Global Aging Pressures: Impact of Fiscal Adjustment, Policy Cooperation, and Structural Reforms

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Abstract

This paper undertakes a rigorous analysis of the effects of policies that may be undertaken to respond to the looming demographic pressures in Europe and elsewhere. We examine the effects of fiscal adjustment by itself, and when pursued in combination with tax, labor and product market reforms, using the IMF's Global Fiscal Model (GFM). The model is calibrated to the German economy, as well as to the euro area, and the United States and used to simulate the growth effects of alternative fiscal adjustment strategies to maintain debt sustainability, particularly in the face of global aging pressures. We also explore the international spill-over effects of demographic pressures and associated fiscal adjustment, and the benefits of cooperative action. In addition, we examine the extent to which structural reforms (including tax reform) to boost productivity growth, labor participation, and product market competition could ameliorate the adverse short-term effects of adjustment. The results suggest (i) substantial spill-over effects of aging on debt sustainability through international financial channels; (ii) the preferred adjustment package is broad-based relying on both revenue and expenditure measures; and (iii) there are substantial benefits from fiscal cooperation. Nonetheless, even a cooperative response has initial contractionary effects, and we show that these effects can be offset by combining fiscal adjustment with expeditious implementation of structural reforms in product and labor markets, as envisaged in the Lisbon Agenda.

I. INTRODUCTION

To address global aging pressures, this paper undertakes a rigorous analysis of the macroeconomic effects of fiscal adjustment in Europe pursued in combination with tax, labor and product market reforms using the IMF's Global Fiscal Model (GFM). We calibrate the model to a large open European economy (Germany), as well to the rest of the euro area, United States, and the rest of the world. GFM is a multi-country dynamic general equilibrium model specifically designed to explore fiscal policy issues, with strong microfoundations, a wide menu of taxes, and a stylized financial sector block. A key feature of the model is that Ricardian equivalence does not hold owing to overlapping generations in the spirit of Blanchard-Weil, limited access of some consumers to financial markets, and distortionary taxation. Within this framework, the paper explores the following four issues:

- First, European countries are facing substantial medium- and long-term fiscal pressures from population aging. Even with the important pension reforms and recent improvements in structural deficits that have been undertaken in a number of countries, maintaining debt sustainability will require substantial fiscal adjustment (including further entitlement reforms) and we assess the relative pros and cons of prefunding future health and pension spending. Such fiscal adjustment could be implemented in a variety of ways and we quantify the effects of alternative revenue and/or expenditure based consolidations on output, investment, and employment.

- A second issue recognizes that fiscal pressures from aging are not limited to any one country or region, but instead will be occurring in many advanced and emerging market countries at broadly the same time, albeit with different magnitudes and starting fiscal positions. We explore what this implies for the efficacy of fiscal adjustment, taking into account the effects on international capital flows. Importantly, we address the role policy cooperation can play in this environment.

- Third, as fiscal consolidations are generally contractionary in the short term, a key question arises, from both an economic and a political economy perspective, as to whether complimentary policies exist to reduce the adverse effects and therefore help the political feasibility of reform. One area of complimentary measures, central in the renewed Lisbon Strategy, is structural reform, in particular increasing labor participation (partly through tax reform, in particular moving from direct to indirect taxation), product market liberalization, and enhancing incentives for innovation and productivity growth. We assess to what extent these policies can help ameliorate the near-term contractionary effects of fiscal consolidation, for both output and consumption.

- Fourth, we analyze the sensitivity of our results to the behavioral assumptions underlying the response of firms and consumers to changes in fiscal policy and structural reform. Specifically, in the non-Ricardian setting of GFM, we explore the

effects of changes in three of the fundamental determinants of the effects of fiscal policy: (i) the planning horizon of consumers; (ii) the fraction of liquidity-constrained consumers, and (iii) the elasticity of labor supply. Furthermore, as GFM is rooted in consumer and producer optimization, we examine the extent to which the intertemporal elasticity of substitution determines the impact of fiscal policy and structural reform.

The rest of the paper is organized as follows: Section II notes the medium and longer-term fiscal pressures facing the European economies, particularly resulting from the projected demographic challenges, and the magnitude of these challenges elsewhere; section III discusses key features of the IMF's Global Fiscal Model, in particular the extension of the "New Open Economy Macroeconomics" framework to incorporate sufficient non-Ricardian features to allow for an analysis of the effects of fiscal policy; an annex provides technical details of the specification of households, firms, government and external sector; Section IV calibrates the model for a large open European economy like Germany, as well as the rest of the euro area, and the United States; Section V provides an analysis of the impact of a range of tax and expenditure measures, both individually and as part of comprehensive strategy in Germany for attaining debt sustainability, while the following section examines the implications of cooperative fiscal consolidation in partner countries facing similar aging pressures. Section VII examines the effect of implementing the Lisbon agenda, and a last section provides summary and conclusions.

II. DEMOGRAPHIC TRENDS AND FISCAL PRESSURES

The budgetary challenges facing the EU countries arising from the demographic trends have been analyzed extensively by the European Commission, country authorities, as well as a wide range of observers (see EC 2006a, EC 2006b; Hauner et al 2007). The assessment of the budgetary challenges is based on the projections by Eurostat that indicate on average a doubling of the old-age dependency ratio (population older than 65 relative to working-age population) from 2005 to 2050 in the EU25 countries. Over this period, the modal age-cohorts move from mid-30s to late 50s. These changes are projected to exert significant upward pressure on age-related expenditures, primarily relating to pensions and health care, by the public sector: for the EU25 as a whole, the average increase (weighted) in age related expenditures is projected at 3.4 percent of GDP; for the EU15, it is 3.7 percent of GDP and for the new EU member states (EU10) it is 0.2 percent of GDP. However, amongst the EU10, Poland has implemented a major pension reform that implies a marked decline in its pension expenditures—amounting to 5.9 percent of GDP. Excluding Poland, the average age related expenditures for EU10 are likely to increase by 4½ percent of GDP (see EC 2006b).

If one considers separately the age related expenditures emanating from pensions, and from health and long-term care, the following picture emerges: pension expenditures are projected to increase by 2.3 percent of GDP on average in EU15 and by 0.3 percent of GDP in EU10 (excluding Poland the increase amounts to 4.8 percent of GDP). Health and long-term care

spending is envisaged to increase by 2.3 percent of GDP in EU15 and by 1½ percent of GDP in EU10. The base line scenario assumes that the increase in life-expectancy will lead to some postponement of the need for additional care. The health care projection, somewhat conservatively, assumes an elasticity of demand higher than unity (1.1) in the short-term, but this is expected to gradually decline to unity over the projection period.

There is a considerable degree of uncertainty relating to these projections, not least arising from the impact of technology and the evolution of health care costs, as well as demographics. Moreover, the impact of aging on the potential growth of the economy—which would have an important bearing on sustainability—is also subject to wide confidence intervals. These uncertainties are amply illustrated for each of the Euro area countries, and Germany is no exception. In the case of Germany, according to EU estimates, the projected increase in age related spending is somewhat below the EU average, rising by about 2 ¾ percent of GDP between 2004 and 2050. This is due to an increase in pension expenditures of around 1.7 which reflects the far-reaching reforms that have been enacted (including Agenda 2010 and Hartz reforms). The increase in health-care expenditure is projected to be 1.2 percent of GDP, lower than the EU average (see EC 2006b). Nonetheless, even these low estimates, given Germany's current budgetary position lead to a sustainability gap of 3½ percent to 4 percent of GDP. However, as the discussion in Section IV below indicates, there are other estimates of aging costs for Germany that are substantially higher.

The projected increases in age related spending and the sustainability gaps in other major countries and regions are also striking: in the case of the United States, in particular, the increase in age-related spending over 2005–50 is projected at 5.9 percent of GDP. Given the structural primary balance of around -1.8 percent (2005), the U.S. faces a sustainability gap of around 7 percent of GDP (OECD, 2001; and Hauner, Leigh, and Skaarup, 2007).[2] There are marked aging related budgetary pressures also in Japan, where the initial conditions, both in terms of the large primary deficit and high debt levels, also warrant substantial adjustment (Hauner and others, op. cit., and Botman, Edison, and N'Diaye, 2007).[3]

It is worth noting that the aging issue is of course not limited to industrial countries: there are marked pressures in many major emerging markets also. Among the largest nine emerging markets,[4] while the population in some is projected to grow substantially over the next four to

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[2] The estimated adjusment need is very sensitive to the assumptions regarding the interest rate-growth differential. In the case of the United States, a 1 percent interest rate/growth differential suggests a primary gap of around 7.2 percent, with the age related spending accounting for the bulk of that.

[3] A 1 percent interest rate/growth differential suggests a primary gap of around 5½ percent, with aging costs accounting for around a third of this, and the rest due to the high primary deficit and debt.

[4] These include Argentina, Brazil, China, India, Indonesia, Korea, Mexico, Russia, and Turkey.

five decades, the 65+ part of the populations is projected to increase significantly in all countries (between 150 and 400 percent), and the old-age dependency ratio is expected to, on average, triple by 2050 (see Kumar and Skaarup, 2007). (Korea faces the steepest increase (almost a five-fold increase, albeit from a favorable starting period with a sizable structural surplus), but there are also significant pressures in China and Russia). The projected increase of the old-age dependency ratio in these countries is also markedly higher than in the G7 countries, as are the projected age-related expenditures (Kumar and Skaarup op. cit).

III. KEY FEATURES OF THE IMF'S GLOBAL FISCAL MODEL

The IMF's Global Fiscal Model (GFM) extends the NOEM framework to incorporate sufficient non-Ricardianness to allow for an analysis of the effects of fiscal policy and of interdependence.[5] The traditional "New Open Economy Models" (NOEM) do not depart from the Ricardian equivalence hypothesis enough to allow detailed consideration of fiscal policy issues.[6] 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.

If the Ricardian equivalence hypothesis holds fully, many of the crucial 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 policy that increases 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 higher future tax contributions, with no effect on interest rates, consumption, investment incentives, or output.

There are three key 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 a short, and more realistic, planning horizon, 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

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[5] GFM is described in more detail in Botman and others (2006).

[6] 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 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.

sufficient access to financial markets to smooth their consumption over time. This is consistent with 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.

In addition, one further difference between traditional NOEM models and GFM is the absence of nominal rigidities in the latter. In the current setup, it is 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.

With regard to interdependence, in the version of GFM used in this paper, the world consists of four blocks (Germany, rest of euro area, United States, and rest of the world). Assuming that all consumers in each of the regions face identical survival probabilities, the relative size of the populations remain constant and this essentially fixes the relative size of the home economy (Germany).

NOEM models have been extended by others 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).[7] 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 steady state for net foreign asset holdings (for an early analysis of this, see Buiter, 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.

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[7] See Frenkel and Razin (1992) for a diagrammatic exposition of a two-country overlapping-generations model without distortionary taxation.

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. 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 the implications of various degrees in home bias in either private and, especially, government consumption.

- Compared to other fiscal models, GFM features a richer menu of taxation. The taxes included are social security contributions paid by workers and employers, a corporate income tax levied on accounting profits of firms, and a personal income tax levied on labor income, accounting profits, and interest income (on government bonds and net foreign assets), and a value added tax. Except for income taxation, each of these taxes has a single, albeit different, marginal rate, which coincides with the average tax rate.

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, which as a result of the perfect capital mobility assumption are shared internationally.

IV. CALIBRATING THE MODEL

The model is parameterized to reflect key macroeconomic features of Germany, as well as the rest of the euro area, the United States, and rest of the world (Tables 1 and 2). In particular, the ratios of consumption, investment, wage income, and income from capital relative to GDP are set to their values in 2006. Similarly, key fiscal variables—revenue-to-GDP ratios from taxation of corporate and personal income, from consumption tax, and from social security contributions by workers and employers, as well as current government

spending and government—have been calibrated to the fiscal structure of Germany, and that of the other regions.

Table 1. Key Macroeconomic and Fiscal Variables in the Initial Steady State 1/

(percent of GDP)

	Germany	Euro Area (excl. Germany)	United States	Rest of the World
Size (percent of world GDP)	6.3	15.9	27.5	50.4
Expenditure Ratios				
Private consumption	63.3	62.8	67.3	63.3
Government expenditure 2/	18.6	16.6	15.9	21.2
Investment	18.1	20.6	16.8	15.5
Exports	31.3	31.3	21.3	32.4
Factor Incomes				
Capital	44.0	44.5	39.2	51.2
Labor	56.0	55.5	60.8	48.9
Government				
Debt	67.5	70	40	40
Trade Flow Matrix				
Total exports to:				
Germany	...	2.1	2.1	2.1
Euro Area (excl. Germany)	5.4	...	6.1	6.1
United States	9.1	10.3	...	13.1
Rest of the World	16.8	18.9	24.2	...

1/ National expenditure accounts at market prices
2/ Net of government transfers

Table 2. Germany: Fiscal Variables and Key Parameter Values

Rule-of-Thumb Versus Forward-Looking Consumers (percent share of variable)

Type of consumers		Interest Rates	
Rule of thumb	40		
Forward looking	60	Nominal short term	5.1
Consumption		Real short term	3.0
Rule of thumb	15.6		
Forward looking	84.4	Price markups over marginal costs (in percent)	
		Tradables	14.3
Intertemporal Elasticity of Substitution	0.33	Nontradables	26.7
Elasticity of labor supply	0.92		
Probability of survival	0.90		
Elasticity of substitution between capital and labor	0.75		
Home bias in government expenditure (excl. transfers)	yes		
Nominal rigidities	no		

Effective Tax Rates, Government Revenue, and Transfers

Social security contributions workers		Personal income tax	11.0
Rate	27.2	Rate	8.9
Revenue (to GDP)	8.7	Revenue (to GDP)	
Social security contributions employers		Consumption	10.1
Rate	22.8	Rate	6.2
Revenue (to GDP)	8.7	Revenue (to GDP)	
Corporate income tax		Transfers	
Rate	29.0	As a percent of GDP	19.7
Revenue (to GDP)	8.1		

The key behavioral parameters are based on microeconomic evidence. These include parameters characterizing real rigidities in investment, markups for firms and workers, the elasticity of labor supply to after-tax wages, the elasticity of substitution between labor and

capital, the elasticity of intertemporal substitution, and the rate of time preference. Simulations examine the impact of changing the values of the following key parameters:[8]

- The wedge between the rate of time preference and the yield on government bonds. This parameter, which determines consumers' degree of impatience, has not been subject to extensive microeconomic analysis. We set the baseline value of the wedge to 10 percent (corresponding to a planning horizon of 10 years), with an alternative simulation using 1 percent (corresponding to a planning horizon of 100 years).

- The fraction of liquidity-constrained consumers. The baseline assumes that 40 percent of consumers experience liquidity constraints. These consumers have no wealth and consume one-fourth of aggregate consumption. An alternative simulation assumes that 10 percent of individuals are liquidity constrained.

- The sensitivity of labor supply to the real after-tax wage (Frisch elasticity). The baseline value (-0.08) is at the low end of those found by microeconomic studies given that the specific German microevidence points to a more inelastic relationship (Evers, de Mooij, and van Vuuren, 2005). Alternative simulations assume almost completely inelastic labor supply (-0.01).

- The elasticity of intertemporal substitution. The baseline value for this parameter, which describes the sensitivity of consumption to changes in the real interest rate, is -0.33. The parameter value in the alternative simulation (-0.29) is consistent with the lower end of microeconomic estimates.

V. DEBT DYNAMICS AND FISCAL ADJUSTMENT IN GERMANY

A. Debt Dynamics: Population Aging in Germany and in Trading Partners

To evaluate the debt dynamics in Germany we assume aging-related expenditure pressures of 4 percent of GDP by 2050 in our baseline (Figure 1). We also factor in the three-percentage point increase in the standard VAT rate from 16 percent to 19 percent in 2007—estimated to generate additional revenue of 1 percent of GDP. To take into account VAT exemptions, we have mapped this into a corresponding "effective VAT rate" of 10.1 percent of total consumption in 2006, which increases by 1.9 percentage points from 2007 onward. In addition, we incorporate the payroll-tax relief equivalent of 0.4 percent of GDP, effective January 2007 and a reduction in the CIT rate at a revenue loss of ¼ percent of GDP from 2008 onward. The proposed reform would reduce the marginal CIT rate from an average of 39 percent to less than 30 percent, partly financed through base-broadening measures. Since the government's plan with regard to the CIT reform is still evolving, the simulation posits an equivalent tax relief through a CIT rate reduction only, yielding a revenue loss of ¼ percent

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[8] Other structural parameters have been calibrated using evidence from Laxton and Pesenti (2003) and Batini, N'Diaye, and Rebucci (2005).

of GDP without offsetting base broadening (see Botman and Danninger (2007) for a more detailed description and assessment of these tax reform proposals and its impact on debt dynamics, output, and consumption). [9]

Figure 1. Germany: Primary Expenditure
(In percent of GDP)

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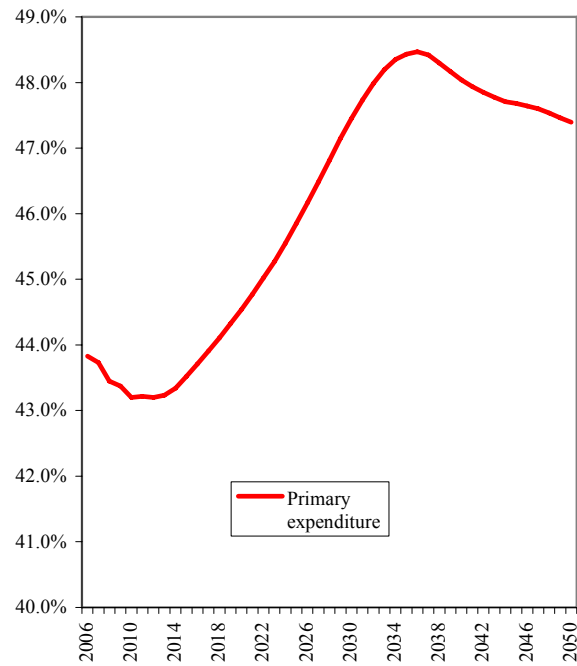
[9] Overall, however, the reforms are likely to achieve a more efficient tax system by shifting from direct to indirect taxation. Over the long run, shifting revenue from direct taxation to less distortionary indirect taxes increases growth through higher employment and investment growth. This is relevant in an aging society where the direct tax base could contract, while the indirect tax base is more stable (see Botman and Danninger, 2007, for a detailed evaluation of these tax policy changes).

Figure 2. Effects on German Debt Dynamics of Population Aging in Germany 1/
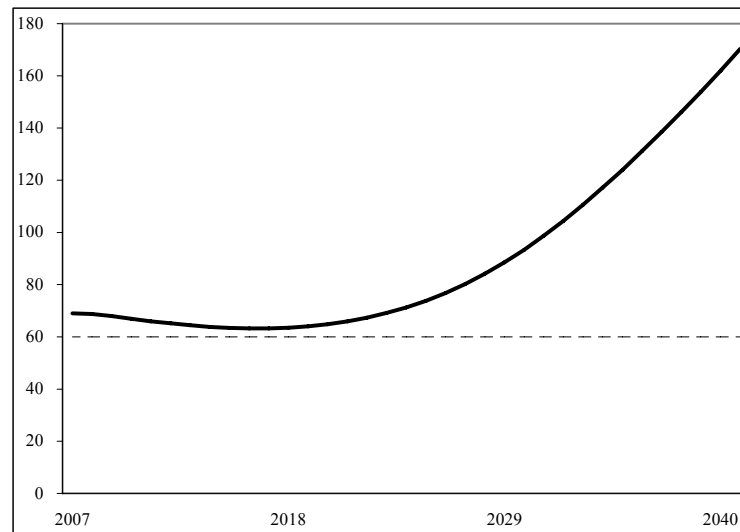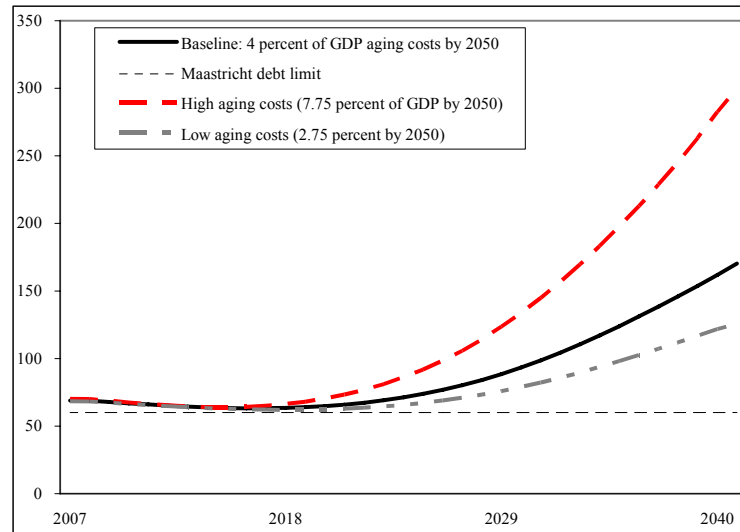

Source: GFM simulations.

1/ Includes the estimated revenue from higher VAT rates in 2007 and revenue loss from
lower social security contributions by workers and employers in 2007 and lower corporate
income taxation in 2008; aging-related expenditure costs are 4 percent of GDP by 2050.

In GFM, responses of the economy to these spending pressures and changes in tax policy are determined endogenously. The structurally adjusted deficit at end-2006, estimated at 2.4 percent of GDP is included, as well as the effect of inflation and growth on debt dynamics. Figure 2 reports the resulting debt dynamics in Germany, holding aging-related expenditure in the rest of the euro area or the United States constant. Although debt declines moderately in the short-term, following lower aging costs and the higher VAT in 2007, it is clearly unsustainable in the long term, and never declines below the Maastricht limit.

The debt dynamics depend crucially on projections related to aging costs. The analysis in Figure 2 assumes that, even after far-reaching reforms (Agenda 2010 and Hartz reforms), aging-related expenditures are projected to increase by some 4 percent of GDP by 2050. This fiscal-aging cost profile is taken from a long-term fiscal scenario developed in Braumann and others (2006), and is in between a more optimistic scenario by the authorities (Federal Ministry of Finance, 2005; and Werding and Kaltschütz, 2005) and the EU's Aging Working Group (2¾ percent), and a more pessimistic view expressed by the IFO institute (7¾ percent). Figure 3 illustrates the sensitivity of the debt dynamics in Germany to these alternative estimates. Despite the sensitivity of the debt dynamics to the uncertainty of aging costs, debt is unsustainable under current policies—even if we ignore the effect of population aging in other countries and the resulting pressure on real interest rates in Germany.

Figure 3: The Effects of Alternative Aging Cost Projections on Debt Dynamics in Germany 1/
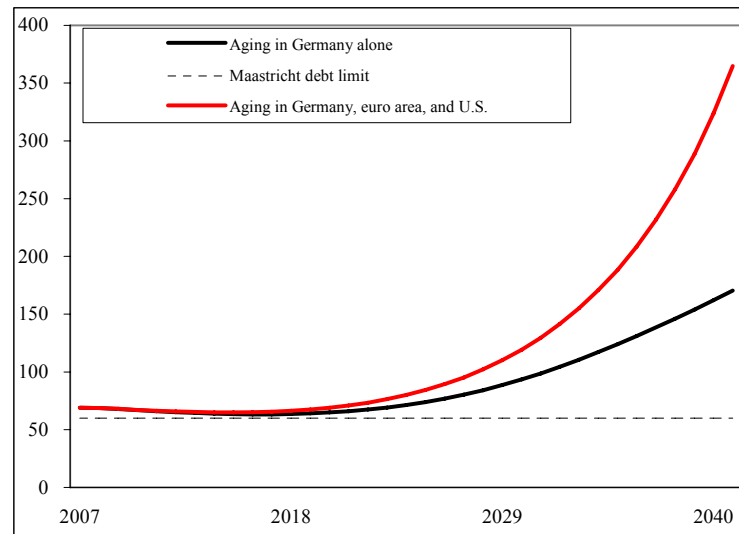

Source: GFM simulations

1/ Includes the estimated revenue from higher VAT rates in 2007 and revenue loss from
lower social security contributions by workers and employers in 2007 and lower corporate
income taxation in 2008.

Taking into account aging pressures in the rest of the euro area and the debt outlook for the
United States, adds a dramatic flavor to the debt dynamics of Germany's own aging issue.
Figure 4 illustrates the effects of global aging, in addition to fiscal pressures from population
aging in Germany, on debt dynamics in Germany. As the euro area and the U.S. face
significant spending pressures from weak starting fiscal positions, fiscal and current account
deficits in the countries emerge and real interest rates will increase. Germany is an open
economy implying that these higher rates will increase borrowing costs for the government
on newly issued debt and make the debt outlook considerably more unsustainable. This
linkage between countries through international financial markets is the key spillover effect
of global aging and ignoring these interdependencies between countries will lead to a
misleading judgment about the macroeconomic outlook of a country.

Figure 4: Effects on German Debt Dynamics of Global Population Aging 1/

Source: GFM simulations and IMF long-term public finances projections for Germany

1/ Includes the estimated revenue from higher VAT rates in 2007 and revenue loss from
lower social security contributions by workers and employers in 2007 and lower corporate
income taxation in 2008; aging-related expenditure costs are 4 percent of GDP by 2050.
Increase in real interest rates consistent with evidence in Ford and Laxton (1999) who find
that a 12.5 percent increase in debt in the OECD increased real interest rates by 100 basis
points (on new debt) during the 1980s. Assumes aging costs of 4.5 percent of GDP by 2050
in the euro area and 6.0 percent in the United States, with debt increasing by 17.5 percent by 2022.

B. Fiscal Adjustment in Germany

As debt is unsustainable, we explore alternative adjustment strategies to achieve debt
sustainability—defined here as a government-debt-to-GDP ratio of below 60 percent by
2050. Achieving fiscal sustainability requires additional efforts beyond those in the
coalition's tax reform package. As set out in its Stability Program, the government aims to
move towards structural balance over the medium-term. In practical terms, this would require
about a ½ percentage point of GDP reduction in the deficit per year during 2008-11 (some 2
percent of GDP in total). However, additional adjustment—the size of which depends on the
type of adjustment measure—is required to maintain debt below the Maastricht limit for the
entire period until 2050. We characterize the size of the adjustment needed, if adjustment is
front loaded, beyond achieving structural balance by 2011 for each measure in Table 3.

Structural fiscal adjustment could be attained through various combinations of expenditure
and revenue measures (Table 3). GFM can be used to analyze the effects of different
consolidation methods: (i) lower government consumption; (ii) lower government transfers;
(iii) higher worker social security contributions; (iv) higher employer social security
contributions; (v) higher personal income tax rates; (vi) a higher VAT; (vii) raising social
security contributions of workers in combination with income tax base broadening measures;

(viii) higher corporate income tax rates, or (ix) a combination of these measures—labeled a "package."

Table 3. Germany: Alternative Fiscal Adjustment Strategies: 2006-17 1/

(In percent unless otherwise indicated)

|	2006	2007	2011	2017
VAT				
Statutory rate	16.0	19.0	24.7	26.6
Effective tax rate	10.1	12.0	15.6	16.8
Revenue (in percent of GDP)	6.2	7.2	9.2	9.8
Labor income tax workers				
Effective tax rate	27.2	26.0	32.0	36.5
Revenue (in percent of GDP)	8.7	8.3	10.3	11.7
Base broadening and higher labor income tax workers				
Base broadening 2/				
Reducing effective exemption rate (in percent of GDP)	...	...	1.5	1.5
Labor income tax				
Effective tax rate	27.2	26.0	27.6	30.6
Overall revenue effect (in percent of GDP)	8.7	8.3	10.4	11.7
Labor income tax employers				
Effective tax rate	22.8	22.8	29.5	40.3
Revenue (in percent of GDP)	8.7	8.7	10.7	13.5
Personal income tax				
Effective tax rate	11.0	11.0	13.0	14.4
Revenue (in percent of GDP)	8.9	8.9	10.9	11.7
Corporate income tax				
Effective tax rate	29.0	29.0	34.9	38.7
Revenue (in percent of GDP)	8.1	8.1	10.1	11.0
Social security transfers				
In the absence of fiscal adjustment (aging effect) 3/				
Spending (in percent of GDP)	19.7	19.6	19.1	19.8
With fiscal adjustment				
Spending (in percent of GDP)	19.7	19.6	17.1	17.6
Government consumption				
Spending (in percent of GDP)	18.6	18.6	16.6	16.4
Percentage reduction (relative to 2007)			-10.8	-11.8
Package of measures (in percent of GDP)				
Spending	18.6	18.6	18.1	18.1
Social security transfers	19.7	19.6	18.0	18.0
Revenue from reducing effective exemption rate	...	...	0.5	1.3
VAT (in percent)				
Effective rate	10.1	12.0	12.6	12.6
Statutory rate	16.0	19.0	20.0	20.0

Source: IMF staff estimates.

1/ Adjustment of 1/2 percent of GDP during 2007-11 in addition to the coalition agreement. All adjustment scenarios achieve structural balance by 2011 with subsequent adjustment to maintain government debt within the Maastricht limit until 2050.
2/ Reduction in the fraction of average labor income that is tax exempt.
3/ Aging costs are projected to decline in Germany during 2007-13 as a result of recent reforms (see Figure 1).

Figure 5. Macroeconomic Effects of Alternative Fiscal Adjustment Strategies 1/

Revenue measures

Expenditure measures
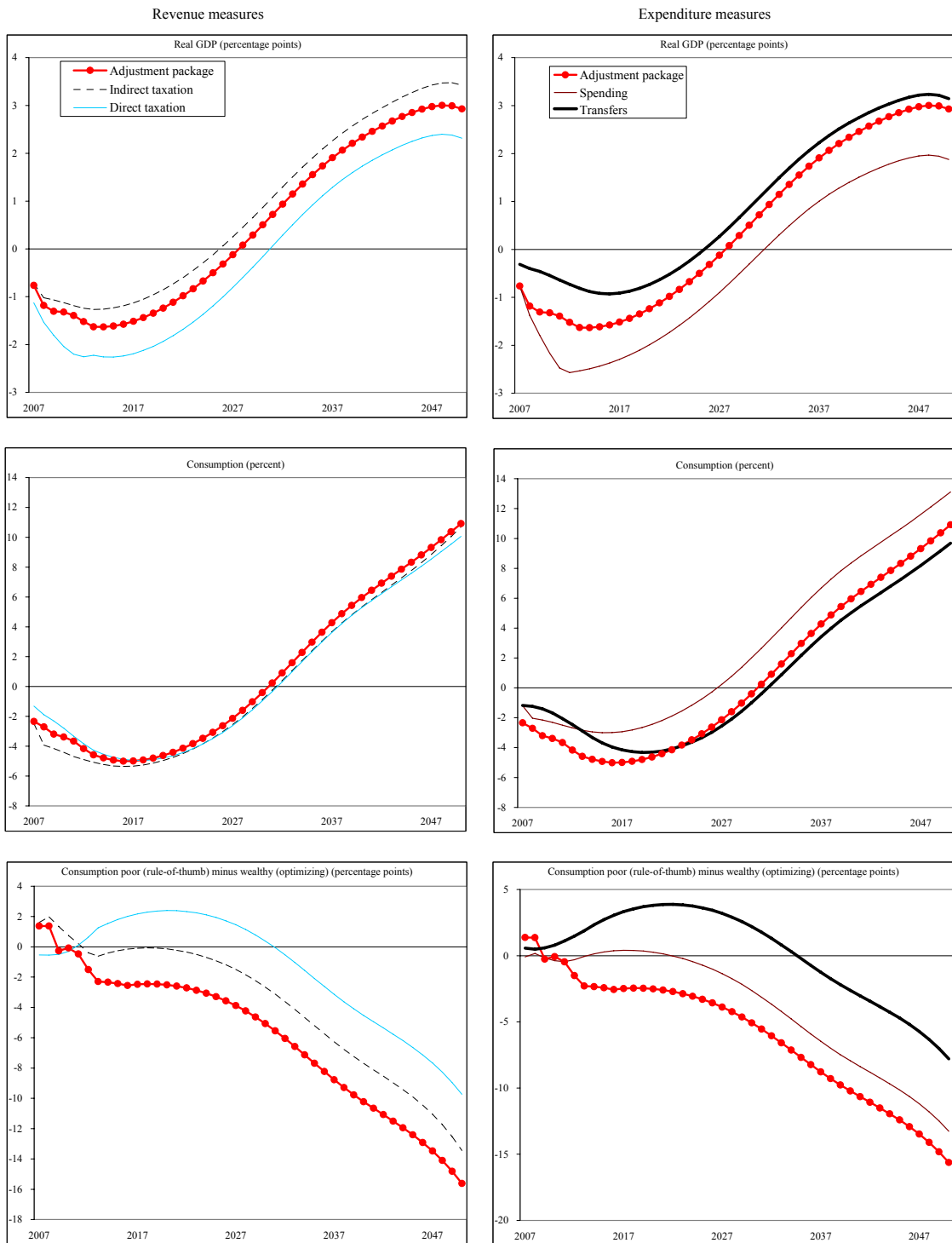
Source: GFM simulations.

1/ All adjustment strategies achieve structural balance by 2011 with subsequent adjustment to maintain government debt below the Maastricht debt limit.
See Table 3 for details on each adjustment strategy. Indirect taxation relies on higher VAT rates; direct taxation relies on higher corporate income taxation.

Figure 6. Debt Dynamics in Germany With Fiscal Adjustment
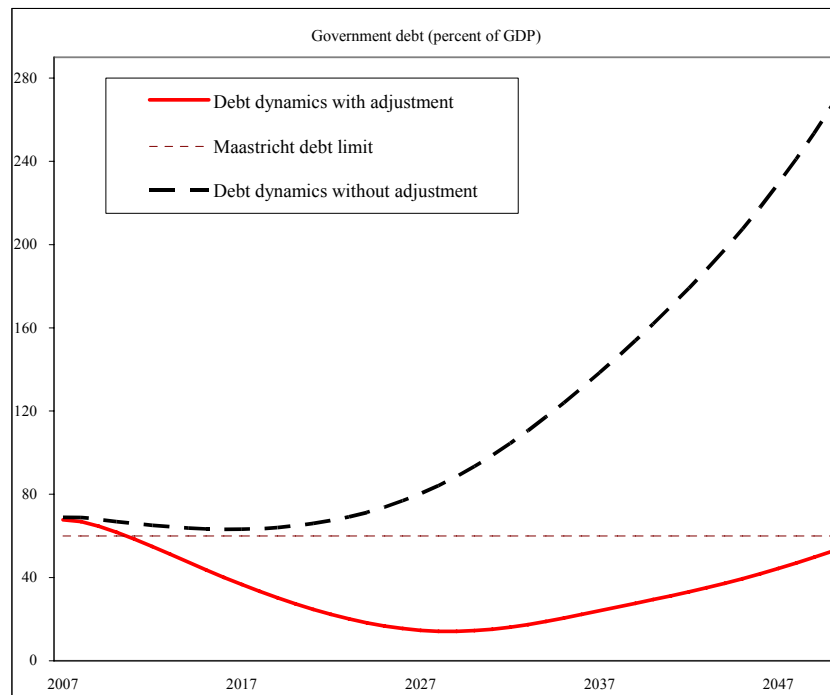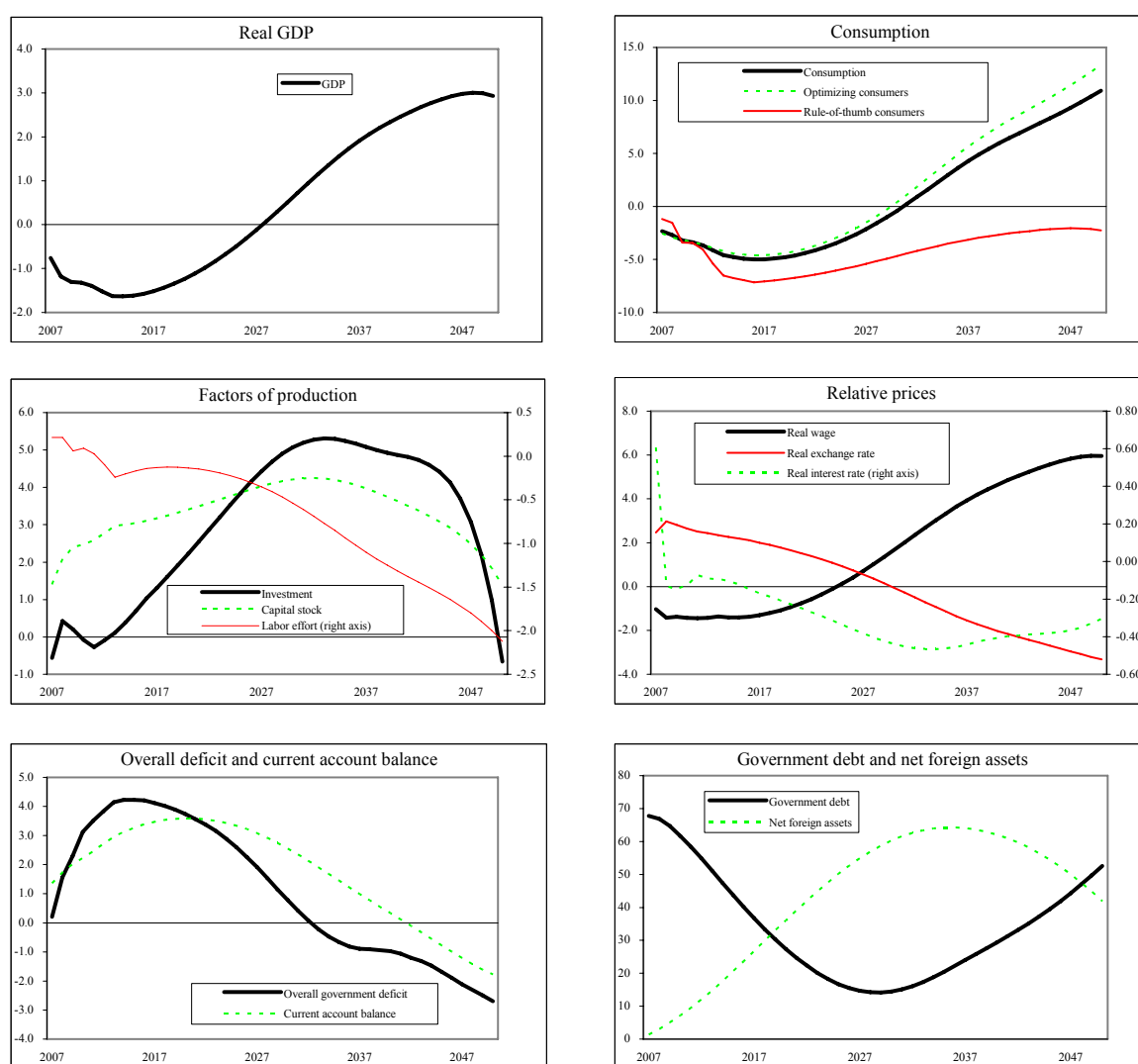

Source: GFM simulations.

Calibration results from GFM suggests that the short-run growth slowdown of achieving structural balance varies with the type of consolidation measure (Figure 5). The impact on short run growth varies between -0.2 percent and -0.3 percent each year between 2007–15, depending on the specific measures, their distortionary effect, and the impact on domestic demand:

- **Revenue increases.** The negative growth impact of the different tax measures ranges from -0.1 percent to -0.3 percent. The VAT is less distortionary than payroll taxes, because it also taxes accumulated savings (i.e., reaches a broader base, including retirees) in addition to affecting the labor-leisure choice. Increasing payroll taxes on workers is more distortionary than reducing tax exemptions (base broadening) owing to marginal tax rates on workers exceeding the average rate. Raising corporate or personal income taxes is roughly equally distortionary in terms of output loss. That payroll taxes are less distortionary than taxation of capital is a result found in other studies as well (Baylor, 2005), and reflects generally inelastic labor supply—in particular among males—in most industrial countries, including in Germany.

- **Expenditure cuts.** Lowering social security transfers has the smallest growth impact per year. This relatively modest growth effect occurs when the benefits that are

reduced are distributed in a lump sum manner—reducing transfers that cause economic distortions (such as unemployment benefits) would imply growth losses similar to those observed for higher payroll taxes. Part of the decline in consumption demand is absorbed by trading partners via reduced import demand. In contrast, reductions in other government consumption would lead to a larger slowing in growth, which reflects the fact that current government spending in most countries is heavily biased towards domestic goods, or nontradables ("home bias").

Figure 7: Macroeconomic Effects on Germany of Adjustment Package 1/

Source: GFM simulations

1/ See Table 3 for details on the adjustment package.

If no specific strategy is proposed, rising aging-related expenditure pressures would likely result in higher direct taxation. German law stipulates that the social security accounts have to maintain balance and as a result, under current rules, growing expenditures must be met with equivalent social security contributions. While this prevents runaway fiscal deficits and a buildup of debt, it implies higher payroll taxes as the default policy response.

Expenditure cuts and entitlement reform, in combination with base broadening and raising indirect taxes, compares favorably to raising direct taxes. Achieving the 2 percent of GDP adjustment between 2008–11 by relying exclusively on just one of the eight adjustment measures appears difficult, and the government likely will need to choose a combination of measures. For instance, reducing government spending—whether on goods and services or social security transfers—by 2 percentage points of GDP by 2011 implies unrealistically large cuts in discretionary spending. Similarly, further increases in the VAT revenue are also limited (including through EU regulations), although further base broadening would be possible by placing fewer items under the lower (7 percent) VAT rate. Raising direct taxation is distortionary and runs counter to the government's intentions to increase incentives for labor participation and investment. The macroeconomic effects of a mixed policy package is also outlined in Figure 5 comprising lower government spending, lower social security transfers, reductions in income tax exemptions (base broadening), and a small further increase in the effective VAT, to a statutory rate of 20 percent.

Eliminating the structural deficit by 2011 through such a package lowers medium-run growth by about 0.2 percent per year (Figure 5). The effects on consumption are more sizable, particularly for those consumers that rely relatively more on labor income as lower social security transfers in particular lower their consumption opportunities. Nevertheless, such a package is not necessarily worse for these rule-of-thumb consumers compared to the long-term effects of raising corporate income taxation. The latter tax affects consumption by the optimizing consumers more in the short term as these consumers hold the equity in the firms, but in the long term the tax incidence shifts to workers as well through lower real wages.

These adjustment strategies achieve a considerable improvement in debt dynamics (Figure 6). Eliminating the structural deficit by 2011, with further adjustment through 2017, implies a substantial improvement in the overall balance of the government. In a sense, this adjustment package prefund (partially) future aging costs: a significant reduction in government debt over the medium term, reduces the interest burden of the government to the extent that rising aging costs can be accommodated with limited increases in debt up until 2050. Although the package prevents debt from rising above the Maastricht debt limit, however, Figure 6 also suggests that, towards the end of the period, further adjustment will be required.

Prefunding future aging costs result in a reduction in real interest rates, by about 40 basis point in the medium term, although the effect is reserved as Germany is a relatively small

open economy in the sense that Germany's national savings rate has only a modest effect on the global savings and investment balance (Figure 7). A higher VAT and base broadening of income taxation imply reduced incentives for labor hours, as indicated by the decline in hours worked and the increase in the real wage. Investment responds positively through "crowding-in" after debt starts to decline. Output gradually increases as a result, although it takes a long time before GDP has returned to the level observed before the fiscal adjustment was initiated. As consumption declines, the real exchange rate depreciates, and the trade balance will record stronger surpluses. Higher national saving results in increasing claims on the rest of the world through accumulation of net foreign assets.

VI. GLOBAL AGING AND FISCAL ADJUSTMENT: INTERNATIONAL COOPERATION?

Since debt is seen to be unsustainable in Germany, the rest of euro area, and the United States, we analyze the implications of each country/region implementing an adjustment package similar to the package implemented in Germany, although the size and composition will depend on starting fiscal position and future aging costs. The focus is on the impact of such an adjustment package on other countries and regions, were the spillover effects materialize through financial and trade channels.

The sequencing of these fiscal consolidations in different countries is particularly interesting. To analyze the potential costs and benefits of fiscal cooperation, we undertake simulations based on two alternative constellations: (i) that the adjustment package is implemented immediately; or (ii) it will be implemented after 10 years. These scenarios capture the relative costs and benefits of fiscal cooperation versus the incentives to potentially free ride on fiscal adjustment in other parts of the world.

The details of the package in the euro area and the United States are different from the one in Germany, given the differences in the structural characteristics and starting points (see Table 4 for details on the package in the euro area and the U.S.). We assume, as was done for Germany, that the package of adjustment measures in the euro area maintains government debt below the Maastricht limit until 2050 and avoids increases in direct taxation if implemented without delay.

Although, the initial fiscal balance and the magnitude of aging costs are different in the rest of the euro area compared to Germany. Nonetheless, the adjustment will reduce the real interest rates more in the euro area as a whole since it is a larger region (compared to Germany). This essentially allows the size and composition of the package (to stabilize debt at about 55 percent) to be similar as in Germany.

For the U.S., the package is designed such that debt remains somewhat below its current level until 2050. However, despite the US being a larger economy compared to Germany, given the substantially higher aging costs including Medicare and Medicaid costs in the U.S.

the package needs to include further measures, assumed here to consist of further increases in indirect taxation.

Table 4. Adjustment Strategies in the euro area and the U.S.: 2006-17
(In percent of GDP unless otherwise indicated)

	2006	2007	2011	2017
Euro area assumptions				
Aging costs by 2050	4.5			
Government debt by 2022 without adjustment	87.5			
Adjustment package stabilizes debt by 2050 at:	53.0			
US assumptions				
Aging costs by 2050	6.0			
Government debt by 2022 without adjustment	57.5			
Adjustment package stabilizes debt by 2050 at:	33.0			
Package of measures in EU				
Spending	16.6	16.6	16.1	16.1
Social security transfers				
in the absence of adjustment	22.5	23.3	23.3	23.3
with adjustment	22.5	23.3	22.7	22.7
Base broadening	...	...	0.5	1.3
VAT				
Effective rate (percent)	11.4	11.4	12.0	12.0
Package of measures in the U.S.				
Spending	15.5	15.5	15.0	15.0
Social security transfers				
in the absence of adjustment	21.7	21.7	22.5	22.7
with adjustment	21.7	21.7	21.1	19.7
Base broadening	...	...	0.5	1.3
Indirect taxation				
Effective rate (percent)	7.6	7.6	8.2	12.7

Source: IMF staff estimates.

To assess the benefits of cooperative action, we analyzed a number of variants for the early adjustment and the late adjustment scenarios: we first considered all three countries/regions undertaking early joint action, and then each one delaying by 10 years, while the other two implemented early adjustment. We also explored pair-wise delays (e.g., U.S. and rest of euro area delay by 10 years, while Germany continues with adjustment), and then all three delaying. A key result is that Germany benefits substantially from early fiscal adjustment in the rest of the euro area, and in the U.S. (Figure 8). Although exports decline following lower consumption in the two regions and therefore lower demand for imports from Germany, this is more than offset by the decline in real interest rates through financial linkages between Germany and the euro area and the U.S. The result is an investment rebound and higher domestic demand in Germany.

Delaying adjustment in Germany has short-term benefits, but substantial medium-terms costs in terms of foregone output, as the adjustment will need to be more sizeable (Figure 8). Germany would also suffer from delays in adjustment in the euro area or in the U.S. as the initial fiscal position and the onset of higher aging costs put upward pressure on real interest rates. Also in the short term, spillovers through this financial channel more than offset the interdependence of countries through trade channels, with delayed adjustment benefiting Germany by maintaining existing export potential. Similarly, while the euro area and the U.S. benefit in the short-run only from delaying their respective adjustments and free riding on consolidation elsewhere, if all countries opt to postpone addressing this issue, each one loses. Effectively, the global economy loses through higher interest rates and increased adjustment in the future.

We also examined the broader macroeconomic effects on Germany (apart from the effect on GDP) of international cooperation in fiscal adjustment to address rising aging costs. The results are illustrated in Figure 9, and suggest appreciable benefits compared to the results of Germany acting alone, shown in Figure 7 above. For instance, investment is now significantly higher (through the interest rate channel), which initially also crowds in higher labor effort; consumption is also higher, and although there is now a weaker external balance, and corresponding less accumulation of net foreign assets, as the above analysis indicated, there is a substantial benefit in terms of higher real output.

Table 5. Net Present Value of GDP of Fiscal Cooperation 1/

	Germany	EU	US
Early cooperated adjustment	167	135	149
Germany delays 10 years	148	128	141
EU delays 10 years	135	79	116
US delays 10 years	91	61	52
Germany and EU delay 10 years	116	71	108
Germany and US delay 10 years	74	52	44
EU and US delay 10 years	56	8	19
10 year delay Germany, EU, and US	40	0	11

Source: GFM simulations.

1/ See Table 2 for baseline parameter values. Net present value equal to the sum of discounted output effects, with discount rate equal to market real interest rate implied by the simulation.

A quantitative assessment of the early versus delayed strategy, and the potential for the prisoner's dilemma to materialize in practice, depends also to a considerable extent on how much weight policymakers attach to the present versus the future. One way of quantifying the tradeoff between short-term gains versus medium-term losses is through a net present value calculations. These calculations depend crucially on the discount rate, but across a range of its plausible values, it is clear that the benefits of early and cooperative action exceed substantially those of delayed action (see Table 5). These estimates suggest that real GDP, in discounted terms, is on average 4 percent higher until 2050 from an early cooperative response. In addition, delaying adjustment will compromise intergenerational equity, as future generations will pay a disproportionate portion of aging costs.

The above estimates are also sensitive to how much government debt crowds out private investment, and the values of a number of other parameters. Sensitivity analysis was undertaken for the effect of longer planning horizon, lower elasticity of labor supply, less liquidity-constrained consumers, and a lower intertemporal elasticity of substitution (see Table 6).

A longer planning horizon implies that consumers anticipate that prefunding of future aging costs will lead to lower interest rates in the future and reduce labor effort and consumption by a smaller amount (i.e., the more Ricardian the consumers, the smaller the effect). This causes a smaller initial decline in output, but also smaller increases in consumption and output in the medium term. Nonetheless, albeit smaller, the relative benefits of cooperative action rather than free riding still remain. Similarly, but to a much smaller extent, reducing the sensitivity of workers to changes in the after-tax real wage rate and reducing the share of liquidity-constrained consumers in the economy, makes the framework more Ricardian, with similar (but quantitatively much smaller) consequences.

With regard to a lower sensitivity of consumption to changes in the real interest rate, the effect is to increase the gains from early adjustment and fiscal cooperation. The reason is that prefunding generates "twin surpluses,"—that is both the current account and the government balance move into surplus. Consistent with external debt sustainability, the trade balance will gradually move into deficit, which occurs through changes in relative prices including the real interest rate as the price of consuming today versus later. As the real interest rate declines, consumption will increase generating trade balance deficits over time. If, however, consumption is less sensitive to changes in the real interest rate, the real interest rate will decline by more, benefiting investment and real GDP in the medium term.

Figure 8. Effects on Real GDP in Germany of Fiscal Cooperation 1/

The Effects of Fiscal Cooperation on Germany
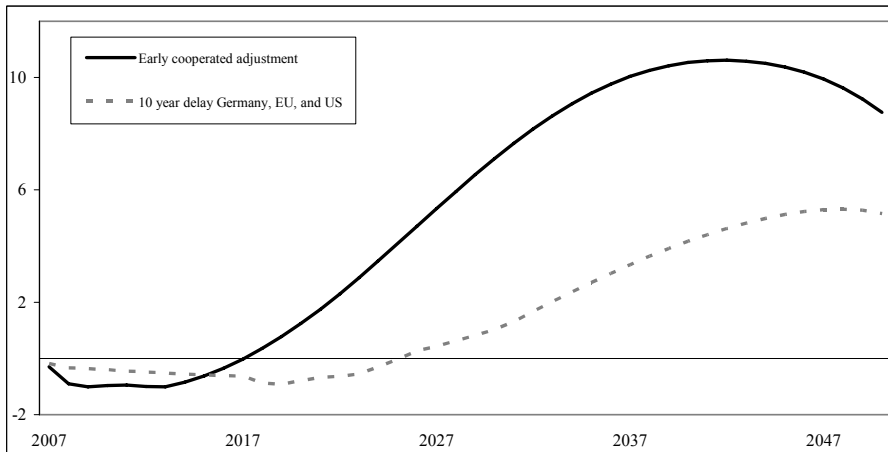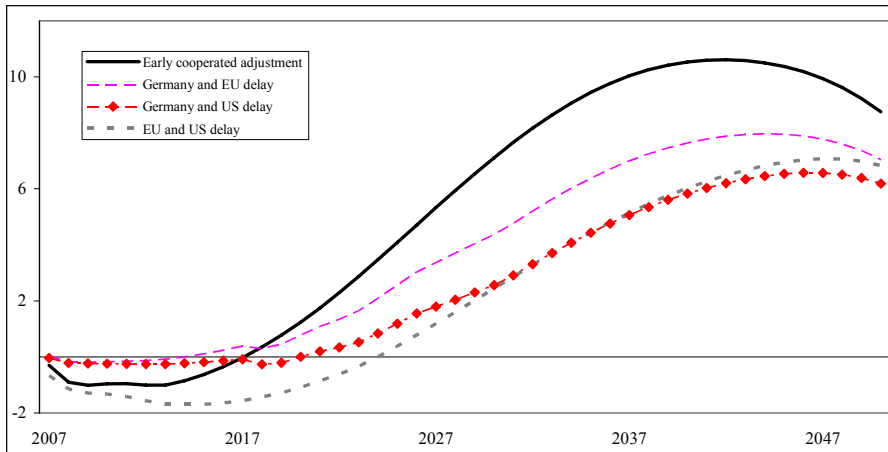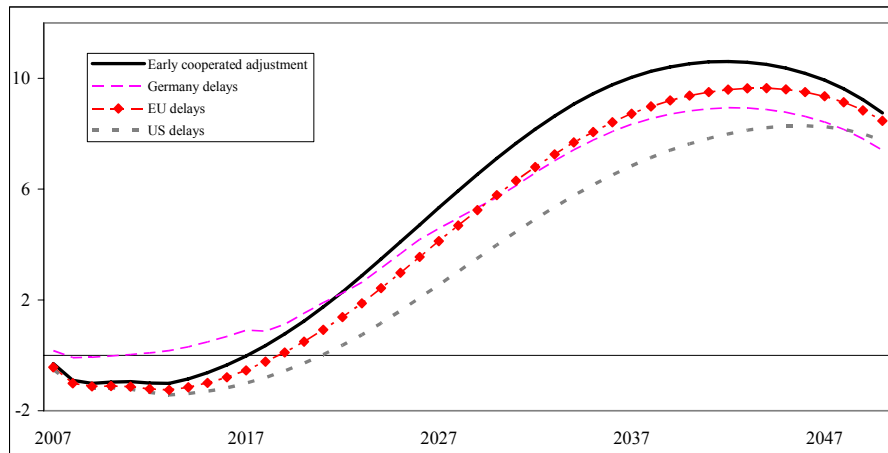
Source: GFM simulations.

1/ See Tables 3 and 4 for details on the adjustment packages in Germany, the euro area, and the United States.
  Delaying adjustment by ten years is assumed to be compensated through higher social security contributions
  by workers.

Figure 8. *cont.* Effects on Real GDP in the euro area of Fiscal Cooperation

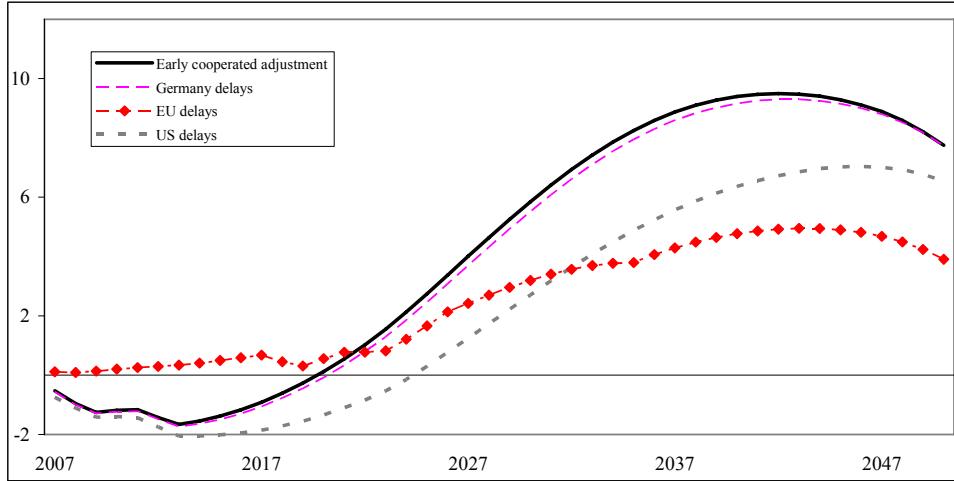The Effects of Fiscal Cooperation on the Euro Area
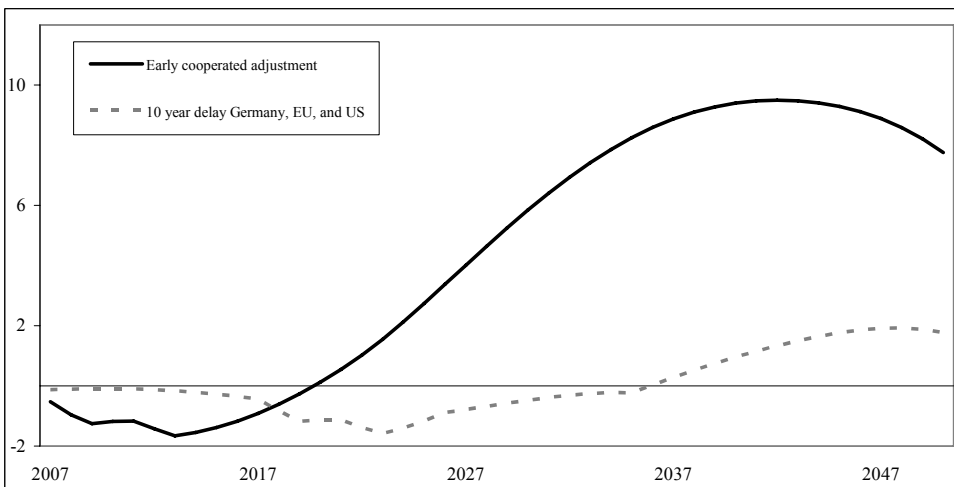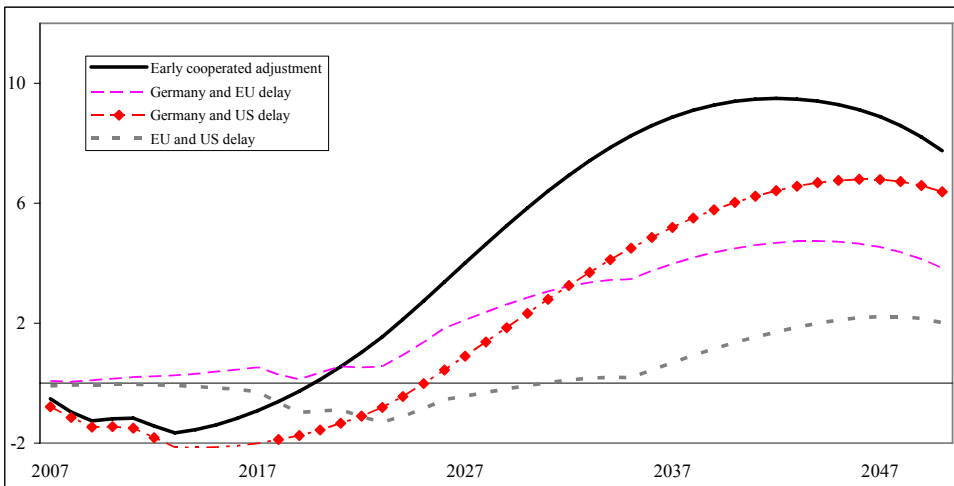
Figure 8. *cont.* Effects on Real GDP in the United States of Fiscal Cooperation
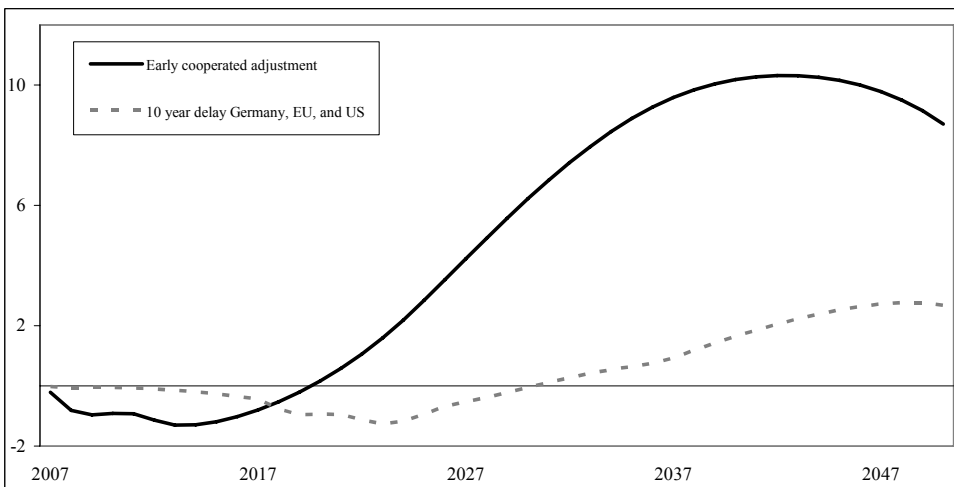
The Effects of Fiscal Cooperation on the US

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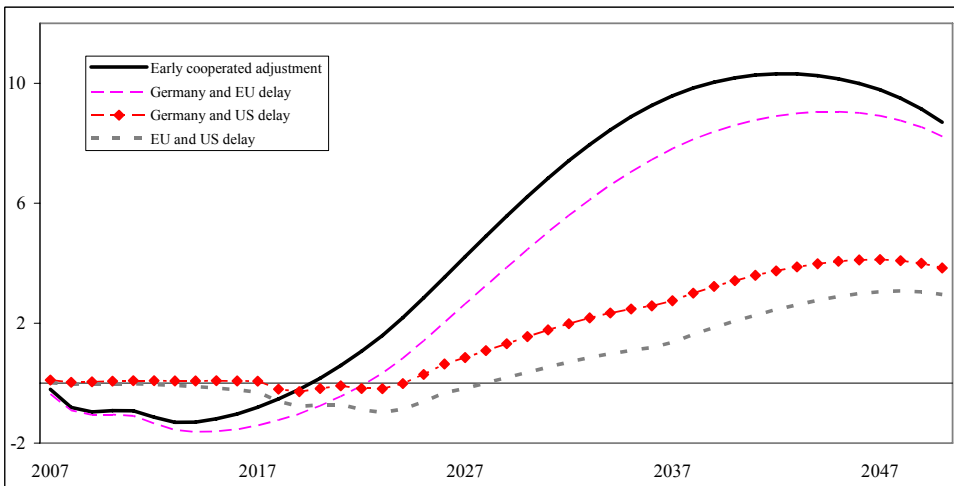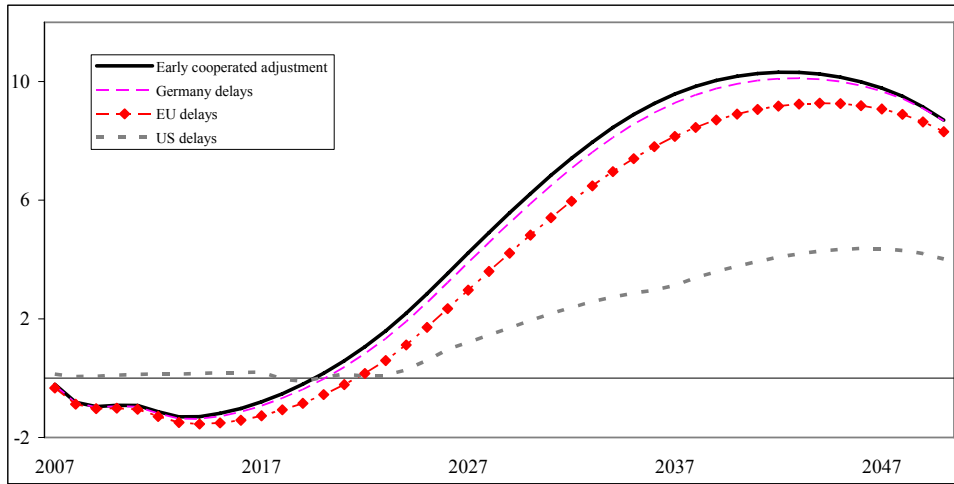Table 6. Sensitivity Analysis of Net Present Value of GDP of Fiscal Cooperation 1/

	Baseline			Long planning horizon 2/			Lower elasticity of labor supply 3/		
	Germany	EU	US	Germany	EU	US	Germany	EU	US
Early cooperated adjustment	167	135	149	7	-17	-12	141	129	131
Germany delays 10 years	148	128	141	4	-18	-13	130	124	125
EU delays 10 years	135	79	116	-1	-25	-27	80	69	64
US delays 10 years	91	61	52	3	-29	-16	122	100	111
Germany and EU delay 10 years	116	71	108	0	-30	-17	111	95	105
Germany and US delay 10 years	74	52	44	-3	-26	-28	70	63	58
EU and US delay 10 years	56	8	19	-5	-37	-31	57	41	42
10 year delay Germany, EU, and US	40	0	11	-7	-38	-32	48	35	35

	Baseline			Less liquidity-constrained consumers 4/			Lower intertemporal elast. of substitution 5/		
	Germany	EU	US	Germany	EU	US	Germany	EU	US
Early cooperated adjustment	167	135	149	135	105	117	191	158	173
Germany delays 10 years	148	128	141	119	99	110	170	150	164
EU delays 10 years	135	79	116	76	47	41	107	76	67
US delays 10 years	91	61	52	109	59	91	156	97	137
Germany and EU delay 10 years	116	71	108	94	53	84	135	88	128
Germany and US delay 10 years	74	52	44	63	41	35	88	66	58
EU and US delay 10 years	56	8	19	49	4	15	68	17	29
10 year delay Germany, EU, and US	40	0	11	36	-2	9	50	8	20

Source: GFM simulations.

1/ See Table 2 for baseline parameter values. Net present value equal to the sum of discounted output effects, with discount rate equal to market real interest rate implied by the simulation.
2/ Longer planning horizon of consumers (horizon equal to 100 years).
3/ Less elastic labor supply making workers less sensitive to changes in the after-tax real wage (absolute elasticity equal to 0.99).
4/ Fewer liquidity-constrained consumers (fraction equal to 10 percent of consumers).
5/ Lower intertemporal elasticity of substitution making consumers less sensitive to changes in the real interest rate (elasticity equal to 0.29).

Figure 9: Macroeconomic Effects of Fiscal Cooperation on Germany 1/
(Deviation from initial steady state in percentage points unless otherwise noted)
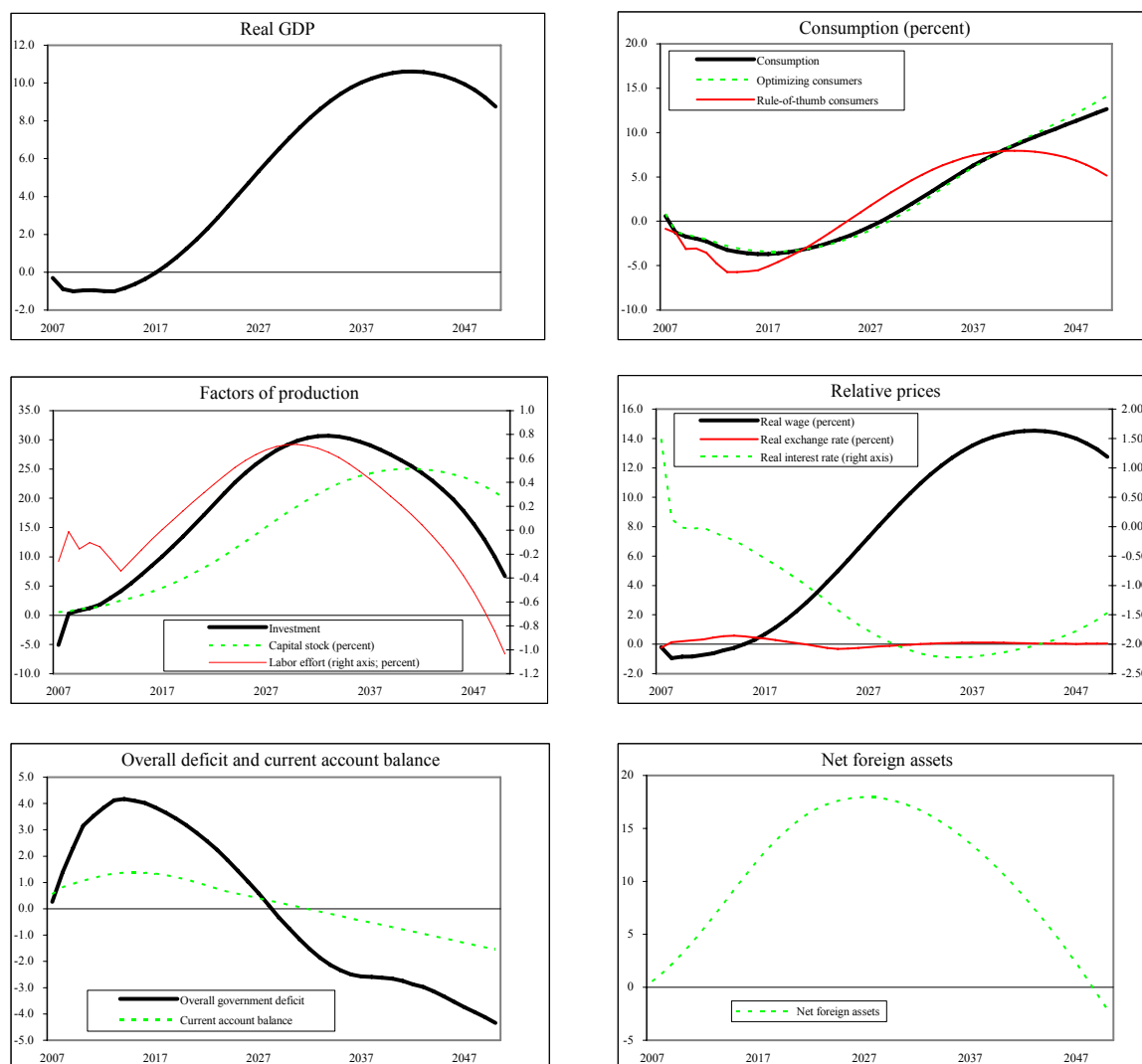
Source: GFM simulations

1/ See Tables 3 and 4 for details on the adjustment package in Germany, the euro area, and the U.S.

VII.   ACHIEVING THE LISBON AGENDA: ARE FISCAL ADJUSTMENT AND STRUCTURAL REFORM COMPLEMENTARY?

The Lisbon strategy adopted in 2000, entailed a wide ranging program of economic, social and environmental reforms, designed to enhance EU's growth and employment and allow it to compete more effectively in the global economy. The backdrop of the strategy was the exposure of EU countries to growing international competition, the needs of the knowledge

based economy, and demographic challenges. The strategy was reinforced in 2005 with a sharper focus on structural reforms to improve competitiveness, dynamism, and employment.
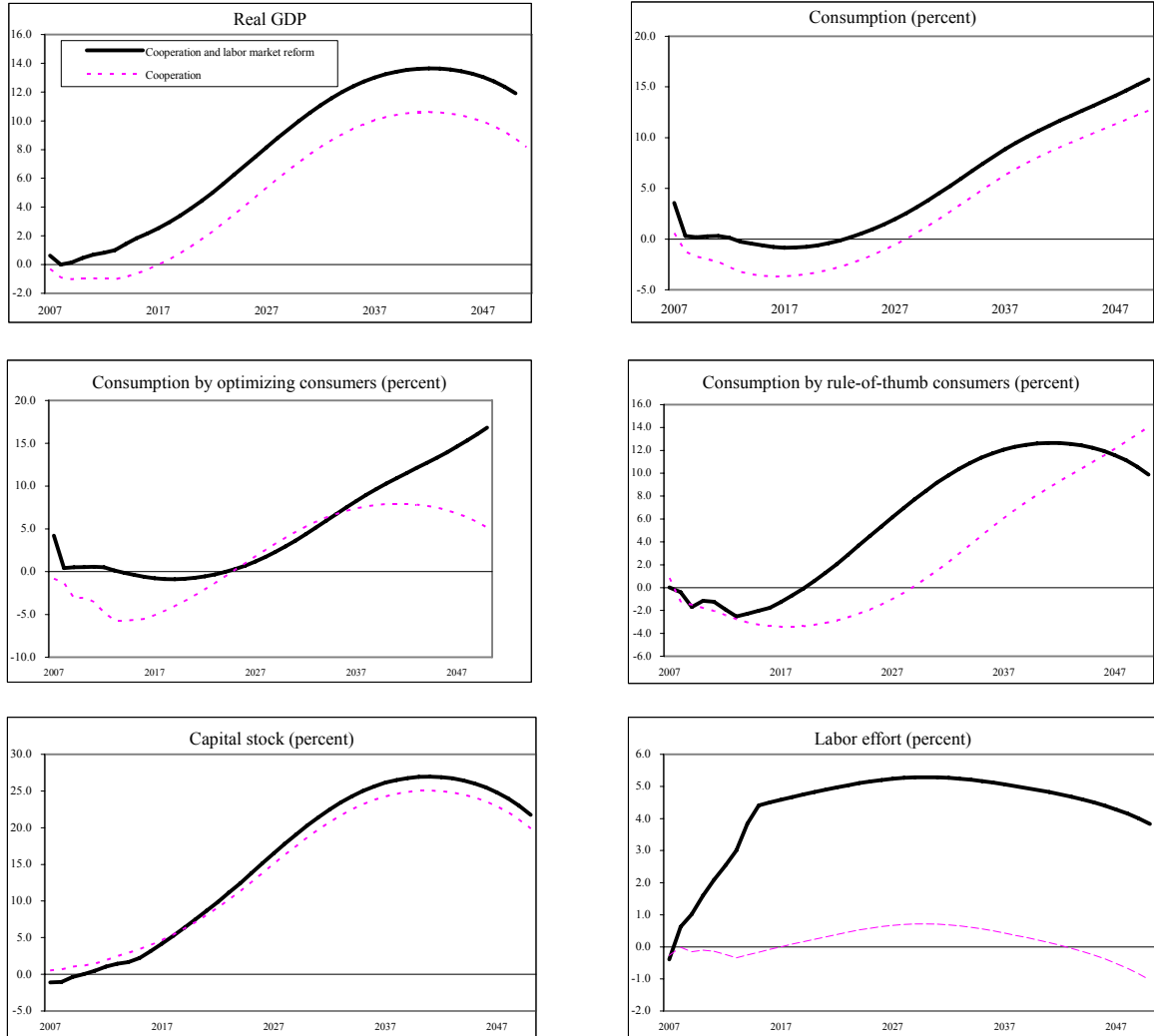
A.   Increasing Labor Participation

We first consider the impact of higher labor participation. This is to be achieved by lower direct taxation of labor and capital, and amount to one-half percent of GDP per year during the period 2009–12. The reform is designed to be revenue neutral—this is achieved by increasing the effective VAT rate, for example through base broadening and VAT rate harmonization rather than increasing the highest statutory tax rate (which in our simulations already reaches the maximum allowed under internal EU rules as part of the adjustment package). The basic premise is that this type of tax reform stimulates incentives to save, work, and invest and therefore increases the demand for labor.

Labor supply increases as a result of a gradual reduction in the elasticity of labor supply over the period 2007–15. Thus, this policy implies a reduction in the bargaining power of workers—in the sense that the markup of the real wage above the level of wages observed if labor supply is completely inelastic. This reduces the utility of leisure, and mitigates the effects of payroll taxation on labor supply. The stronger incentives for labor demand and labor supply together imply an increase in labor participation equal to 5 percent of the labor force over the five year period.

As illustrated in Figure 10, increasing labor participation by this amount has large positive effects on consumption and real GDP, offsetting most of the short-term costs from fiscal adjustment. Consumption of rule-of-thumb consumers increases in particular, as labor income expands despite the reduction in the real wage that accompanies such a large increase in participation. However, because of the reduction in real wage, overall consumption increases by a smaller amount than output.

Figure 10: Fiscal Cooperation and Higher Labor Participation in Germany 1/
(Deviation from initial steady state in percentage points unless otherwise noted)

Source: GFM simulations

1/ Increase in labor participation through stronger incentives for labor supply and labor demand. A lower elasticity of labor supply, reduces the bargaining power of workers, reduces the utility from leisure, and reduces the distortions created by payroll taxation. Labor demand increases as a result of revenue-neutral tax reform involving higher revenue from indirect taxation--VAT base broadening--and lower corporate income and payroll taxation. This revenue-neutral tax reform is assumed to take place from 2009-2012 and amounts to one-half percent of GDP per year during this period.

B. Higher R&D Spending

In this simulation, Germany's R&D intensity—defined as the share of R&D spending in GDP—(2½ percent in 2004), is assumed to increase to 3 percent by 2010. Higher spending on R&D gradually increases productivity where we have assumed a social rate of return of 50 percent (see Griffith (2000) and as discussed in CPB (2006) in the middle of a rather wide range of empirical estimates). The implications for real GDP and consumption are strongly positive, although the effect on government debt by 2050 is modest as public finances and expenditure to a large extent grow with nominal GDP (see Figure 11).

The domestic spillover elasticity is assumed to be 10 percent, in between estimates by Jacobs, Nahuis, and Tang (2002), and Keller (1997) who find elasticities of about 15 percent and results from the CPB (2006) who suggest 7.4 percent. The elasticity of own sector R&D spillover is assumed to be 5 percent, similar to CPB (2006), but below other estimates in the literature (Nadiri, 1993). Together, these estimates imply a total elasticity of 15 percent. Thus, an increase in Germany's R&D stock equivalent to 1 percent of GDP leads to a 0.15 increase in total factor productivity and a social rate of return of R&D spending of about 65 percent, which is at the middle level of available estimates.[10]

The increase in the ratio of R&D to GDP from 2½ percent to 3 percent translates into an increase of 20 percent over and above replacing depreciating R&D stock. By 2025, this increases GDP by about 3.3 percent, which corresponds to a R&D elasticity of about 15 percent. Since labor effort is endogenous, the GDP effects are somewhat different from the productivity effects. (These estimates are consistent with those reported in CPB (2006), after one makes adjustments to the different modeling frameworks). The increase in productivity leads to lower consumer, producer and export prices, causing a negative terms of trade effect. Consumption will therefore increase by less than the increase in GDP. Over time, as real wages increase, consumption of rule-of-thumb consumers increases, both relative to the baseline without additional R&D spending and relative to wealthier, optimizing, consumers.

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[10] Canton and others (2005) conclude that these estimates are usually in the range of 30–100 percent; Griffith, Redding, and van Reenen (2000) estimate that for most OECD countries social rates of return on R&D are equal to about 50 percent. The 30 percent assumption here thus reflects these estimates and takes into account that Germany is already closer to the Lisbon objective of 3 percent of GDP spending relative to other euro area countries.

Figure 11: Fiscal Cooperation and Higher R&D Spending in Germany 1/
(Deviation from initial steady state in percentage points unless otherwise noted)
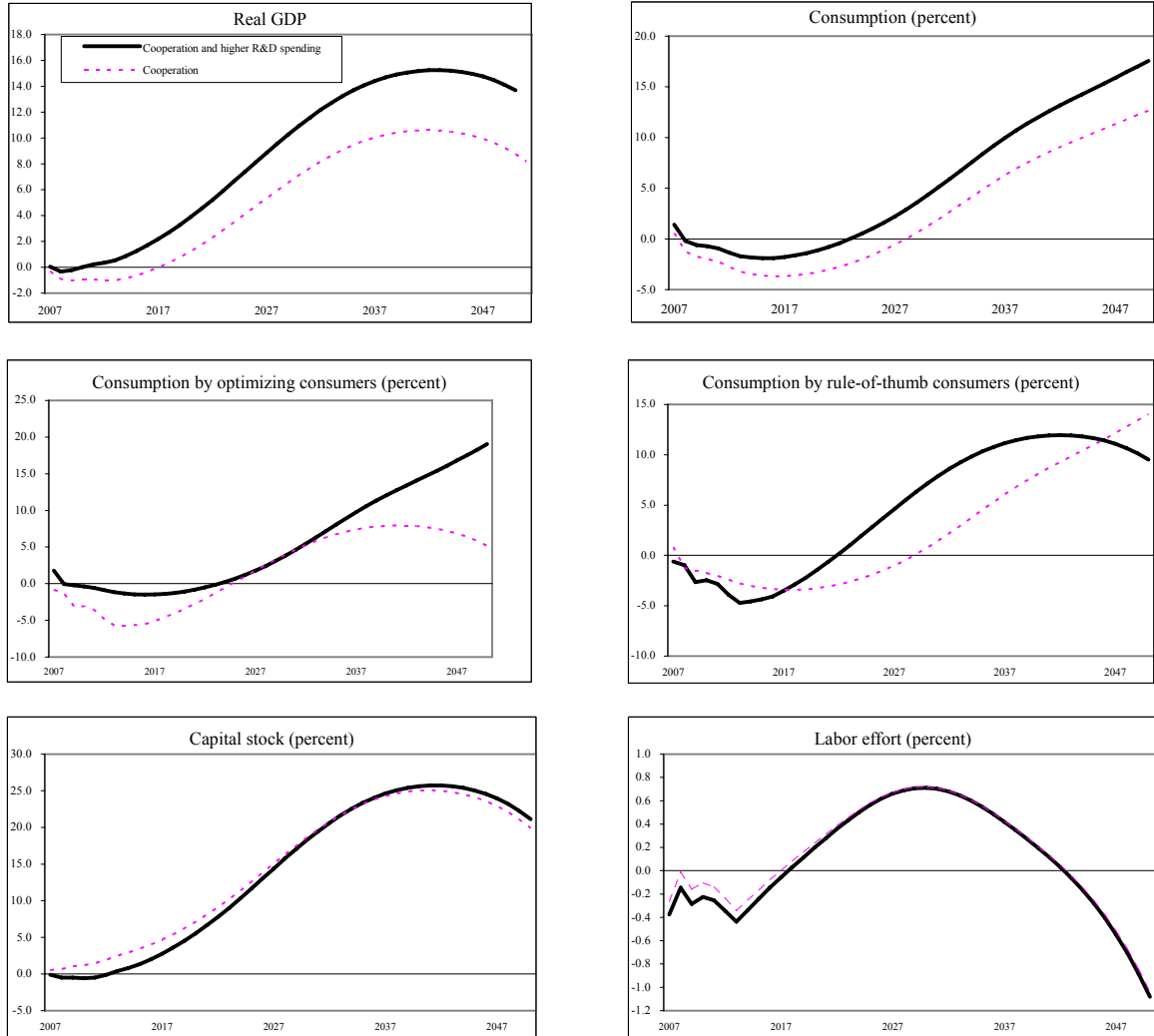
Source: GFM simulations

1/ R&D intensity increases by 0.5 percent of GDP by 2010 in Germany so that R&D spending as a share of GDP equals 3 percent, causing a
gradual increase in productivity in both the tradeables and nontradeables sectors of the economy.

C. Higher Product Market Competition

The baseline assumes that the markup over marginal cost in the tradable sector in Germany is equal to 14 percent and, in the nontradables sector, 27 percent. This is a conservative estimate relative to estimates for other countries. For instance, Bayoumi et al (2004) find that greater product market competition has larger effects on activity than reducing labor market rigidities, with these differences being much starker for investment, output, and international spillovers than for consumption and labor effort. Everaert and Schule (2006) also find sizable long-term gains in output and employment of reform in product and labor markets. They also find that most of these gains accrue to the reforming country regardless of whether reform takes place elsewhere. Thus, spillover effects of these reforms are modest relative to the macroeconomic effects on the country implementing the reform. They use price markups of respectively 19 and 39 percent in the tradable and nontradables sector in Belgium, and 21 percent and 41 percent respectively for France. Everaert and Schule (2006) consider a scenario in which markups in Belgium and France decline to the average level observed for a reference group of countries, consisting of Denmark, Sweden, and the United Kingdom. This implies a sizable reduction in markups, particularly in the nontradables sector, to respectively 14 percent and 24 percent in the tradable and nontradables sector.

Here we consider a gradual decline in markups, such that by 2015, markups have declined by a quarter to 11.1 percent and 20.3 percent respectively. For the period 1970–92, the average markup in Germany's manufacturing sector is found to be about 20 percent of fragmented markets and close to 30 percent for segmented markets in Oliveira et al (1996). Usually, markups in manufacturing are believed to be somewhat lower compared to the economy-wide average, due to higher competition from abroad. As a result of the relatively modest reduction in markups simulated here compared to previous studies, and the relatively lower initial markups compared to empirical estimates, our estimates could be interpreted as reasonable, albeit probably lower bound estimates of the potential gains from product market liberalization in Germany and the rest of the euro area.

In GFM the markups, as in the other studies cited above, are modeled by a single parameter (θ), the sensitivity of substitution of demand by different between products of different firms, which determines the market power of each firm:

$$P_t(i) = \frac{\theta}{(\theta-1)} MC_{i,t}$$

With $MC_{i,t}$ denoting the marginal cost of the firm producing variety i. Thus, modifying the elasticity of substitution between varieties can simulate the impact of structural product market reforms that raise competition. However, the simplicity of this relation comes at the expense of being agnostic about the specific reasons for imperfect competition, which could be related to past R&D expenditures, government regulation, public goods provision etc.

Thus, our experiment involves a gradual increase in the substitution elasticity between varieties from a value of 8 to 10 for tradables, and from a value of 4.8 to 5.9 in nontradables.

Product market reform has a large positive effect on the real wage, causing consumption of rule-of-thumb consumers to increase disproportionately (see Figure 12). If Germany implements product market reform by itself, the real exchange rate will depreciate relative to the baseline, implying that total consumption declines despite the increase in output and improved consumption by the rule-of-thumb consumers. Optimizing consumers not only lose from the real exchange rate depreciation, but also the equity value of their wealth declines due to lower profit margin of firms. Also, they need to save more to finance the higher investment of firms after they expand output and lower prices following the erosion of the monopolistic power. Increasing competition across firms reduces the price markup as these firms increase output since the demand curves they face have become more elastic. The increase in output benefits capital more than labor effort (or hours worked) as in the long run, labor is the less elastic resource (see also Bayoumi et al op. cit.). Output increases by 1.7 percentage point, relative to the baseline of fiscal cooperation only, with product market reform, by 2025.

Figure 12: Fiscal Cooperation and Product Market Reform in Germany 1/
(Deviation from initial steady state in percentage points unless otherwise noted)
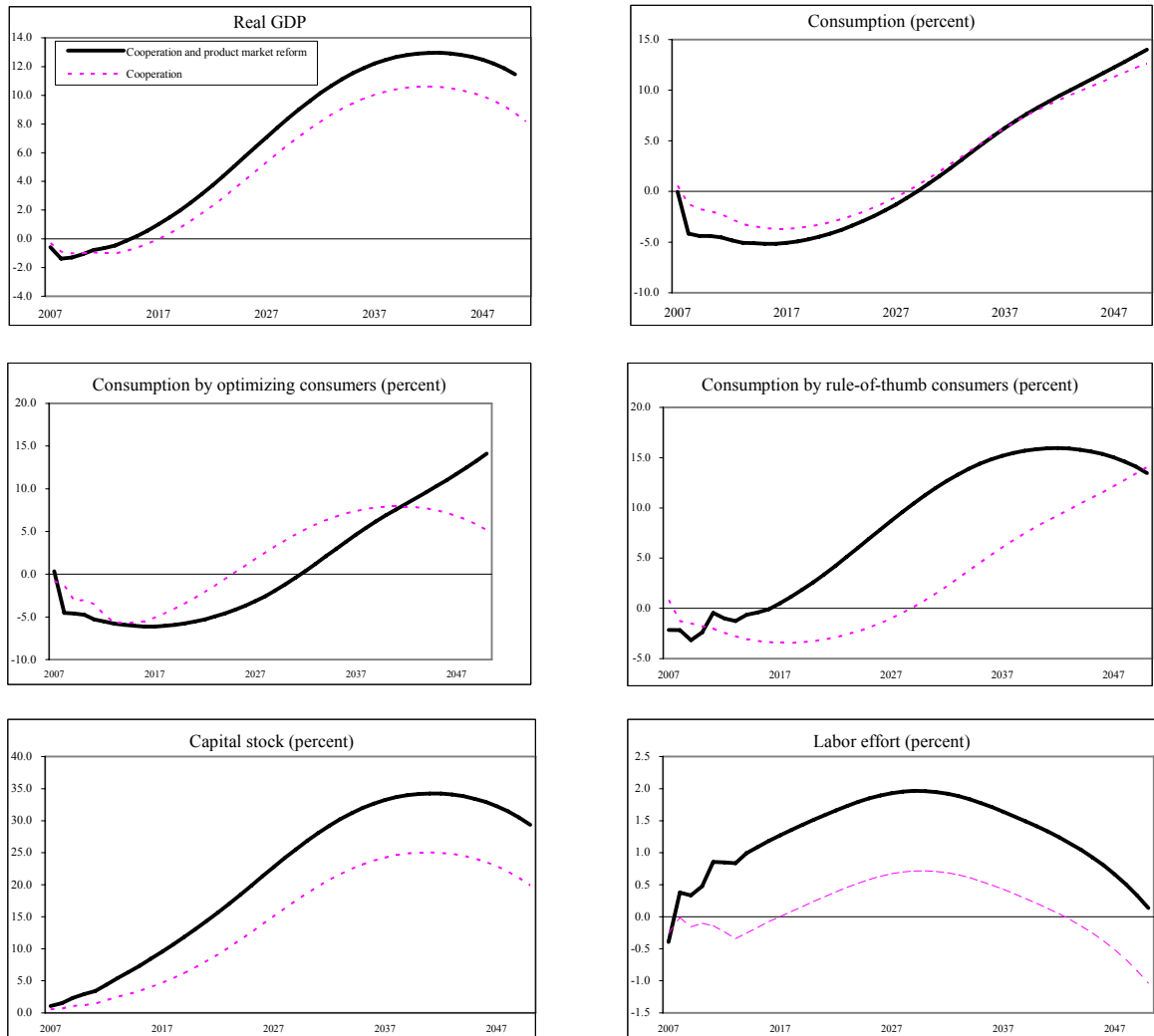
Source: GFM simulations

1/ Higher product market competition in Germany is assumed to reduce price markups over marginal costs gradually, by 25 percent by 2015.

D. Implementation of Lisbon Agenda in Germany and the Euro Area

Next we consider the effects of Germany implementing the full Lisbon agenda as discussed previously. In addition, we consider the effects on the euro area, both under fiscal cooperation but without structural reform, and under fiscal cooperation and full implementation of Lisbon agenda.

Regarding the latter, the assumptions for the euro area to meet the objectives in the Lisbon agenda are as follows:

- **Labor market reforms**: the participation rate for the euro area, excluding Germany, is approximately 62½ percent (see CPB, 2006). As a result, relatively more reform on both the demand and supply side will be needed to meet the target of 70 percent participation rate compared to Germany where the starting position was 65 percent employment.

- **Higher spending on R&D**: For the euro area as a whole, excluding Germany, R&D spending is about 2.1 percent of GDP. To reach the goal of 3 percent of GDP spending by 2010, the required increase is 40 percent. Our simulations below suggest that GDP increases by 7.4 percent by 2025 as a result of this increase in R&D, which corresponds to a R&D elasticity of about 18½ percent. As a result, given estimates for the initial stock of R&D in GDP in the euro area, the social rate of return is about 90 percent, in line with empirical estimates. Regarding the value of this elasticity, we now need to take into account international R&D spillovers between countries. CPB (2006) suggests that this spillover effects add about 5.6 percent to the elasticity reported for Germany by itself (15 percent) previously.[11] As a result, our overall elasticity for the effect of higher R&D spending in the euro area is conservative and our simulated effect on GDP growth in between the upper and lower bound estimates reported in CPB (2006).

- Similarly, we included the international spillover of R&D spending, to Germany's overall R&D elasticity, which increased from 15 percent previously to 17½ percent, slightly below the euro area minus Germany average reflecting the fact that Germany is already spending a larger share on R&D. In short, the effect of higher R&D spending on GDP in the euro area are larger than in Germany because the starting position of R&D spending is lower and because the international spillover effects need to be accounted for.

- **Product market competition**: in our baseline calibration, we assume that average product price markups in the euro area excluding Germany are equal to 21.3 percent and 40 percent in the tradable and nontradables sectors respectively. We assume a reduction by 25 percent by 2015 such that the markups are 16.3 and 29.6 respectively.

It is notable that output expands considerably if Germany implements the full Lisbon strategy and meets all its objectives. Also, consumption, for both the "wealth, optimizing" consumers and the "poor, rule-of-thumb" consumers increases, more than compensating for any losses from the fiscal adjustment. As such, fiscal adjustment and structural reform are

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[11] This estimate is consistent with Coe and Helpman (1995) who find an elasticity of total factor productivity growth to foreign R&D between 6–9 percent.

complementary and the former could increase the need for the latter, while the latter facilitates the former.

Labor effort, and especially capital accumulation expand considerably (Figure 13). Note that the positive spillover effects on Germany of the euro area as a whole implementing its Lisbon strategy are relatively modest. This is consistent with Everaert and Schule (2006), who also find that most of the benefits of structural reform accrue to the country implementing the reforms. There may, however, be additional benefits in that euro area wide structural reform, by reducing inflation and inflationary expectations (following in particular product market reforms) could facilitate monetary easing, increasing the positive short-term output effects. In addition there could be important "demonstration" effects which could help from a political economy perspective.

The effects on GDP and consumption in the euro area of full implementation of the Lisbon agenda are larger compared to those for Germany(Figure 14). This reflects the fact that price markups decline by more, R&D investment needs to increase further and also is accompanied by international positive spillover effects, and labor participation needs a somewhat stronger policy action than in Germany to increase labor demand and supply. For the euro area as a whole as well, achieving the Lisbon agenda more than compensated for output losses from fiscal adjustment, again highlighting the complementarities between the two.
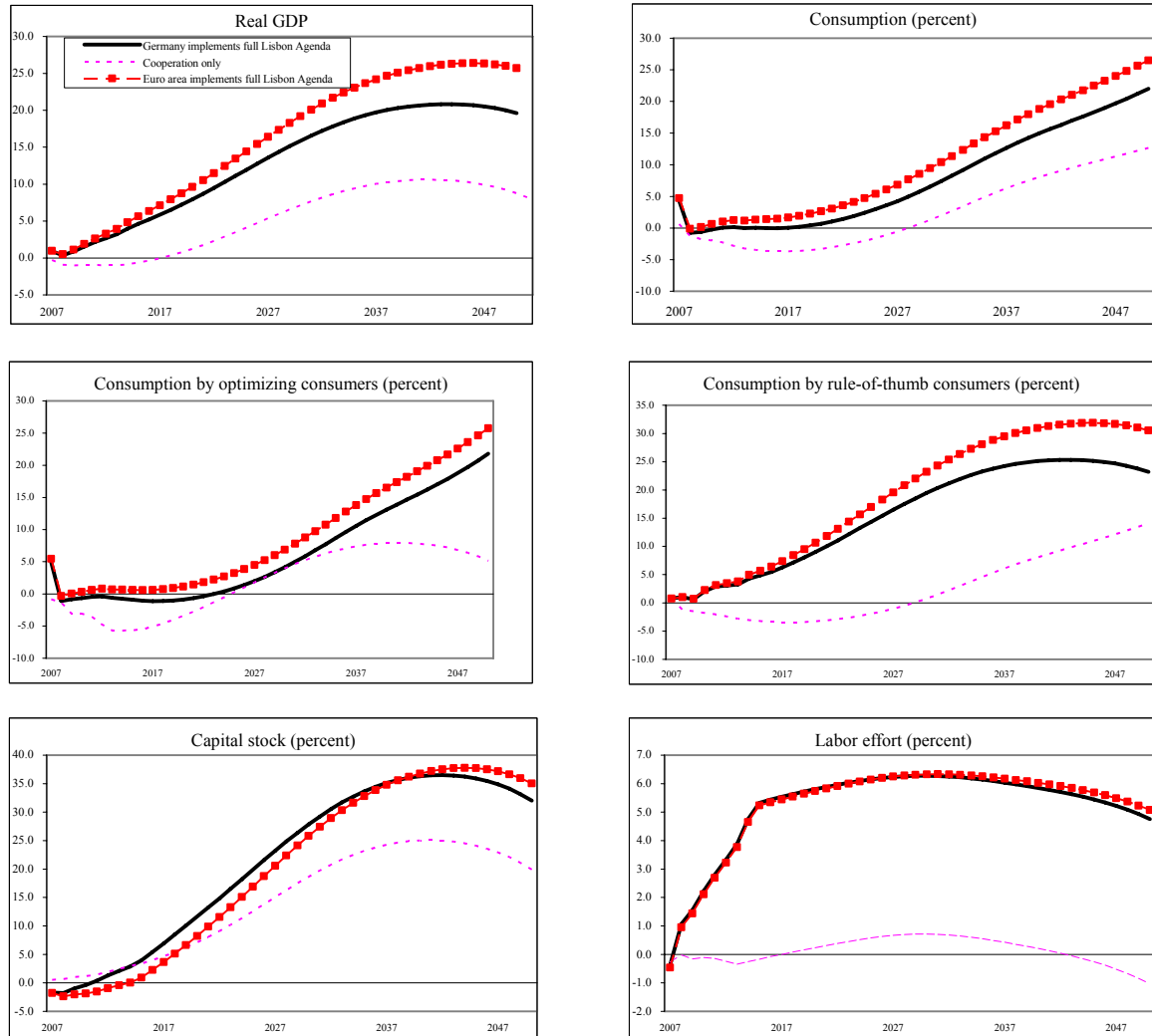
The model does assume that all the reforms are announced, fully credible, and all the consumers and producers have perfect information and knowledge of the economy. In reality, not all the reforms may be perceived as credible, and economic agents face uncertainty about the response of the economy. On the other hand, there may be synergies between labor and product market reforms, with labor market reforms being more effective, the more deregulated are the product markets (Berger and Danninger, 2005). Moreover, markups on wages and prices could be linked (Jean and Nicoletti, 2002). This highlights the complimentarity of reforms in the Lisbon strategy, beyond the complementarity between structural reforms and fiscal adjustment.

The latter complimentarity could even be stronger than seems here as structural reform could reduce unemployment and thereby government spending, while higher productivity growth could reduce the initial stock of debt. Also, product market reform could reduce government spending as it could reduce the price the government pays for some of its services.

The effects of conversely delaying and not meeting the objectives in the Lisbon agenda are illustrated in Figure 15 for Germany and Figure 16 for the EU. In these simulations, higher product market competition in the euro area reduces markups by 12.5 percent by 2020, R&D spending increases from 2.1 to 2.6 percent of GDP by 2015, and measures increasing labor demand and labor supply increase labor participation from 63 to 67 percent by 2020. This contrasting scenario of partial and delayed achievement of the Lisbon objectives may appear more practical, but it has the negative consequence that the short-term output and

consumption losses from prefunding of future aging costs cannot be mitigated. In turn, if these effects are not offset, policymakers may be inclined to postpone, or implement a more gradual fiscal consolidation, both in Germany as well as the rest of the euro area. As illustrated earlier, such a course of action, would in turn have large negative consequences for the medium and longer term and for intergenerational equity.
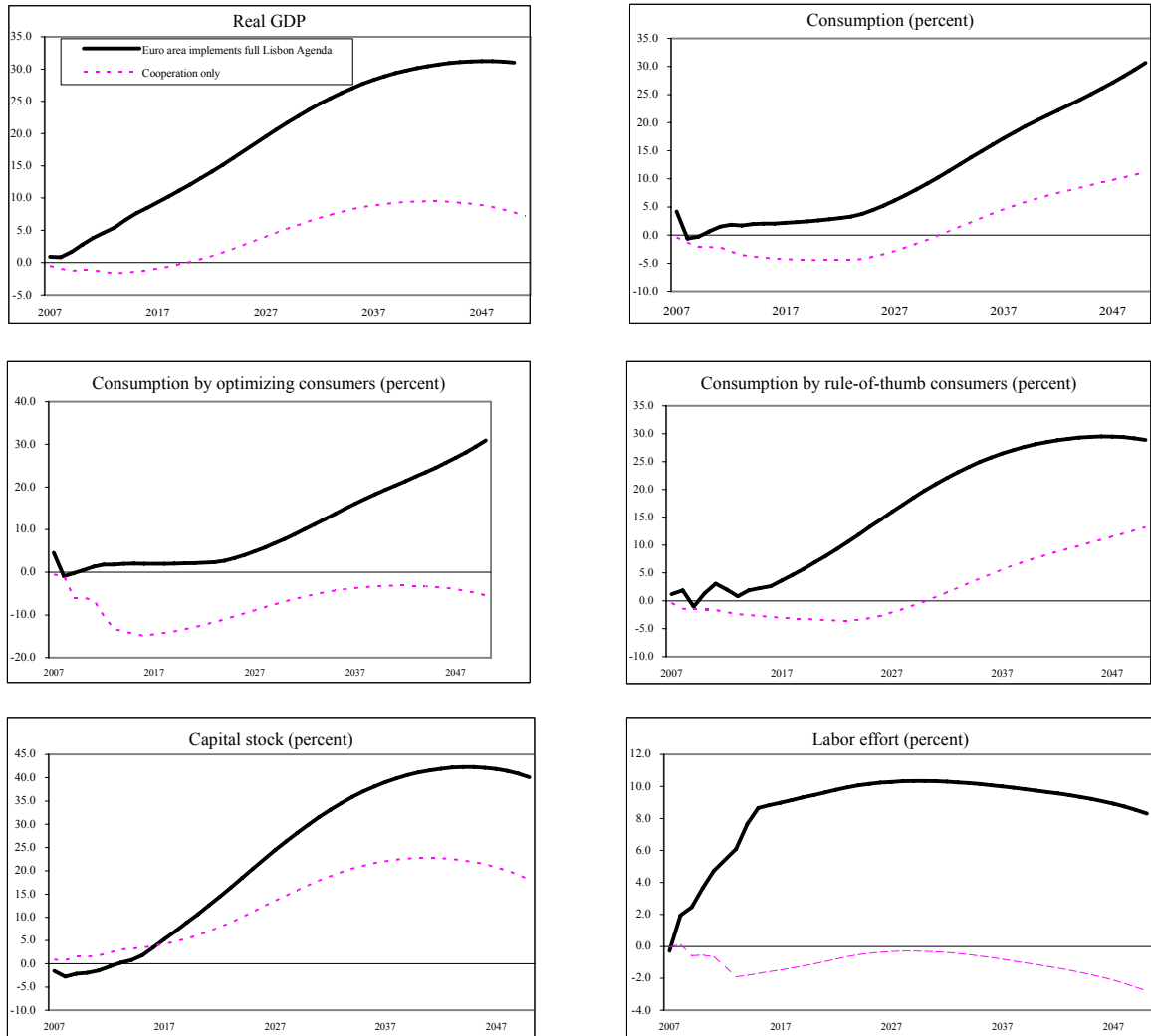
Figure 13: Fiscal Cooperation and the Lisbon Agenda: Effects on Germany 1/
(Deviation from initial steady state in percentage points unless otherwise noted)

Source: GFM simulations

1/ See Figures 10-12 for details on higher labor participation, R&D spending, and product market reform in Germany. Higher product market competition in the auro area reduces markups by 25 percent by 2015, R&D spending increases from 2.1 to 3 percent of GDP by 2010, and measures increasing labor demand and labor supply increase labor participation from 63 to 70 percent by 2015.
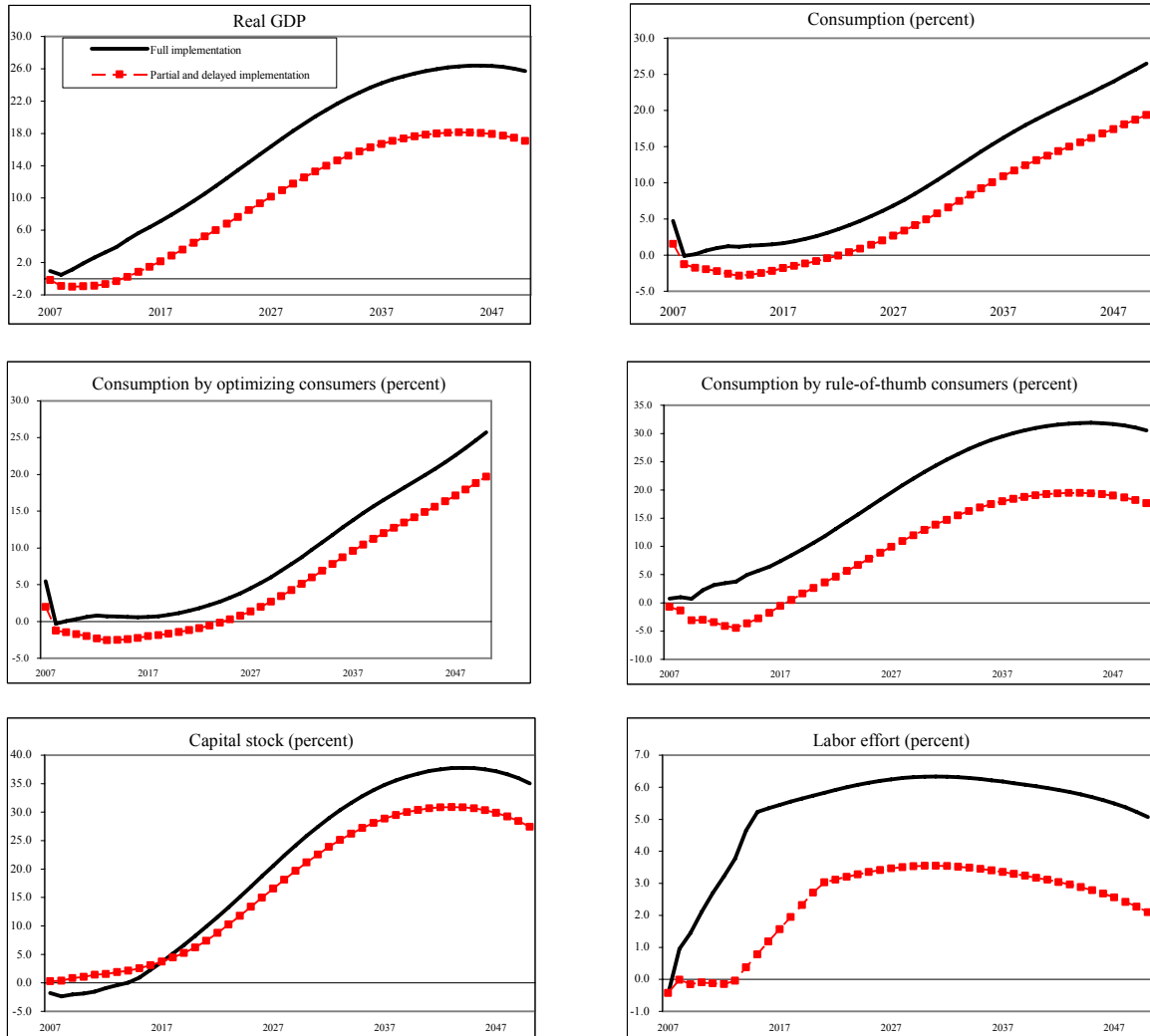
Figure 14: Fiscal Cooperation and the Lisbon Agenda: Effects on the euro area 1/
(Deviation from initial steady state in percentage points unless otherwise noted)

Source: GFM simulations

1/ See Figures 10-12 for details on higher labor participation, R&D spending, and product market reform in Germany. Higher product market competition in the auro area reduces markups by 25 percent by 2015, R&D spending increases from 2.1 to 3 percent of GDP by 2010, and measures increasing labor demand and labor supply increase labor participation from 63 to 70 percent by 2015.

Figure 15: Fiscal Cooperation and Delayed and Partial Implementation of the Lisbon Agenda: Effects on Germany 1/
(Deviation from initial steady state in percentage points unless otherwise noted)

Source: GFM simulations

1/ See Figures 10-12 for details on higher labor participation, R&D spending, and product market reform in Germany. Higher product market competition in the auro area reduces markups by 12.5 percent by 2020, R&D spending increases from 2.1 to 2.6 percent of GDP by 2015, and measures increasing labor demand and labor supply increase labor participation from 63 to 67 percent by 2020.

Figure 16: Fiscal Cooperation and Delayed and Partial Implementation of the Lisbon Agenda: Effects on the euro area 1/
(Deviation from initial steady state in percentage points unless otherwise noted)
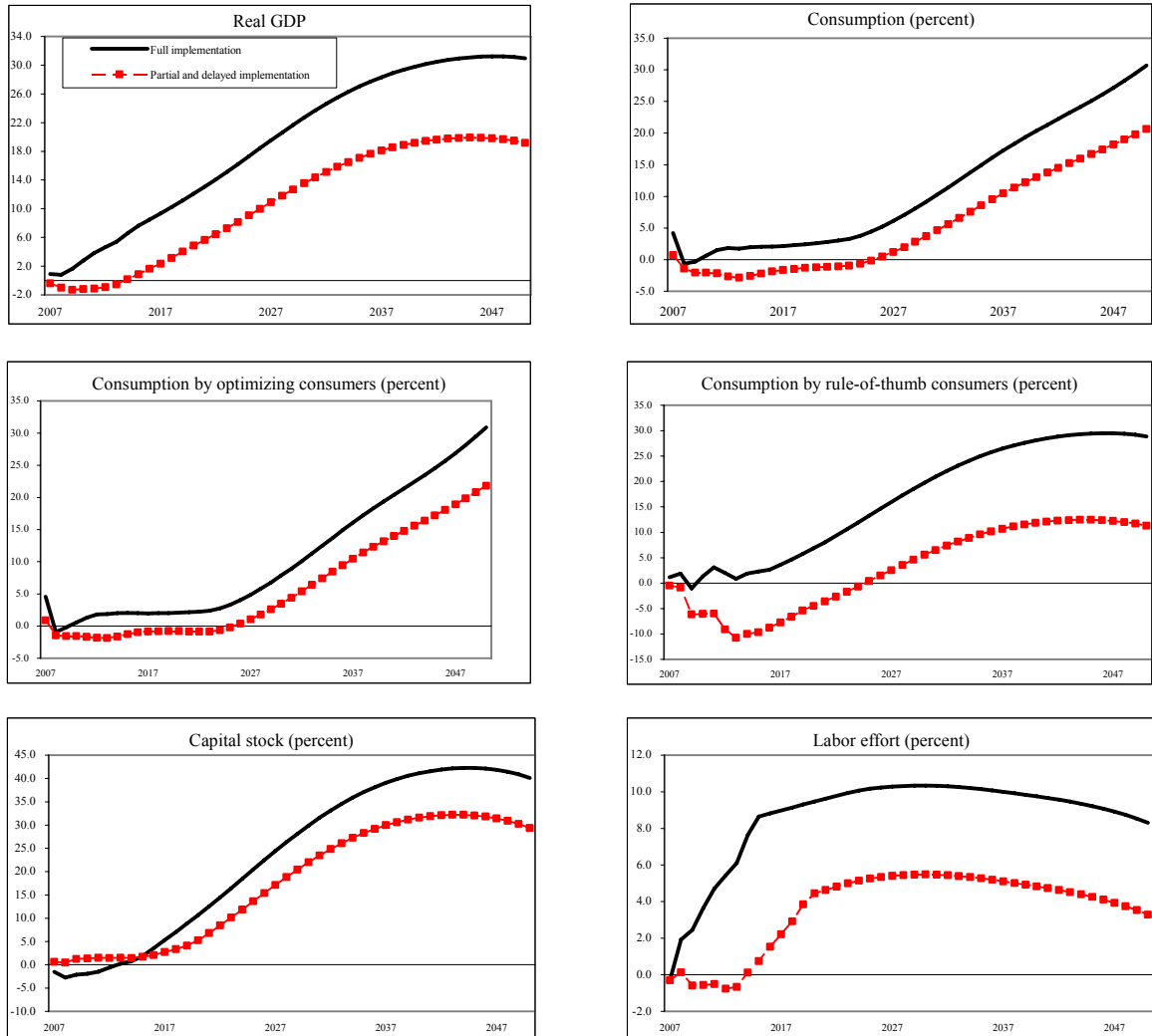
Source: GFM simulations

1/ See Figures 10-12 for details on higher labor participation, R&D spending, and product market reform in Germany. Higher product market competition in the auro area reduces markups by 12.5 percent by 2020, R&D spending increases from 2.1 to 2.6 percent of GDP by 2015, and measures increasing labor demand and labor supply increase labor participation from 63 to 67 percent by 2020.

VIII. SUMMARY AND CONCLUSIONS

This paper has undertaken a rigorous analysis of the macroeconomic effects of the policy response to global demographic pressures. We considered the effects of fiscal adjustment by itself, and when pursued in combination with tax, labor and product market reforms, using the IMF's Global Fiscal Model (GFM). The model is calibrated to the German economy, as well as to the rest of the euro area, and to the United States, and used to analyze the growth effects of alternative fiscal adjustment strategies to maintain debt sustainability, particularly in the face of aging pressures. The model also explores the international spill-over effects of demographic pressures and the benefits of cooperative fiscal adjustment. In addition, we examine the extent to which the Lisbon Agenda—structural reforms to boost productivity growth, labor participation, and product market competition—and tax reform could ameliorate the adverse short-term growth effects of fiscal adjustment. A key conclusion relates to the synergy between fiscal adjustment and the pursuit of Lisbon objectives: individually, either may be politically difficult to implement because of the short-run adverse effects on output and consumption but our results suggest that jointly the net benefits they yield are likely to ameliorate such concerns.

The specific key findings that emerge from the analysis are the following:

- First, there is little doubt that debt is unsustainable under current policies in the euro area as well as in the United States—this applies even in the case of the low estimates regarding the increased cost of health care and pensions.

- Second, debt in any particular country or region is seen to be even more unsustainable if the trading partners are also aging. The spillover effects of global aging occur through both financial and trade channels, with the former dominating through the higher borrowing costs that higher interest rates entail.

- Third, fiscal adjustment that combines both revenue and expenditure measures is the only feasible and relatively efficient method to maintain debt sustainability. Such a package should aim for a modest surplus in the primary balance over the next decade, to prefund future aging costs, and maintain intergenerational equity.

- Fourth, the short-term contractionary consequences of such a fiscal reform on GDP and consumption can be substantial. However, these effects can be ameliorated somewhat if there is international cooperation regarding reforms, thereby maximizing the reduction in borrowing costs. If all countries that face aging pressures delay adjustment, the consequences for each and collectively would be highly adverse.

- Fifth, achieving the objectives set out in the Lisbon agenda in Germany and the euro area is likely to overcome the adverse short-term effects on real GDP and consumption of the fiscal response. Raising labor participation through measures affecting both labor demand and supply, increasing competition in product markets, and higher productivity growth through stronger incentives for innovation raise growth and consumption. The effects on GDP and consumption in the euro area of full implementation of the Lisbon agenda are larger compared to those for Germany

- Sixth, partial and delayed achievement of the Lisbon objectives has the negative consequence that the short-term output and consumption losses from prefunding of future aging costs cannot be mitigated. In turn, if these effects are not offset, policymakers may be inclined to postpone, or implement a more gradual fiscal consolidation, with large negative consequences for the medium and longer term and for intergenerational equity.

- Seventh, regardless of actions by other countries, it is in each country's own interest to take early resolute measures to address the budgetary consequences of the looming aging pressures.

APPENDIX I: SPECIFICATION OF GFM

A.   Households

In each period t, n individuals are born in the home country, where the world population is normalized to unity. Each agent has a planning horizon of $1/(1-q)$ derived from the constant probability of survival q. A representative agent born in period a derives utility from consumption, C, leisure, $(1-L)$, where L denotes labor effort, and real money balances, (M/P), which are described by the following utility function:

$$U_t = E_t \sum_{t=0}^{\infty} (q\beta)^t \left[\frac{\left(C_{a,t}^{\eta}\left(1-L_{a,t}\right)^{1-\eta}\right)^{1-\rho}}{(1-\rho)} + \frac{\chi}{1-\rho}\left(\frac{M_{a,t}}{P_t}\right)^{1-\rho} \right]$$

where E_t denotes the mathematical expectation conditional on information available at time t, β is the subjective discount factor, $\rho>0$ is the inverse of the intertemporal elasticity of substitution, and we restrict the remaining parameters such that $0< \eta<1$ and $\chi>0$. Notice that with a constant probability of death, the agent discounts the future by an additional factor q.

As in Blanchard (1985) we assume the existence of insurance companies which charge a premium $(1-q)/q$ to each agent that survives in a period and also confiscates the wealth of deceased agents. Denoting government debt with $B_{a,s}$, Π after tax dividends by the firms, τ_L labor income tax, Φ any relevant rebates, P the aggregate price index, W the nominal wage, S the nominal exchange rate, $A_{a,t} = F_{a,t} + S_{t-1}F_{a,t}^*$ net foreign assets (NFA), V_i the value claim to all future profits of firm i, where $i \in [0,n]$, and, finally, $x_{a,t}^i$ the share of firm i owned by the representative agent born in period a in the beginning of period t, we have the agent's nominal budget constraint (abstracting from personal income taxation for simplicity):

$$P_t C_{a,t} + M_{a,t} + F_{a,t+1} + S_t F_{a,t+1}^* + \int V_t^i x_{a,t+1}^i di$$

$$= \frac{1}{q}\left[M_{a,t-1} + (1+i_t)(B_{a,t}+F_{a,t}) + (1+i_t^*)S_t F_{a,t}^*\right]$$

$$+ \frac{1}{q}\left[(1-\tau_l)W_t L_{a,t} + \int V_t^i x_{a,t}^i di + \int \Pi_t^i x_{a,t}^i di + \Phi_t\right]$$

Maximizing the utility function subject to the budget constraint yields optimality conditions that dictate the agent's behavior. Among them is an Euler equation (stating the preference to smooth consumption), and a labor supply schedule. It is important to underscore that because agents choose the amount of labor effort optimally, the labor income tax will have distortionary effects on the consumption and leisure choices. Furthermore, since NFA is composed of a home and a foreign asset, a standard uncovered interest parity (UIP) follows from the households' optimization problem, which underpins the main financial linkage between countries.

Botman, Laxton, Muir, and Romanov (2006) show that using the budget constraint along with the first order conditions, the decision rule of the optimizing agents, denoted $C_{a,t}^{opt}$ can be written as the sum of human wealth, $H_{a,t}$, and financial holdings:

$$P_t C_{a,t}^{opt} = \frac{1}{D_t}\left\{H_{a,t} + \frac{1}{q}\left[M_{a,t-1} + (1+i_{t-1})(A_{a,t-1} + B_{a,t-1})\right]\right\},$$

$$H_{a,t} = \sum_{s=t}^{\infty} R_{t,s} q^{s-t} (1-\Psi)\left[(1-\tau_{L,s})W_s L_s + \Theta_s\right],$$

Where, for simplicity, we assume that period profits (captured by the term Θ_s) are distributed equally across consumers. Also, Ψ denotes the share of rule-of-thumb consumers and D_t is the marginal propensity to consume out of total wealth. Aggregate consumption by rule-of-thumb consumers is given by:

$$P_t C_{a,t}^{rot} = \Psi\left[(1-\tau_{L,s})W_s L_s + \Theta_s\right],$$

The final consumption good in the home economy comprises traded, C_T, and nontraded, C_N, goods, and takes the form,

$$C = \left[\gamma^{\frac{1}{\varepsilon}} C_T^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma)^{\frac{1}{\varepsilon}} C_N^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

In turn, C_T is composed of home, C_H, and foreign, C_F, goods, which is also aggregated using a similar CES function. Both the traded and nontraded goods are themselves baskets of individual goods. For example, the nontraded good is composed of varieties, $C_N(i)$, produced by an arbitrary firm in the nontraded goods sector, with $i \in [0,n]$. More formally,

$$C_N = \left[\left(\frac{1}{n}\right)^{\theta} \int (C_N(i))^{\frac{\theta-1}{\theta}} di\right]^{\frac{\theta}{\theta-1}}$$

The domestic traded good, C_H, is a similar basket of differentiated varieties. With the standard restrictions on parameters, we can obtain a optimization-based price index for each consumption aggregate.

B. Firms

A typical firm, in either sector, maximizes the discounted value of current and future dividends, subject to a CES production technology, and a law of motion for capital. Denoting output with Y, capital with K (subject to quadratic adjustment costs), investment with I, productivity with Z, and the corporate income tax rate with τ_n, we have:

$$Max \sum_{s=t}^{\infty} R_{t,s} P_s \left[\Pi_{i,s} - \tau_{\Pi,s} P_s \left(MPK_s - \delta \right) K_s \right]$$

$$\Pi_{i,s} = \left(1 - \tau_{\Pi,s}\right) \left[\frac{\left(P_s(i)\right)^{1-\theta}}{\left(P_{H,s}\right)^{\theta}} Y_s - W_s L_{i,s} - P_s \left(I_{i,s} + \frac{\psi}{2} \frac{I_{i,s}^2}{K_{i,s}} \right) \right]$$

$$Y = \left[\mu^{\frac{1}{\xi}} K^{\frac{\xi-1}{\xi}} + \left(1 - \mu\right)^{\frac{1}{\xi}} \left(ZL\right)^{\frac{\xi-1}{\xi}} \right]^{\frac{\xi}{\xi-1}}$$

$$K_{i,s+1} = \left(1 - \delta\right) K_{i,s} + I_{i,s}$$

where δ, ξ, μ, θ, and *MPK* denote the rate of capital depreciation, the elasticity of substitution between the factors of production, the bias towards the use of capital in the production function, the elasticity of substitution between the goods produced by the firm, and the marginal product of capital, respectively. Firms choose the optimal levels of capital and labor for production, but, exploiting their monopoly power, they also optimally set the price of their individual variety above marginal cost. Notice that the corporate income tax applies to both the return of capital and excess profits resulting from monopolistic competition.

C.   Government and Fiscal Policy

All government spending, *G*, falls on nontraded goods. Expenditures are financed by collecting taxes, issuance of debt, and seignorage. The nominal government budget constraint is therefore:

$$P_{N,t} G_t + \left(1 + i_t\right) B_t = T_t + \left(M_t - M_{t-1}\right) + B_{t+1}$$

Fiscal closure is achieved by specifying a target path for the desired level of government debt as a ratio of GDP, denoted by b^*. In the standard version of GFM, the aggregate tax rate, τ, adjusts until the actual debt-to-GDP ratio coincides with the target. By default, the change in the aggregate tax rate is achieved through a change in the labor income tax, but alternative adjustment (personal or corporate income taxation) are possible as well. The tax rate is determined by the following set of equations:

$$\tau_t = \varphi_t \left(\tau_t + debtgap_t\right) + \left(1 - \varphi_t\right) \bar{\tau}_t,$$

$$debtgap_t = \left(\frac{B_t}{GDP_t} - v_1 b_t^* - \left(1 - v_1\right) \frac{B_{t-1}}{GDP_{t-1}} \right) + v_2 \left(\frac{\Delta B_t}{GDP_t} - \Delta b_t^* \right),$$

where φ is an exogenous (or dummy) variable that can temporary fix the tax rate at a certain level, $\bar{\tau}$. As shown in Botman and others (2006), in the case when $\varphi=1$, this rule reduces to a

simple error-correction formulation whereby the gap between the actual and desired government debt-to-GDP ratio gradually disappears. More specifically:

$$\frac{B_t}{GDP_t} = v_1 b_t^* + (1 - v_1)\frac{B_{t-1}}{GDP_{t-1}} - v_2\left(\frac{\Delta B_t}{GDP_t} - \Delta b_t^*\right),$$

where the term $v_2 > 0$, prevents excessive cycling in the tax rate and the real economy.

D. Characteristics of the "Rest of the World"

The current account balance for the home economy is the sum of interest receipts on the stock of net foreign assets plus the trade balance,

$$CBAL_t = i_{t-1} A_{t-1} + TBAL_t,$$

where $TBAL_t$ is defined to be equal to nominal exports minus nominal imports. The change in net foreign assets will simply be equal to the current account balance. For the foreign economy the mirror image of this expression will be the following,

$$A_t^* = -\frac{n}{1-n}\frac{A_t}{S_t},$$

where S_t denotes the nominal exchange rate, which (with RER_t denoting the real exchange rate) is equal to:

$$S_t = RER_t \frac{P_t}{P_t^*}$$

From the uncovered interest parity (UIP) condition, the real exchange rate, with r denoting the real interest rate, will be the following.

$$RER_{t+1} = RER_t \frac{1+r}{1+r^*}$$

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