



IMF Working Paper

Macroeconomic Effects of Public Pension Reforms

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Abstract

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The paper explores the macroeconomic effects of three public pension reforms, namely an increase in retirement age, a reduction in benefits and an increase in contribution rates. Using a five-region version of the IMF's Global Integrated Monetary and Fiscal model (GIMF), we find that public pension reforms can have a positive effect on growth in both the short run, propelled by rising consumption, and in the long run, due to lower government debt crowding in higher investment. We also find that a reform action undertaken cooperatively by all regions results in larger output effects, reflecting stronger capital accumulation due to higher world savings. An increase in the retirement age reform yields the strongest impact in the short run, due to the demand effects of higher labor income and in the long run because of supply effects.

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Contents	Page
Introduction.....	4
I. Pension Spending Trends, Theory and Existing Studies.....	5
A. Current and Projected Public Pension Spending.....	5
B. Theory and Existing Studies	7
II. The Methodology For Modeling Public Pension Reforms	8
A. Overview of the Model’s Key Features	9
B. Quantifying Public Pension Reforms	10
C. Caveats and Qualifications.....	12
D. Calibration.....	12
III. Results: Public Pension Reforms	13
A. Baseline.....	13
B. Region-by-Region Benchmark Public Pension Reform Scenarios	13
C. Benchmark Global Scenario—Simultaneous Reforms in all Regions.....	33
IV. Sensitivity Analysis	41
V. Conclusion	42
Tables	
1. Required Pension Age Extensions across the Regions.....	11
2. Cooperative Versus Regional Pension Reform—Increase in Retirement Age.....	38
3. Cooperative Versus Regional Pension Reform—Reducing Spending on Pension Benefits.....	39
4. Cooperative Versus Regional Pension Reform—Raising Contribution Rates	40
Figures	
1. Change in Public Pension Expenditures, 2010–30	6
2. Increase in the Retirement Age in the United States (Excluding Fiscal Consolidation)	17
3. Increase in the Retirement Age in the United States	18
4. Increase in the Retirement Age in the Euro Area	19
5. Increase in the Retirement Age in Emerging Asia.....	20
6. Increase in the Retirement Age in the Remaining Countries Block	21
7. Reducing Pension Benefits in the United States.....	24
8. Reducing Pension Benefits in the Euro Area.....	25
9. Reducing Pension Benefits in Emerging Asia	26
10. Reducing Pension Benefits in the Remaining Countries Block.....	27
11. Raising Contribution Rates in the United States.....	29
12. Raising Contribution Rates in the Euro Area	30
13. Raising Contribution Rates in Emerging Asia.....	31
14. Raising Contribution Rates in the Remaining Countries Block	32

15. Cooperative Versus Regional Pension Reform—Increase in Retirement Age.....	35
16. Cooperative Versus Regional Pension Reform—Reducing Pension Benefits	36
17. Cooperative Versus Regional Pension Reform—Raising Contribution Rates	37
18. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario— Labor Supply Response	55
19. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario—Role of the Planning Horizon (Degree of Myopia)	56
20. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario— Share of LIQ Households at 50 Percent Worldwide.....	57
21. Sensitivity Analysis Around the Benchmark Coordinated Global Reduction in Public Pension Spending—Rapid Implementation.....	58
22. Sensitivity Analysis Around the Benchmark Coordinated Global Reduction in Public Pension Spending—U.S. Reduction Levels Applied Globally.....	59
23. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario— Monetary Policy Accommodation	60
24. Sensitivity Analysis Around the Benchmark Reduction in Public Pension Spending by the United States Only—Different Inflation Behaviors.....	61
 Appendices	
1. GIMF’s Main Features and Calibration	44
2. Sensitivity Analysis	51
 Appendix Table	
1. Selected Steady-State Values.....	50
 References.....	 62

INTRODUCTION

The fiscal impact of the global crisis has reinforced the urgency of pension and health entitlement reform.² Staff projections suggest that age-related outlays (pensions and health spending) will rise by 4 to 5 percent of GDP in the advanced economies over the next 20 years, underscoring the need to take steps to stabilize these outlays in relation to GDP. With the economic recovery not yet fully established, this paper emphasizes their short-run macro impact in order to address concerns that these reforms can undermine short-run growth.³

We examine the preferred set of public pension reforms using the IMF's Global Integrated Monetary and Fiscal (GIMF) model parameterized on data for five regions as representing the entire world. We consider three policy reform options relating to pay-as-you-go public pension systems that are commonly discussed in the literature. This analytical framework allows us to approximately gauge the effects of these reforms on labor and capital markets and growth in the short and long run.⁴ (i) *Raising the retirement age*: this reduces lifetime benefits paid to pensioners. Encouraging longer working lives with higher earned income may lead to a reduction in saving and increase in consumption during working years. In addition, increased fiscal saving will have long-run positive effects on output through lowering the cost of capital and crowding in investment. (ii) *Reducing pension benefits*: this increases agents' incentives to raise savings in order to avoid a sharper reduction in income and consumption in retirement. It would reduce consumption in the short to medium run, but would increase investment over the long run. (iii) *Increasing contribution rates*: this leads to distortionary supply-side effects for labor, which combined with a negative aggregate demand on real disposable income, depresses real activity in both the short and long run.

We assess how the policies compare in attaining the twin goals of strong, sustainable, and balanced growth and fiscal stability (i.e., stabilizing the debt-to-GDP ratio against rising pension entitlements). The key results show that increasing the retirement age has the largest impact on growth compared to reducing benefits, while increasing contribution rates as approximated by an increase in taxes on labor income has the least favorable effect on output. Besides boosting domestic demand in the short run, lengthening working lives of employees reduces the pressure on governments to cut pension benefits significantly or to

² Pension and health entitlements already represent over a third of total spending in G-7 countries. Over the next 20 years, the net present value of pension spending increases alone is estimated at about 8 percent of GDP in advanced and emerging countries. See IMF (2010a).

³ See Blanchard and Cottarelli (2010), "The great false choice, stimulus or austerity," *Financial Times*, August 11 on attaining the twin goals of strong, sustainable, and balanced growth and fiscal stability.

⁴ Our analysis is undertaken relative to a 'baseline' scenario, constructed such that an elevated long-run public-debt-to-GDP ratio is reached in steady state based on staff's pension spending projections into the distant future.

raise payroll and labor income taxes. Reducing such benefits can lead to an increase in private savings and an unwarranted weakening of a fragile domestic demand in the short run, while raising taxes can distort incentives to supply labor. We also found that if regions cooperate in pursuing fiscal reform, the impact will be greater than if only one or some of the regions in the world undertake reform separately. In all, early and resolute action to reduce future age-related spending or finance the spending could improve fiscal sustainability over the medium run, significantly more if such reforms are enacted in a cooperative fashion.

The paper is organized as follows. Section II provides a background on past and projected age-related pension outlays and discusses the reform options considered to offset them. Section III provides a brief overview of the GIMF model while focusing on the details pertinent to this exercise. Section IV presents the effects of the three different reforms taken by each country at a time, then in all regions simultaneously. The global scenario highlights the compounding effect of the reforms and their impact on external variables through trade and (predominantly) financial spillover channels. Section V assesses in further detail the possible reasons for the size of the macroeconomic impacts based on a sensitivity analysis around the main results. Section VI concludes.

I. PENSION SPENDING TRENDS, THEORY AND EXISTING STUDIES

Age-related spending has been the main driver of current public spending increases over the past two decades. These trends are expected to continue in the coming years for both advanced and emerging economies pointing to needed entitlement reforms. *Old-age dependency ratios*, which are already large in the advanced economies, particularly European countries and Japan, are projected to double between 2009 and 2050, putting enormous pressures on pension systems.⁵ Furthermore, relatively high *gross replacement rate* of pensions relative to average wages has also contributed to large pension spending and could undermine the viability of pension system over the long run. In terms of *contribution rates*, taxes on earnings are already high in a number of countries but in others, there is room for raising payroll contribution rates (see IMF, 2010a). In this section, we examine the current and projected pension spending and provide a short review and assessment of public pension reform measures based on theory and existing studies.

A. Current and Projected Public Pension Spending

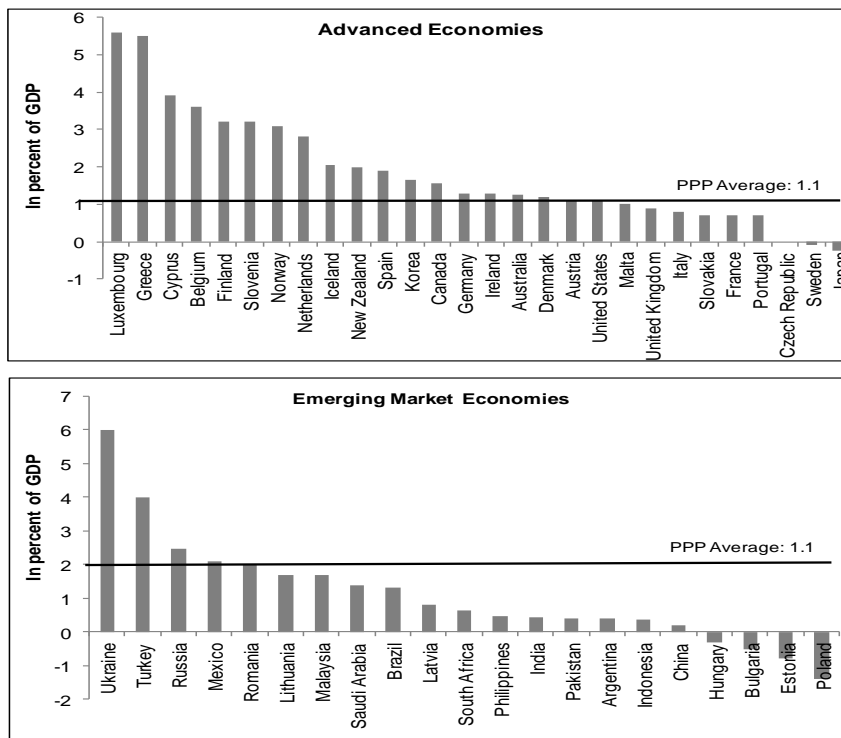
Within the advanced G-20 countries, pension outlays have risen by 1¼ percentage points of GDP since 1990. Increases have been especially large for pensions in Japan and Korea in the

⁵ Based on the European Commission's Ageing Report (2009), it is evident that the anticipated demographic transition will affect future pensions significantly. Despite recent pension reforms which may have strengthened the counterbalancing impact of other factors, considerable spending pressures remain, however, in light of the anticipated increase in dependency ratios.

past decade. Strong demographic factors were an important catalyst behind the increase in pension outlays in France, Germany, Italy, and Japan where pension spending has already surpassed 20 percent of total public spending. Looking forward, these trends are expected to continue in all economies. Given the strong demographic pressures on these outlays, reducing this spending would be difficult. A more realistic, if conservative, goal followed in this paper would aim at stabilizing spending-to-GDP ratios—which would still require significant structural reforms (IMF, 2010b).

Figure 1 shows *pension spending projected to increase* by an average of 1 percentage point of GDP over the next 20 years. Large increases are projected in advanced countries that have not substantially reformed their traditional pay-as-you-go systems, but in other advanced economies, the increase would be less marked due to the projected impact of already legislated reforms (IMF 2010a, Appendices IV and V). Adjustment needs may well be larger, though, as the projections assume that these reforms will not be reversed, even when they involve large cuts in replacement rates such as in Italy and Japan. Among emerging economies, those with relatively high spending in 2010 are projected to experience the steepest increase in outlays over the next 20 years. In other countries with currently low coverage such as China and India, the projected increase is much less severe, but could rise more rapidly if the system expands to cover a larger share of the population. Moreover, beyond 2030, emerging economies are expected to experience a faster pace of aging compared to the advanced economies.

Figure 1. Change in Public Pension Expenditures, 2010–30
(In percent of GDP)



Sources: Country authorities; EC (2009); OECD (2009); ILO (2010); and IMF staff estimates.

B. Theory and Existing Studies

A large body of research exists on fiscal consolidation in the face of demographic shifts and the impact of public pension system reforms on growth and public debt dynamics. We focus on three key reforms: (i) raising the retirement age, (ii) reducing benefits, and (iii) increasing contribution rates.

Raising retirement age raises participation in the labor force beyond a certain age and slows down the increase in the pension system dependency ratio.⁶ This leads to a reduction in transfer payments to pensioners, an increase in contributions and an increase in tax revenues through increased income and consumption, therefore leading to higher public savings. In the long run, output rises as firms demand more capital inputs to work with higher labor. Before retirement, forward-looking consumers who will be providing more labor services and face a shorter retirement period reduce their saving and increase consumption in anticipation of increased future income. Earning income over a longer working period makes up for this initial drop in savings and has a positive impact on their stock of wealth in the long run.

Reducing benefits has been the policy choice of several countries, with cuts of nearly 20 percent or more set to occur within the next 20 years. Benefits could be reduced by modifying the base used to calculate benefits, modifying indexation rules, or taxing pensions. Rules that link benefits to demographic and economic variables to maintain actuarial balance could also lead to benefit cuts.⁷ Based on theory, there are strong incentives for working households to increase their savings in the face of announced decline in replacement rates of the pension regime, in order to avoid a sharp reduction in their income and consumption after retirement. A higher saving rate leads to stronger capital accumulation and an improvement in the net asset position of the country, but the effect on short- and medium-run consumption levels can be negative.

Increasing contribution rates needs to be assessed along with potential changes in the tax rate on labor income, since it is their combination that determines the effective marginal and average tax rates that are likely to affect decisions about labor participation and hours worked.⁸ These incentive effects of social contributions, however, might be less marked if

⁶ In this paper, *raising the retirement age* by a year induces individuals to effectively work one year longer on average. This would cover those that retire at an age with full retirement benefits and those that choose early retirement. It assumes that replacement rates stay constant, implying a decrease in total lifetime pension benefits (see Section IV).

⁷ For example, in Japan, ‘macro indexing’ is achieved by reducing pensionable earnings and benefits by the rate of decrease in the number of contributors and increase in life expectancy at age 65. In Canada, benefits are required to be reduced, or contributions increased, to address long-term actuarial imbalances.

⁸ A richer menu of taxation would allow a further distinction between personal income tax levied on labor and social security contributions paid by workers and employees. Changing payroll tax on workers vis-à-vis changing personal income tax can have different distortionary effects. We abstract from these details here.

their payment is seen as implying increased benefit entitlement. Overall, offsetting the spending pressures from the pay-as-you-go regime based on an increase in contribution rates usually reduces the potential output of the economy by distorting labor supply. A demand effect through households' lower disposable income also adds to the negative impact of this option.

Empirical findings on the other hand appear to be inconclusive, reflecting perhaps country-specific and empirical methodology differences. Botman and Kumar (2007) look at age-related reforms, but focused exclusively on the European Union (with Germany as an example). They also analyze the impact of broader structural reforms, such as increasing labor participation, product market liberalization, and higher R&D to help increase productivity and find positive output effects in the short run. Nickel and others (2008) show that timely tax-cut measures can moderate the adverse effect on consumption (and encourage labor supply) of future announcement of cuts in pension benefits, and lower public debt; while increasing retirement age, without cutting pension benefits, fails to lower public debt.⁹ In contrast, Cournède and Gonand (2006) and Andersen (2008a, b) find that raising retirement age is optimal based on a likely boost in growth and improved public debt dynamics. Real GDP growth is stronger when rebalancing the pension regime by increasing the retirement age (and containing spending) rather than lowering replacement rates and raising taxes. Barrell and others (2009) have also demonstrated an improvement in public debt dynamics following an increase in effective working life (for the United Kingdom and the euro area countries taken together). As workers know that they will work longer, they save less now and increase their consumption ahead of the prospective income increase. Over the long run, labor and capital rise leading to an increase in GDP. Importantly, under constant tax rates and spending, increasing the pension age would result in reduced budget deficits and public indebtedness in European economies, on average.

II. THE METHODOLOGY FOR MODELING PUBLIC PENSION REFORMS

This section provides a summary of the methodology followed in addressing the aging-related reforms of public finances, while strictly focusing on the main features of the model's sectors (households, firms, and government) and parameters which have a direct and relevant impact on our analysis.¹⁰ Caveats and areas for future work remain given that the model, like most others cannot reflect all complexities that can influence the effect of the considered reform policies.

⁹ While the finding that a tax decrease aimed at offsetting the age-related fiscal consolidation effect on consumption and labor is sensible, it should be assessed in light of the current situation with mounting fears of unstable debt dynamics.

¹⁰ Appendix 1 provides further explanation of the sectors and the optimization involved. For a fuller exposition of GIMF's properties and calibration, see Kumhof and others, KLMM (2010).

A. Overview of the Model's Key Features

We use GIMF, a dynamic stochastic general equilibrium model widely used inside the Fund, as a framework for analyzing the short- and long-run effects of the planned pension policy actions. Key in analyzing the positive aspects of achieving fiscal sustainability in the face of aging as well as the normative aspects of adjusting public policies to changes in demographics, is GIMF's underlying overlapping generations' and finite horizons' structure. It produces meaningful medium- and long-run crowding-out effects of government debt and captures important life cycle income patterns, including age-dependent labor productivity. Moreover, labor and capital markets are endogenous—the first allowing labor income taxes to have distortionary effects and the latter providing an important channel through which government debt crowds out economic activity. As such, a realistic supply side enables us to consider the impact of public pension reforms on investment decisions.

The multi-country structure of GIMF allows an analysis of *global interdependence and spillover effects*. The world in this model consists of five regions, the United States (US), the euro area (EU), Japan (JA), emerging Asia (AS),¹¹ and remaining countries (RC). The regions trade with each other at the levels of intermediate and final goods, with a matrix of bilateral trade flows based on recent historical averages. International asset trade is limited to nominally non-contingent bonds denominated in U.S. dollars. Importantly, the link between regions through international financial markets provides the key channel for spillover effect of aging-related spending at a global level while adding realism to the macro outlook and the impact of policy response. The financial spillover effect is likely to dominate the trade channel because of the compounding effects of cooperative public pension reform on real interest rates, which in turn affect the cost of borrowing and overall debt dynamics (Section IV.C.).

To emphasize the potential interaction role of fiscal and monetary policies, GIMF combines sufficient *non-Ricardian features* with a number of *nominal and real adjustment costs*, such that short-run dynamics of the model would be determined by the interaction of both of these policies while longer-run dynamics are influenced mainly by fiscal policy. This combination is missing from other new-open-economy macroeconomic models and fiscal models, including the IMF's Global Fiscal Model (GFM).

There are three groups of agents and sectors in the model: households, firms, and the government.

¹¹ AS comprises China, Hong Kong S.A.R. of China, India, Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand. For pension projections below a subset of those countries is considered, comprising China, India, Indonesia, and Korea.

In the *households sector*, three parameters of interest determine the degree of non-Ricardian behavior of agents: ψ , θ and χ . ψ is the share of liquidity-constrained households (*LIQ*) in the economy, without access to financial markets, that are limited to consuming their after-tax income in every period. The size of this group, assumed to differ significantly across economic regions, can be crucial to the analysis of the effects of the labor income tax reform measure for instance, as will be seen later. The remainder of the households, are overlapping generations (*OLG*) households, who are fully optimizing agents. Each of these agents faces a constant probability of death $(1-\theta)$ in each period, which implies an average planning horizon of $1/(1-\theta)$. In addition to the probability of death, households also experience labor productivity (and hence labor income) that declines at a constant rate χ over their lifetimes. Life cycle income adds another powerful channel through which fiscal policies have *non-Ricardian* effects, as this along with θ (probability of survival) produce a high degree of myopia. Households of both types are subject to labor income, consumption and lump-sum taxes and the presence of these taxes along with transfers and government spending (see fiscal policy block in Appendix 1) allows us to relate the pension-related tax and expenditure reforms to specific model's parameters and variables.

In order to represent an *increase in retirement age* in GIMF, we rely on two parameters in particular: χ (which corresponds to a decline in labor productivity over an average working life—it defines agents' "income profile") and N (which is an index of the population size assumed to correspond to population of the work force age, ages 15 to 64).

Firms are managed in accordance with the preferences of their owners, myopic *OLG* households, and they therefore also have finite-planning horizons.

Government's intertemporal budget constraint is discussed in Appendix 1. We suffice by highlighting the role of fiscal policy in stabilizing deficits and the business cycle, through a typical fiscal rule. The latter stabilizes the government deficit-to-GDP ratio at a long-run target (structural) level, which rules out default and fiscal dominance (dynamic stability). It also stabilizes the business cycle by letting the deficit fall with the output gap. Finally, monetary policy in the model is based on an inflation-forecast-based interest rate reaction function in which the central bank sets interest rates in order to stabilize inflation at an announced target level.

B. Quantifying Public Pension Reforms

For all public pension reform measures, we use 2014 as the starting point for our benchmark scenario. This is near the end of the current version of the IMF's World Economic Outlook, when most economies are forecasted to have returned to stable output gaps around zero, and inflation close to their target levels. Starting from such a position, pension reforms are likely to generate short-run increases in output leading to a monetary policy reaction (as will be

seen in Figure 15 later). However, we also assess how the results might change if monetary policy remained accommodative for a year or two, as a pre-announced and conscious decision to accommodate a stimulative fiscal policy measure. This is dealt with in the sensitivity analysis Section V. The results below show that delaying a monetary policy action would boost short-run consumption and real GDP (considerably more relative to the benchmark), and public finances improve as government deficits decline faster in light of lower debt service payments. When normal conduct of monetary policy returns, there is the usual dampening effect on demand in the medium run (Section V and Appendix 2).

We consider differentiated retirement age increases which are sufficient to stabilize pension spending as a share of GDP at its 2014 level, over the next three to four decades. Differences in necessary retirement age increases stem from different baseline projections of the pension gap (size determined exogenously based on country-specific demographics and pension parameters) across the five regions, implying different consolidation needs such that the resulting debt trajectory as a share of GDP is stabilized. Based on staff estimates of the projected pension spending in the five regions, the required ‘pension age extension’ is shown in Table 1. The estimates suggest, for instance, that Japan would not require additional reforms.

Table 1. Required Pension Age Extensions across the Regions

	US	JA	AS	EU	RC
	(Number of years)				
2015–2030	2.5	...	1.0	1.5	3.0
2030–2050	0.0	...	0.5	0.5	1.5

Source: IMF (2010a) and staff estimates.

In line with the change in the lifetime income horizon, we implement a two-year extension of working lives on average, globally, by lengthening agents’ income profile (χ), and assuming an increase in the working-age population (N).¹² The income profile is assumed to increase immediately following the start of the reform, with the labor force gradually increasing over the next 15 years. The increase in the income profile is consistent with a decrease of private saving as a percent of GDP, as found in studies focused on European countries.¹³ Both measures are consistent with a gradual phase in of increases in retirement age as well as

¹² In GIMF, by assuming that the working-age population spans the ages 15–64, a two-year extension is roughly equivalent to a 4 percent increase in this population size. This can be made more moderate, since cohorts usually congregate near the middle of the age distribution (or in the case of aging Western societies, between 40 to 60 years old).

¹³ See, in particular, Khoman and Weale (2008) and Barrell and others (2009).

evidence which suggests that agents react by delaying retirement (several years ahead of the change itself) thereby leading to an increase in labor supply over their lifetime horizon.

The two other considered reform options, a *reduction in pension benefit payments* and an *increase in contribution rates*, are simply modeled as non-distortionary lump-sum transfers to all households and an increase in the labor income tax rate, respectively.

C. Caveats and Qualifications

The fiscal block of the GIMF model does not allow for an explicit breakdown of working-age and retired population,¹⁴ nor does it feature an elaborate pay-as-you-go pension regime. In light of this, it is not possible to interpret a rising dependency ratio as due to reduced fertility or increased longevity. Other issues like labor force perception of the pension system as a tax-and-transfer system versus an insurance mechanism, and movement to more actuarially-based public programmes¹⁵ may affect individuals' saving and labor supply behavior differently, influencing in turn the normative assessment of reform—we leave these interesting extensions for future work. But unlike other large simulation models dealing with full-blown demographics and pension systems which may complicate the interpretation of results, GIMF focuses on the dynamics and long-run equilibrium of the main variables in a transparent way, and these dynamics and equilibria can be changed by modifying a few essential parameters. The structure is flexible enough to compensate for missing households who *really* retire by treating an extension of working lives with regard to agents' income profile coupled with a potential increase in *working age* population.

Another caveat lies in examining the contribution rate hike scenario which we proxy by an increase in the labor income tax rate. This can be seen as a lower bound on this issue, since we have only captured the effect on the labor supply decision and not the direct effects on labor demand from higher contributions by employers. The decline in pension payments to retirees is then captured through lower pension transfers and pension deficits.

D. Calibration

Relevant steady state ratios and parameters of particular importance for this exercise are discussed in Appendix 1, with a brief summary of the important ratios provided in Appendix Table 1. The model is calibrated to reflect key macro features in the five regional blocs (including key expenditure ratios of consumption, government, investment, net exports, and

¹⁴ Changes in the population structure are not captured in a detailed way in GIMF compared to models with a richer cohort distribution. A change in participation rate of older workers is calibrated in GIMF through some relative measures of working-age population, as discussed.

¹⁵ This is a purely design question of social security programmes, to emulate a private retirement saving plan. See Disney (2005).

factor incomes) as well as key fiscal variables reflecting the fiscal structure of the regional blocs (revenues and spending, net debt- and deficit-to-GDP ratios). More detailed calibration tables are presented in KLMM (2010). Unless otherwise stated, similar behavioral parameter values apply to all regions and are based on microeconomic evidence. We use an annual version of the model because the critical pension-related fiscal issues stressed are of a medium- to long-run nature.

Calibrated government debt-to-GDP ratios are based on 2014 net debt projections for the five regions from the IMF's World Economic Outlook Update, February 2010 (IMF, 2010c) but have taken into account the mounting pressure of pension gaps. The real global growth rate is 2.5 percent, the global population growth is 0.5 percent, and the long-run global real interest rate is 4.0 percent.

III. RESULTS: PUBLIC PENSION REFORMS

A. Baseline

The baseline scenario is based on the IMF's February 2010 World Economic Outlook for public debt in G-20 countries, up to 2014–15, close to what the May 2010 update shows. It is also based on Fiscal Affairs Department staff's projections of public pension spending and primary fiscal balances over the next four decades, which translate in a very distant future into higher steady state debt-to-GDP ratios and a higher world real interest rate than usually used in GIMF.

B. Region-by-Region Benchmark Public Pension Reform Scenarios

This section discusses the effect of reforms undertaken in each region on its own, beginning in 2014. While similar behavioral parameter values apply to all regions, country-specific variation in the demographics is reflected in the size and pace of the adjustment as described in Table 1 above. Such an individual action is then compared to a cooperative action (albeit still allowing for country differences) in Section IV.C.

Three reform options relating to pay-as-you-go public pension systems are assessed. They are broadly equivalent in terms of their fiscal impact, all of them being broadly sufficient to offset the projected increase in pension spending over the long run, excluding their possible and distinct effect on growth. With the economic recovery still under way, it is important to assess the short- and medium-run impact of such reforms on the pace of activity as well as their budgetary impact. *Results show that the type of reform matters: increasing the retirement age has the largest positive impact on real GDP, while increasing contribution rates has the least favorable effect on output.*¹⁶

¹⁶ As will be seen, while pension gaps are reduced steadily with the adoption of any of the planned pension reforms discussed below, we observe that along the transition path to higher long-run real GDP, the short-run

(continued...)

Increasing retirement age

To anticipate the results, increases in the retirement age are the most effective tool: on average across regions, raising the retirement age by two years on average¹⁷ would raise GDP by almost 1 percent in the short to medium run and 4¼ percent by 2050 above the baseline scenario. It reduces the debt-to-GDP ratio by 30 percentage points over the same period.

Figure 2 illustrates the effect on the United States of an increase in retirement age in the United States alone, *while first keeping public pension spending (transfers) constant*. As expected, a delay in the retirement age boosts labor supply and labor income. Agents reduce their saving and their demand for assets during working years, while increasing consumption. Future earning incomes over a longer working period are higher and are brought forward through higher consumption by optimizing agents. The private saving rate as a ratio of GDP declines immediately by 0.2 percentage points, while consumption rises above baseline by close to 2 percentage points in the short run, preceding the increase in real GDP.¹⁸ In the short run, the increase in real GDP is 0.75 percent above baseline in period 2, and public finances improve slightly (the debt-to-GDP ratio is only 4 percentage points below baseline after 20 periods), a direct result of increased tax revenue collected on income and consumption. Considering Figure 2 alone, despite providing a partial analysis of the overall reform scenario (no implied transfer reductions are modeled thus far), it gives a clear interpretation of the boost in consumption as stemming from an increase in lifetime income horizon (the effect of which is brought forward) and working age population. A cut in benefits as embedded in Figure 3, will dampen this effect.

Figure 3 depicts the complete analysis of this reform as the *concurrent fiscal consolidation implied by the cuts in public pension spending*, as the number of years over which pensions are paid are reduced, is added to Figure 2. The budget deficit improves as a result by close to 3 percentage points of GDP after 30 years and settles around 2.2 percentage points once reached in the long run, given the target we impose in the distant future. Equivalently, the debt-to-GDP ratio declines by roughly 43 percentage points in the long run—more than tenfold the improvement shown in Figure 2. At the same time, a lower government debt which is perceived as a decline in *OLG* agents' net wealth along with the decline in transfer

dynamics of the macroeconomic adjustment differ substantially. Size, speed, and timing of the fiscal consolidation plan, alongside the incentive effect of reforms on consumption and savings all play a role.

¹⁷ The two-year average reflects variation across regions in the increase in the retirement age needed to stabilize the debt-to-GDP ratio against rising pension entitlements.

¹⁸ Such a strong response in labor supply is assumed to be absorbed quickly with minimal effect on the unemployment rate and the associated unemployment benefits to be paid by the government.

payments (with a more pronounced effect on *LIQ* agents) both work to depress consumption markedly, which now only rises modestly above baseline, compared to Figure 2.

In the short run, there is a tightening of interest rates (by 80 basis points in year 4) in response to inflationary pressure emanating from a short-run increase in domestic demand. As the demand pressures continue from the stimulative increase in labor supply, the monetary authority maintains a tight stance for a long period. This interest rate effect dampens domestic demand in the short run. But in the medium to long run, investment is boosted as real interest rates fall in response to the fiscal consolidation, leading to visible improvement in output. In addition, output rises with the increase in labor supply (and a fall in marginal cost from the falling real wage) which in turn attracts more capital. This rises marginally less than labor supply¹⁹ and output continues on an upward trend, reaching over 3.5 percent above baseline in the long run.

Discussing next the external variables, if we only focus on the effect of the increase in the retirement age without the fiscal adjustment (Figure 2), the United States experiences an appreciation of the real exchange rate, and, therefore, a deterioration in the trade balance and the current account. Here, the saving-investment perspective predominates, as real wages decline (as more labor is supplied), the higher return on capital attracts capital inflows and leads to a current account deficit which needs to be closed through a depreciation in the exchange rate. However, the effect on external variables is dominated by the fiscal consolidation that is occurring simultaneously (Figure 3). Now, lower real interest rates from increased world saving crowds in investment in external assets, leading to an accumulation of net foreign assets. In the very long run, with declining interest payments to foreigners, current balances are above baseline which means that the real effective exchange rate begins appreciating again. However, relative to the baseline, the real effective exchange rate has depreciated, albeit much less in 50 years into the future, relative to only 30.

Figures 4 to 6 show the same ‘package’ of reforms (akin to Figure 3) being undertaken by each of the three other regions facing notable challenges to their pension systems—the euro area, emerging Asia, and remaining countries (recall, in the case of Japan, no pension age extension was needed). Although the quantitative results are different, the story behind each scenario is intrinsically the same as that of the United States, with some qualification.

For the *euro area* (Figure 4), results are qualitatively similar to the United States, but there is a smaller required pension-age increase to attain given budgetary saving (this is primarily due to the fact that in the euro area a pensioner receives on average larger benefits), more rigid prices and a more aggressive monetary rule, leading to a weaker consumption profile

¹⁹ Private capital rises less than employment due to an expected marginal upward pressure on interest rates from increased demand which may lead to a partial crowding-out.

relative to the United States, in the short run.²⁰ Over the long run, consumption improves by more as pension transfers are cut more aggressively in the later periods, bringing with them a larger drop in interest rates, and therefore lower debt level (close to 47 percentage points below baseline). Driven by higher domestic demand, real GDP rises 5.8 percent above baseline.

An exception is *emerging Asia*, because it pursues a fixed nominal exchange rate vis-à-vis the United States, instead of inflation targeting. In this case (Figure 5), there is a depreciation of the real exchange rate, as occurs in the cases of other regions such as the United States (Figure 3) or the euro area (Figure 4). But emerging Asia's nominal exchange rate peg constrains them to importing their short-run interest rate profile from the United States (as uncovered interest rate parity holds in GIMF). In order that the real effective exchange rate in emerging Asia depreciates in the long run, there will be downward pressure on domestic prices, resulting in sustained disinflation, relative to the baseline scenario. Here, GIMF may overstate the actual inflation and interest rate dynamics in emerging Asia, as there is no role for capital or credit controls, which may play some role in the actual conduct of exchange rate policy.

This story related to the conduct of monetary policy in emerging Asia will also hold in the other two public pension reform options discussed below. A policy aiming at greater exchange rate flexibility in emerging Asia over the medium run, whether through a nominal appreciation or through higher inflation is not assessed here.

²⁰ A stylized Taylor-type interest rate reaction function is adopted, where the central bank adjusts the policy rate on the basis of the deviation of inflation from its target to stabilize inflation at a pre-specified target level. The rule matters in the response to offset inflationary pressures arising from a boost in domestic activity. A persistent underlying inflation process with monetary policy being tightened as a result would put downward pressure on growth. Reduced price rigidities can mitigate this effect by effectively speeding the response of inflation and shortening the period of tighter policy. Delaying the response of monetary policy will also boost short-run consumption and real GDP (for further clarification, please see Section V and Appendix 2). Moreover, while the size and time profile of the fiscal adjustment play a role, initial conditions and market responses to the adjustment plans are crucial.

**Figure 2. Increase in the Retirement Age in the United States
(Excluding Fiscal Consolidation)**

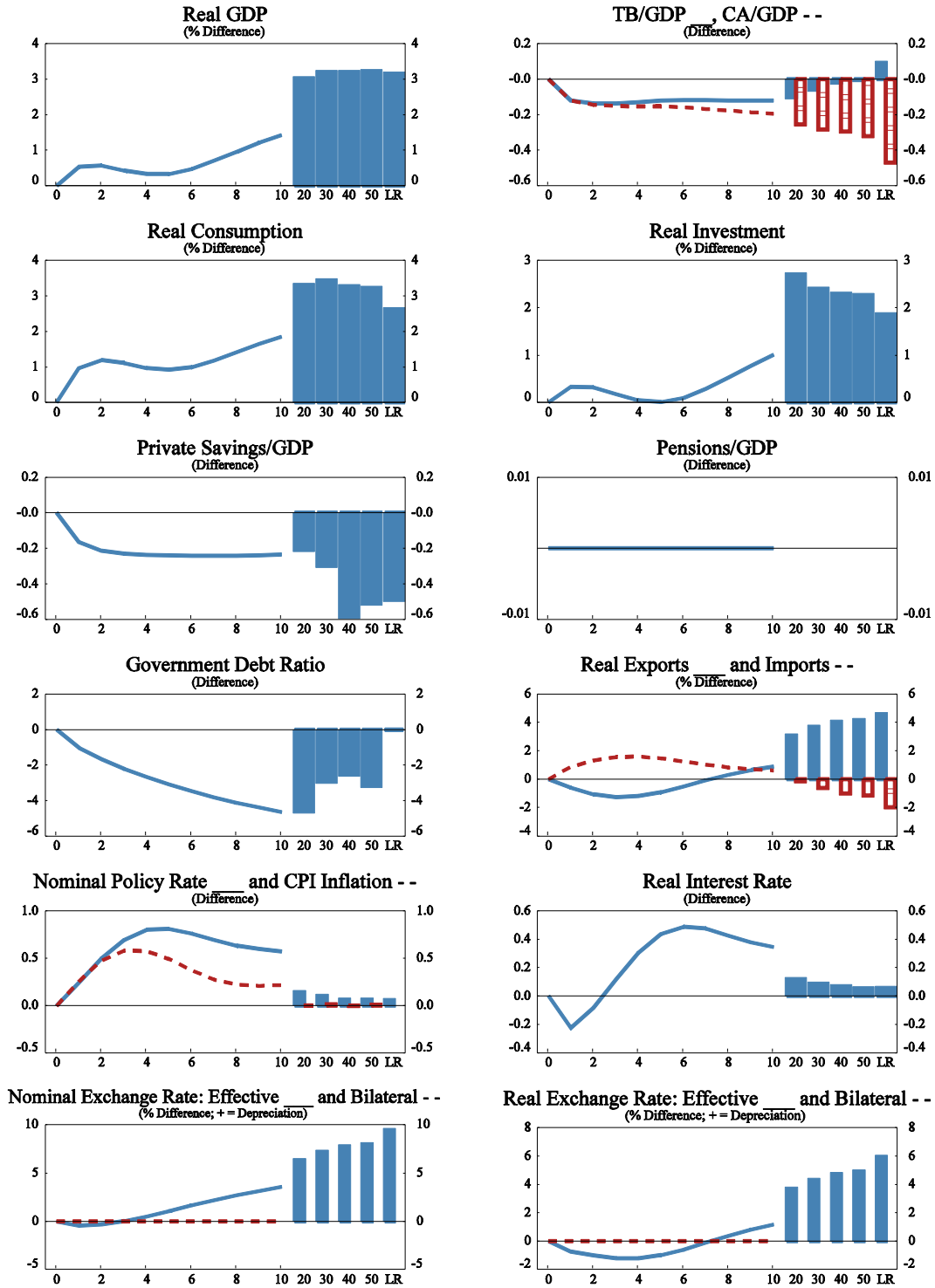


Figure 3. Increase in the Retirement Age in the United States

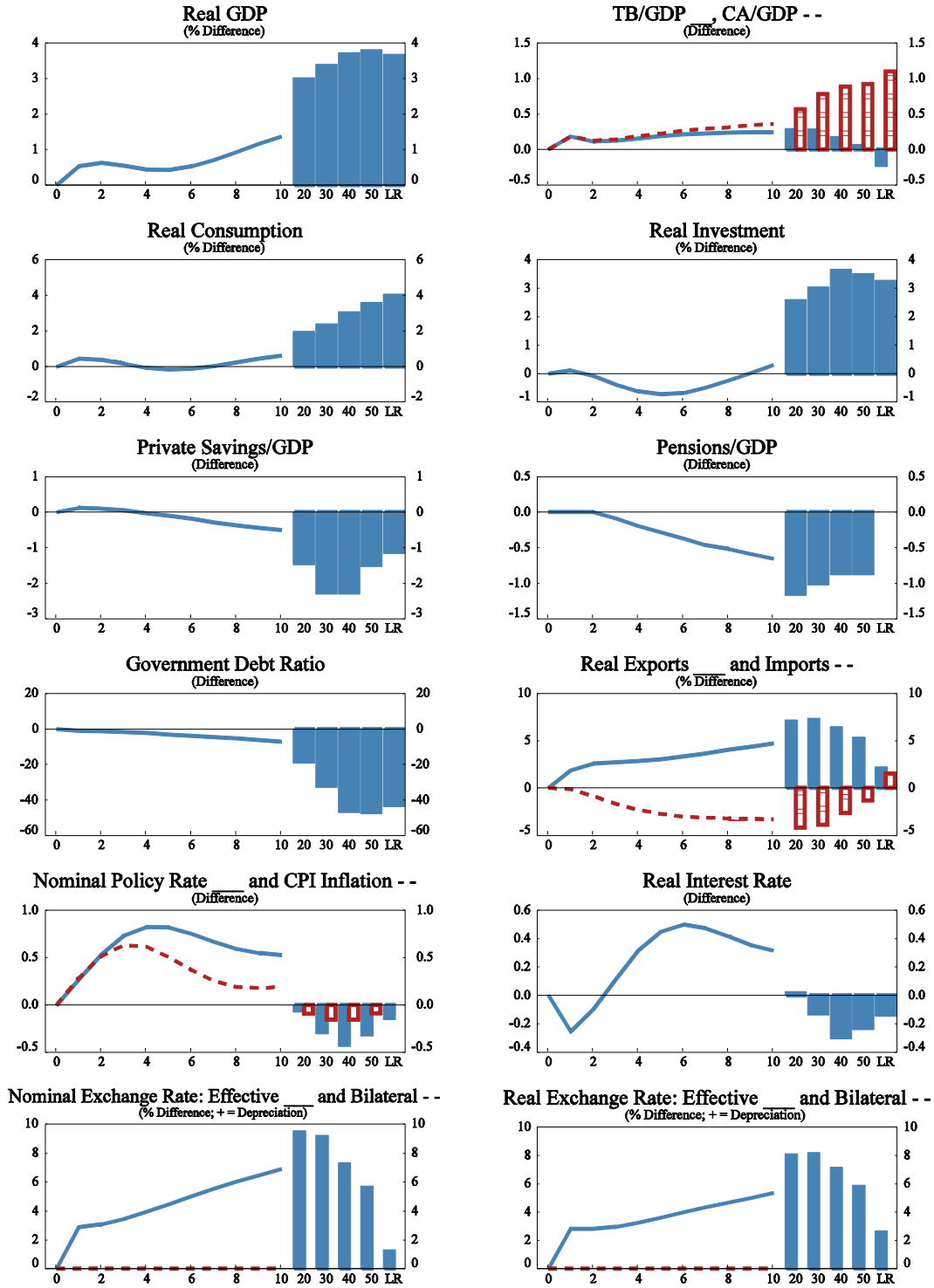


Figure 4. Increase in the Retirement Age in the Euro Area

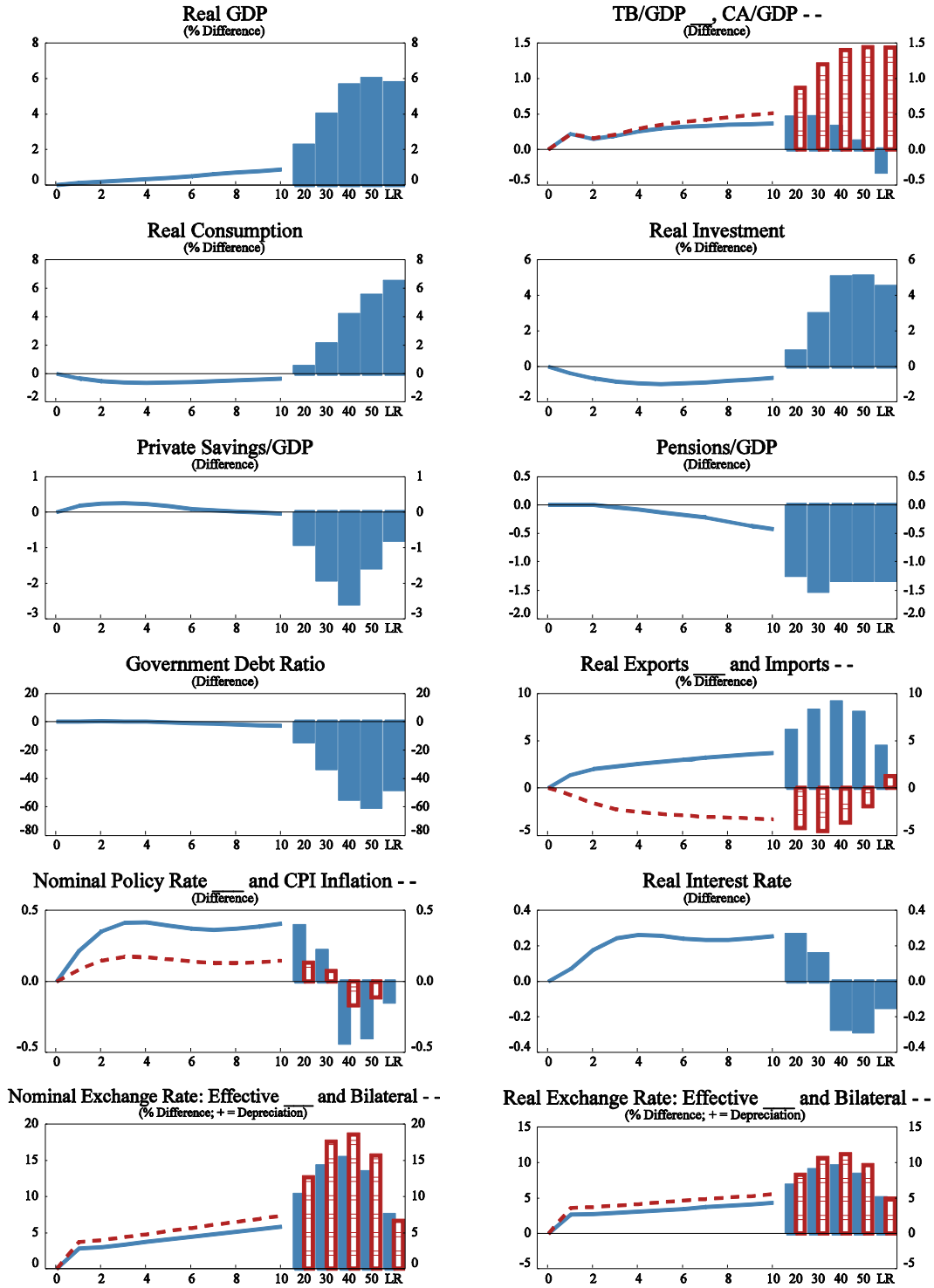


Figure 5. Increase in the Retirement Age in Emerging Asia

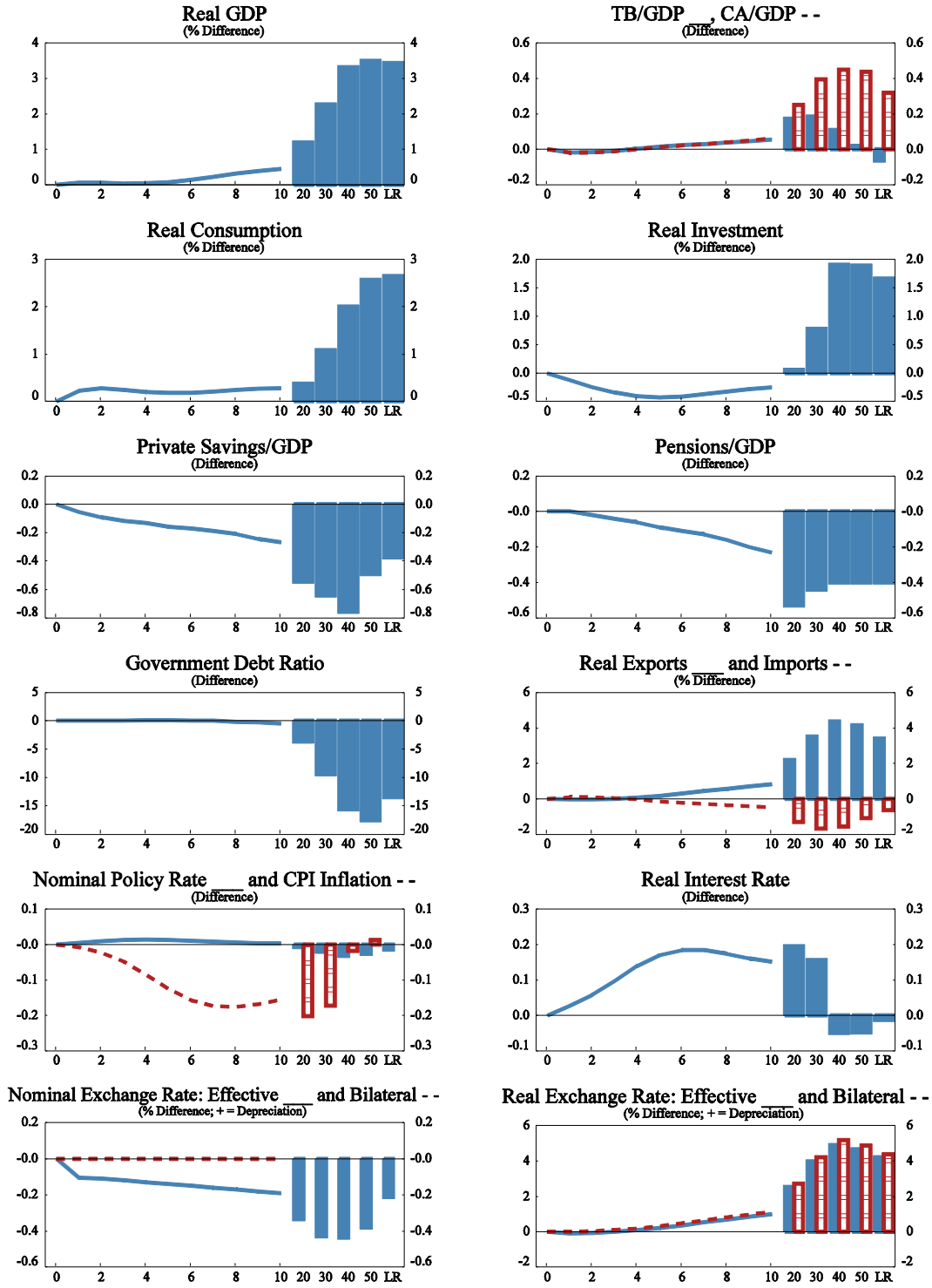
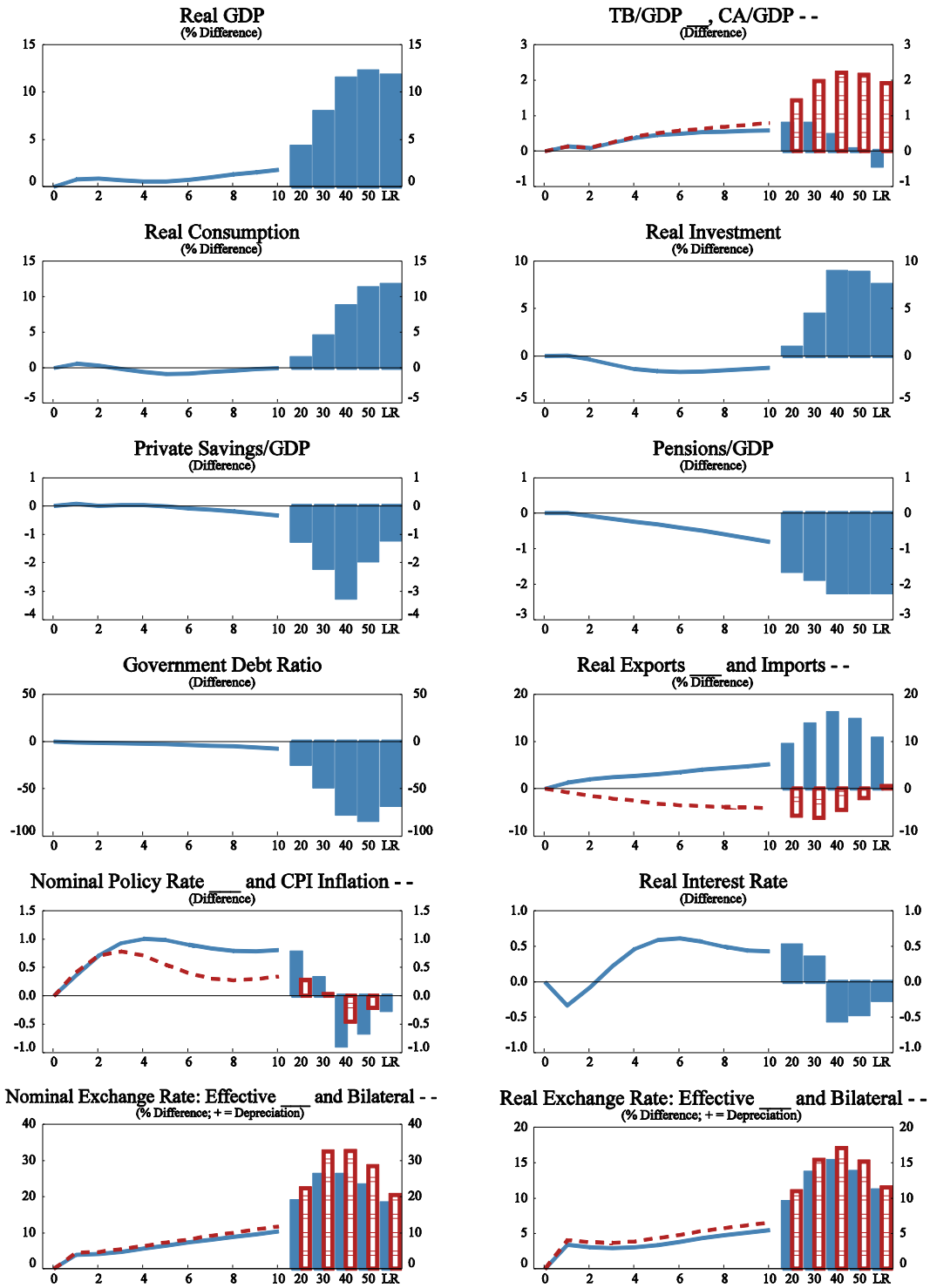


Figure 6. Increase in the Retirement Age in the Remaining Countries Block



Reducing benefits²¹

This reform generates rewards over time following the transitory short-run initial costs of fiscal tightening on aggregate demand. Consider if the decline in benefit payments (and the consequent decline in government debt) occurs only in the *United States*. Figure 7 shows the simulated effects of reduced government debt-to-GDP ratio brought about by decreases in pension benefit payments (that behave in GIMF as non-distortionary lump-sum transfers) to reverse past promises of enlarged public pension spending. Although consumption drops by about 1 percent below baseline in the short run, this is largely outweighed by the persistent benefits of lower real interest rates and higher real GDP—over time, real GDP rises and settles at a higher level in the long run, almost 0.5 percent above the baseline scenario.

World real interest rates decline, moderately, beginning in period 10, before they hit a trough close to -0.4 percentage points below the baseline after 40 years.²² Such an effect is transmitted to the global economy with all countries experiencing a boom in investment, varying between 0.5 and 2 percent in the euro area and emerging Asia, respectively, and a permanent expansion in real GDP, varying between 0.3 to 0.5 percent. In sum, the U.S. policy scenario generates a positive and large effect in other regions as long-run real interest rates are equalized internationally to a lower level and capital investment is boosted.

So, following a reduction in pension benefit payments, U.S. domestic demand (consumption and investment) decreases for a rather prolonged period of time, while real GDP experiences an uptick for a brief period,²³ buoyed by improved external balances, but decreases moderately thereafter before increasing and settling at higher levels in the long run. Consumption declines in light of the non-Ricardian nature of the model whereby a fiscal consolidation reduces the net wealth of *OLG* agents (as the value of taxes for which they are now expected to be responsible has increased, if taxes were to be used as an instrument). For a given marginal propensity to consume, these reductions in (human) wealth lead to a reduction in consumption, accompanied by a decline in real interest rates. During the initial phase, real interest rates are predominantly driven by the monetary policy response to excess

²¹ The average reduction in benefit payments is high exceeding 20 percent as driven by large projected pension spending in the remaining countries block. This differs across regions depending on the savings needed to stabilize the debt-to-GDP ratio against rising pension entitlements.

²² Potentially reduced sovereign risk premia associated with favorable market responses to improved public finances, as a result of pension reform, are not taken into account.

²³ The short-lived increase in GDP occurs since demand for foreign goods (imports) falls rapidly in response to the quick movement in the real exchange rate (a property of the standard risk-adjusted uncovered interest rate parity condition determining exchange rate), but domestic demand falls more slowly, as it is driven by the slower decline from the fiscal consolidation. In other words, imports fall more quickly than consumption and investment, and this, by simple accounting, leads to higher real GDP.

supply in the economy and deviation of inflation from target. Externally, reduced import demand (part of the consumption demand decline is absorbed by trading partners) leads to improvement in trade balances and a real depreciation.

Over the longer run, real GDP increases relative to the baseline. Higher fiscal saving leads to an increase in both in U.S. and world savings, given the size of the U.S. economy. Real interest rates decline by close to 40 basis points in order to re-equilibrate world saving and investment. The non-Ricardian *OLG* structure of the model and the endogenous capital formation provide the channels through which government debt crowds in investment in U.S. physical capital, so that real output increases. Moreover, agents' decreased investment in government debt instruments frees up resources to other forms of investment, including foreign assets. This implies that current balances improve subsequently necessitating a real appreciation in the exchange rate, which only comes gradually.

In other regions (euro area, emerging Asia, and the remaining countries block) which undertake similar reforms, the effects are similar (Figures 8 to 10). However, the spillover effects are different as they are driven by their responsiveness to movements in the world real interest rate. For instance, the spillover effects of reforms initiated by a large economic region (i.e., the United States or the euro area) on other regions' real GDP is four times the spillover effect if a smaller region (i.e., emerging Asia constitutes is calibrated in GIMF to be 13 percent of world nominal GDP, versus 27 percent for the United States) undertakes reforms, since a smaller region will have less of a long-run impact on world interest rates, and by extension on investment and output on those regions which do not undergo reform.

Figure 7. Reducing Pension Benefits in the United States

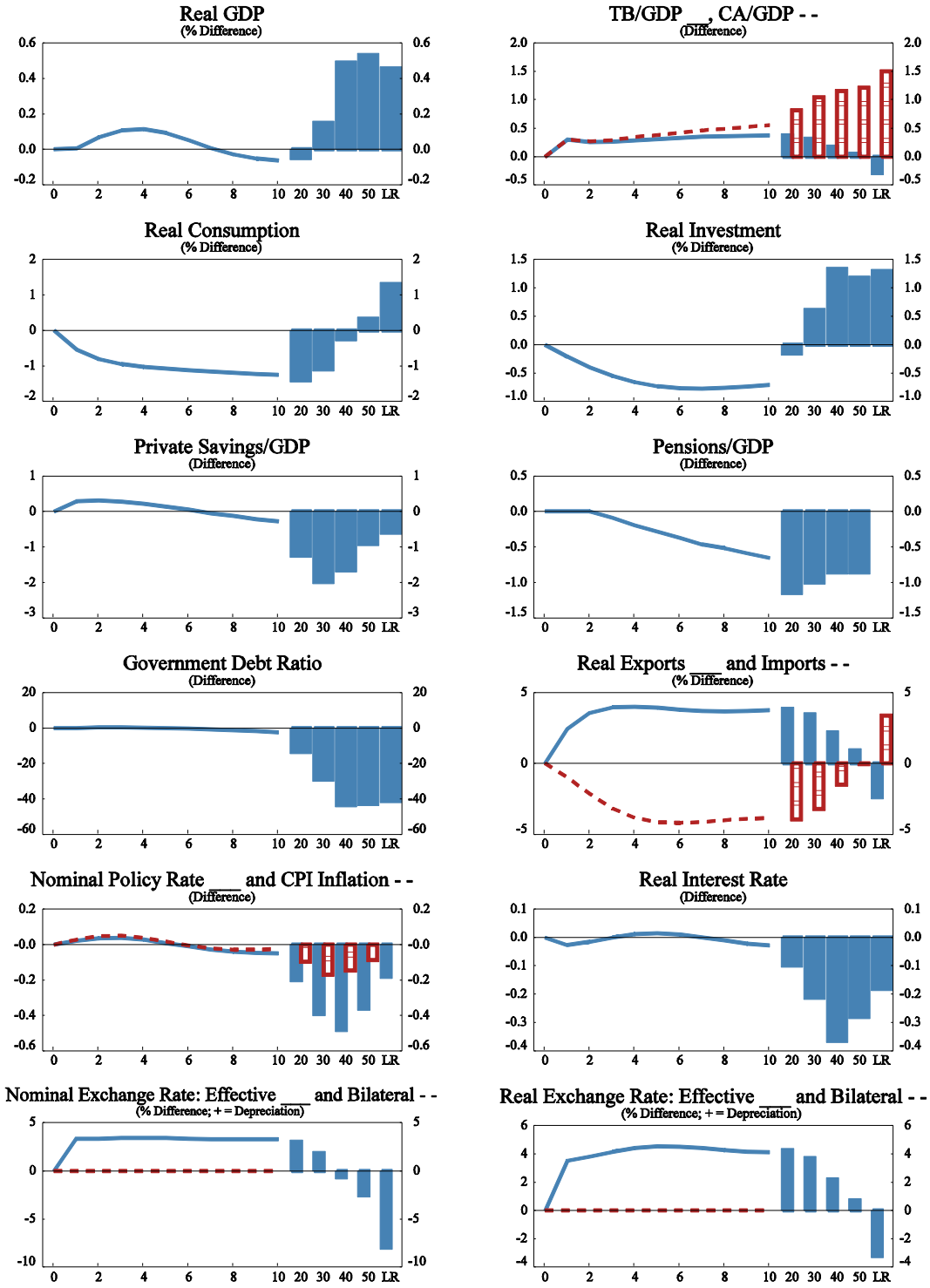


Figure 8. Reducing Pension Benefits in the Euro Area

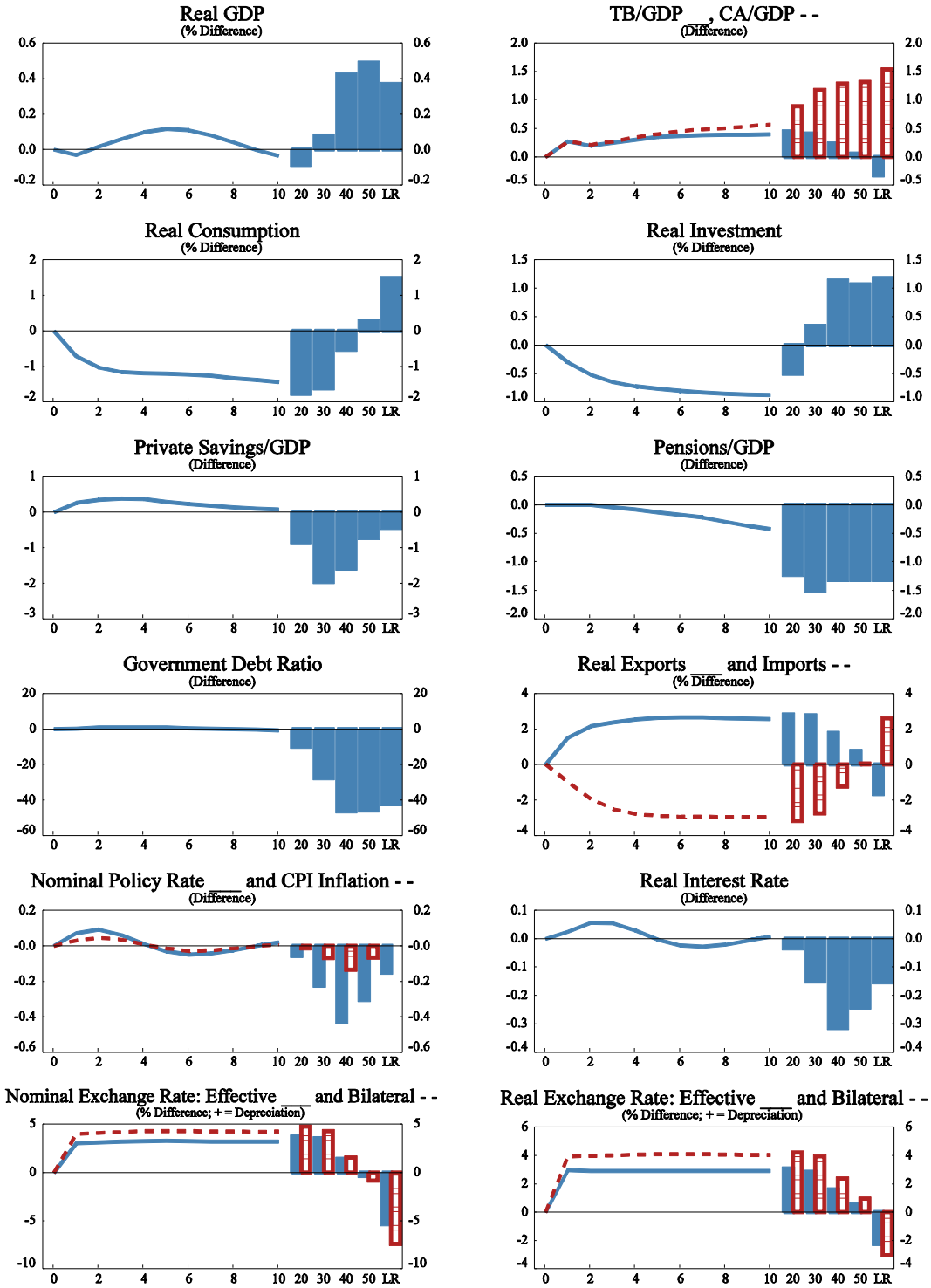


Figure 9. Reducing Pension Benefits in Emerging Asia

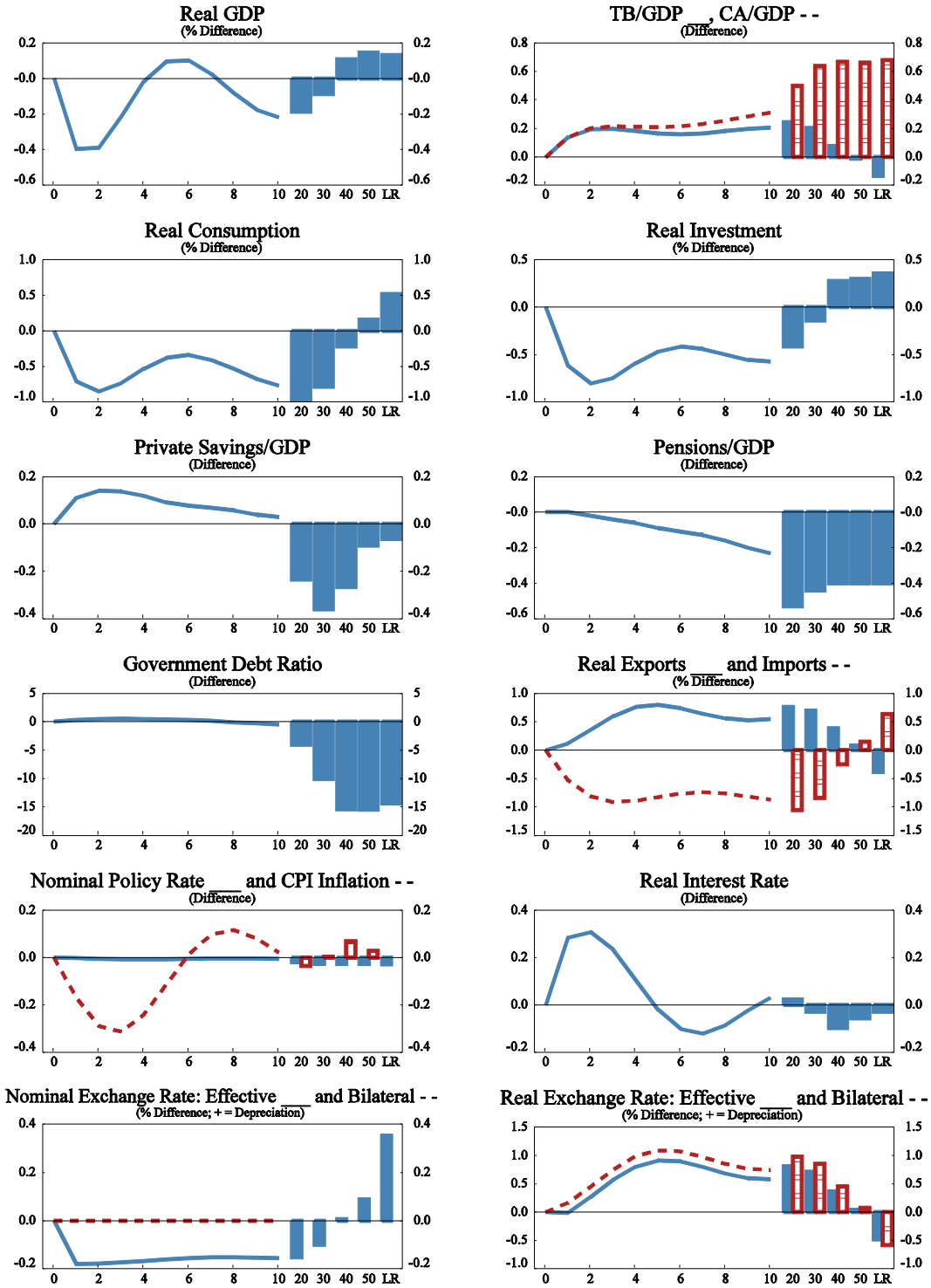
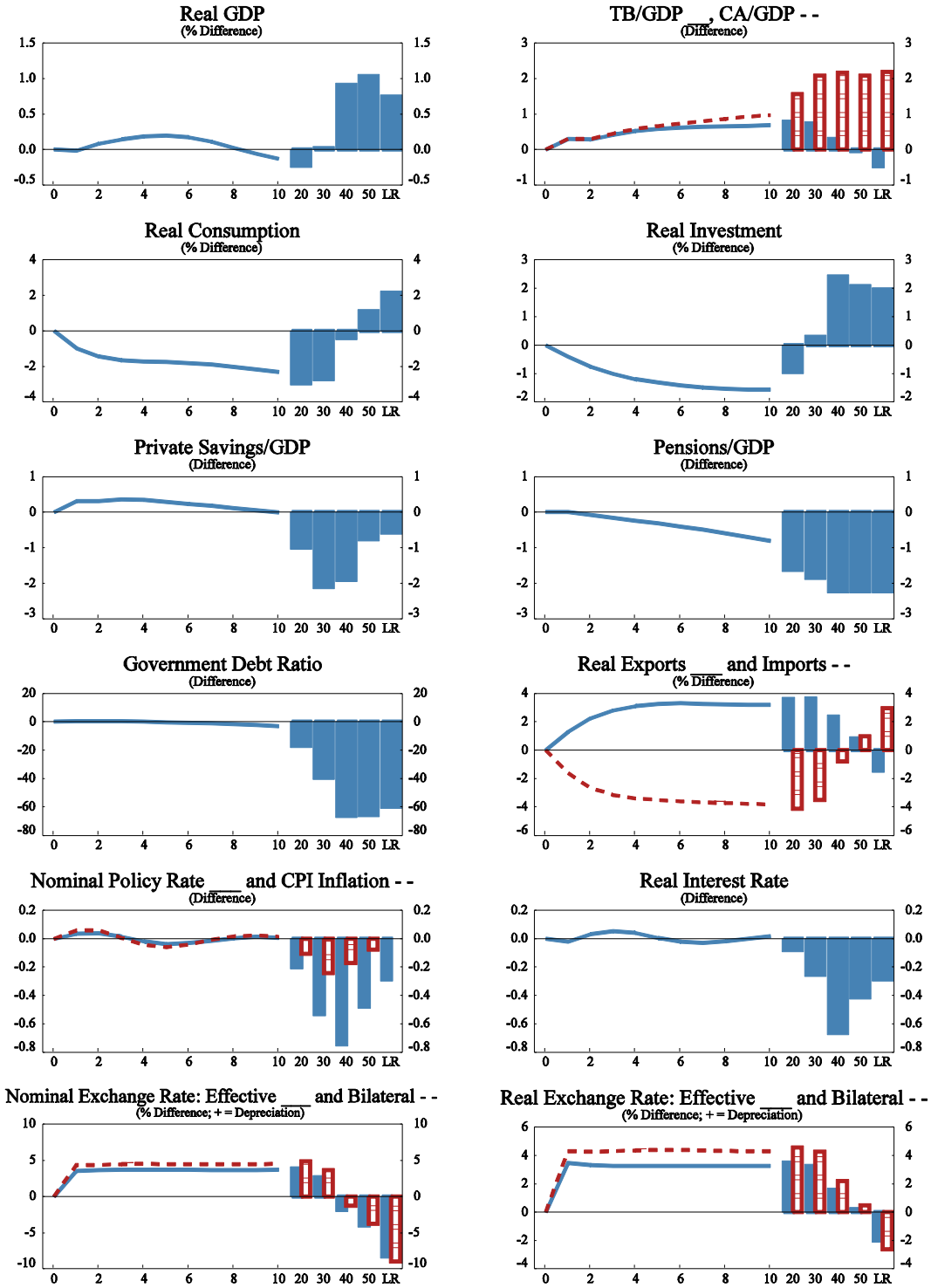


Figure 10. Reducing Pension Benefits in the Remaining Countries Block



Raising contribution rates²⁴

We proxy the increase in contribution rates in GIMF, by considering an increase in the labor income tax rate, in this case, the United States only (Figure 11). Consequently, there is a decline in the supply of labor with negative effects on actual and potential output. Besides this supply-side effect, this policy measure affects the demand side of the economy indirectly through a decline in households' real disposable income—this income and wealth effect is an important channel given the myopic nature of both *LIQ* and *OLG* agents (in light of the θ planning horizon parameter and χ finite remaining working life of 20 years on average). Given that the *LIQ* households consume at most their after-tax current income, the size of this group, which is assumed to be significantly different across economic regions, is critical for the analysis of this labor income tax measure. Moreover, a decline in potential output is likely to exert upward pressure on inflation. In all, the effect on U.S. real GDP is notably worse than in the benefit-reduction scenario in the short run, and even in the long run. This should not be surprising, since GIMF, like most models in the literature, find that the multiplier effect of a change in the labor income tax rate is higher than an equivalent shift in a lump-sum transfer, such as a pension benefit cut (Coenen and others, 2010).

Therefore, the results of this form of public pension reform are similar to those found under a cut in pension benefits, but the distortionary nature of this reform means the short-run losses are more significant—real GDP declines by about 0.7 percent below baseline by period 10. The negative effect of distortionary taxes on potential output also means significant losses in the long run. Also, the consequent decrease in the real world interest rate does not play as effective a role in raising real GDP in the long run as in scenario 2 above—real GDP remains close to 0.4 percent below baseline versus an increase of 0.4 percent when cuts in pension benefits are the fiscal measure of choice.

Once again, these results also hold in the other three regions, the euro area, emerging Asia, and the remaining countries block (Figures 12–14).

²⁴ On average, the necessary increase in contribution rates is 2¾ percentage points or over 10 percent. Again, this differs across regions depending on the requirement to stabilize the debt ratio against rising pension entitlements.

Figure 11. Raising Contribution Rates in the United States

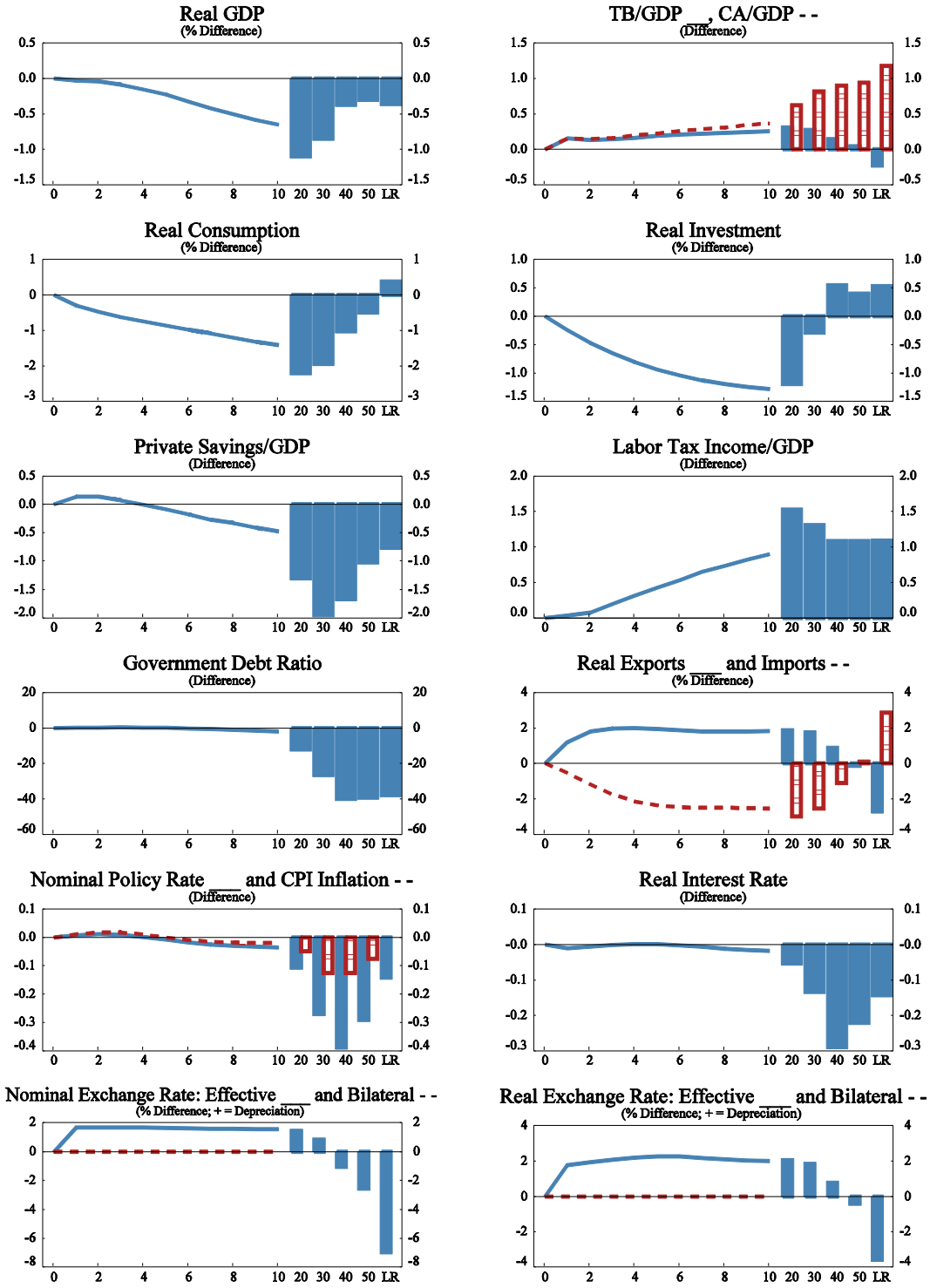


Figure 12. Raising Contribution Rates in the Euro Area

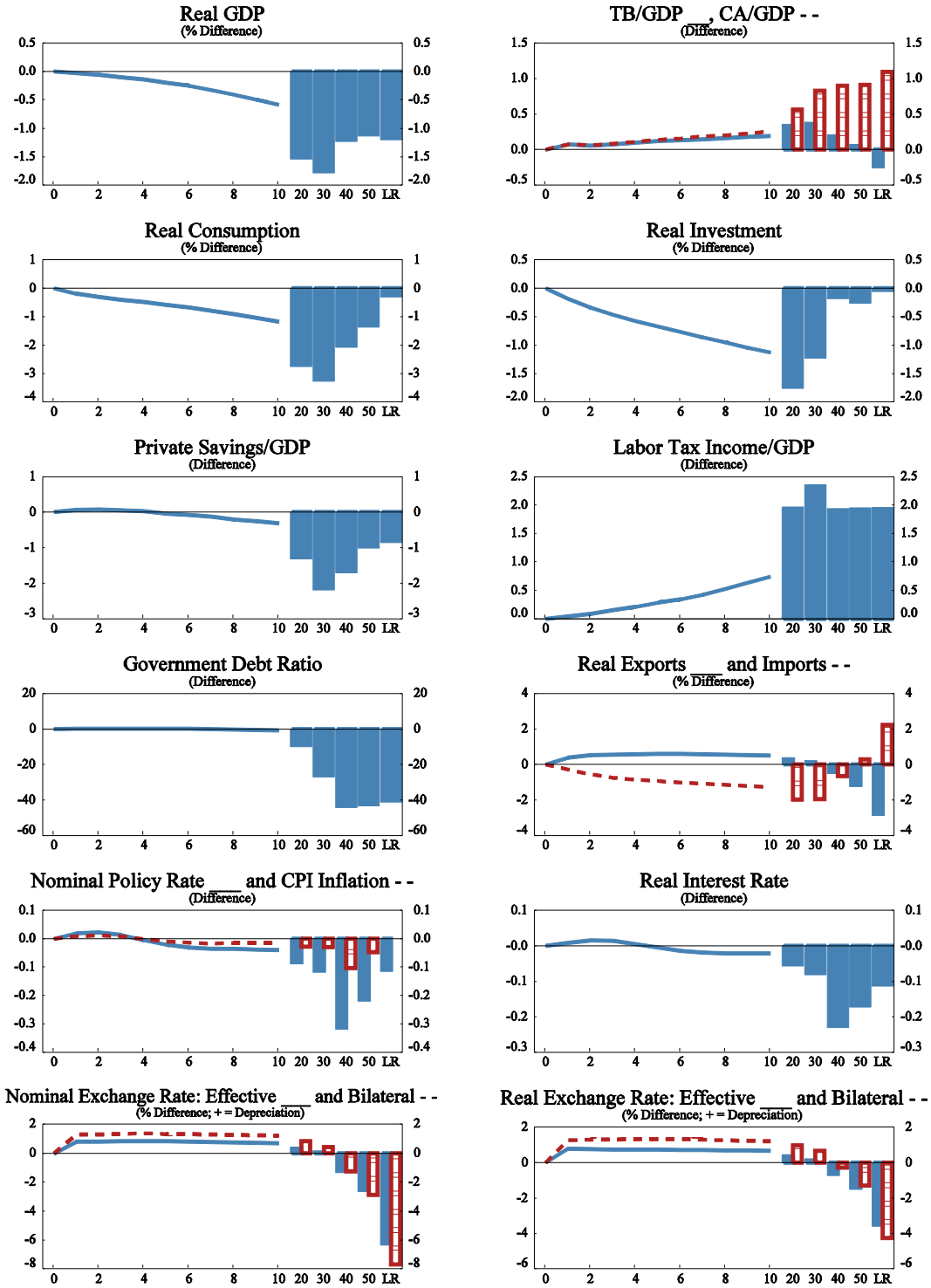


Figure 13. Raising Contribution Rates in Emerging Asia

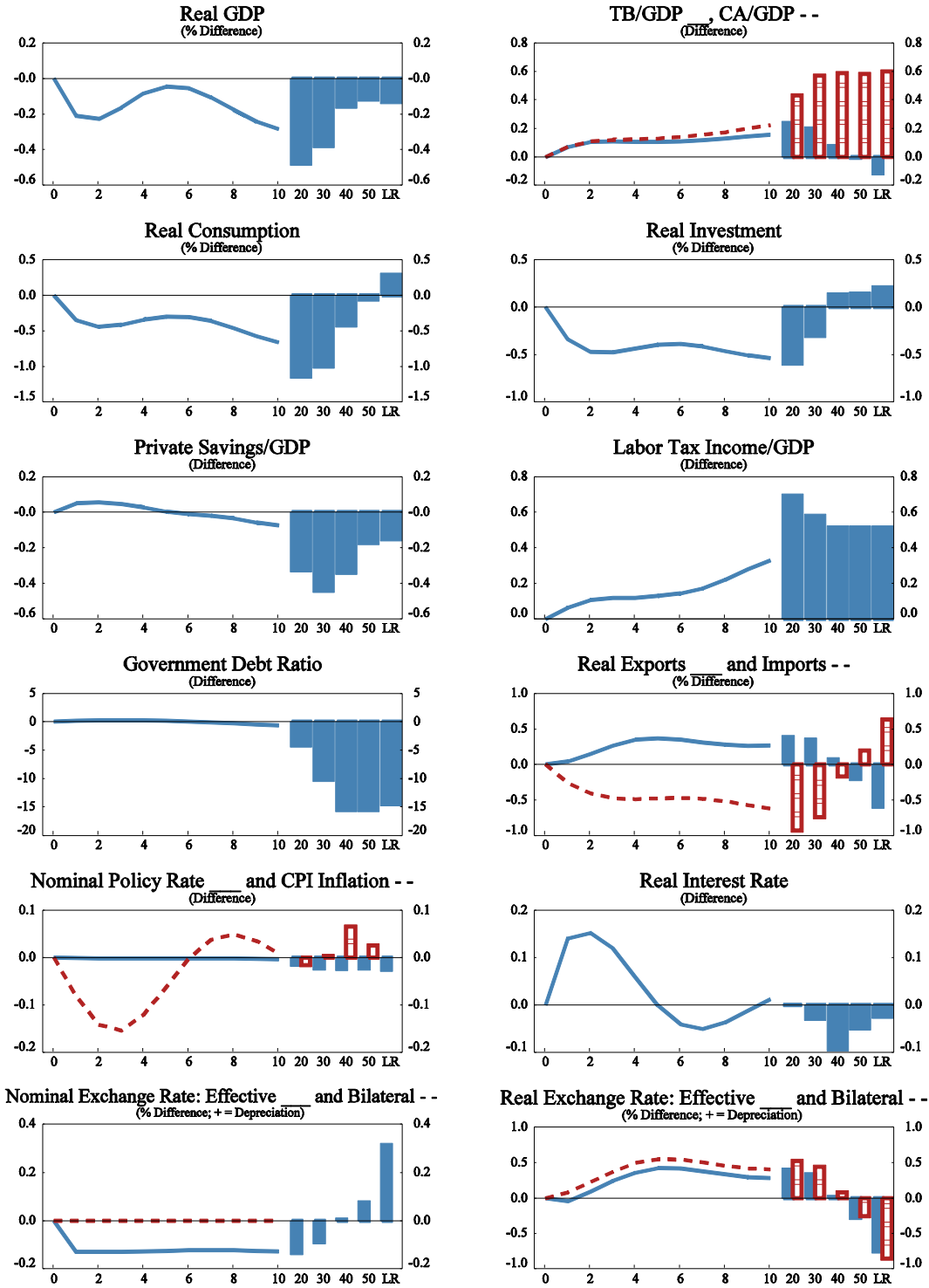
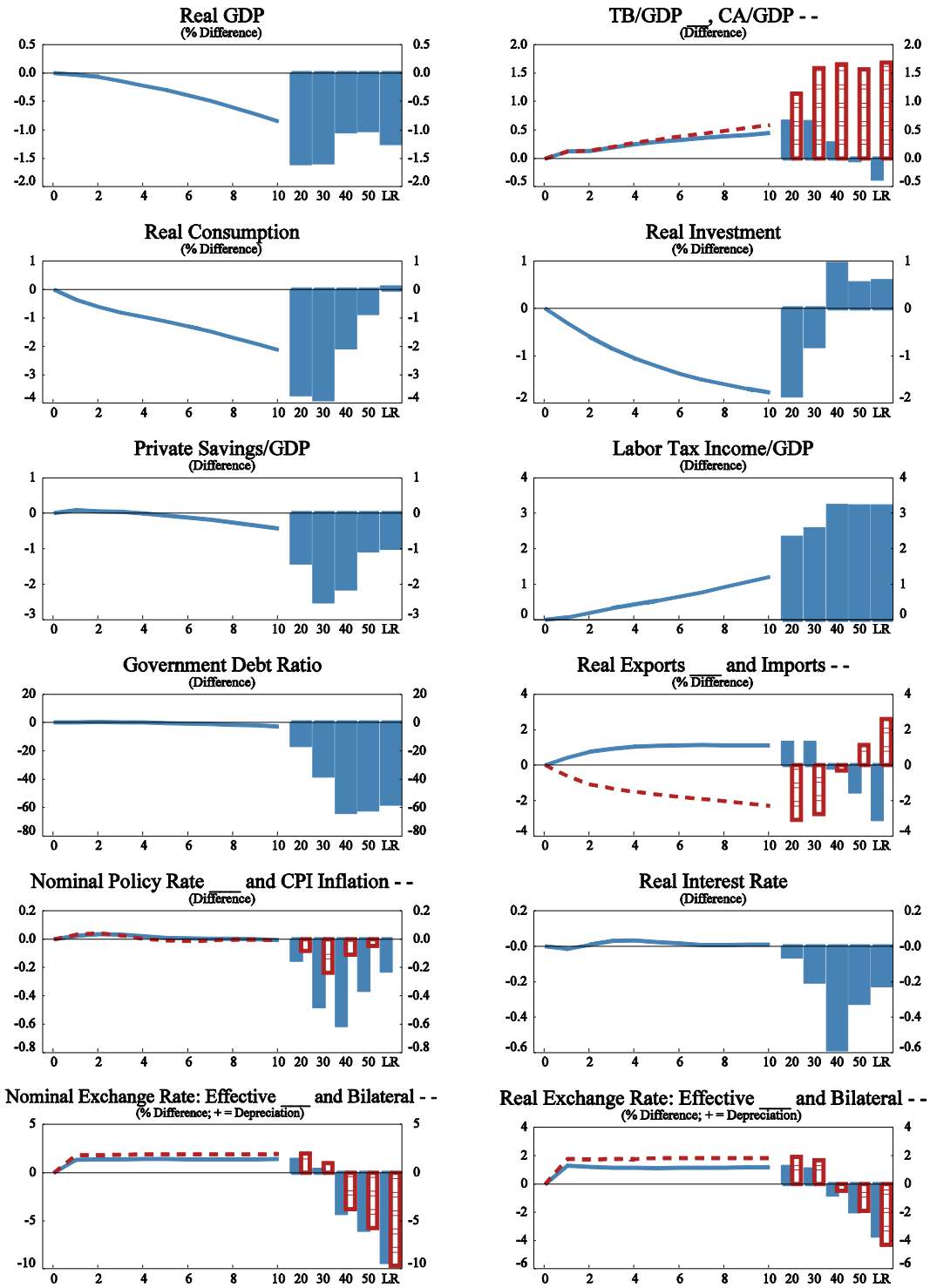


Figure 14. Raising Contribution Rates in the Remaining Countries Block



C. Benchmark Global Scenario—Simultaneous Reforms in all Regions

A cooperative strategy to pursuing fiscal reform has a larger impact on output and fiscal sustainability than if regions undertake reform alone. The cooperative benefit is greater than the sum of individual country/region benefits. The magnification effect of global reforms on key variables is driven by the significantly stronger decline in the world real interest rate corresponding to larger compounding effect on world savings under the cooperative strategy.

Thus far, we have only considered reforms in each region of the world in isolation. While it is in each country's interest to pursue reforms regardless of what other countries or regions do, there can be a clear advantage from promoting global policy cooperation. In the cases of individual action, the effects of the policy measure will often leak abroad, which, while benefitting other regions, reduces the potential impact domestically. Countries can simply delay reforms and free ride on adjustments undertaken elsewhere.²⁵ Faced with a common and an unavoidable demographic shift and a future of possibly muted growth and high unemployment, cooperative action for public pension reform among all regions can be key. Cooperation can buttress the twin goals of growth and fiscal stability by stabilizing the debt-to-GDP ratio against rising pension entitlements. It is expected that the world real interest rate will over time change by more than when an individual region engages in reform alone, which leads to a larger effect on capital accumulation and potential and actual output levels in the long run.

Figure 15 clearly shows those benefits by looking at the effects on the United States when it undertakes an *increase in retirement age* pension reform alone (the right column), versus a cooperative global effort (the left column), both beginning in 2014. Under the cooperative case, real GDP is 50 percent higher in the long run. A cooperative action results in an interest rate decline that is about five times that under an individual action. As a result, a permanent expansion in real GDP worldwide (average over the five regions) in the order of 7.2 percent above baseline follows (Table 2)—this table also shows that this is about 40 percent larger than the sum of benefits from individual country reforms.

The magnified effects of simultaneous public pension reforms by all regions, relative to reform by each region alone, are further illustrated in Table 2 (the increase in retirement age case). It highlights the effect of reform on real GDP, consumption, the real interest rate, and the government debt-to-GDP ratio in the five regions, which are clearly larger in every case under a cooperative policy action (the first set of rows) versus the individual action (the second through fifth set of rows). While all regions benefit relatively more from a

²⁵ Botman and Kumar (2007) analyze the macroeconomic effects of a coordinated policy response to global demographic pressures in a four-country version of GFM (Germany, the rest of the euro area, the United States, and the rest of the world) and show clear benefits from a cooperative fiscal adjustment. Freedman and others (2009a,b) also show the benefits of a coordinated approach to fiscal activism in a GIMF setting.

cooperative action, the euro area, a large and relatively less open region benefits relatively less than a smaller and more open emerging Asia (40 percent and 110 percent improvement, respectively).

Figures 16 and 17 make a similar point for the other two policy options. In the case of an *increase in labor income taxes* to finance the pension gap, real GDP no longer falls relative to the baseline scenario in the long run. However, real GDP in the United States in this case increases by only 0.5 percent, while rising above baseline by more than three times that amount in the long run (1.6 percent) if the fiscal measure was a *decrease in pension benefits*. Tables 3 and 4 summarize the results of these corresponding reforms if carried out individually (along with their spillover effects into other regions) or globally.

To sum up, promoting a global cooperative increase in retirement age appears to yield the largest impact on activity—the relative improvement in real GDP worldwide is four and over 10 times larger than under reform options 2 and 3.

In terms of external balances, the global cooperative scenario yields a weaker external balance in each country, and corresponding less accumulation of net foreign assets. The current account improves by less under a cooperative action than when a policy is taken by each country or region on its own. Under a global scenario where only one country does not reform, improvements in the current account balances of the reforming countries would be reflected in a deteriorating balance of the non-reformer—private saving declines or consumption rises due to an appreciating real exchange rate and an investment rises due to lower interest rates.

As for improving public finances, stabilizing the GDP share of age-related (pension) expenditures leads to a sizable decline in the debt-to-GDP ratio. Early and resolute action to reduce future age-related spending could significantly improve fiscal sustainability in several countries over the medium run and more so if such reforms are again enacted in a cooperative fashion; for instance, debt-to-GDP ratios decline by 40 to 50 percentage points (depending on the undertaken reform) below baseline on average across the regions, an improvement of approximately 30 percent relative to a non-cooperative strategy (Tables 2–4). This is due to the magnified effect of fiscal consolidation efforts on world savings and world real interest rates with larger attendant crowd-in effect on investment.

Figure 15. Cooperative Versus Regional Public Pension Reform—Increase in Retirement Age

Global (LEFT Column) versus US (RIGHT Column)

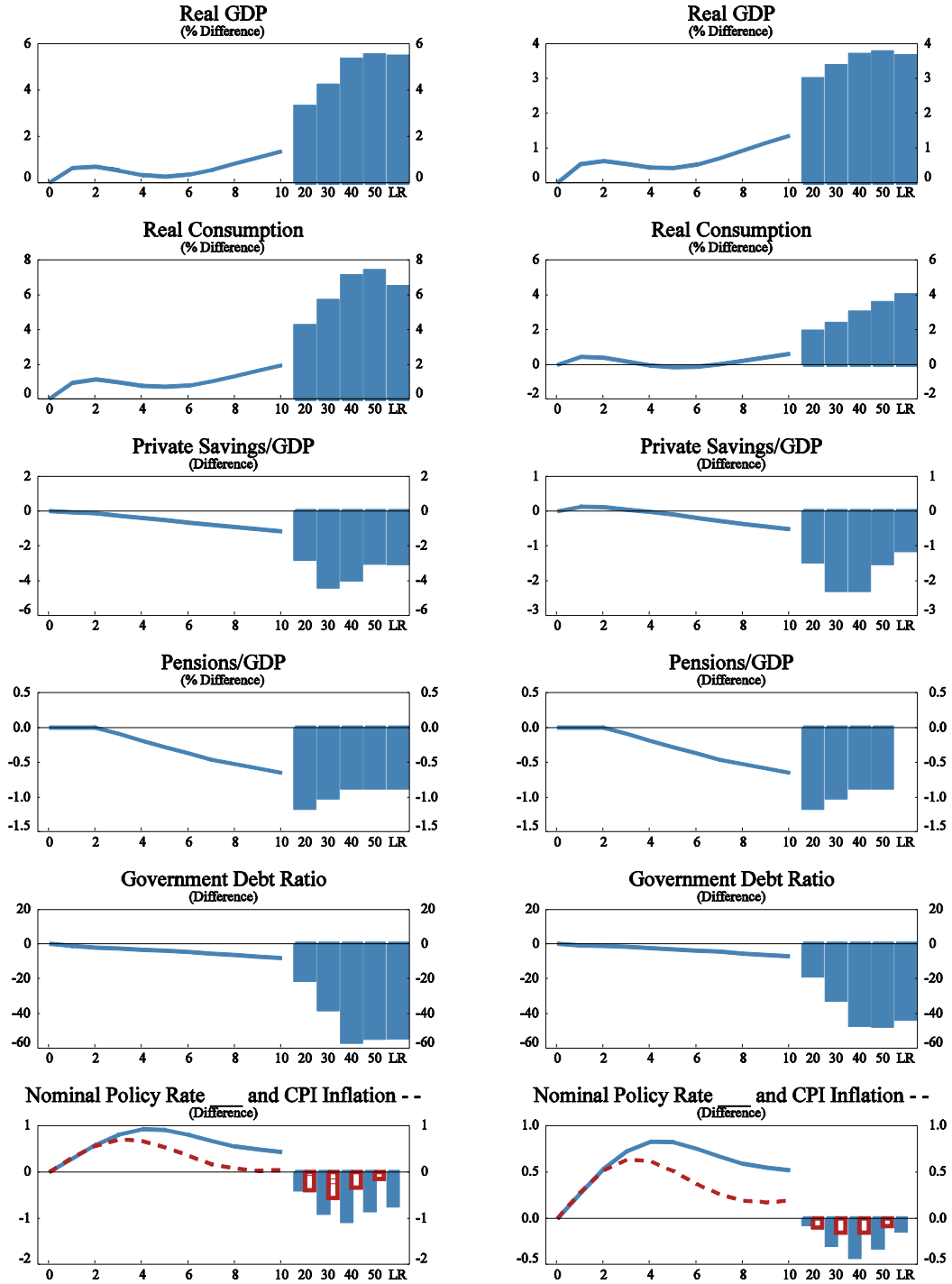


Figure 16. Cooperative Versus Regional Public Pension Reform—Reducing Pension Benefits

Global (LEFT Column) versus US (RIGHT Column)

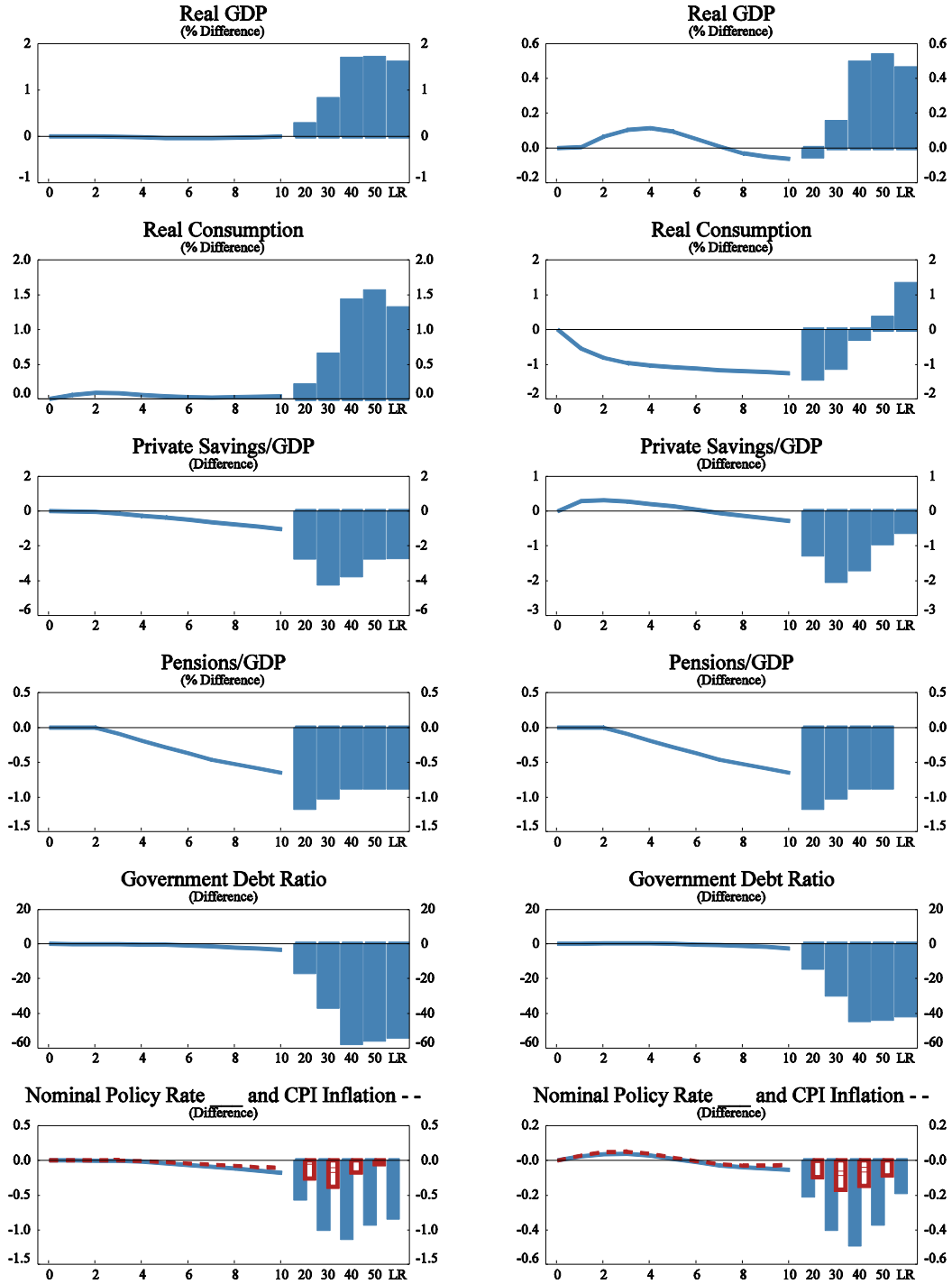


Figure 17. Cooperative Versus Regional Public Pension Reform—Raising Contribution Rates

Global (LEFT Column) versus US (RIGHT Column)

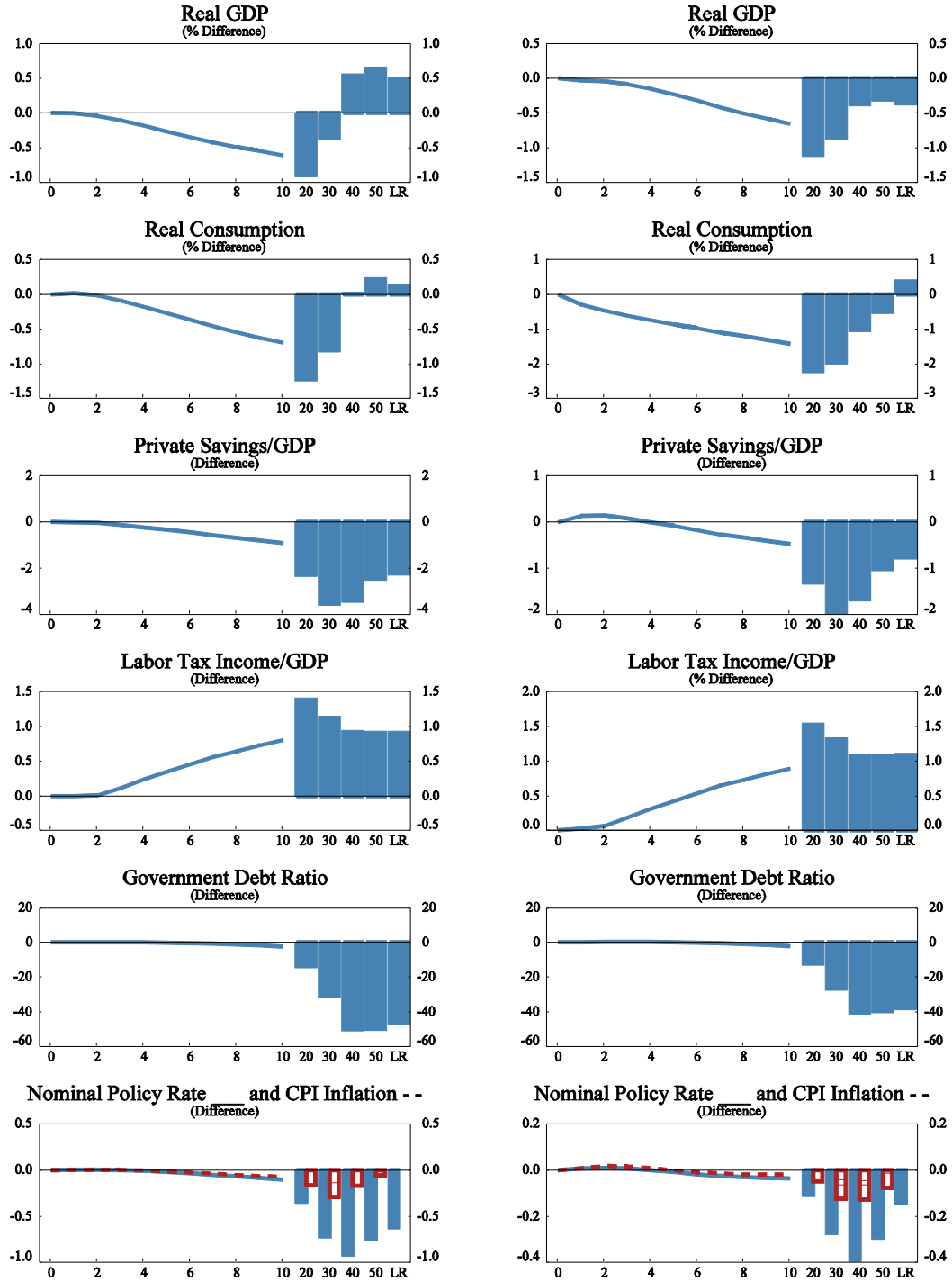


Table 2. Cooperative Versus Regional Public Pension Reform—Increase in Retirement Age

	<u>US</u>	<u>EU</u>	<u>JA</u>	<u>AS</u>	<u>RC</u>
Global Scenario					
Real GDP	5.4	7.9	2.1	7.2	13.5
Consumption	6.4	10.5	2.1	8.2	14.3
Real Interest Rate	-0.72	-0.72	-0.72	-0.72	-0.72
Government Debt to GDP	-53.6	-64.8	-0.0	-21.2	-77.1
United States Scenario					
Real GDP	3.6	0.3	0.4	0.5	0.5
Consumption	4.0	0.2	0.2	0.4	0.6
Real Interest Rate	-0.13	-0.13	-0.13	-0.13	-0.13
Government Debt to GDP	-43.0	0.0	-0.0	0.0	-0.0
Euro Area Scenario					
Real GDP	0.4	5.7	0.4	0.6	0.8
Consumption	0.2	6.5	0.2	0.6	1.4
Real Interest Rate	-0.14	-0.14	-0.14	-0.14	-0.14
Government Debt to GDP	0.0	-47.4	-0.0	0.0	0.0
Emerging Asia Scenario					
Real GDP	0.1	0.1	0.1	3.4	0.2
Consumption	0.3	0.3	0.4	2.6	0.4
Real Interest Rate	-0.01	-0.01	-0.01	-0.01	-0.01
Government Debt to GDP	0.0	0.0	0.0	-13.5	-0.0
Other Countries Scenario					
Real GDP	1.0	1.3	0.9	2.2	11.7
Consumption	1.6	3.1	1.3	4.1	11.6
Real Interest Rate	-0.25	-0.25	-0.25	-0.25	-0.25
Government Debt to GDP	0.0	0.0	-0.0	0.0	-67.0

Table 3. Cooperative Versus Regional Public Pension Reform—Reducing Spending on Pension Benefits

	<u>US</u>	<u>EU</u>	<u>JA</u>	<u>AS</u>	<u>RC</u>
Global Scenario					
Real GDP	1.6	1.7	1.7	2.0	1.9
Consumption	1.3	1.7	-0.3	0.8	2.4
Real Interest Rate	-0.82	-0.82	-0.82	-0.82	-0.82
Government Debt to GDP	-53.2	-58.1	-0.0	-21.3	-68.8
United States Scenario					
Real GDP	0.5	0.3	0.4	0.4	0.4
Consumption	1.3	-0.2	-0.0	0.1	-0.0
Real Interest Rate	-0.18	-0.18	-0.18	-0.18	-0.18
Government Debt to GDP	-41.0	0.0	-0.0	0.0	0.0
Euro Area Scenario					
Real GDP	0.2	0.4	0.3	0.4	0.3
Consumption	-0.1	1.5	-0.0	0.0	-0.0
Real Interest Rate	-0.15	-0.15	-0.15	-0.15	-0.15
Government Debt to GDP	-0.0	-42.5	0.0	0.0	0.0
Emerging Asia Scenario					
Real GDP	0.0	0.1	0.1	0.1	0.1
Consumption	-0.0	-0.0	-0.0	0.5	-0.0
Real Interest Rate	-0.03	-0.03	-0.03	-0.03	-0.03
Government Debt to GDP	-0.0	0.0	-0.0	-14.3	0.0
Other Countries Scenario					
Real GDP	0.5	0.6	0.6	0.6	0.7
Consumption	-0.2	-0.0	-0.2	-0.1	2.1
Real Interest Rate	-0.29	-0.29	-0.29	-0.29	-0.29
Government Debt to GDP	0.0	0.0	0.0	0.0	-59.8

Table 4. Cooperative Versus Regional Public Pension Reform—Raising Contribution Rates

	<u>US</u>	<u>EU</u>	<u>JA</u>	<u>AS</u>	<u>RC</u>
Global Scenario					
Real GDP	0.5	0.0	1.2	1.0	0.0
Consumption	0.1	-0.5	-0.6	-0.3	-0.1
Real Interest Rate	-0.62	-0.62	-0.62	-0.62	-0.62
Government Debt to GDP	-45.9	-50.2	-0.0	-19.2	-62.3
United States Scenario					
Real GDP	-0.4	0.2	0.3	0.3	0.2
Consumption	0.4	-0.2	-0.1	-0.0	-0.2
Real Interest Rate	-0.14	-0.14	-0.14	-0.14	-0.14
Government Debt to GDP	-37.8	-0.0	-0.0	0.0	-0.0
Euro Area Scenario					
Real GDP	0.1	-1.2	0.2	0.2	0.1
Consumption	-0.2	-0.3	-0.1	-0.1	-0.4
Real Interest Rate	-0.11	-0.11	-0.11	-0.11	-0.11
Government Debt to GDP	0.0	-40.4	-0.0	0.0	0.0
Emerging Asia Scenario					
Real GDP	0.0	0.0	0.1	-0.1	0.1
Consumption	-0.1	-0.1	-0.0	0.3	0.0
Real Interest Rate	-0.03	-0.03	-0.03	-0.03	-0.03
Government Debt to GDP	0.0	-0.0	-0.0	-14.5	0.0
Other Countries Scenario					
Real GDP	0.3	0.3	0.4	0.2	-1.2
Consumption	-0.4	-0.5	-0.4	-0.8	0.1
Real Interest Rate	-0.22	-0.22	-0.22	-0.22	-0.22
Government Debt to GDP	0.0	0.0	-0.0	0.0	-57.0

SENSITIVITY ANALYSIS

The benchmark reform scenarios depend on many assumptions, ranging from agents' degree of impatience and myopia, to the timing of fiscal consolidation. As such, we test the sensitivity of those benchmark results to changes in selected key parameter values and investigate the potential shifts in the impact of the public pension reform on the economy. We focus on the results of the benchmark cooperative global reform scenarios²⁶ and apply the tests to the benefit cut scenario except for two tests, the sensitivity of hours worked to a raise in retirement age and the role of monetary policy accommodation in the short run. To keep the paper concise, we report the qualitative results of the main tests and refer the reader to Appendix 2 for a quantitative assessment accompanied by Figures 18 to 24. The sensitivity tests are the following:

- A smaller increase in labor supplied in response to an increase in retirement age reduces real activity. The benchmark case assumes no change in hours worked and effort.
- A shorter planning horizon with more myopic agents leads to a larger drop in consumption initially but higher real GDP in the medium run driven by a boost in investment resulting from an increased labor supply. Under a much longer planning horizon, agents become far more Ricardian in their behavior. The demand effect is far weaker with consumption behavior barely changing in response to reform in both the short and long run. The supply and the capital intensity of production respond a lot less which in turn reduces the effect of fiscal reform on real interest rates—the latter does not respond in the long run to the global reform which lowers debt permanently.
- Increasing the share of liquidity-constrained agents in the population to 50 percent in all regions leads to a reduction in consumption in the United States and the euro area (regions where this share has doubled), contrary to the benchmark results. Over the medium run, interest rates fall relative to benchmark, boosting investment and the long run level of real GDP. Emerging Asia and the block of remaining countries (regions for which this share does not change) benefit from lower world interest rates, which actually leads to a small improvement in consumption starting in the first year.
- As for the timing of fiscal consolidation, having the public pension spending adjust immediately to its lower long-run level depresses consumption in the short run for most regions. The difference is larger in the remaining countries block due to a larger share of *LIQ* households. The increase in government savings crowds out the need for private savings much quicker, but investment picks up faster, which means that

²⁶ For the most part, individual country reform scenarios (as discussed in Section IV. B.) rely on the parameters discussed below in a similar fashion.

the recovery in real GDP happens much earlier than in the benchmark reform scenario.

- Monetary policy accommodation for one or two years boosts consumption and real GDP at the expense of added inflation volatility. Short-run demand pressure results in movements in inflation away from its target and a further decline in real interest rates, prolonging the initial positive impact of the public pension reforms. Over the short run, real GDP and consumption rise considerably more relative to the benchmark scenario, and public finances improve as government deficits decline faster in light of lower debt service payments. When normal conduct of monetary policy returns, there is the usual dampening effect in the medium run. In the long run, the economy follows the same path as in the benchmark scenario.
- The formulation of inflation behavior can have an effect on real variables. In the case where the United States alone carries out public pension reform, there is a short-run decline in consumption, because of inflationary pressures that lead to an increase in interest rates by the monetary authority. However, by either cutting the degree of inflation persistence, or altering how inflation persistence is determined, consumption will be positive. Such a change to the calibration of the model would be at the expense of other properties such as the volatility of exchange rates, and the possibility for effective monetary accommodation.²⁷

IV. CONCLUSION

We considered reforms to the pension system that can help ensure the long-run viability of public finances, while mindful of their short-run effect on economic activity in the midst of a global financial crisis. This is carried out within a dynamic general equilibrium model (GIMF) that captures the important economic interrelationships at a national and international level. We emphasized measures to contain and fund the rising costs of age-related spending in the medium to long run. We find that reforms which lead to short-run adverse effects on real GDP (i.e., benefit reductions) are largely outweighed by the benefits of declining real interest rates and the positive effect on future potential productive capacity. The reform which has the most positive effects in the long run is lengthening the working lives of employees, effectively raising the size of the active labor force relative to the retiree population. It helps boost domestic demand in the short run but also eases off the pressure on governments to cut pension benefits alone—which can lead to additional private savings and cause fragile domestic demand to fall in the short run—or to raise payroll and labor income taxes—which can distort incentives to supply labor. We also found that the impact on real

²⁷ The latter property is a linchpin of many results in other work on fiscal stimulus and consolidation with GIMF, such as Freedman and others (2009a).

GDP of a cooperative approach to age-related fiscal reforms is greater compared to a case where one but not all regions undertake reform.

In terms of public finances, our results generally show that stabilizing the GDP share of age-related expenditures leads to a sizable decline in the debt-to-GDP ratio. Early efforts and resolute action to reduce future age-related spending or finance the spending through additional tax increases and other measures (preferably through an increase in retirement age) could significantly improve fiscal sustainability in several countries over the medium run, and more so if such reforms are enacted in a cooperative fashion.

Appendix 1. GIMF's Main Features and Calibration

The model economies feature three main sectors: households, firms (and entrepreneurs) and a government. An external sector is also fully developed. The appendix describes households' optimizing behavior including aggregation across generations, highlights the firms' constrained profit maximization problem and discusses the government sector's intertemporal budget constraint and fiscal policy aimed to stabilize deficits and the business cycle. Real aggregate variables, say x_t , are *rescaled* by dividing by the level of labor augmenting world technology T_t and by population growth; hence the notation $\tilde{x}_t = x_t / (T_t n^t)$. The *steady state* of \tilde{x}_t is denoted by \bar{x} . The world economy's technology grows at the constant rate $g = T_t / T_{t-1}$ and world population grows at the constant rate n . Under the assumption that all consumers in the five regions face identical survival probabilities, the relative size of the populations remain constant.

Households' Sector and Optimality Conditions

The share of liquidity-constrained (*LIQ*) households agents in the population is $\psi(z)$ where z refers to a country. In each period $N(z)n^t\psi(z)\left(1 - \frac{\theta}{n}\right)$ of such individuals are born, where $N(z)$ indexes absolute population sizes in period 0. Second, there are *OLG* households with finite planning horizons with a share equals to $1 - \psi(z)$; in each period $N(z)n^t(1 - \psi(z))\left(1 - \frac{\theta}{n}\right)$ of such individuals are born. Each of these agents faces a constant probability of death $(1 - \theta)$ in each period, which implies an average planning horizon $1/(1 - \theta)$. In addition to the probability of death households also experience labor productivity (and hence labor income) that declines at a constant rate χ over their lifetimes, reaching near zero in 20 years.²⁸ Life-cycle income adds another powerful channel through which fiscal policies have non-Ricardian effects, as this along with θ produce a high degree of myopia. Households of both types are subject to uniform labor income, consumption and lump-sum taxes.

²⁸ This stylized treatment of life-cycle income is made possible by the absence of explicit demographics in GIMF, which means that an assumption of declining labor productivity suffices to be correct for the average worker.

Overlapping Generations (OLG) Households

Analytically, the key relation for *OLG* households is their optimal consumption rule which states that consumption equals the marginal propensity to consume out of wealth times real wealth. The current aggregate consumption is expressed as a function of real aggregate financial wealth and human wealth. The latter is composed of the expected present discounted value of households' time endowments evaluated at the after-tax real wage, and of the expected present discounted value of capital or dividend income net of lump-sum transfer payments to the government. The implication is that government debt adds to agents' net worth, that the time profile of taxes affects the time profile of consumption, and that in the long run government debt crowds out private capital and net foreign assets. The reason is that a household with finite planning horizon attaches less importance to higher tax payments in the distant future, by discounting future tax liabilities at rates that are higher than the market real interest rate due to their myopia $\theta < 1$ and the rate of decline of their labor income $\chi < 1$. Government debt is therefore net wealth to the extent that households, due to short planning horizons, disregard the future taxes necessary to service that debt.

A *fiscal consolidation* through higher taxes represents a tilting of the tax payment profile from the more distant future to the near future, resulting in a reduction in the debt stock. The present discounted value of the government's future primary deficits has to remain equal to the current debt under this scenario. But for households the same tilting of the tax profile represents a decrease in human wealth because it increases the expected value of future taxes for which the household expects to be responsible—this is true, for example, for the direct effects of labor income tax on labor income receipts. For a given marginal propensity to consume, this decrease in human wealth leads to a decrease in consumption. This is particularly relevant in explaining the likely negative demand effects of raising contribution rates on consumption.

A key parameter for the marginal propensity to consume, the intertemporal substitution in consumption ($1/\gamma$) is in line with the business cycle literature—this parameter affects the sensitivity of consumers to changes in the real interest rate. For a conventional assumption of $\gamma > 1$, the income effect of an increase in the real interest rate is stronger than the substitution effect and tends to increase the marginal propensity to consume, thereby partly offsetting the contractionary effects of a higher real interest rate on human wealth. A larger γ therefore tends to give rise to larger interest rate changes in response to fiscal shocks, which is possible to analyze given the more general utility functions added in GIMF.

Consumption, Wealth, and Labor

The household's budget constraint, derivation of the first-order conditions for each generation and aggregation across generations are discussed in detail in KLMM (2010), Appendices 1–3. The lifetime expected utility of a representative household is such that a

representative member of the *OLG* group of households and of age a derives utility at time t from consumption $c_{a,t}^{OLG}$ and leisure $(S_t^L - l_{a,t}^{OLG})$ where S_t^L is the stochastic time endowment and l is the supply of labor by households,

$$\sum_{s=0}^{\infty} (\beta\theta)^s \left[\frac{1}{1-\gamma} \left((c_{a+s,t+s}^{OLG})^{\eta^{OLG}} (S_t^L - l_{a+s,t+s}^{OLG})^{1-\eta^{OLG}} \right)^{1-\gamma} \right] \quad (5)$$

β is the discount factor, $\theta < 1$ determines the planning horizon, $\gamma > 0$ is the coefficient of relative risk aversion, and $0 < \eta^{OLG} < 1$ determines the consumption-leisure choice.

The key result for *OLG* households—their optimal consumption rule, states that consumption equals the marginal propensity to consume out of wealth times real wealth. The current aggregate consumption of *OLG* households is expressed as a function of their real aggregate financial wealth fw_t and human wealth hw_t , with the marginal propensity to consume out of wealth given by $1/\Theta_t$. Human wealth is in turn composed of hw_t^L , the expected present discounted value of households' time endowments evaluated at the after-tax real wage, and hw_t^K , the expected present discounted value of capital or dividend income net of lump-sum transfer payments to the government. After rescaling by technology we have

$$\check{c}_t^{OLG} \Theta_t = \check{f}w_t + \check{h}w_t^L + \check{h}w_t^K \quad (6)$$

where

$$\check{f}w_t = \frac{1}{\pi_t gn} \left[i_{t-1} (\check{b}_{t-1} + \check{b}_{t-1}^N + \check{b}_{t-1}^T) + i_{t-1}^* \varepsilon_t (1 + \xi_{t-1}^f) \check{f}_{t-1} e_{t-1} \right], \quad (7)$$

$$\check{h}w_t^L = \left(N(1-\psi)(\check{w}_t(1-\tau_{L,t})) \right) + \frac{\theta \chi g}{r_t} \check{h}w_{t+1}^L, \quad (8)$$

$$\check{h}w_t^K = \left(\sum_j \check{d}_t + r \check{b}r_t - \check{\tau}_t^{ls,OLG} + \check{Y}_t^{OLG} \right) + \frac{\theta g}{r_t} \check{h}w_{t+1}^K, \quad (9)$$

$$\Theta_t = \frac{p_t^R + \tau_{c,t}}{\eta^{OLG}} + \frac{\theta j_t}{r_t} \Theta_{t+1} \quad (10)$$

$$j_t = (\beta r_t)^{\frac{1}{\gamma}} \left(\frac{p_t^R + \tau_{c,t}}{p_{t+1}^R + \tau_{c,t+1}} \right)^{\frac{1}{\gamma}} \left(\chi g \frac{\check{w}_{t+1}(1-\tau_{L,t+1})(p_t^R + \tau_{c,t})}{\check{w}_t(1-\tau_{L,t})(p_{t+1}^R + \tau_{c,t+1})} \right)^{(1-\eta^{OLG}) \left(\frac{1}{1-\gamma} \right)} \left(\frac{\check{c}_t^{OLG} g}{\check{c}_{t-1}^{OLG}} \right)^{\eta^{OLG} \left(\frac{1-\frac{1}{\gamma}}{1-\gamma} \right)} \quad (11)$$

Liquidity Constrained (LIQ) Households and Aggregate Households

These agents can consume at most their current income, which consists of their after-tax wage income plus net government transfers. This group of households therefore has a

marginal propensity to consume out of present income of unity, so that fiscal multipliers of revenue-based fiscal stimulus measures such as tax cuts and increases in transfers are particularly high whenever such agents constitute a large share of the population. The objective function of *LIQ* households is assumed to be identical to that of *OLG* households. *LIQ* households take their wage as given, accepting the *OLG* households' wage. Similarly, *LIQ* households supply labor in an amount proportionate to the amount supplied by *OLG* households in response to their consumption-leisure optimization problem. Aggregate consumption and labor supply are given by $\check{C}_t = \check{c}_t^{OLG} + \check{c}_t^{LIQ}$ and $\check{L}_t = \check{l}_t^{OLG} + \check{l}_t^{LIQ}$.

Firms

Firms are managed in accordance with the preferences of their owners, myopic *OLG* households, and they therefore also have finite-planning horizons. The productive sector features a conventional setup with standard features for the tradables, nontradables, intermediate goods, final consumption and investment goods. An added financial accelerator mechanism amplifies the propagation mechanism for standard shocks and creates a role for new shocks. So except for capital goods producers, entrepreneurs and retailers, firms are monopolistically competitive and subject to nominal rigidities in price setting. Each firm maximizes the present discounted value of net cash flow or dividends. The first-order conditions are standard except for the presence of the probability of survival term, θ , in the discount factors. Again, KLMM (2010) contains the complete details for all firm and union sectors for the interested reader.

Government

Budget Constraint

Fiscal policy consists of a specification of government consumption and investment spending ($G_t = G_t^{cons} + G_t^{inv}$), lump-sum taxes on both *LIQ* and *OLG* households, lump-sum transfers to both *LIQ* and *OLG* households ($\Upsilon_t = \Upsilon_t^{OLG} + \Upsilon_t^{LIQ}$), and tax rates on labor income ($\tau_{L,t}$), consumption ($\tau_{c,t}$) and corporate income ($\tau_{k,t}$). This rather detailed representation of taxes, transfers and government spending enables us to analyze the impact of pension-related tax and expenditure reforms. Pensions, in particular, are part of the untargeted lump-sum transfers to households, whereas social security contribution rates are embedded in taxes on labor income.

Government consumption spending is unproductive, while government investment spending augments a stock of publicly provided infrastructure capital that depreciates at some rate. Tax revenue is endogenous and given by the sum of labor, consumption, capital, and lump-sum taxes. The real government budget constraint is

$$\bar{b}_t = \frac{i_{t-1}}{\pi_t gn} \bar{b}_{t-1} + \bar{G}_t + \bar{Y}_t - \bar{\tau}_t = \frac{i_{t-1}}{\pi_t gn} \bar{b}_{t-1} - \bar{s}_t \quad (1)$$

where the government issues nominally non-contingent one-period nominal debt \bar{b}_t at the gross nominal interest rate i_t and \bar{s}_t is the primary surplus.

The government's policy rule for transfers partly compensates for the lack of asset ownership by *LIQ* agents by redistributing a small fraction of *OLG* agents' dividend income receipts (in various sectors, retail, unions, etc.) to *LIQ* agents. Government lump-sum transfers and lump-sum taxes are received and paid by *LIQ* agents in proportion to their share in aggregate consumption, but this rule can be easily changed, for example, to allow for transfers that are 100 percent targeted to *LIQ* agents.

Fiscal Policy

A fiscal policy rule stabilizes deficits and the business cycle. First, it stabilizes the interest-inclusive government deficit to GDP ratio gd_t^{rat} at a long-run target (structural) level gds_t^{rat} , which rules out default and fiscal dominance (dynamic stability). Second, it stabilizes the business cycle by letting the deficit fall with the output gap. We have

$$gd_t^{rat} = gds_t^{rat} - d^{gdp} \ln \left(\frac{g\bar{d}p_t}{g\bar{d}p_{pot}} \right) \quad (2)$$

Here $d^{gdp} \geq 0$, and gd_t^{rat} is given by

$$gd_t^{rat} = 100 \frac{\frac{(i_{t-1} - 1)\bar{b}_{t-1}}{\pi_t gn} - \bar{s}_t}{g\bar{d}p_t} = 100 \frac{\bar{b}_t - \frac{\bar{b}_{t-1}}{\pi_t gn}}{g\bar{d}p_t} \quad (3)$$

Shocks to gds_t^{rat} represent changes in government saving preferences. We denote the current value and the long-run target of the government debt to GDP ratio by \bar{b}_t^{rat} and bss_t^{rat} . The relationship between bss_t^{rat} and gds_t^{rat} follows directly from the government's budget constraint as

$$bss_t^{rat} = \frac{\bar{\pi} gn}{\bar{\pi} gn - 1} gds_t^{rat} \quad (4)$$

where $\bar{\pi}$ is the inflation target of the central bank. In other words, for a given trend nominal growth rate, choosing a deficit target gds_t^{rat} implies a debt target bss_t^{rat} and therefore keeps debt from exploding. We note that the long run autoregressive coefficient on debt, at $1/\bar{\pi} gn$, is quite close to one. An identical relationship holds between the long run net foreign liabilities to GDP ratio and the long run current account deficit to GDP ratio.

The value of d^{gdp} can be thought of as quantifying the automatic stabilizers in the economy. So for a given one percent increase in the output gap, the fiscal authority increases its target surplus by d^{gdp} percent. GIMF allows for permanent shocks to technology and to private saving, which have permanent effects on potential GDP due to the non-Ricardian features of the model. Potential output is therefore modeled as a moving average of past actual values of GDP to allow for the gap to close over time. Fiscal policy can typically be characterized by the degree to which automatic stabilizers work. Finally, the fiscal rule equation above is not an instrument rule but rather a targeting rule. Any of the available tax and spending instruments can be used to make sure the rule holds. The default setting in this paper is that this instrument is lump-sum transfers.

Monetary Policy

The model uses a stylized Taylor-type interest rate reaction function in which central bank set interest rates on the basis of the deviation of current and one-year ahead inflation from the inflation target, to stabilize inflation at a pre-specified target level.

Calibration

The steady state ratios which are of particular importance for this exercise are presented in Appendix Table 1. Steady state GDP decompositions and trade flows are based on recent historical averages. Tax revenues are decomposed into its four components, with the assumed shares, based on somewhat detailed data, used to infer the model's steady state tax rates.

As for other parameter of interest, household utility functions are equal across countries. The intertemporal elasticity of substitution is 0.5 (describing the sensitivity of consumption to changes in the real interest rate), or $\gamma = 2$, and the wage elasticity of labor supply is 0.5. The parameters ψ , θ and χ are critical for the non-Ricardian behavior of the model. The shares of *LIQ* consumers are 25 percent in the United States, the euro area, and Japan, and 50 percent in emerging Asia (reflecting among other things the nascent or underdeveloped financial markets for domestic consumers) and other countries. The planning horizon is equal to 20 years for $\theta = 0.95$ and the average remaining time at work is 20 years for $\chi = 0.95$. The main criterion used in choosing θ and χ is the empirical evidence for the effect of government debt on real interest rates.²⁹

²⁹ Our model is calibrated so that a 1 percentage point increase in the government debt to GDP ratio in the United States leads to a long-run increase of approximately 1 to 2 basis points in the U.S. (and world) real interest rate. This value is on the low end of the range of estimates provided by Laubach (2003), Engen and Hubbard (2004), and Gale and Orszag (2004).

As for production technologies, the elasticities of substitution are equal to 1 between capital and labor, 0.75 between domestic and foreign goods, and 0.5 between tradables and nontradables. Steady state markups equal 1.1 in manufacturing and wage setting, 1.05 in retailing, investment and consumption goods production, and 1.025 for import agents.

In calibrating the fiscal rule, we use OECD estimates (Girouard and André, 2005) for the output gap coefficients, d^{gdp} which proxy for the automatic stabilizers in the economy. We assume the overall target deficit-to-GDP ratios are equal to the projected 2014 government debt to GDP ratios (IMF, 2010c). Finally, the calibration of monetary rule parameters is conventional for an annual model. For emerging Asia, we assume a fixed nominal exchange rate vis-à-vis the U.S. dollar.

Appendix Table 1. Selected Steady-State Values

A. Expenditure Shares (In percent of GDP)					
	US	AS	EU	JA	RC
Consumption	65.3	59.0	58.2	59.5	59.0
OLG Consumption	51.8	33.7	46.5	46.9	34.0
LIQ Consumption	13.5	25.3	11.7	12.6	25.0
Private Investment	17.2	25.0	18.3	21.0	19.0
Government Expenditures	17.5	16.0	23.5	19.5	22.0
Government Consumption	15.0	12.0	20.5	17.0	20.0
Government Investment	2.5	4.0	3.0	2.5	2.0
Exports	11.5	27.0	17.4	11.0	21.9
Imports	11.5	27.0	17.4	11.0	21.9
B. Deficit, Debt, Taxes, and Transfers					
	US	AS	EU	JA	RC
Net Debt / GDP	128.7	48.5	136.2	156.0	94.4
Deficit / GDP	6.8	2.6	6.6	6.1	4.6
Labor Income Tax Rate	29.3	8.3	40.8	26.3	22.3
share in tax revenues	61.9	20.1	60.5	55.2	33.8
Capital Income Tax Rate	15.8	12.2	13.4	19.3	13.4
share in tax revenues	11.3	13.9	6.9	17.5	7.3
Consumption Tax Rate	7.0	17.0	18.4	8.7	17.0
share in tax revenues	16.3	46.3	26.4	18.2	25.2
Lump-Sum Taxes / Total Tax Revenue	10.2	18.9	6.1	9.1	33.8
Government General Transfers / GDP	9.5	5.1	15.6	7.5	16.7
C. Factor Shares (In percent of GDP)					
	US	AS	EU	JA	RC
Labor Income	60.0	54.0	60.0	60.0	60.0

Source: KLMM (2010); IMF (2010c); and staff estimates.

Appendix 2. Sensitivity Analysis

Labor Supply Response to an Increase in the Retirement Age

Figure 15 above shows the impact of a global increase in retirement ages assuming that, in all countries, workers will effectively stay longer in the labor force for as many years as the official increase in the retirement age. Arguably, labor supply among older workers would decrease in such an event. Figure 18 considers the same reduction in pension benefits as in the benchmark reform scenario, but the increases in hours worked are $2/3$ and $3/4$ the amount assumed to be associated with the extension of working life presented earlier.

As expected, a smaller increase in the labor supplied by older workers reduces real GDP by roughly 20 to 25 percent worldwide in the $3/4$ case, and 27 to 33 percent in the $2/3$ case. This is the result of both a direct effect on production and an indirect effect through a lower marginal product of capital with a negative effect on investment growth. Human wealth decreases cumulatively over time, leading to a decline in consumption under an unchanged marginal propensity to consume.

Role of the Degree of Myopia or the Planning Horizon

The short-run adjustment of the global economy is influenced by the behavior of households and firms, and depends to a large extent on *OLG* households' degree of myopia, exemplified in the length of their planning horizon, assumed to be 20 years ($\theta = 0.95$) under the benchmark scenario. Figure 19 shows the results under two alternative values of θ , (i) $\theta = 0.90$ reflecting a shorter planning horizon or more myopic *OLG* agents and, (ii) $\theta = 0.98$ reflecting a much longer planning horizon. The latter case is expected to bring the results closer to a typical representative-agent Ricardian model in stark contrast to the standard GIMF non-Ricardian *OLG* structure.

Under a 10-year planning horizon with more myopic consumers, consumption initially drops notably for the United States and the euro area which are characterized by a lower share of *LIQ* households in their population. *OLG* agents do not take into account the crowding-in benefits and the higher future income from later retirement that is foreseen in the long run, and while simply consuming their (lower) after-tax current income they react more on impact to a fall in pension benefits. By a wealth effect, labor supply also rises more (agents consume less leisure). This, coupled with a lower marginal propensity to consume, brings investment up by a substantial amount, and in the long run the real GDP boost leads to lower debt to GDP ratios and real interest rates.

Under a much longer planning horizon of 50 years, agents become far more Ricardian in their behavior and their debt holdings are no longer treated as a source of wealth. Accordingly, the demand effect is far weaker and saving and consumption behavior barely

changes under the considered public pension reform in both the short and long run. The supply and the capital intensity of production respond a lot less which in turn reduces the effect of fiscal reform on real interest rates. Importantly, the real interest rate does not respond in the long run to the global reform which lowers debt permanently. However, such an extreme and unrealistic near-Ricardian behavior does not garner much empirical support.

Share of Liquidity—Constrained Households

The introduction of *LIQ* consumers adds further realism to the dynamic responses of macro variables, with changes in their share value in the population (ψ) expected to have a notable impact on the results.

We analyze the change in results when the share of *LIQ* agents equals 50 percent for all countries. As Figure 20 portrays, consumption now declines for the United States and the euro area, contrary to the benchmark results. The supply side is not affected in the short and medium run, but after 10 periods, interest rates will have fallen more than in the benchmark, propelling investment and long run growth. Emerging Asia and the block of remaining countries (regions for which the share of *LIQ* households did not change) benefit from lower world interest rates, which actually leads to a small improvement in consumption already in the first periods.

Timing of the Fiscal Consolidation

Pension gaps are reduced steadily with the adoption of any of the planned public pension reforms. In Section IV, the dynamics of the macroeconomic adjustment were shown to have been strongly influenced by the way the profile of fiscal consolidation was phased in, pursuant to an increase in retirement age. Under the benchmark scenario above, pension spending cuts by the government, on average, were more tilted toward the longer run with relatively less adjustment undertaken in the medium run. This, and to the extent that agents are non-Ricardian, had attenuated the impact of the reform on reducing agents' wealth in the short run, and consequently the expected negative impact on consumption. Moreover, there is less of a crowding-out effect on private saving in comparison with a more front-loaded fiscal consolidation scenario.

To illustrate this point, Figure 21 shows an immediate and permanent decline in public pension spending while preserving the magnitude of the fiscal consolidation itself in the long run. As a result, consumption drops in the short run for the United States, the euro area and the block of remaining countries. The difference is larger in the latter, due to the larger share of *LIQ* households. As expected, *OLG* agents' consumption is not affected to the same extent. As just noted above, the increase in government savings crowds out the need for

private savings much quicker, but investment picks up faster, which means that the recovery in real GDP happens much earlier than in the benchmark reform scenario.

Finally, Figure 22 considers the case where all countries mimic the fiscal consolidation profile adopted in the United States (that is, benefit reduction is similar over time). The magnitude of responses in real GDP, consumption, and private saving are much closer to what is seen for the United States case, particularly in the long run. However, the external adjustment patterns—imports, exports and real effective exchange rate—across the various economic regions remain unchanged, as they are mostly dictated by trade linkages as calibrated in GIMF.

Monetary Policy Accommodation

The monetary policy rule can play an important role in moderating the short-run effects of public pension reforms. When reforms are announced, forward looking consumers immediately anticipate a higher future income. The expected rise is particularly large and faster when retirement ages increase, as discussed in Section IV. This leads to higher consumption and inflationary pressures, which under the benchmark scenario triggers a usual policy rate increase, dampening the increase in consumption and real GDP.

In Figure 23, we consider the effect of a *monetary accommodation* of the initial boost in consumption and real GDP. Nominal interest rates are kept fixed at their initial levels for either one year, or two years. This in turn reduces real interest rates because the nominal interest rate is lower than it would be otherwise, and because inflation is higher than it would be otherwise. There is a crowding in effect on consumption and investment, driving up real GDP. Public finances are improved as public debt declines further and fiscal deficits improve on the account of lower debt service payments and the effect of larger real GDP on the relevant tax bases. Eventually, the role of the stabilizing impact of the interest rate reaction function is restored and policy rates now rise by a larger magnitude than was the case under the benchmark case, as monetary policy must bring a larger deviation from the inflation target under control.

This exercise demonstrates how a short-run boost in activity can be extended through a pre-announced monetary accommodation. This may be adopted as a policy choice to sustain a confidence effect in structural (entitlement) reforms, without deviating for too long from the price stability mandate of central banks. The long-run impact of the public pension reforms does not change with monetary accommodation.

Behavior of Inflation

The way in which we determine the behavior of inflation can affect the short-run macroeconomic effects of the public pension reform scenarios under consideration. A useful

example, explored in Figure 24, bases its results on the benchmark public pension reform scenario where the United States alone undertakes public pension reform by increasing the pensionable age accompanied by a reduction in public pension spending (see Figure 3).

Inflation dynamics are affected in GIMF by the level and the formulation of nominal rigidities; we study their implications by conducting two experiments: cutting the level of nominal rigidities (by half) and changing the way nominal rigidities enter in the model. On the latter, we deviate from the usual and modern practice of allowing an increase in inflation from year to year (Ireland, 2001) to a hybrid formulation where half of the rigidities come from the Ireland formulation and the other comes from the use of a more traditional Rotemberg (1982) formulation, where adjustment costs depends on the deviation of inflation each year from the stated inflation target.

Recall that under the benchmark scenario, consumption weakens during years 2 to 7. Under lower inflation persistence (as a result of lower nominal rigidities or adopting a different formulation of the inflation process), it is shown here that consumption can actually strengthen. This can be explained as follows. First, by effectively speeding up the response of inflation, the time horizon over which the monetary authority has to offset the inflationary impact is shortened. Second, inflation is now more responsive to interest rates, since inflation either moves faster (lower rigidities) or naturally tends towards the long-run inflation target (a weight of 0.5 on the Rotemberg formulation of nominal price rigidities); as such, interest rates would need to increase by less to get the same movement in inflation. Consequently, lower interest rates exert less downward pressure on the real economy in the short run.

Note that the perceived benefits of these experiments on domestic activity may suggest a change in the inflation process calibration. We should however carefully consider their implications on the overall model properties and not just the impact on domestic activity (a subject for future research). To draw an example, monetary accommodation under these experiments, would be less effective in the model (and consequently, in light of other policy work with GIMF, less realistic). Moreover, some variable responses of the model are less sensible; for example, the REER moves much less now (less inflation persistence) at odds with observed movements in the data.

Figure 18. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario—Labor Supply Response

_____ Baseline Reform Scenario; - - 2/3 of labor supply; ... 3/4 of labor supply

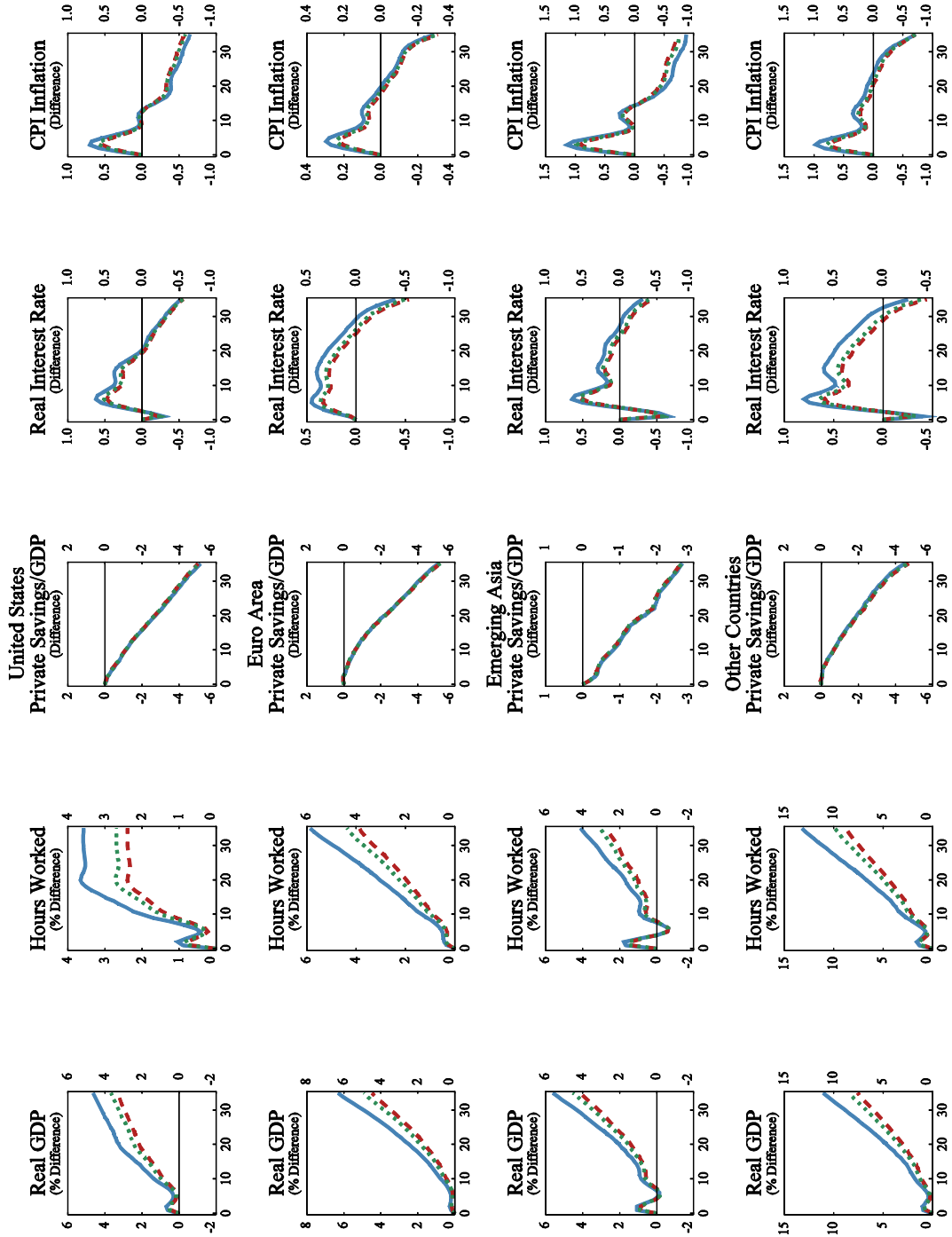


Figure 19. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario—Role of the Planning Horizon (Degree of Myopia)

_____ Baseline Reform Scenario; - - - 10-year planning horizon; ... 50-year planning horizon

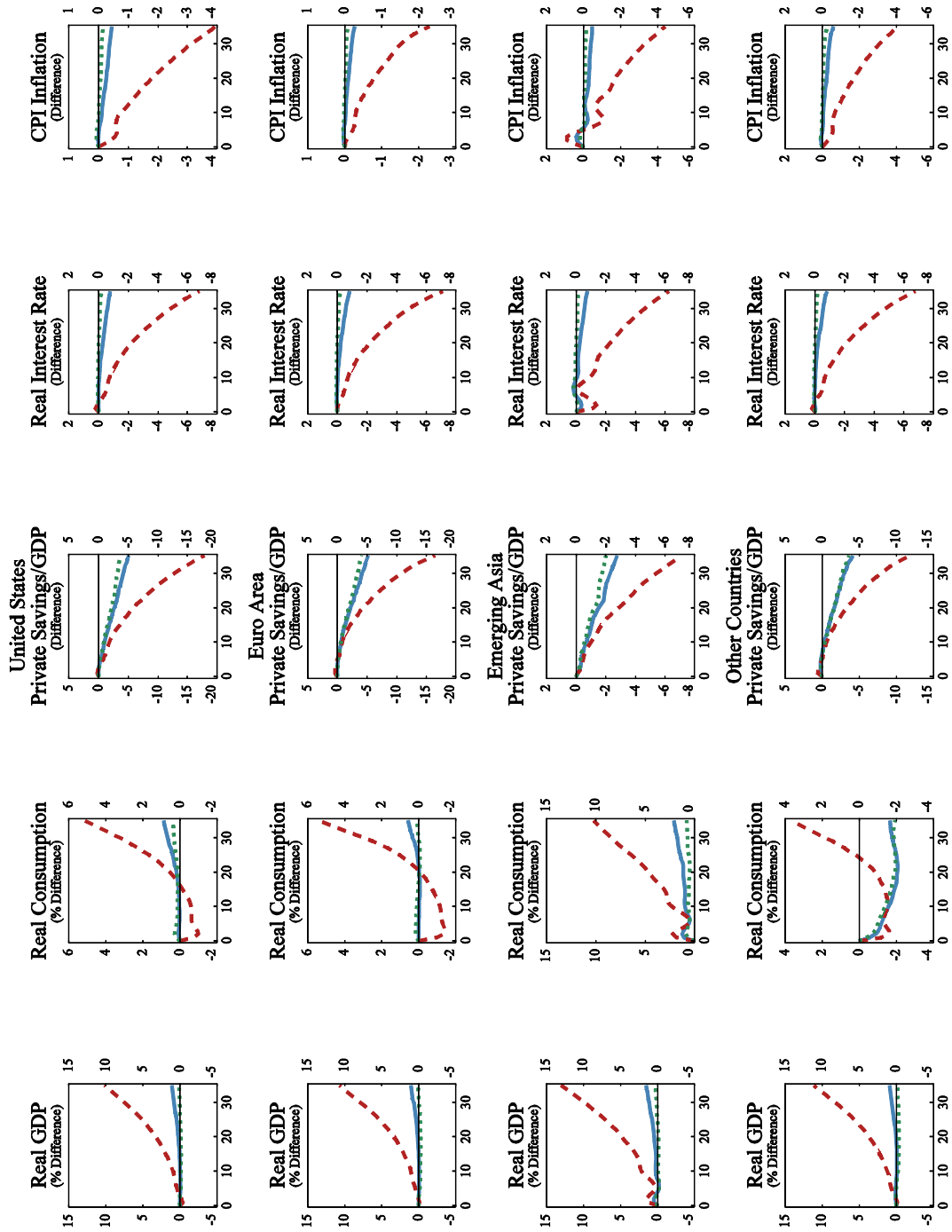


Figure 20. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario—Share of LIQ Households at 50 Percent Worldwide

Baseline Reform Scenario; -- LIQ agents are 50% of total globally

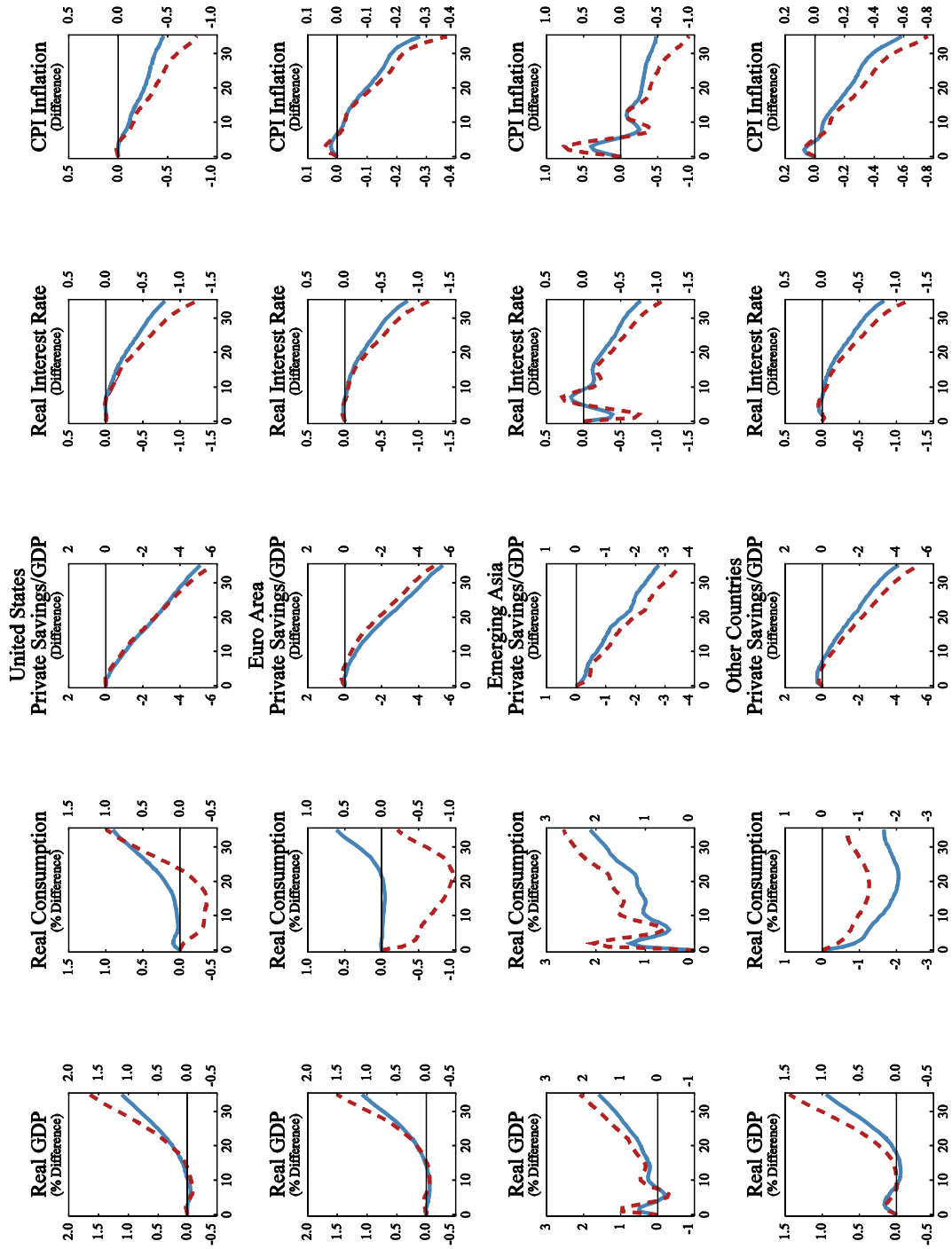


Figure 21. Sensitivity Analysis Around the Benchmark Coordinated Global Reduction in Public Pension Spending—Rapid Implementation

Baseline Reform Scenario; - - Rapid Implementation of Pension Cuts

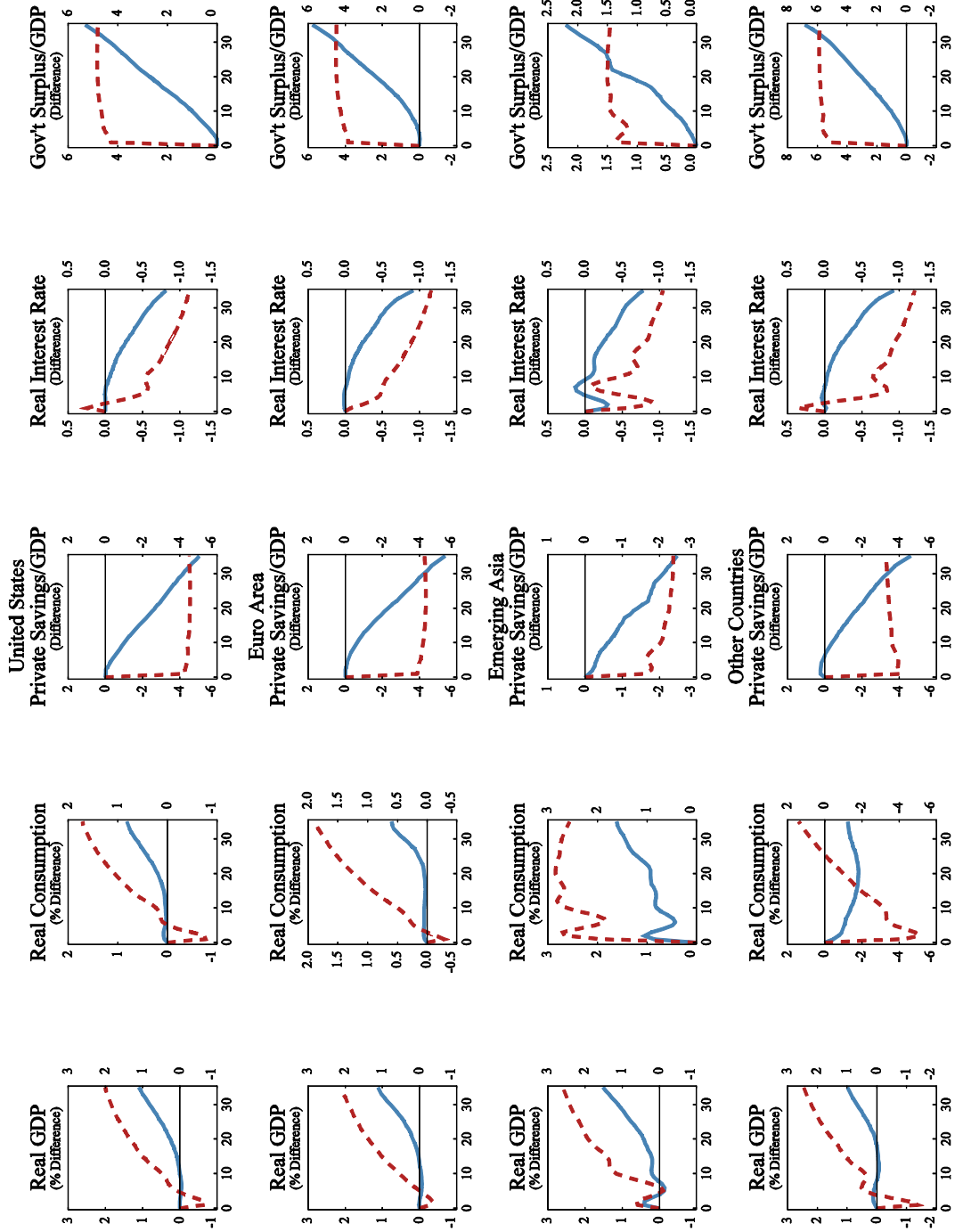


Figure 22. Sensitivity Analysis Around the Benchmark Coordinated Global Reduction in Public Pension Spending—U.S. Reduction Levels Applied Globally

___ Baseline Reform Scenario; - - U.S. Reduction Levels Applied Globally

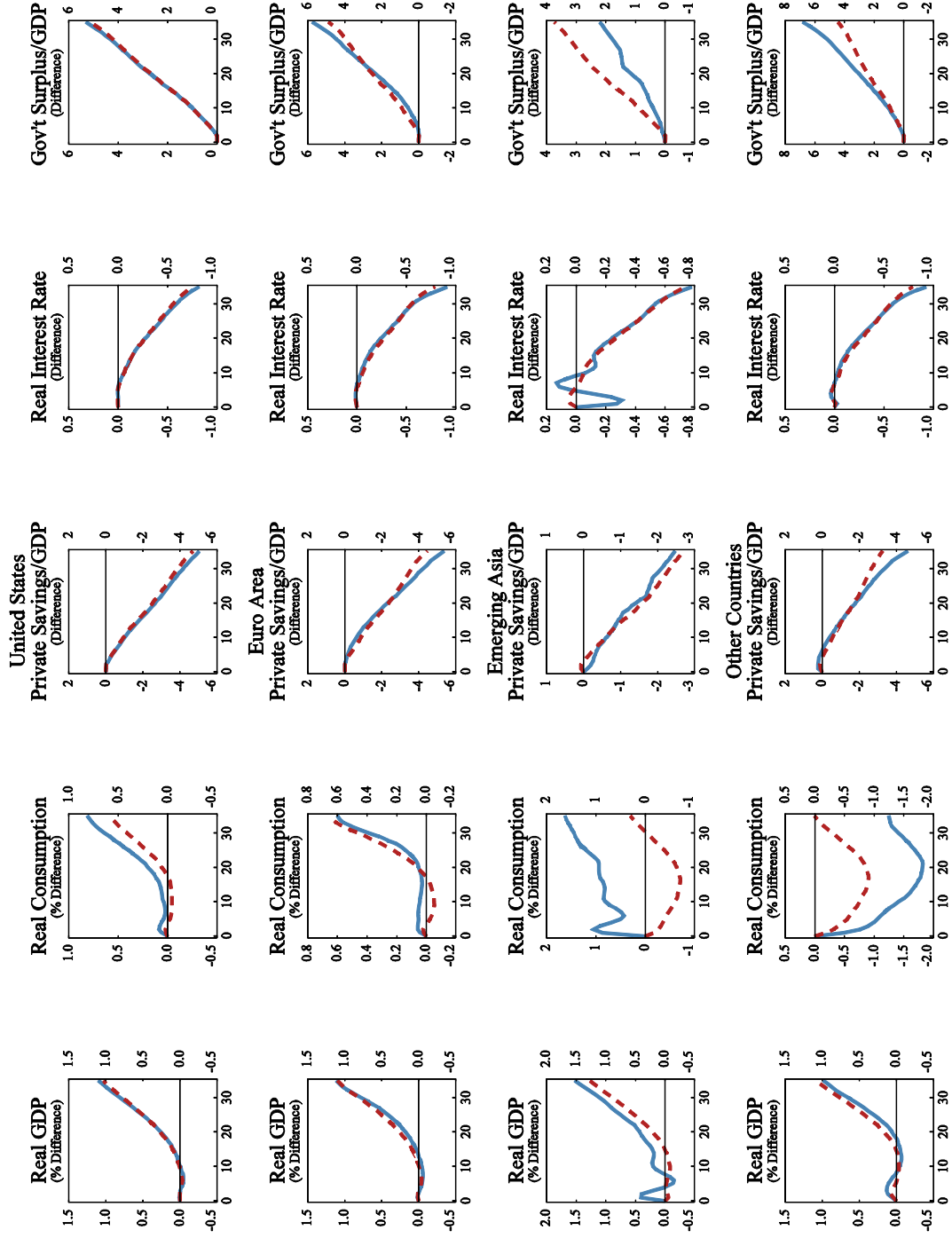


Figure 23. Sensitivity Analysis Around the Benchmark Coordinated Global Reform Scenario—Monetary Policy Accommodation

— Baseline Reform Scenario; - - 1 Year of Monetary Accommodation; ... 2 Years of Monetary Accommodation

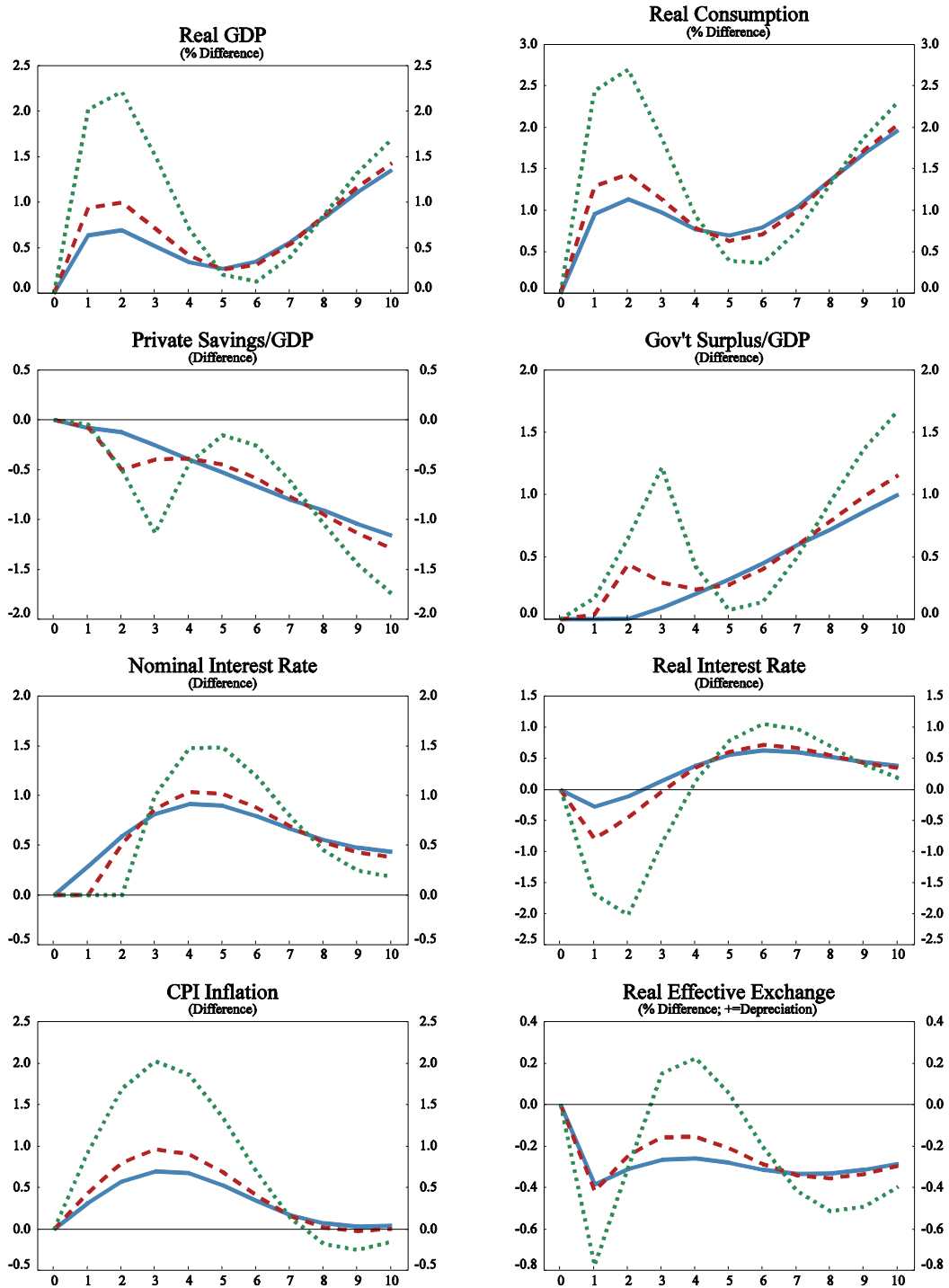
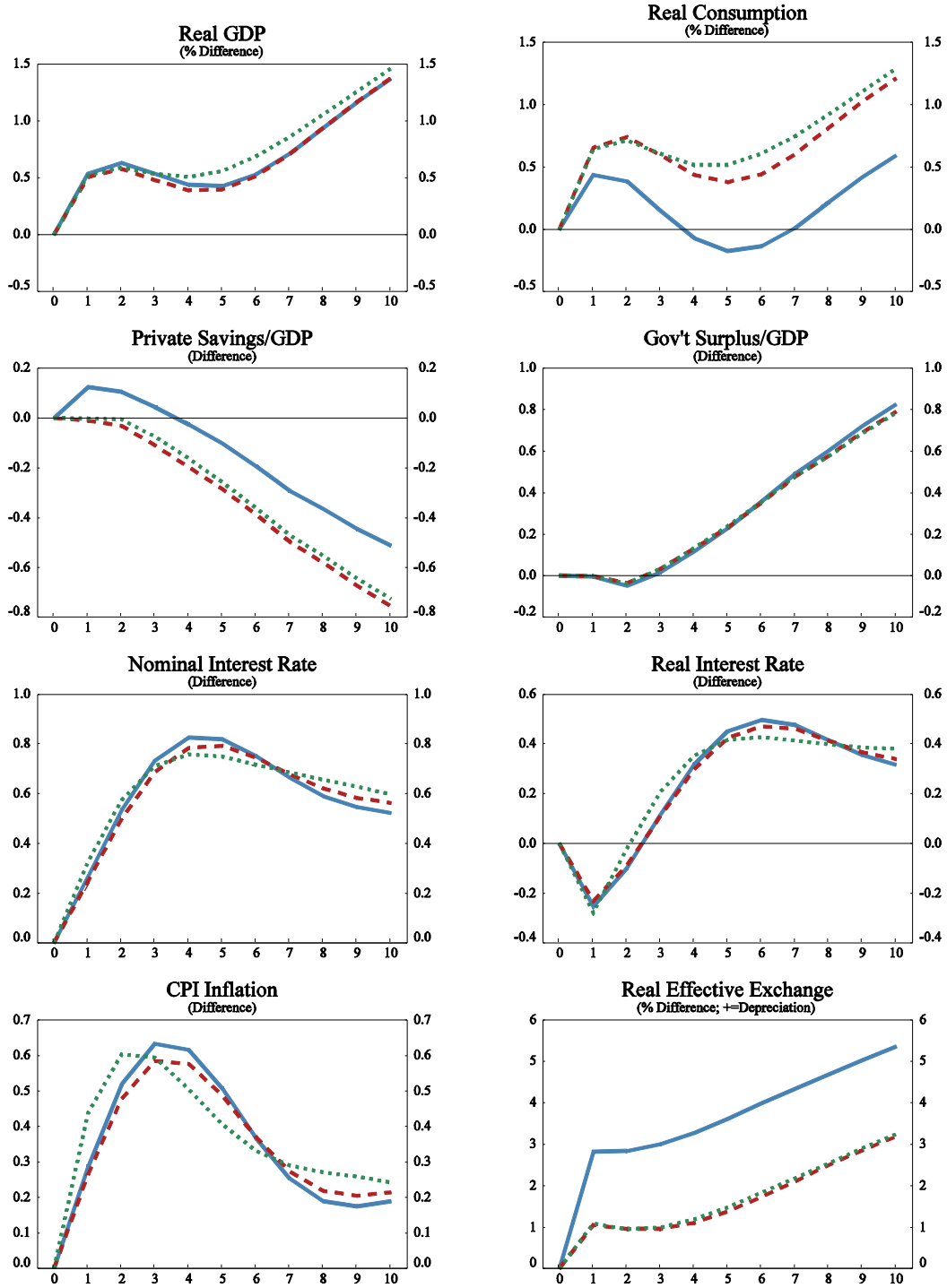


Figure 24. Sensitivity Analysis Around the Benchmark Reduction in Public Pension Spending by the United States Only—Different Inflation Behaviors

— Baseline Reform Scenario; - - Halve the Level of Nominal Price Rigidities; ... Alter the Form of Nominal Price Rigidities



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