact of voluntary private pension contributions depends to a large extent on the extent of consumer myopia (Figure 16). If consumers have longer planning horizons—making them more Ricardian—there is less of an initial consumption boom as they factor in the loss of traditional pension benefits in the long run. Consumers save more in the form of private pension contributions, which results in higher capital accumulation, output, and consumption over the long run. Conversely, if labor supply is relatively inelastic, the effective tax reduction does not induce greater incentives to work and higher output, lowering savings, which results in a somewhat greater output loss over the long run.

Rule-of-thumb consumers affect the results similarly as a longer planning horizon. Assuming a Cobb-Douglas production function has little impact. A lower elasticity of substitution implies large losses in the medium term to consumption and output for the large economy. The reason is the same as before: the current account moves substantially into deficit, requiring large real interest rate increases to stimulate savings. The impact on interest rates will only start to wane when social security transfers start to decline. This is also illustrated in Figure 16, with the response of private saving after the change in the system for retirement financing. The question of whether individuals will actually save for retirement is shown to depend primarily on the extent to which they wish to smooth their consumption over time, as formalized by the intertemporal elasticity of substitution. Also, a longer planning horizon results in a relatively more flat savings profile.

For a small open economy, the sensitivity analysis yields similar qualitative results, although the quantitative effects are substantially smaller than in the case of the large economy (Figure 17). The incentive to save is shown to depend primarily on the planning horizon of individuals (Figure 18). All in all, therefore, we can conclude that voluntary opt-out of retirement system is unlikely to generate sufficient long-term private saving to compensate

for lower future social security benefits from the traditional system if individuals have a smaller desire to smooth their consumption over time and have short planning horizons.

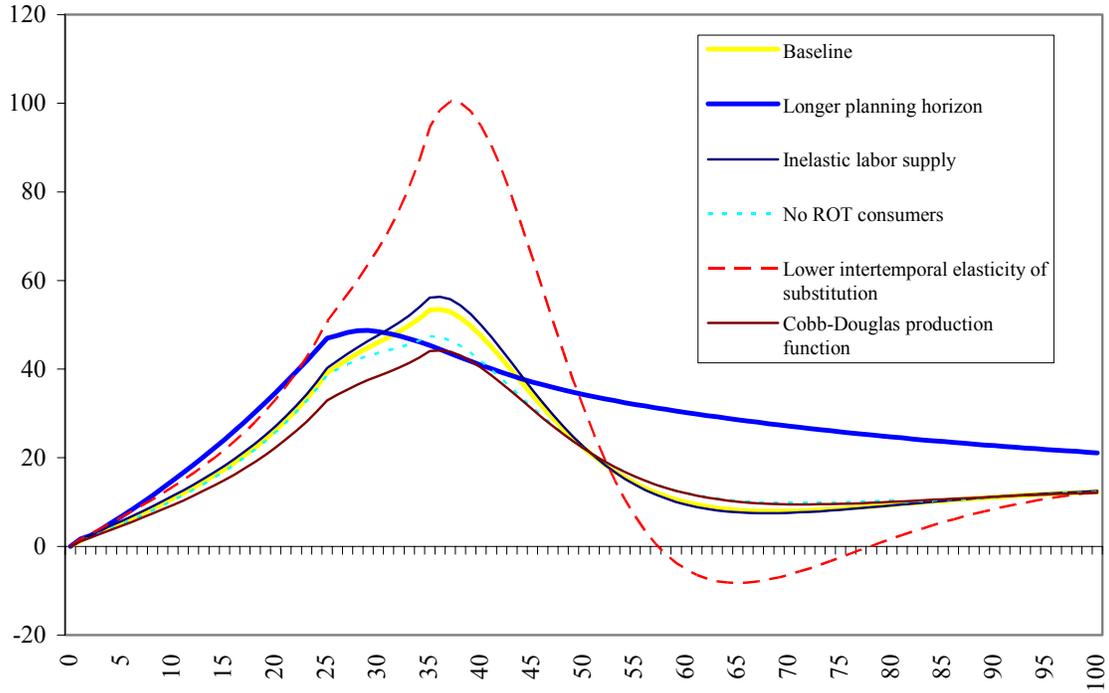
**Figure 15. Voluntary Opt Out: Large Economy 1/**  
(Deviation from initial steady state in percent)



Source: GFM simulations.

1/ Workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts, but are given the option to consume or save. Government transfers decline after 25 years as illustrated in Figure 13.

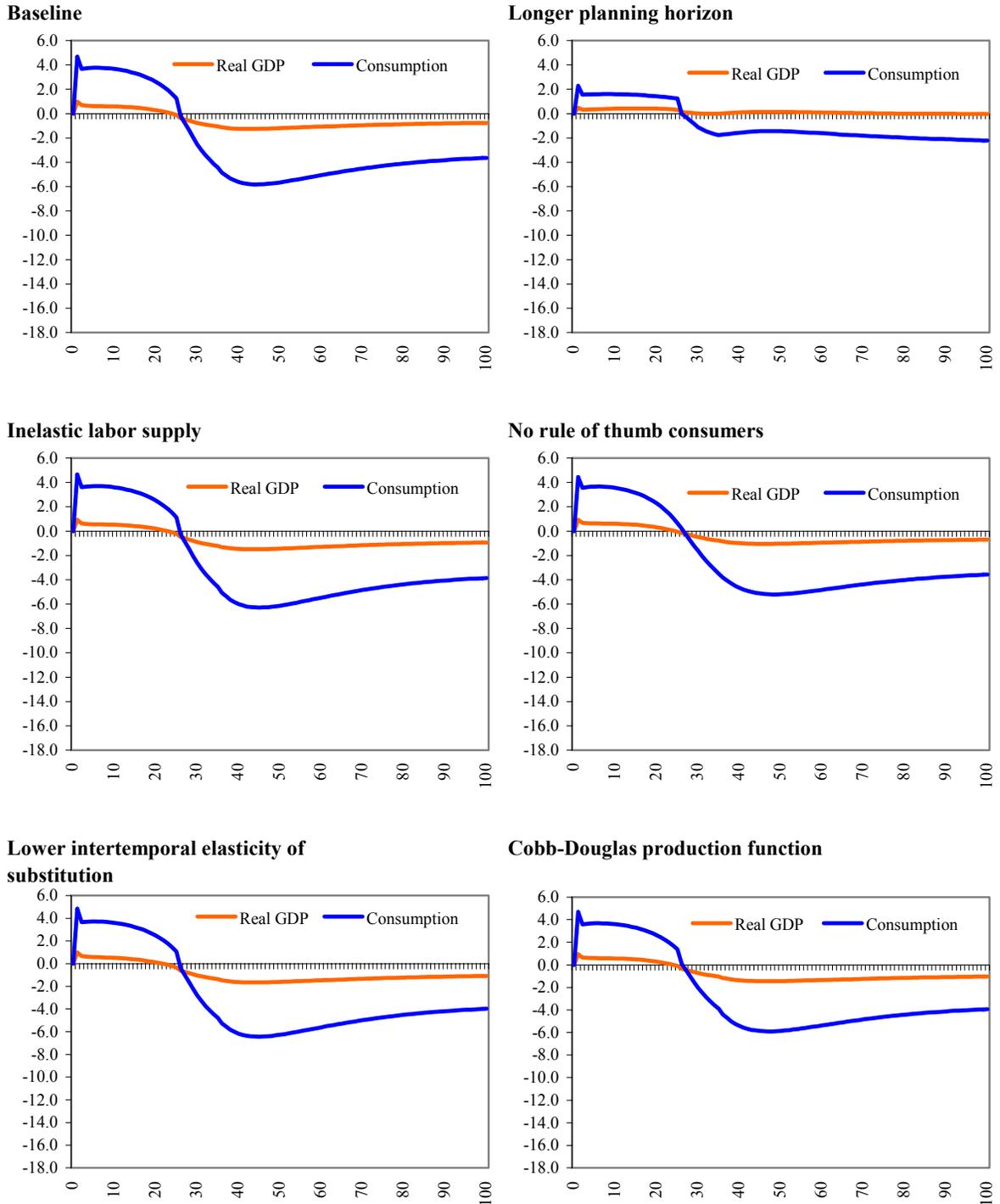
**Figure 16. Response of Private Saving to Voluntary Retirement: Large Economy 1/**  
(Deviation from baseline in percent of GDP)



Source: GFM simulation.

1/ See Table 2 for alternative parameter values except for the intertemporal elasticity of substitution, which is equal to -0.25.

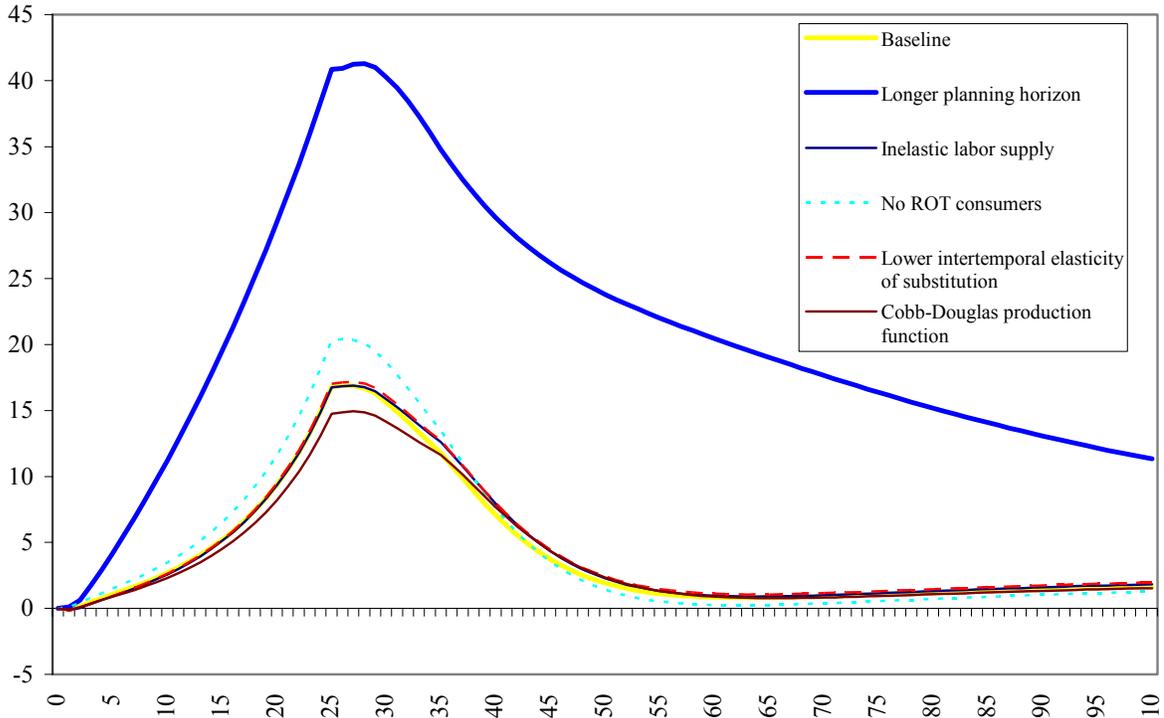
**Figure 17. Voluntary Opt-Out: Small Economy 1/**  
(Deviation from initial steady state in percent)



Source: GFM simulations.

1/ Workers are allowed to divert 4 percentage points of social security contributions into personal retirement accounts, but are given the option to consume or save. Government transfers decline after 25 years as illustrated in Figure 13.

**Figure 18. Response of Private Saving to Voluntary Retirement: Small Economy 1/**  
(Deviation from baseline in percent of GDP)



Source: GFM simulation.

1/ See Table 2 for alternative parameter values except for the intertemporal elasticity of substitution, which is equal to -0.25.

## VIII. CONCLUDING REMARKS

This paper utilizes the IMF’s Global Fiscal Model to analyze the underlying determinants of the macroeconomic effects of fiscal policy and tax and social security reform and to explore their spillover effects. GFM is a multi-country non-Ricardian dynamic general equilibrium model rooted in the NOEM tradition, and it is used to specifically address four current issues in fiscal policy: (i) the macroeconomic implications of changes in tax policies that lead to higher government debt and the spillover effects of such policies to other countries; (ii) the effects of higher current government spending on private consumption; (iii) the distortions created by alternative forms of taxation and the resulting macroeconomic benefits of revenue-neutral tax reform; and (iv) the macroeconomic implications of proposals to privatize the pension system where such a reform can take place in either a compulsory or a voluntary manner.

This paper explores the extent to which the planning horizon of consumers, the fraction of liquidity-constrained consumers, and the elasticity of labor supply determine the qualitative and quantitative effects of fiscal policy. Furthermore, as GFM is rooted in consumer and producer optimization, the extent to which the effects of fiscal policy depend on the sensitivity of consumption to changes in the real interest rate—the intertemporal elasticity of

substitution—and the substitutability between capital and labor, as reflected in the production structure of the economy, are also investigated. In addition, since GFM features monopolistic competition, we analyze the extent to which the degree of competition matters for the effects of fiscal policy. The two-country dimension of GFM allows a consideration of the relative size of an economy in the world economy that affects the response of the real interest rate to changes in fiscal policy.

The simulation analysis shows that the crowding-out effects of government debt are substantial, both at home and abroad. Fiscal deficits lead to a substantial deterioration in the current account, about half the size of the decline in the revenue-to-GDP ratio, during the entire period of fiscal loosening. The magnitude of this response highlights the potentially important contribution fiscal adjustment in a large open economy suffering from twin deficits could make to reduce the external (and global) imbalances. Furthermore, the short-term benefits of a debt-financed fiscal expansion do not outweigh the long-term cost when fiscal adjustment takes place. This is particularly the case if agents have short planning horizons, if labor supply is elastic, if a large share of consumers is liquidity constrained, if consumption is less sensitive to changes in the real interest rate, or if the production structure is more flexible. Throughout the paper we highlight the important role of the size of the economy relative to its trading partners. In general, the less open an economy is, the larger the crowding-out effects of permanently higher government debt.

We also show that the fundamental determinants of the effect of government spending shocks on private consumption include the planning horizon of agents, as well as the timing and composition of the tax policy response to make the spending shock debt neutral.

Corporate income taxation creates more distortions than labor or personal income taxation. However, there is an equity concern here. Higher spending on transfers by the government, in a lump-sum manner, compensated by higher taxation creates larger distortions in small open economies. Revenue-neutral tax reform aiming to increase incentives to save could yield significant gains in potential output by stimulating incentives to save and invest. The benefits of eliminating the double taxation of dividends is shown to depend in particular on the distortions created by offsetting tax policy changes as well as by the sensitivity of consumption to changes in real interest rate and the flexibility of the production structure to take advantage of changes in the marginal cost of different production factors.

Retirement reform aimed at increasing private saving for retirement, but in a compulsory manner, leads to a considerable increase in government debt. Prefunding future pension liabilities, which essentially is a combination of compulsory private retirement saving and fiscal consolidation, could yield substantial long-term benefits. This is particularly the case if lower future traditional social security payments could lead to lower corporate income taxation. Instead, changing the system toward private retirement system but allowing individuals to opt out, could lead to a short-term increase in output as individuals prefer to consume rather than save. The long-term costs of such a policy in terms of potential output could be substantial.

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