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Can Fiscal Budget-Neutral Reforms Stimulate Growth? Model-Based Results

M. Bussière[1], L. Ferrara[2], M. Juillard[3], D. Siena[4]

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ABSTRACT

This paper focuses on growth enhancing budget-neutral fiscal reforms, i.e. changes in the composition of government revenues and spending that stimulate GDP growth while keeping the ratio of the fiscal budget to GDP constant. To this aim, we present simulation results using a multi-country DSGE model with three large economic regions, the US, the euro area and the rest of the world. The model features constrained and unconstrained non-Ricardian households and a detailed government sector; its multi-country nature allows investigating cross-country spillovers. The paper focuses on the most growth-friendly budget-neutral fiscal measures: (i) an incomplete fiscal devaluation (ii) a rise in government investment compensated by a fall in government consumption and (iii) a rise in government investment compensated by a rise in consumption and labor taxes. Dampening or amplifying effects due to coordination across policies (monetary and fiscal) and across economic regions are also considered. Three main results stand out. First, an increase in government investment financed by rising less distortionary taxes appears to be an effective growth-friendly budget-neutral reform in the sense that it generates both short- and long-run GDP growth and improves fiscal sustainability. Second, benefits and costs of budget-neutral reforms are not equally distributed across agents, giving rise to a policy trade-off between growth and distributional consequences. Third, budget-neutral reforms do not have large cross-border trade spillovers; however, reforms coordinated across all countries in periods of accommodative monetary policy do have amplified domestic effects.

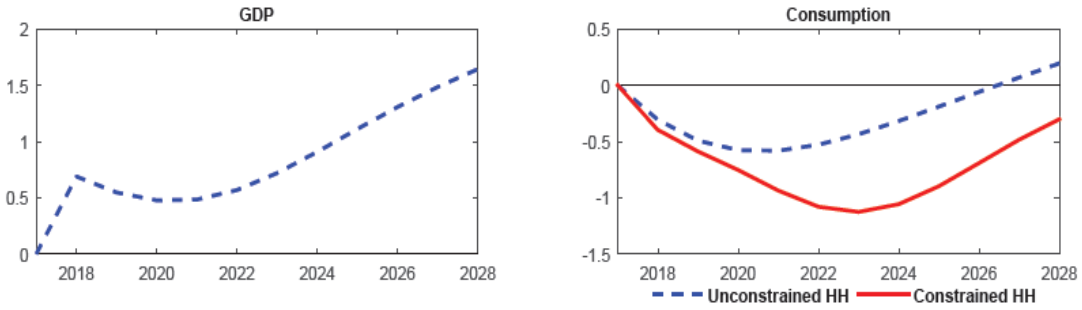
Keywords: Fiscal composition, budget-neutral reforms, taxes, government spending, multi-country DSGE model, international spillovers

JEL classification: E62, E63, F42

[1] Banque de France, matthieu.bussiere@banque-france.fr
[2] Banque de France, laurent.ferrara@banque-france.fr
[3] Banque de France, michel.juillard@banque-france.fr
[4] Banque de France, daniele.siena@banque-france.fr

NON-TECHNICAL SUMMARY[5]

Figure: Output and redistribution effects of a revenue-spending mixed budget-neutral reform



Since the start of the global financial crisis, fiscal policy issues have been at the core of the policy debate and the subject of numerous academic papers. Most of the studies so far have focused on the stance of fiscal policy and the size of fiscal multipliers, following empirical (see, for example, Blanchard and Leigh [2013] and Alesina et al. [2015]) or theoretical approaches (as, among others, Freedman et al. [2010], Christiano et al. [2011] and Coenen et al. [2012]). More recently, however, the debate shifted towards the composition aspect of fiscal policy, for a given fiscal stance (see Furman [2016] for a review on the recent debate on fiscal policies). This evolution partly stems from the fact that, in the aftermath of the crisis, many countries have experienced strongly disappointing growth performance while facing limited fiscal space, which constrained the possibility of moving towards more accommodative fiscal stances to support growth. Against this background, alternative fiscal growth drivers should not be ignored.

The aim of this paper is to evaluate the impact on economic fluctuations of changes in the fiscal composition while keeping the ratio of the fiscal budget to GDP balanced. Particular attention is devoted to the international dimension of these reforms and to the interaction between fiscal and monetary policy decisions. Budget-neutral reforms, i.e. changes in the composition of fiscal revenue and spending that do not modify the total government budget with respect to GDP, have been proposed and discussed in recent policy debates.

Against this background, our objective is to further inform this growing policy debate by presenting results from a multi-country DSGE model on the macroeconomic impact of changes in fiscal composition while keeping the fiscal budget balanced. This is done using a three-country specification of the Global Integrated Monetary and Fiscal model (henceforth GIMF) calibrated at yearly frequency.

Throughout the paper, the analysis concentrates on the most growth-enhancing budget-neutral fiscal reforms selected first by separating fiscal revenues from spending and second by mixing the two budget sides. It is important to notice that our selection criterion will be GDP growth and not a measure of welfare. We claim that this selection criterion will help setting a clear upper bound to guide the policy debate. In line with this reasoning, we will deliberately select compositional

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fiscal changes maximizing GDP growth without relying extensively on the use of non-distortionary fiscal instruments (i.e. lump-sum taxes or transfers), which are barely implementable in reality. Reforms are supposed to be permanent (and fully credible) shocks in a given country to one (or a combination) of the eight fiscal instruments, normalized to 1% of GDP. Changes in one of the fiscal instruments are then compensated by one (or a combination) of the remaining seven instruments to maintain the ex-ante budget unaltered. We assume that these unexpected changes in fiscal composition are made during normal economic times. To our knowledge this is the first paper quantitatively and comprehensively analysing domestic and international effects of budget-neutral fiscal reforms within a multi-country DSGE model.

To keep the analysis tractable, we focus on three specific policy experiments. First, we concentrate on the fiscal revenue side. We run a simulation in which labor and capital taxes are cut, compensated by an increase in consumption tax. This scheme is sometimes referred to as fiscal devaluation in the literature. This strategy is generally considered in a country seeking to regain international competitiveness to boost the external trade channel without being able to devaluate (e.g. countries belonging to a monetary union). However, as explained by Farhi et al. [2014] for a fiscal devaluation to mimic standard nominal exchange rate devaluation, in some environment, it is necessary to do more than just increase value-added tax and reducing payroll taxes. This is also the case in the reform we consider, which on impact will generate a real exchange rate appreciation. To avoid confusions, we will refer to this reform as incomplete fiscal devaluation. Second, we focus separately on the spending side of the fiscal budget. We look at the effects of a fall in government consumption compensated by a rise in public investment. In other words, this experiment would consist in deploying government resources towards the most productive outlets (those that are, for instance, complementary to private investments). Third, based on lessons from the previous simulations, we consider the most growth enhancing mix of revenue and spending reforms. We look at the effects of an increase in government investment of 1 pp of GDP compensated by an increase in both labor and consumption taxes. The real income gain after one year is of 0.7 pp of GDP, though it declines in the following years (the level of GDP is increased by 1.6% after ten years). This reform is the one that presents the largest positive effect on output. On impact, the public debt to GDP ratio is reduced by 1pp and the deficit to GDP ratio is reduced by 0.2pp. However, the benefits are not symmetrically distributed across agents: liquidity-constrained households being the most negatively impacted in terms of consumption.

Finally, to better understand the relevance of those three budget-neutral reforms we investigate (i) the role of the monetary policy for both the domestic and the international responses, by examining the size of fiscal multipliers and the effects of those reforms when monetary policy is constrained and irresponsive for two years, due for example to the Zero Lower Bound (ZLB henceforth), and (ii) international spillovers from one country to the other. The main results suggest, first, that the absence of monetary policy reaction leads to much stronger multipliers, around twice the impacts obtained with monetary policy tightening. Second, we do not get large cross-border spillovers for such budget-neutral reforms. However, reforms coordinated across all countries in periods of accommodative monetary policy do have considerably amplified domestic effects.

RÉSUMÉ : LES RÉFORMES FISCALES BUDGÉTAIREMENT NEUTRES PEUVENT-ELLES STIMULER LA CROISSANCE? QUELQUES RÉSULTATS DE MODÈLES.

Cette étude cherche à évaluer l'impact sur la croissance économique de mesures fiscales neutres du point de vue budgétaire, c'est-à-dire de changements dans la composition des dépenses et des recettes de l'État qui laissent le budget inchangé. À cette fin nous utilisons un modèle DSGE multi-pays avec trois grandes zones géographiques: les États-Unis, la zone euro et le reste du monde. L'intérêt de ce modèle d'équilibre général est qu'il intègre des ménages contraints et non-contraints financièrement, qu'il comporte un secteur public très détaillé et que sa nature multi-pays permet de modéliser les effets transnationaux des politiques publiques. Nous nous penchons plus particulièrement sur trois types de mesures: (1) une dévaluation fiscale incomplète, (2) une hausse de l'investissement public compensée par une baisse de la consommation publique, (3) une hausse de l'investissement public compensée par une hausse des impôts sur le travail et le capital. Nous évaluons également le rôle de la coordination des politiques économiques, au sein de chaque pays (coordination des politiques budgétaires et monétaires) et entre pays. Les résultats principaux de cette étude soulignent d'abord qu'une réforme budgétaire qui finance une hausse de l'investissement public par une hausse de la TVA et des taxes sur le travail représente la combinaison optimale pour stimuler la croissance à court et long termes, tout en améliorant la soutenabilité de long terme. Ensuite, il s'avère que les coûts et les bénéfices de cette réforme ne sont pas distribués uniformément entre les agents économiques, ce qui conduit à des arbitrages entre croissance et redistribution. Enfin, les résultats ne montrent pas de répercussions internationales importantes entre les zones géographiques considérées ; toutefois, des réformes fiscales coordonnées dans tous les pays, en période de politique monétaire accommodante, engendrent des effets domestiques amplifiés.

Mots-clés : Composition budgétaire, Réformes fiscales neutre budgétairement, Modèle DSGE multi-pays, Effets transfrontaliers

1 Introduction

Since the start of the global financial crisis, fiscal policy issues have been at the core of the policy debate and the subject of numerous academic papers. Most of the studies so far have focused on the stance of fiscal policy and the size of fiscal multipliers, following empirical (see, for example, Blanchard and Leigh (2013) and Alesina *et al.* (2015)) or theoretical approaches (as, among others, Freedman *et al.* (2010), Christiano *et al.* (2011) and Coenen *et al.* (2012)). More recently, however, the debate shifted towards the composition aspect of fiscal policy, for a given fiscal stance (see Furman (2016) for a review on the recent debate on fiscal policies). This evolution partly stems from the fact that, in the aftermath of the crisis, many countries have experienced strongly disappointing growth performance while facing limited fiscal space, which constrained the possibility of moving towards more accommodative fiscal stance to support growth. Therefore, alternative fiscal growth drivers should not be ignored.

The aim of this paper is to evaluate the impact on economic fluctuations of changes in the fiscal composition while keeping the ratio of the fiscal budget to GDP unchanged.[1] Particular attention is devoted to the international dimension of these reforms and to the interaction between fiscal and monetary policy decisions. Budget-neutral reforms - i.e. changes in the composition of fiscal revenue and spending that do not modify the total government budget with respect to GDP - have been proposed and discussed in recent policy debates. The IMF and the OECD stated, in a note written under the auspices of the G20, that "for countries that cannot (or do not need to) expand fiscal space, growth prospects can be enhanced through budget-neutral reforms". In 2014 in Cairns, G-20 Finance Ministers, Central Bank Governors and Leaders committed to consider how changes in the composition and quality of government expenditures and revenues may enhance the contribution of our fiscal strategies to growth. This message was repeated in subsequent G20 communiqués and is likely to be discussed again looking forward given that this issue is of critical importance, globally. In fact, in a closely integrated world economy, domestic fiscal policy decisions tend to have international spillovers (Mendoza and Tesar, 1998). Investigating the role played by idiosyncratic vs coordinated fiscal policies across countries is one of the goals of our analysis. The Great Recession also highlighted an additional important element to be considered when studying fiscal reforms within a country: the interaction between fiscal and monetary policy. Therefore, important emphasis will be devoted in our study also to the relationship between the monetary policy stance and budget-neutral reforms.

Against this background, our objective is to further inform this growing policy debate by presenting results from a multi-country DSGE model on the macroeconomic impact of changes in fiscal composition while keeping the fiscal budget unchanged. This is done using a three-country specification of the Global Integrated Monetary and Fiscal model (henceforth GIMF) calibrated at yearly frequency.[2] GIMF lends itself particularly well for this kind of exercise. First, it is a fully-fledged micro-founded general equilibrium model, which is well suited to analyze the effect of policy decisions. Second, it features two types of non-Ricardian households (i.e. liquidity constrained agents, as in Galí *et al.* (2007) and finite planning horizon households, as in Blanchard (1985)), which im-

[1] Henceforth we will refer simply to budget-neutral reforms as changes in the fiscal composition keeping *ex ante* the fiscal budget to GDP ratio constant. However, we show in section 4 that dynamic general equilibrium effects can lead to *ex post* reductions of public deficit and debt.

[2] Laxton *et al.* (2010) provides a complete description of the model while Kumhof and Laxton (2013) highlight the international and fiscal details of the model.

plies non-neutrality of fiscal policy and allows a comparison across reforms of the distribution of benefits and costs among households. Third, within this class of models, it offers a detailed fiscal structure including eight fiscal tools, allowing for multiple experiments using different compositional changes. Finally, GIMF is a multi-country open economy model in which the external sector is very carefully accounted for, which makes it possible to study international spillovers of fiscal policy. The model features three countries/regions: the United States, the euro area and the rest of the world. Simulation results are presented for the first two economic areas.[3]

Throughout the paper, the analysis concentrates on the most growth-enhancing budget-neutral fiscal reforms selected first by separating fiscal revenues from spending and second by mixing the two budget sides. It is important to notice that our selection criterion will be GDP growth and not a measure of welfare. We claim that this selection criterion will help setting a clear quantitative upper bound to guide the policy debate. In line with this reasoning, we will deliberately select compositional fiscal changes maximizing GDP growth without relying extensively on the use of non-distortionary fiscal instruments (i.e. lump-sum taxes or transfers), which are barely implementable in reality. Reforms are assumed to be permanent (and fully credible) shocks in a given country to one (or a combination) of the eight fiscal instruments, normalized to 1% of GDP. Changes in one of the fiscal instruments are then compensated by one (or a combination) of the remaining seven instruments to maintain the *ex-ante* budget unaltered. We assume that these unexpected changes in fiscal composition are made during normal economic times. We will therefore focus on deviations from a steady state calibrated at the average of the business cycle. To our knowledge this is the first paper quantitatively and comprehensively analysing domestic and international effects of budget-neutral fiscal reforms within a multi-country DSGE model.

We first comment the domestic reactions (e.g. of the US economy to a change in US policy) and subsequently the reaction of the foreign economy (e.g. of the euro area economy following a change in US policy). Responses on the economic activity and main macroeconomic variables are considered both at a short and at a longer horizon (after 10 years). The baseline results are computed assuming that monetary policy reacts according to a standard calibrated Taylor rule responding to inflation deviations from the target. The relevance of policy and international coordination is also analysed first by assuming different domestic monetary policy reactions and second by comparing baseline results to ones in which both economic areas and the rest of the world implement contemporaneously the same policy change.

To keep the analysis tractable, we focus on three specific policy experiments.[4] First, we concentrate on the fiscal revenue side. We run a simulation in which labor and capital taxes are cut, compensated by an increase in consumption tax.[5] This scheme is sometimes referred to as *fiscal devaluation* in the literature. This strategy is generally considered in a country seeking to regain international competitiveness to boost the external trade channel without being able to devalue

[3]Detailed results regarding the rest of the world are available upon request. In the paper we assume that euro area countries conduct the same fiscal policy. Obviously, this is not the case in practice: our aim here is to give a sense of the effects of fiscal policy changes in Europe.

[4]The choice of three policy experiments is made for clarity and tractability. However, all other sets of fiscal combinations are available upon request.

[5]In the paper we assume that the US and the euro area can implement a tax on consumption for the entire area. Currently, however, this it is not the case; these results aim at illustrating the magnitude of the effects under consideration for both areas.

(e.g. countries belonging to a monetary union). However, as explained by Farhi *et al.* (2014) for a fiscal devaluation to mimic standard nominal exchange rate devaluation, in some environment, it is necessary to do more than just increase value-added tax and reduce payroll taxes.[6] This is also the case in the reform we consider, which on impact will generate a real exchange rate appreciation. To avoid confusions, we will refer to this reform as *incomplete fiscal devaluation*. Second, we focus separately on the spending side of the fiscal budget. We look at the effects of a fall in government consumption compensated by a rise in public investment. In other words, this experiment would consist in deploying government resources towards the most productive outlets (those that are, for instance, complementary to private investments). Third, based on lessons from the previous simulations, we consider the most growth enhancing mix of revenue and spending reforms. We look at the effects of an increase in government investment of 1 pp of GDP compensated by an increase both in labor and consumption taxes. It turns out that the real income gain after one year is of 0.7 pp of GDP and the level of GDP is increased by 1.6% after ten years. This reform is the one that presents the largest positive effect on output on impact. Thus, on impact, the debt to GDP ratio is reduced by 1 pp and the deficit to GDP ratio is reduced by 0.2 pp. However, benefits are not symmetrically distributed across agents: liquidity-constrained households being the most negatively impacted in terms of consumption.

Finally, to better understand the relevance of the three budget-neutral reforms analysed in the paper, we investigate (i) the role of monetary policy for domestic and international responses[7] and (ii) international spillovers from one country to the other. As main results, we get first that the absence of monetary policy reaction leads to much stronger multipliers, around twice the ones obtained with monetary policy tightening. Second, we do not get large cross-border spillovers for such budget-neutral reforms. However, reforms coordinated across all countries in periods of accommodative monetary policy do have amplified domestic effects.

The rest of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 presents the model and a first set of benchmark fiscal multipliers, for both tax and expenses (general equilibrium budgetary consolidations multipliers). This section mostly serves as pedagogical purpose, which is to introduce the key concepts and benchmarks, before starting to combine fiscal instruments. Section 4 turns to the budget-neutral reforms, reviewing in turn each of the three policy designs. Section 5 looks at the effects on benchmark multipliers and on our set of three budget-neutral reforms when we assume that monetary policy is constrained for two years. Section 6 investigates the international effects of budget-neutral reforms. Section 7 concludes.

2 Review of the literature

There has been a renewed interest in fiscal policies in advanced economies since the onset of the Great Recession. On one hand, in the US, fiscal stimuli were rapidly put in place through the

[6]The reason is that a simple reduction in payroll taxes compensated by value-added taxes can generate a real exchange rate appreciation, which is not present in the standard nominal exchange rate devaluation. Indeed, while the combination of labor and capital tax cuts with an increase in consumption tax successfully depreciates the terms of trade, the overall effect of the consumption tax generates an increase in the overall consumption basket price index, which also explains tighter monetary policy.

[7]We do this by examining the size of fiscal multipliers and the effects of those reforms when monetary policy is constrained and irresponsive for two years, due for example to the Zero Lower Bound (ZLB henceforth).

American Recovery and Reinvestment Act, from 2009 to 2012, amounting to around 4% of GDP, when including automatic stabilizers (see Furman (2016)). On the other hand, in the euro area, fiscal consolidations occurred in some countries between 2011 and 2013, triggering an important debate on the size of fiscal consolidation multipliers. These were shown to be larger than initially expected (see Blanchard and Leigh (2013)), leading thus to stronger than expected negative macroeconomic performances.

The non-linearity of fiscal multipliers and the idea that these might be larger during recessions than expansions has been put forward by different studies (e.g. Auerbach and Gorodnichenko (2012), Corsetti *et al.* (2012) and Michaillat (2014), among others), even though this result is not a unanimous finding (e.g Owyang *et al.* (2013)). Today, in the current environment of low borrowing costs and still negative output gaps in the main advanced economies, a greater role of fiscal policies to support growth appears justified (e.g. Furman (2016)).

Theoretical interactions between fiscal and monetary policies have been widely studied in the literature, especially in new-Keynesian models. A non-comprehensive list includes Eggertsson and Woodford (2003), Eggertsson and Woodford (2004), Christiano *et al.* (2011), Eggertsson (2011) and Farhi and Werning (2012). These papers argue that multipliers are indeed larger when the ZLB on the nominal interest rate is binding (or more broadly when the economy is in liquidity trap). This is the case because expansionary fiscal policies cause a fall in real interest rates due to both the increase in inflation expectations and the constrained nominal interest rates.

The non-linearity of fiscal policy, the larger fiscal multipliers in liquidity traps and the growing perception that monetary policy might have reached its limit (ZLB and unconventional tools) have prompted policy circles to reassess the correct policy mix. International institutions like the IMF and the OECD are now supporting the possibility of a global fiscal stimulus. In the World Economic Outlook (henceforth WEO) report published in October 2014 (International Monetary Fund (2014)), the IMF makes the point that world growth is weak, interest rates are close to zero and the need of infrastructures is high. Based on those stylized facts, they show that pushing up investment in infrastructures leads to higher growth for both short and medium terms horizons without increasing the debt to GDP ratio. More recently, Gaspar *et al.* (2016) explain the new IMFs 3C approach for economic policies (Comprehensive, Consistent and Coordinated) to boost the current global GDP growth and avoid a low-growth trap: at the current juncture a mix of fiscal and monetary policies associated with structural reforms, implemented simultaneously by all G20 countries, would be a good way to generate economic growth at the global level.[8] In line with this approach, the WEO 2016 (IMF, 2016) shows that a coordinated fiscal stimulus relying on infrastructure investment, active policy on the job market, R&D expenses and targeted transfers to some households would be able to avoid a potential secular stagnation scenario. This is supported by the papers by Eggertsson *et al.* (2016a) and Eggertsson *et al.* (2016b) showing that in a world with a low natural rate of interest and large capital integration, expansionary fiscal policy, and not monetary policy, carries positive spillovers implying gains from coordination.

An issue often discussed by policy makers is that all the countries do not necessarily have a

[8] As in this paper, results are derived using the Global Integrated Monetary and Fiscal model. The fiscal stimulus package suggested by the IMF proposes to raise government investment, government consumption and targeted transfers by 1% of GDP in each region for two years and by 0.5% of GDP in the third year. Differently from budget-neutral reforms, as we will see later, this coordinated fiscal expansion has important international spillovers.

sufficient fiscal space to undertake a fiscal stimulus at the current juncture of high public debt. Defining fiscal space can be complicated. On the one hand it can be seen as the room for undertaking discretionary fiscal policy without undermining fiscal sustainability, which is however difficult to measure. On the other hand it can be defined as the debt level at which a sovereign borrower loses market access (as for Ghosh *et al.* (2013) or Fournier and Fall (2015)), which is a limit that may seem to far off for policy makers. Complicating the figures, other variables can affect measurements of the fiscal space, such as the ability of a government to collect taxes (Pappadà and Zylberberg, 2015).

The difficulties to measure fiscal space and the uncertainty on the true ability of given countries to implement fiscal stimulus, moved the attention towards the composition of fiscal policies, in particular on the difference between taxes and expenses. Alesina *et al.* (2015) show that adjustments based upon spending cuts are much less costly in terms of output losses than tax-based ones. They find that spending-based consolidations have been associated with mild and short-lived recessions, in many cases with no recession at all. Alesina and Ardagna (2013) even point out that certain combinations of policies have made it possible for spending-based fiscal adjustments to be associated with additional growth. The possibility that fiscal instruments may have different multipliers has been studied, among others, by Alesina and Ardagna (2010) and Mertens and Ravn (2013). The punchline of these studies is that a fiscal boost based upon tax cuts is more likely to increase growth than one based upon spending increases and also that tax composition matters. The OECD has also carried out recent research on the optimal fiscal composition for countries with low fiscal room of maneuver. Cournède *et al.* (2013) empirically show that during fiscal consolidations it is preferable to reduce excess debt to preserve education expenses, child-care and family or social security contributions instead of subsidies, pensions or property taxes.

In line with the idea that fiscal space might be limited for countries in recession with potentially high government debt, our paper will also be focusing on the composition of spending but with a different angle: changes in fiscal composition that keep the government budget to GDP ratio *ex-ante* unaltered. A similar approach is followed by Attinasi *et al.* (2016) who however focus only on the macroeconomic impact of reforms reducing labor taxation under alternative government financing instruments. We pursue a more comprehensive analysis of budget-neutral reforms mixing all available government instruments with particular attention on the distributional consequences of these policies.

International spillovers are also considered in our analysis of budget-neutral reforms. Mendoza and Tesar (1998) and Mendoza *et al.* (2014) show that indeed spillovers from unilateral reductions in factor income taxes in one country can be large. This is true for strongly integrated open economies, like members of a monetary union, where full consumption risk-sharing can be assumed.[9] Spillovers, in perfectly integrated international financial markets, take the form of large net foreign asset movements and strongly elastic capital tax base (Mendoza *et al.* (2014)). However, Clancy *et al.* (2016) show that spillovers in open economy DSGE models with incomplete international financial markets are small unless a direct import content in government spending is included. In our framework we will focus on spillovers from unilaterally and coordinated budget-neutral reforms, assuming that

[9]The presence of complete international financial market in fact implies equalized expected marginal utility of consumption across countries, as in Mendoza and Tesar (1998) and Mendoza *et al.* (2014).

countries are only partially integrated on the international financial market and that there is only indirect import content in government consumption and investment.

3 Model-based benchmark multipliers for non-compensated fiscal consolidations

3.1 A brief presentation of the GIMF model

The Global Integrated Monetary and Fiscal model (GIMF) is an open economy, multi-region, multiple-good, forward-looking and fully micro-founded DSGE model (Laxton *et al.* (2010)). The economies considered are characterized by sticky prices and wages, real adjustment costs and non-Ricardian households. These calibrated features, among others, entitle monetary and fiscal policies to play an important role for economic stabilization. The model explicitly accounts for all the bilateral trade flows and tracks relative price dynamics for each region, as for example bilateral and effective exchange rates. The model is calibrated at a yearly frequency for 3 regions of the world: United States, Euro Area and Rest of the World.

GIMF lends itself particularly well for fiscal policy analysis as it has an accurately modelled fiscal sector and two types of non-Ricardian households in the economy, which allows us to study both the effects of budget-neutral policies and its distributional consequences. The economy is in fact populated by two types of agents: first, unconstrained overlapping generation households, which can work, consume and save but take decisions with finite planning horizon (see Blanchard (1985)); second, liquidity constrained households, who are forced to consume entirely their current income. Notice that both unconstrained and constrained households will therefore not be indifferent to fiscal policy changes. For constrained households, the logic is straightforward. As in Galí *et al.* (2007) liquidity constrained households will not be able to smooth their consumption path in face of fluctuations in labor income. Therefore, any fiscal intervention changing labor demand or supply would directly affect liquidity constrained households. For unconstrained agents, the limited planning horizon, therefore the overlapping generation structure, guarantees that, even if able to smooth consumption, households will discount future at a higher rate than the market (see Blanchard (1985)). Therefore, this structure is extremely well suited to study not only the effects of fiscal policy but also its distributional consequences.

In details, the model features eight different types of fiscal instruments: (1) government consumption, (2) government investment, (3) general transfers, (4) targeted transfers, (5) labor tax rates, (6) consumption tax rates (7) corporate tax rates and (8) lump sum taxes. This allows for a rich analysis of the compositional effects of each one of these instruments, which is the aim of this paper.

The non-linear solution of the model allows testing the different reactions of the economy in the presence of a constrained or unconstrained monetary policy. This will be important to compare our results to the literature looking at fiscal multipliers in a liquidity trap and, importantly, to understand if the size of international spillovers are somehow dependent on monetary policy reactions.

We refer to Laxton *et al.* (2010) and Kumhof and Laxton (2013) for a detailed description of the model. The detailed calibration of the model and the trade matrix are available upon request.

3.2 Benchmark consolidation multipliers for the US and the euro area

In this section, for comparison purposes, we present benchmark model multipliers obtained by imposing a fiscal budgetary consolidation of 1% of GDP. Consolidation is undertaken by using all available instruments individually, both on revenue and spending sides, one at the time (i.e. not compensated by a change in any of the other seven instruments). Shocks are assumed to be credible, unexpected and first permanent and then temporary (two years). Monetary policy is assumed to be able to react to the shocks (unconstrained by the ZLB), meaning that the monetary policy stance becomes more accommodative, as all eight instruments generate a drop in inflation.[10] In section 5 we will present the same results assuming that monetary policy is constrained at the ZLB. Table 1 summarizes the main results for the US, while Table A1 in the appendix shows results for the euro area. The left-hand panel considers a permanent shock to each of the eight instruments and reports the effect on GDP in the short-run (after one and two years) and in the long-run (after ten years). It also reports the change in the ratio of government debt to GDP after two years. The right-hand panel presents the results of a temporary fiscal consolidation while keeping the same structure just described.

Table 1: Fiscal multipliers for permanent and temporary consolidation in the US

	United States							
	Permanent				**Temporary (2 years)**			
	Real GDP			Gov. Debt/GDP	Real GDP			Gov. Debt/GDP
	First year	Second year	After 10y	After 2y	First year	Second year	After 10y	After 2y
Gov. consumption	-0.717	-0.490	-0.316	-2.112	-0.913	-0.801	0.005	-1.478
Gov. investment	-1.001	-0.922	-2.232	-1.205	-1.071	-1.082	-0.299	-1.197
General transfers	-0.108	-0.044	0.167	-2.625	-0.134	-0.115	0.019	-1.748
Targeted transfers	-0.334	-0.338	-0.231	-2.319	-0.511	-0.46	0.009	-1.449
Labor tax	-0.373	-0.504	-0.602	-2.214	-0.211	-0.246	0.027	-1.745
Consumption tax	-0.266	-0.302	-0.241	-2.359	-0.34	-0.336	0.014	-1.564
Capital tax	-0.765	-0.949	-1.667	-1.047	-0.296	-0.285	-0.031	-1.481
Lump sum tax	-0.108	-0.044	0.167	-2.625	-0.134	-0.115	0.019	-1.748

The main takeaways of this analysis are as follows. First, the effect of a fiscal consolidation on GDP crucially depends on the choice of the instrument. Looking first at how the US economy is responding to various shocks, we get that, starting with government spending, a consolidation that is taking place through a permanent reduction in public consumption has a sizeable negative effect in the short-run that dies out progressively. Indeed, after a drop of 0.72% the first year vs the baseline, it falls to 0.49% the second year and stays at low level in the long-run (drop of 0.32%). By contrast, when the consolidation takes place through a permanent reduction in public investment the effect

[10]The only exception is the temporary decrease in labor taxation which will not generate a fall in inflation. This is due to the negative temporary shift in labor supply, which pushes up wages. See section 5 for more details.

is very long lasting and tends to increase over time reaching -2.23% in the long-run with respect to -1% in the short-run. The main reason is that public investments are important complements of private investments (e.g. roads, bridges, research, or infrastructures in general) and boost aggregate productivity (see Kumhof and Laxton (2013)). Focusing on transfers (e.g. unemployment benefits), we see that transfers targeted to liquidity constrained agents (i.e. transfers to the hand-to-mouth consumers) have a larger effect than general transfers (to all agents).

Turning now to the revenue side, the results indicate that a permanent increase in all types of taxes would have a significant negative effect on GDP. On the one hand, an increase on capital taxes clearly leads to the largest fall, reaching -0.95% the second year and -1.67% in the long run. On the other hand, in line with the literature (see for example Nguyen *et al.* (2017)), a permanent increase in consumption taxation would have a more moderate effect reaching only -0.24% in the long-run.

It is noteworthy that our simulations suggest that tax consolidations are not always more costly, in terms of GDP, than spending-based consolidations (see Alesina and Ardagna (2013) and Alesina *et al.* (2015)). In the short/medium run this seems to be the case only for capital taxation. In fact, comparing consolidations resulting from increases in labor and consumption taxes with respect to decreases in government consumption, we see that the latter is more recessionary. In addition, cutting government investment is generally more recessionary than an increase in taxation, both in the short and in the long run.[11]

In all those simulations, it turns out that government debt after two years is reduced, successfully consolidating the budget balance to GDP ratio. However, as expected, the effect on the debt/GDP ratio tends to be weaker for the instruments that have the largest negative impact on GDP, namely government investment and capital taxation. This is true because of two forces. On one side, the mechanical fall in GDP decreases the denominator; on the other side, a larger fall in GDP triggers a fall in tax revenues and an increase of automatic stabilizers which dampens the budget consolidation.

Temporary changes (the right-hand panel of Table 1), by contrast, have a short-lived effect on GDP, which practically reverts back to the steady-state after 10 years, except notably in the case of a temporary fall in government investment, which still lowers the level of GDP by 0.3% in the long run. Even in the presence of non-Ricardian agents, and differently from permanent shocks, now government expenses both have a clear larger multiplier after two years than taxes. All the instruments lead to a reduction in the ratio of public debt to GDP, but the consolidating power of government spending is lower than taxes, due to their stronger negative effect on GDP.

Multipliers for the Euro Area as a whole, both for temporary and permanent shocks, are similar to the one computed for the U.S. (see Table A1 in the appendix). This is a natural result of our calibration which does not show large differences in structural parameters as elasticities and markups. Concerning public investment, for example, we assume that the output elasticity to the public capital stock is the same across the two economies and it is equal to 0.04. The few differences are anyway explained by three factors: (i) a higher share of liquidity constrained agents in the U.S., (ii) more openness of the Euro Area and larger home bias in the U.S. and (iii) differences in average (steady state) ratios of macro variables to GDP. These factors can explain, for example, the difference in long-run multipliers in response to a permanent decrease in public investment (-3.0% in the Euro Area vs -2.2% for the US): the larger effect in the Euro Area is a result of higher openness

[11] in 't Veld (2013) finds similar results for the euro area using the European Commission QUEST model.

and a different steady state level of investment to GDP, resulting from larger fixed costs. Table A1 summarizes all the multipliers for the Euro Area.

4 Model-based results for budget-neutral fiscal reforms

Budget-neutral fiscal reforms are usually defined as changes in the composition of government revenues and expenses which are keeping the fiscal budget unchanged. In policy debates, however, what matters is not the fiscal balance *per se* but its ratio to GDP. We will therefore focus on the ratio and define budget-neutral fiscal reforms those keeping constant the budget balance over GDP. Notice that this is an important and not innocuous assumption. When GDP decreases/increases, our definition of budget-neutral fiscal policy in terms of ratios implies a more contractionary/expansionary fiscal policy that we would have if we were simply looking at levels. However, in order to explicitly disclose the consequences of this assumption, throughout this section, we will compare our results on public finances to a case in which we neutralize the effects of movements in GDP.

The Global Integrated Monetary and Fiscal model features eight fiscal instruments, four on the spending side and four on the revenue side of the fiscal balance sheet. A complete analysis of all possible compositional changes while keeping the budget-neutral is performed, but for expositional purposes we will focus on the three most growth-enhancing reforms.[12] We first look at the two sides of the fiscal budget separately and then we combine both spending and revenue sides. More in details, we first consider a scenario focusing only on the tax side, referred to as incomplete fiscal devaluation. Second, we concentrate on the spending side, assuming that a boost on public investment is compensated by a cut in public consumption. Last, we propose a budget-neutral scenario based on a simultaneous increase in both taxes and expenses.

Particular attention will be given to the distribution of the benefits and costs, across different agents, of these budget-neutral reforms. In fact, by changing the composition of tax and spending, constrained and unconstrained agents are likely to be affected differently. The intuition is straightforward: any reform reducing labor wealth will directly and immediately affect the consumption of liquidity constrained agents while unconstrained agent will be able to use current and expected financial wealth to smooth the consumption dynamics. We will see that indeed budget-neutral reforms do have important distributional consequences.

Note that throughout this section all fiscal reforms are supposed to be credible, unexpected and permanent. These reforms are also assumed to be implemented only in the US and during periods of unconstrained monetary policy. Then, Section 5 will show how results might change when monetary policy is unresponsive for two years, i.e. accommodative, as our reforms are increasing GDP. Section 6 investigates the spillovers from both unilateral and coordinated fiscal reforms across countries.

[12] Results from other budget-neutral reforms are available upon request. A clarification is also necessary regarding the selection of the three reforms selected in the paper. We decided to concentrate on the most growth-enhancing reforms which did not rely significantly on lump-sum taxes and general transfers. While the fiscal literature teaches us that those can be the least distortionary source of government revenues (as we also saw in section 3), we also know that these have limited realistic counterparts and are often politically difficult to implement.

4.1 Budget-neutrality on the revenue side: incomplete fiscal devaluation

Fiscal devaluation is a policy tool aiming at boosting countries competitiveness through changes in their tax system. Typically cuts in labor and capital taxes are compensated by a rise in consumption tax (see de Mooij and Keen (2012), Farhi *et al.* (2014) and Gomes *et al.* (2016) for a theoretical analysis). While the rise in consumption tax increases prices for all domestic and imported goods, the reduction in labor and capital taxes dampens only domestic production costs. This increases the competitiveness of domestic firms, with respect to foreign ones, both on domestic and export markets. Fiscal devaluations are therefore often discussed for countries that cannot use the standard nominal exchange devaluation, e.g. because they belong to a monetary union. The main advantage of this policy tool is that it does not put pressure on the public deficit as it is budget-neutral while at the same time it is designed to support economic growth.

Table 2: Change in revenues and tax rates from the incomplete fiscal devaluation in the U.S.

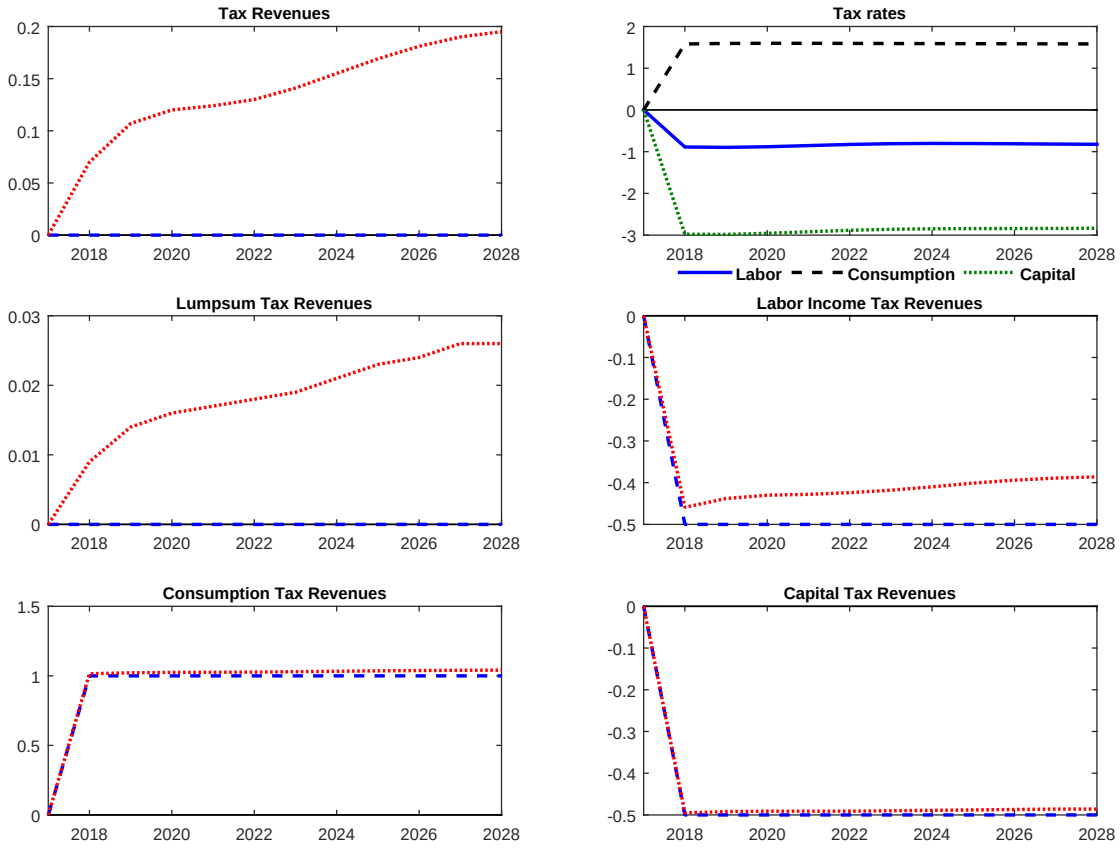
Revenues/GDP	Permanent	**Tax Rates (% points)**	First year
Labor tax	- 0.5%	Labor tax	-0.888
Corporate tax	- 0.5%	Corporate tax	-2.978
Consumption tax	1%	Consumption tax	1.581
Total Tax Revenue =	0%		

In practice however there is no strong empirical evidence that this strategy can prove fruitful, especially in a regime of flexible exchange rates, as it relies on many conditions, including for example the willingness of exporters to pass-through the devaluation to export prices. In addition, it is extremely important to define clearly what compositional change lies under the name of fiscal devaluation. In fact, as shown by Farhi *et al.* (2014), the ability to replicate the effects of a nominal exchange rate devaluation using fiscal composition depends crucially on the structure of the economy (e.g. asset markets completeness or net foreign asset positions), on the timing of the reform (anticipated or unanticipated) and on the fiscal instruments available. The main intuition is that a simple increase in consumption tax compensated by a reduction in payroll taxes may generate an overall rise in the price of the home consumption bundle, resulting in a real exchange rate appreciation which is not present in a standard nominal devaluation.

In our analysis, we label incomplete fiscal devaluation a permanent decrease in labor and corporate taxes of respectively 0.50 p.p. of revenues with respect to GDP, compensated by a permanent increase in consumption taxes for an amount equivalent to 1% of revenues to GDP. Lump-sum tax rates are also allowed to vary just to make sure, if necessary, that lump-sum revenues to GDP, and consequently total revenues to GDP, stay constant over time.[13] The logic of the reform is therefore to keep total tax revenues to GDP ratio constant while changing permanently their composition. Figure 1 shows the evolution of tax revenues and tax rates over time while Table 2 quantifies the impact of a change in tax rates.

[13]This assumption is not relevant for our macroeconomic results but it is done for a more transparent interpretation of fiscal variable dynamics. Results of incomplete fiscal devaluation without lump-sum rates adjustments are available upon request.

Figure 1: **Percentage change in revenues and tax rates in response to the incomplete fiscal devaluation**



Blue dashed lines represent the ratio of the variable of interest with respect to GDP. The Red dotted lines are indicating the evolution of the variable of interest relative to constant GDP. The top right panel represents (1) labor tax rate: solid/blue, (2) consumption tax rate: dashed/black , (3) capital tax rate: dotted/green. Initial shock equivalent to 1% of GDP. Percentage deviations from the steady state.

The macro impact of this incomplete fiscal devaluation is first analyzed decomposing real GDP in its real aggregate expenditure components (Table 3). The reform is expansionary both on impact and after ten years, increasing real GDP level by respectively 0.27% and 0.87%.

Two forces, pushing in opposite directions, are responsible for real GDP movements (Figure 2). On the one hand, the upward pressure on GDP is coming from the long lasting increase in capital, due to the permanently higher investment and to the rise in the amount of labor, due to both higher labor supply and labor demand. On the other hand the fall in consumption, due to the increasing post-tax prices of retail goods, dampens, especially in the short-run, the positive effects of the decrease in payroll taxes. Overall, aggregate demand jumps higher than aggregate supply, explaining a negative net foreign asset position and an increase in inflation. To this movement, the

Table 3: US Real effects of an incomplete fiscal devaluation

Real Effects	First year	Second year	After 10y
Real Income	0.267	0.398	0.874
Consumption	-0.071	-0.080	0.420
OLG agent	-0.092	-0.116	0.366
Liquidity-constraint agent	0.030	0.092	0.682
Investment	2.613	3.801	3.030
Government Spending	0.000	0.000	0.000
Exports	-0.193	-0.265	0.868
Imports	0.355	0.572	-0.017
Nominal Effects			
Real effective exchange rate (positive = depreciation)	-0.148	-0.126	0.443
Consumer Price Inflation %	0.050	0.090	-0.004
Nominal Policy rate %point	0.116	0.189	0.007

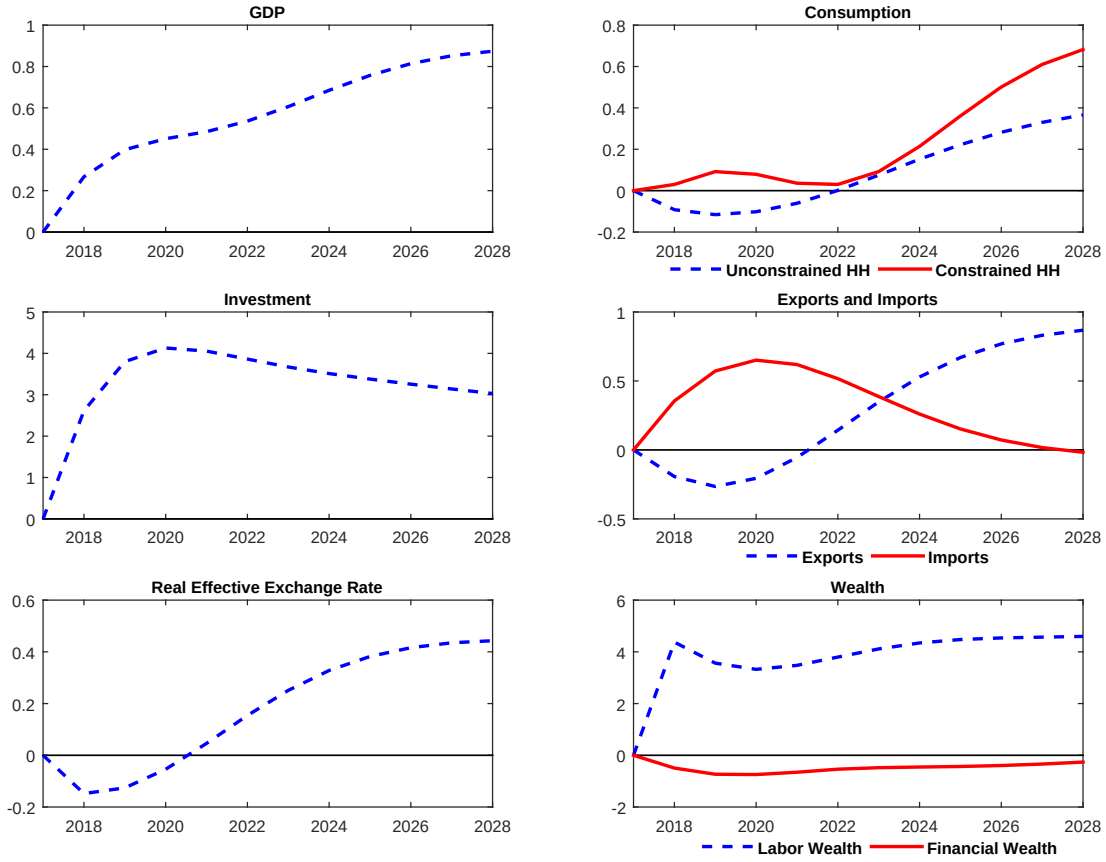
monetary authority responds by rising the nominal interest rates, dampening on impact the positive effects of the reform. Explained by the increase in interest rates and by the inflow of capital due to the large demand for investment, the real exchange rate appreciates in the short-run (see Farhi *et al.* (2014)).

In a second phase (after 3 years), the real exchange rate starts to depreciate, net exports revert to positive and the domestic economy keeps growing thanks to the increase in supply (Figure 2). Therefore, it is noteworthy that the objective of the incomplete fiscal devaluation (increasing export competitiveness) is achieved only after few years, because the sluggishness in the economy makes aggregate demand respond faster than aggregate supply.

It is noticeable (Table 3) that, both in the short- and long-run, liquidity constrained agents are the ones benefitting more from this reform. In fact their consumption increases on impact, as a result of the increase in labor income, and changes twice more than unconstrained agents after ten years. This can be seen also by comparing financial wealth to labor wealth in the bottom-right panel of Figure 2.

As regards public finances, in particular the deficit and debt evolutions, we get that insuring zero movements in tax revenues does not mean constant deficit/GDP and debt/GDP ratios (Figure 3). Indeed, the debt/GDP ratio decreases over the years, reaching the plateau of -0.85 pp after eight years and then reverts back to the steady state. On the contrary, deficit tends first to decrease rapidly, but marginally, and then rebounds back to zero after a period of overshooting. These evolutions can be explained by focusing on both the denominator and the numerator. First, as the incomplete fiscal devaluation proved to be expansionary, the increasing GDP pushes deficit/GDP and debt/GDP ratios down. The role of GDP growth can be seen in the differences between the blue dashed lines (ratios to GDP) and the red dotted lines (ratios to constant steady state GDP) in Figure 3. Second, higher growth implies an increase in inflation and a decrease in government automatic stabilizers (i.e. a reduction in the cyclical component of government consumption) resulting in a decreased government deficit. Finally, the higher interest rates is responsible for the increasing and overshooting behavior of the deficit from the second period onwards.

Figure 2: **Real macroeconomic impact of the incomplete fiscal devaluation (%)**



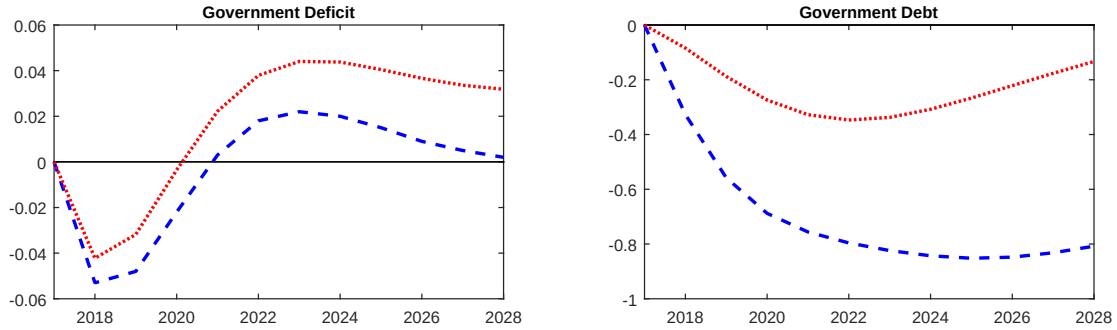
Note: Initial shock equivalent to 1% of GDP. Real variables in percentage deviation from the steady state. An increase in REER reflects a depreciation

To summarize, these results show three interesting salient facts: first, a well-designed composition of a budget-neutral reform from the revenue side can at the same time generate growth and decrease the debt persistently; second, a reform thought for stimulating domestic competitiveness through fiscal devaluation, can, in the short run, be the cause of real exchange rate appreciation and enlarging negative net foreign asset positions; third, an incomplete fiscal devaluation benefits more liquidity constrained agents, favoring labor wealth despite financial wealth.

4.2 Budget-neutrality on the spending side

In today's macroeconomic discussion among policy-makers, there is an important debate about the use of public investment to exit the current *low growth-low inflation* regime. Therefore, while in the previous section we focused only on the revenue side of the fiscal budget, we now move to the spending side. The aim is to understand if we can generate economic growth by changing only the composition

Figure 3: **Government deficit/GDP and debt/GDP response to the incomplete fiscal devaluation (%)**



Blue dashed lines represent the ratio of the variable of interest with respect to GDP. The Red dotted lines are indicating the evolution of the variable of interest relative to constant GDP. Initial shock equivalent to 1% of GDP. Percentage deviations from the steady state.

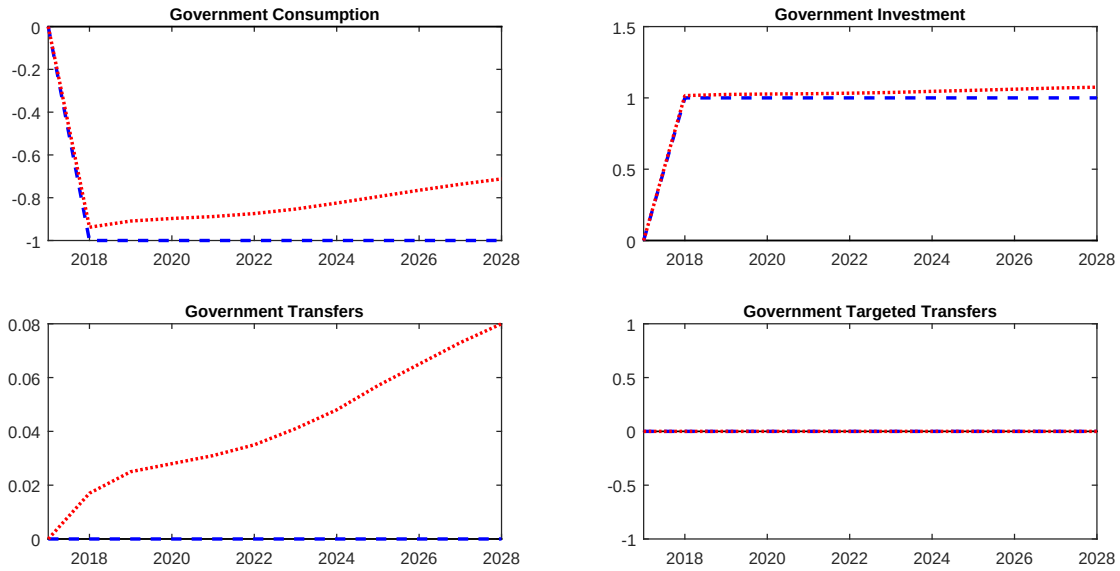
of government spending. There are four types of government expenses included in our model: government investment, government consumption and government general and targeted transfers. We select the change in fiscal combination that guarantees highest growth keeping the budget to GDP ratio constant: an increase in government investment of 1% of GDP that is compensated by a decrease of government consumption of 1% of GDP (Figure 4). As we did for lump-sum taxes in the previous section, we choose here to limit the use of fiscal transfers, although they represent the government spending instrument with the lowest multiplier. We do that to avoid analyzing what in reality would be a non-implementable reform. We therefore constrain the changes of fiscal transfers to those marginal movements necessary to keep the total government spending with respect to GDP constant.

Table 4 presents the short- and long-run effects of the main macroeconomic variables to this reform. A compensated government investment increase generates a persistent boom in output, guaranteeing an increase of GDP in the long-run (level of GDP being 1.9% above its starting point after 10 years), rapidly visible already in the first two years. All the components of the national accounts are positively impacted. Not surprisingly, the largest effect can be observed on overall investment. Indeed, an increase in government investment crowds-in private investment, which in turn increases persistently. This is a feature obtained by modelling government investment as an increase in the public capital stock which raises the productivity in the economy.

Interestingly, as shown in Figure 5, GDP follows a slow but smooth increase, that is well distributed across all agents in the economy. Consumption of both liquidity constrained and unconstrained agents smoothly and almost equally increases.

Looking at the foreign sector, on impact, the reform mimics a domestic rise in aggregate demand. The increase pushes up domestic prices inducing the monetary authority to tighten monetary policy, leading in turn to an appreciating nominal exchange rate which augments the increase in imports and decreases exports. The high aggregate demand for goods and capital, in fact, generates an inflow of capital from abroad explaining the appreciated real exchange rate. After four years, however, the increase in overall investment, and the consequent decrease in marginal costs, generates a

Figure 4: **Spending neutral fiscal reform: increase in gov. investment compensated by a fall in government consumption (%)**



Blue dashed lines represent the ratio of the variable of interest with respect to GDP. The Red dotted lines are indicating the evolution of the variable of interest relative to constant GDP. Initial shock equivalent to 1% of GDP. Percentage deviations from the steady state.

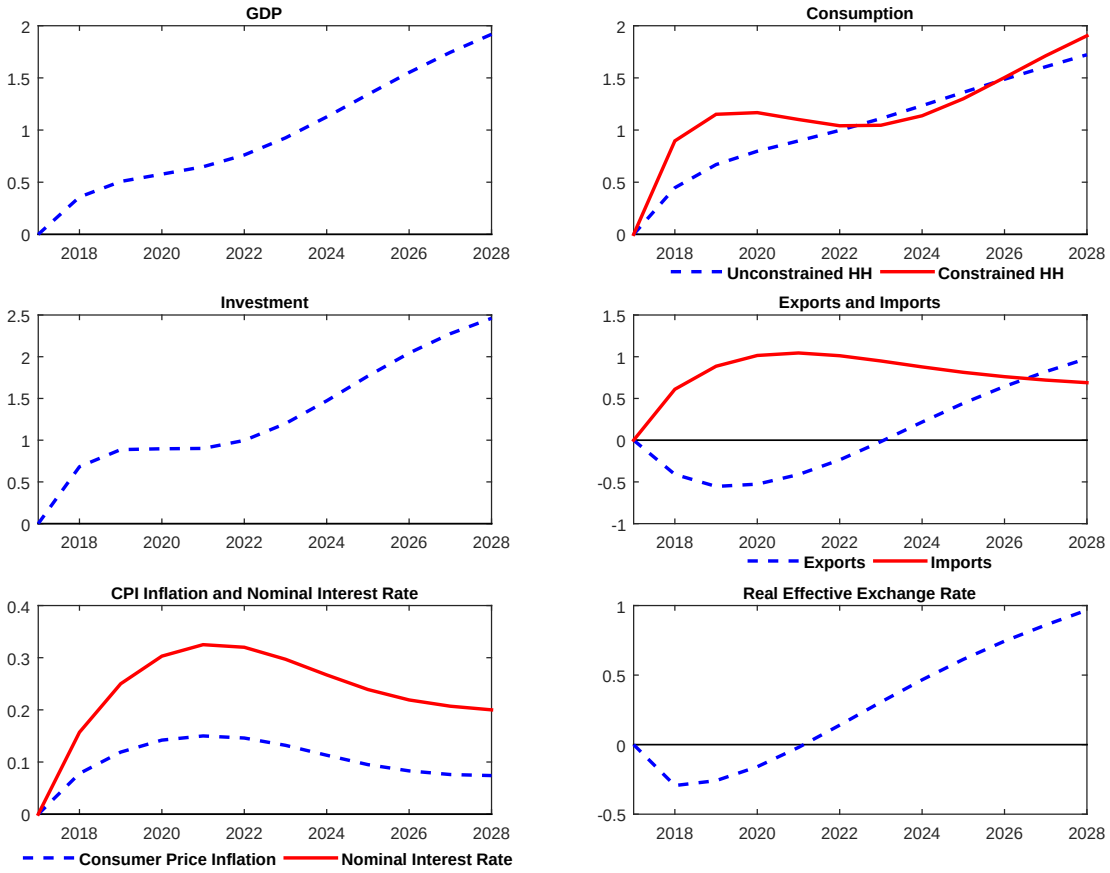
Table 4: US Real effects of a spending-neutral increase in government investment (%)

Real Effects	First year	Second year	After 10y
Real Income	0.358	0.507	1.918
Consumption	0.523	0.751	1.753
OLG agent	0.447	0.669	1.722
Liquidity-constraint agent	0.896	1.151	1.904
Investment	0.682	0.887	2.461
Government Spending	0.383	0.562	1.8
Exports	-0.410	-0.554	0.978
Imports	0.610	0.886	0.689
Nominal Effects			
Real effective exchange rate (positive = depreciation)	-0.294	-0.259	0.967
Consumer Price Inflation %	0.078	0.119	0.074
Nominal Policy rate %point	0.157	0.25	0.2

depreciation of the terms of trade and an increase in net exports. As a result, in the long-run, net export turns positive and acts as a driver of aggregate GDP growth (Figure 5)

Before moving to analyze the public finance stance, it is interesting to notice that the increase in inflation and the subsequent monetary reaction tend to mitigate the expansionary effect of this budget-neutral reform. Section 5 will study how the transmission to the real economy of this reform

Figure 5: **Real effects of a spending neutral fiscal reform (%)**



Note: Initial shock equivalent to 1% of GDP. Real variables in percentage deviation from the steady state. An increase in REER reflects a depreciation

changes when monetary policy is constrained for two years.

As in the incomplete fiscal devaluation, targeting the ratio of one of the two sides of the government budget to GDP does not imply overall zero movements in the deficit/GDP and debt/GDP. In fact, two forces are at play. On the one side, exactly as before, GDP growth, by decreasing automatic stabilizers and interest rate payments, generates fluctuations in the deficit to GDP ratio and consequently in the debt to GDP. On the other side, increases in labor and capital income plus the raise in consumption generate an increase in tax revenues. The result is a short-run surplus of around 0.1% and a long-run consolidation of the debt/GDP ratio of 2%, which is more than twice the one obtained when the fiscal revenue reform is implemented (section 4.1).

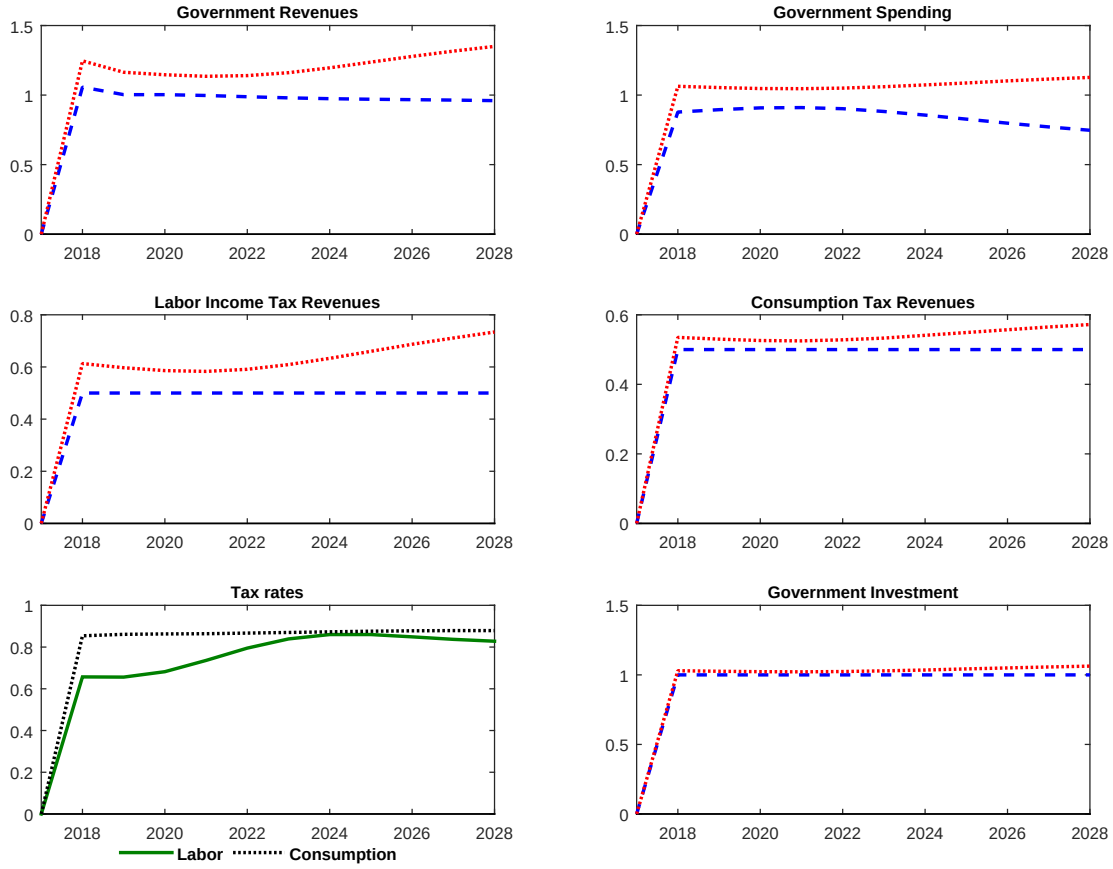
Finally, it should be noted that the overall short- and long-run economic gain achieved through this spending reform is larger than the one obtained in the previous incomplete fiscal devaluation. In fact, it turns out that public investment, as a source of public capital, appears to be a powerful growth-enhancing tool. It is important to highlight however, that this is crucially related to the

particular choice of complementarity between public and private investment. Results could be significantly smaller if, for example, we were to assume that public investments were crowding out private ones.

4.3 Budget-neutral reform mixing revenue and spending sides

We now combine the two lessons learned from the previous analyses and study the effects of the most growth-enhancing budget-neutral reform mixing the revenue and spending side of government's budget.

Figure 6: **Increase in gov. investment compensated by labor and consumption taxes (%)**



Blue dashed lines represent the ratio of the variable of interest with respect to GDP. The Red dotted lines are indicating the evolution of the variable of interest relative to constant GDP. The bottom left panel represents (1) labor tax rate: solid/green, (2) consumption tax rate: dotted/black. Initial shock equivalent to 1% of GDP. Percentage deviations from the steady state.

We implement, as shown in Figure 6, an increase in government investment compensated by an increase in labor and consumption taxes: the fiscal room left by an increase in revenues from labor (0.5% of GDP) and consumption (0.5% of GDP) taxes is used to increase government investment by

1% of GDP.[14] In this mixed *ex-ante* budget-balanced reform we do not target specifically the ratio of one side of the government budget, as we did in section 4.1 and 4.2. Therefore, both government spending and revenue ratios to GDP will be freely adjusting over time in response to our reform, as shown in Figure 6. Table 5 summarizes the initial change in revenues and tax rates necessary to implement such a policy. The dynamic adjustment of tax rates can be seen in the bottom-left panel of Figure 6.

Table 5: Percentage change in revenues and spending from a mixed budget-neutral reform

Revenues/GDP	Permanent	Tax Rates (p.p.)	Spending/GDP	Permanent
Labor tax +	0.50%	0.657	Gov Investment -	1%
Consumption tax +	0.50%	0.854		

Government Deficit/GDP_{t-1} = 0%

Figure 7 and Table 6 present the macroeconomic impact of this mixed revenue/spending reform. In terms of GDP, in the long-run, the budget-neutral reform is slightly less expansionary than the previous spending reform (1.65% vs. 1.92%), while significantly stronger on impact (0.69% vs. 0.36%). Decomposing GDP in its expenditure components, we observe that consumption first decreases in the short-run because of the augmented consumption tax, but then increases by 0.1% in the long-run. At the same time, the jump in government spending (around 5%, both in the short- and long-run) generates a boom in private investment (2.1% after 10 years) through large crowding-in effects. In turn, this boom leads to an increase in labor demand that pushes up wages and inflation, appreciating the real exchange rate. The monetary authority responds to this evolution on prices by tightening the monetary policy stance, which is responsible for the appreciation of the nominal exchange rate on impact and the subsequent increase in government deficit burden. As a result, as seen in previous simulations, this generates an increased, but slowly reverting, trade deficit.

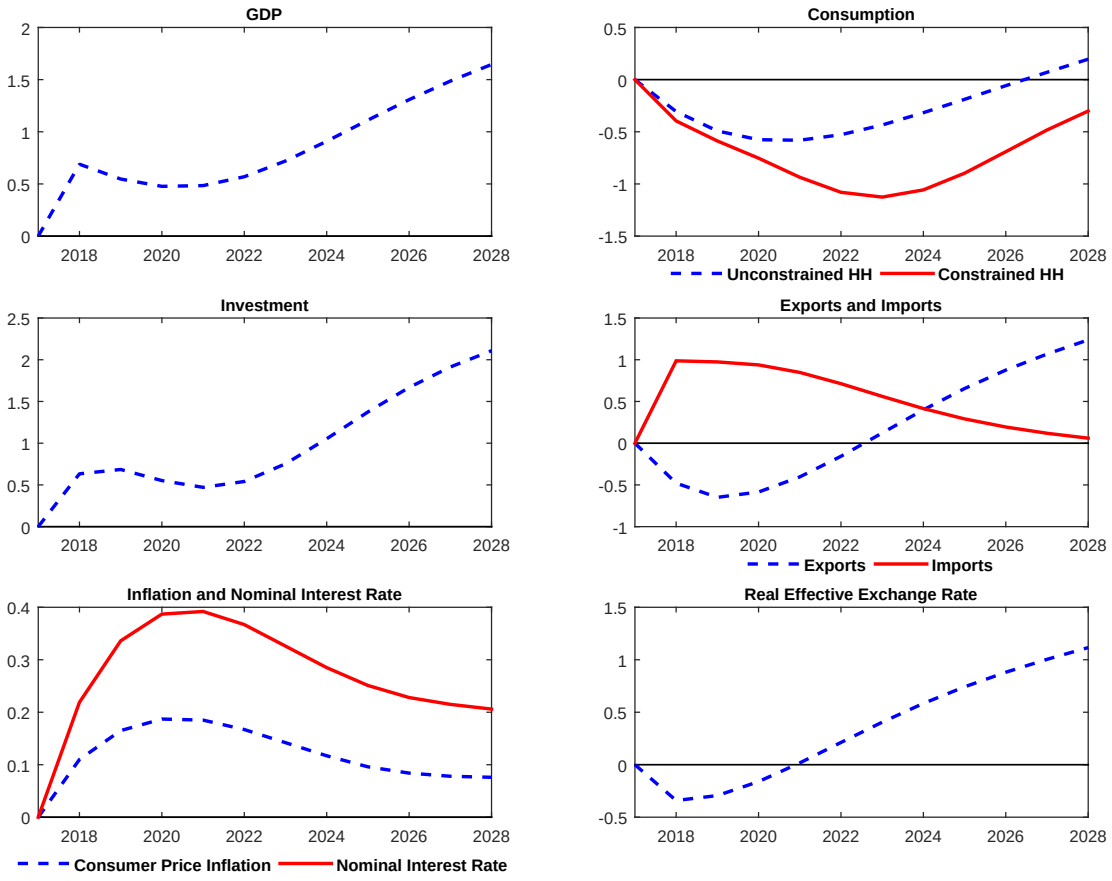
Table 6: US Real effects of a mixed revenues and spending budget-neutral reform (%)

Real Effect	First year	Second year	After 10y
Real Income (GDP_FISH)	0.689	0.547	1.645
Consumption (CONS_FISH)	-0.321	-0.509	0.111
OLG agent	-0.306	-0.492	0.196
Liquidity-constraint agent	-0.396	-0.588	-0.301
Investment (I_FISH)	0.633	0.685	2.108
Government Spending (G_FISH)	5.075	5.053	5.236
Exports (EXPORTS_FISH)	-0.479	-0.649	1.238
Imports (IMPORTS_FISH)	0.987	0.974	0.06
Nominal Effect			
Real effective exchange rate (positive = depreciation)	-0.341	-0.294	1.116
Consumer Price Inflation %	0.11	0.165	0.076
Nominal Policy rate %point	0.219	0.336	0.206

[14]For simplicity in the interpretation of the results we also assume that the transfer to GDP ratio stays constant over time after the reform. This has marginal impact but allows to interpret more simply the dynamics of the fiscal variables. Anyway, results without this assumption in place and all other combinations are available upon request.

Differently from the spending reform, now the financing of government investment using consumption and labor taxation affects the agents in the economy in an heterogeneous way, distributing the benefits of the reform differently across agents. Liquidity constrained households are in fact bearing most of the burden of the mixed budget-neutral reform, directly and indirectly. In fact, on the one side, the increase in labor taxation affects directly their only source of wealth (the return on labor) while, on the other side, the increase in consumption taxes influences their consumption decisions, increasing the cost of consumption goods. This explains the larger and longer fall in consumption for those agents unable to smooth consumption across time and constrained away from enjoying the effects of the increasing present discounted value of financial wealth. The comparison between the spending and the mixed budget-neutral reforms highlights that the financing of the increase in government investment is not irrelevant and strongly affects the distribution of costs and benefits across agents in the economy.

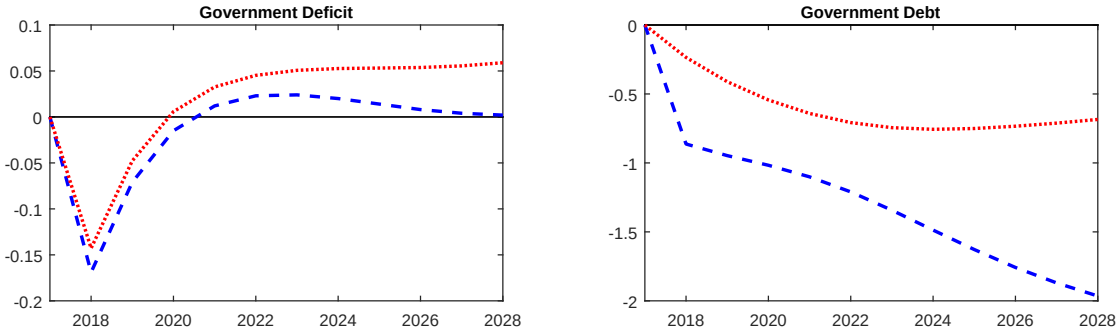
Figure 7: **Real Macroeconomic impact of a revenue-spending mixed budget-neutral reform**



Note: Initial shock equivalent to 1% of GDP. Real variables in percentage deviation from the steady state. An increase in REER reflects a depreciation

Focusing now on fiscal variables, even though the reform is constructed to be *ex-ante* neutral, it turns out that it is actually leading to a consolidation of public finances. In fact it generates a fall in government deficit (at least in short-run) and a persistent debt reduction (see Figure 8). On impact, the debt to GDP ratio is reduced by 1% and the deficit/GDP is reduced by 0.2%. This can be thought as an example of a budget-neutral fiscal consolidation achieved in virtuous way and through economic growth. Indeed, stronger economic growth leads to a decrease in the fiscal debt burden through three channels. On the one hand, it (i) mechanically pushes down the deficit/GDP and (ii) reduces automatic stabilizers, while on the other hand, it (iii) increases fiscal revenues from taxation. The temporary increase in the deficit/GDP ratio from period two onward, as before, is due to the increase in interest payments due to the monetary tightening.

Figure 8: **Gov. deficit and debt response to a revenue-spending mixed budget-neutral reform (%)**



Blue dashed lines represent the ratio of the variable of interest with respect to GDP. The Red dotted lines are indicating the evolution of the variable of interest relative to constant GDP. Initial shock equivalent to 1% of GDP. Percentage deviations from the steady state.

Overall, all three budget-neutral policy reforms considered in this section are expansionary and lead to fiscal consolidation of public finances. Those involving also the spending side of the fiscal budget prove to be more expansionary. In particular, the reform focusing only on fiscal expenditures maximizes the long-run GDP growth while the one mixing revenues and spending ensures a larger short-run GDP increase, only marginally sacrificing the long-run effect. However, timing is not the only trade-off that a policy maker might face when taking a decision on how to finance the increase in spending. By looking more closely at our simulation we learn that if the increase in government investment is financed through a simultaneous rise in taxation, this comes at the cost of making liquidity constrained agents sustaining most of the costs of the reform.

The decision of favoring a slower but more uniformly distributed growth or a faster but more unequal development is a political one which goes behind the scope of this paper. We just point out that each reform has its pros and cons which are worth to be investigated to take informed policy decisions.

5 The role of monetary policy

In this section we investigate the role of monetary policy reactions for the real effects of the analyzed fiscal reforms. In line with the literature investigating fiscal multipliers in periods of constrained monetary policy (e.g. in the presence of the ZLB), we want to evaluate if real effects are amplified or mitigated in the absence of an instantaneous monetary policy reaction. We start by assessing the differential size of the baseline fiscal consolidation multipliers presented in section 3 by constraining monetary policy at the ZLB. Second we implement the three budget-neutral reforms, analyzed in section 4, assuming that monetary policy is not reacting for two years. Contrary to the multiplier analysis, where the constrained monetary policy is restrictive, here it will be accommodative. By not reacting to the increase in real and nominal economic activity, the monetary stance will be expansionary.

5.1 Benchmark fiscal consolidation multipliers at the ZLB

Table 7: Benchmark multipliers at the ZLB for the United States

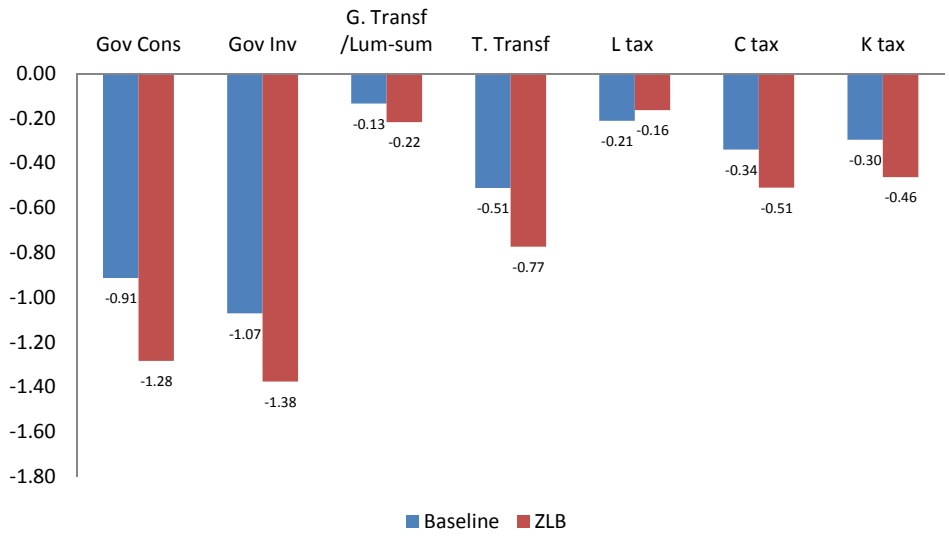
	United States							
	Permanent				**Temporary (2 years)**			
	Real GDP			Gov. Debt/GDP	Real GDP			Gov. Debt/GDP
	First year	Second year	After 10y	After 2y	First year	Second year	After 10y	After 2y
Gov. Consumption	-0.717	-0.49	-0.316	-2.112	-0.913	-0.801	0.005	-1.478
ZLB	-0.98	-0.75	-0.33	-1.77	-1.28	-1.18	-0.01	-0.98
Gov. Investment	-1.001	-0.922	-2.232	-1.205	-1.071	-1.082	-0.299	-1.197
	-1.61	-1.55	-2.27	-0.36	-1.38	-1.39	-0.32	-0.80
General transfers	-0.108	-0.044	0.167	-2.625	-0.134	-0.115	0.019	-1.748
ZLB	-0.19	-0.13	0.16	-2.51	-0.22	-0.20	0.02	-1.63
Targeted transfers	-0.334	-0.338	-0.231	-2.319	-0.511	-0.46	0.009	-1.449
ZLB	-0.45	-0.45	-0.24	-2.16	-0.77	-0.72	-0.01	-1.10
Labor tax	-0.373	-0.504	-0.602	-2.214	-0.211	-0.246	0.027	-1.745
ZLB	-0.44	-0.57	-0.61	-2.122	-0.16	-0.20	0.03	-1.81
Consumption tax	-0.266	-0.302	-0.241	-2.359	-0.34	-0.336	0.014	-1.564
ZLB	-0.36	-0.40	-0.25	-2.23	-0.51	-0.51	0.01	-1.33
Capital tax	-0.765	-0.949	-1.667	-1.047	-0.296	-0.285	-0.031	-1.481
ZLB	-1.51	-1.70	-1.71	-0.03	-0.46	-0.45	-0.04	-1.25
Lump sum tax	-0.108	-0.044	0.167	-2.625	-0.134	-0.115	0.019	-1.748
ZLB	-0.19	-0.13	0.16	-2.51	-0.22	-0.20	0.02	-1.63

We start by assessing the basic multipliers from a fiscal consolidation, as in section 3, but assuming that monetary policy is not reacting, for two years, to the negative consolidations' effects on growth and inflation. Typically this is the case when nominal interest rates are already constrained by the Zero Lower Bound (henceforth ZLB). From the literature investigating fiscal policy in a liquidity trap, we learn that fiscal multipliers are usually higher in absolute terms (see e.g. Eggertsson

(2011), Christiano *et al.* (2011) and Farhi and Werning (2012)). The intuition of why this is the case is straight-forward. Assume that a fiscal consolidation reform, as the one presented in section 3, decreases GDP and inflation. Suppose this reform happens in a period in which nominal interest rates are at zero and cannot go negative. The inability to further decrease nominal interest rates hinders the monetary authority from reacting to the fall in GDP and inflation. The result is a constant nominal interest rate and a fall in inflation. This raises the real interest rate which contracts the demand even further. Additionally, in an open economy, the inability of decreasing nominal rates constrains the possibility to depreciate the nominal exchange rate, hampering a recovery towed by foreign demand (i.e. net exports). Therefore, a fiscal consolidation in a period of binding ZLB is more recessionary than it would be in a situation in which the monetary authority could ease.

As before, and for both the US and the EA, we implement two types of fiscal consolidation shock: a permanent and a temporary one of 2 years. Comparing the baseline multipliers with the case of constrained monetary policy, we see in table 7 that in response to permanent shocks, multipliers are larger in the short run for all fiscal instruments considered. As the constraint in monetary policy lasts only two years and the fiscal shock is permanent, multipliers are similar in the long-run. The most sensitive permanent fiscal consolidation with respect to monetary policy reactions is capital taxation. The multiplier, as shown in table 7, is respectively 0.75 pp higher in the first and second year. Government investment and transfers also sharply increase. In the case of a permanent reduction of government investment the GDP effect goes from -1.0 to -1.6 in the first year and from -0.9 to -1.6 during the second year. Overall, all multipliers tend to increase in the short-run, in line with the standard result in the literature.

Figure 9: **Temporary fiscal consolidation multipliers in the United States after one year: unconstrained vs constrained monetary policy**



When we implement a temporary shock, the enlargement of the multiplier is generally smaller, up to even generating a dampening when the consolidation comes through an increase in labor taxation.

In this particular case, the reason why the monetary constraint ends up reducing the multiplier is quickly explained. The temporary feature of the labor tax shocks reduces, temporarily, the labor supply. This pushes upwards, and not downwards, wages and consequently inflation. As a result, the constraint on monetary policy is equivalent to a monetary easing which depreciates the real exchange rate, boosts net exports and reduces the fall in GDP. In all other temporary consolidation episodes, the monetary constraint enlarges, sometimes only marginally, the multiplier. Figure 5.1 shows graphically the differences across multipliers of a temporary fiscal consolidation.

Looking at the debt/GDP ratio, the larger recessionary effect of the fiscal reforms due to the constrained monetary policy are naturally reflected in smaller consolidation. As shown in Table 7 the debt to GDP ratio falls by significantly less.

We then analyze the role of the constraint on monetary policy in the euro area. Interestingly, we see that results are qualitatively similar but different in magnitude. In fact, the amplification effect of the fiscal multiplier is consistently smaller. Table A2, in the appendix, summarizes all the results for the euro area. The differences are explained by the three main differences listed in section 3 and three additional channels: (i) larger automatic stabilizers in the Euro Area; (ii) larger price stickiness in the Euro Area with the exception of tradable goods; (iii) more aggressive monetary response of the monetary authority in the Euro Area to movements in inflation from the target.

5.2 Budget-neutral reforms with constrained monetary policy

We now try to understand how constraining monetary policy might affect the macroeconomic reaction to the three budget-neutral reforms considered in section 4. In those simulations monetary policy was allowed to react right in the wake of the reform. As those reforms were all expansionary and inflationary, monetary policy responded by increasing the nominal interest rate. This, as we saw in the previous section, often dampened the expansionary effect (and the consolidation power) of the budget-neutral reforms through three main channels. First the increase in the real rate reduces consumption and investment; second the increase in the nominal rate increases interest payments slowing the consolidation power of the reforms; third an increase in the nominal interest rate is responsible for an appreciation of the nominal exchange rate. Nominal appreciation and higher inflation lead to a real exchange rate appreciation, putting some downward pressure on exports. As imports are boosted by the increasing domestic demand, the contribution to growth of net exports turns negative. Overall turning off the monetary reaction in the model is thus likely to generate more growth.

In addition to our permanent reforms we assume that monetary policy is constrained for two years. We then look at the effects on GDP in the first year and then compare it to the baseline result presented in section 4. Results for the US are presented in Table 8. We clearly see that the absence of monetary tightening generates significantly higher GDP growth starting from the first year. Especially, when we carry out the third scenario that funds a rise in public investment by a rise in the less distortive taxes (on consumption and on labour), the effect on GDP is almost doubled. Also in terms of consolidation the three reforms are achieving a larger drop of the debt to GDP ratio, which almost doubles in the case of a spending reform.

Those results point out that a monetary policy guided by a Taylor rule that reacts mechanically to inflation during growth-friendly budget-neutral reform is likely to significantly reduce the impact

Table 8: Effects on US GDP of the three budget-neutral scenario, with and without monetary reaction (in % vis--vis the baseline)

	United States			
	Real GDP - first year			
	With monetary reaction		No monetary reaction	
Permanent Reform	GDP	Debt/GDP	GDP	Debt/GDP
E1: Fiscal Devaluation	0.267	-0.327	0.543	-0.67
E2: Government investment	0.358	-0.46	0.808	-1.02
E3: Mixing spending and taxation	0.689	-0.863	1.185	-1.478

on economic activity and its ability to consolidate the overall public debt to GDP ratio.

6 International spillover effects and collective action

International spillovers are a key point in the discussions among policy-makers in international fora and, as noted in the introduction, international organizations as the IMF and the OECD are currently pushing a lot for putting in place a collective fiscal stimulus in order to benefit from the positive spillovers between countries. In this section we take advantage of the multi-country dimension of our model to assess the potential gains from spillovers and from a collective action in the framework of budget-neutral fiscal reforms. While the positive spillovers of coordinated fiscal stimuli have been studied in recent policy and academic papers, we are unaware of any study looking at spillovers of budget-neutral reforms.

We start by looking at spillovers on euro area GDP when a fiscal consolidation of 1% of GDP is implemented in the US using one of the eight available instruments at a time. Those multipliers can be referred to as benchmark spillover multipliers and are presented in Table 9 below. We simulate both a permanent and a temporary shock of two years and we allow for monetary policy reaction. In both cases, it turns out that international spillovers are quite small, the maximum impact being observed for government investment, in line with the domestic results presented in section 3. In fact, it turns out that the fall in the US domestic demand is not sufficiently large to have a significant effect on euro area exports. Note that the same holds true for spillovers from the euro area to the US, which are also really small.[15] While the trade spillovers are fully modelled, financial spillovers are only accounted for in a mechanical and simplistic way. This might explain the limited size of spillovers and it is a topic for further research.

Let's turn now to the spillovers on euro area GDP of the three budget-neutral experiments described in section 4, namely the incomplete devaluation (E1), the spending reform (E2) and mixed budget compositional reform (E3). Results are presented in Table 10, decomposed according to the national accounts. Again, note that we allow for monetary reaction both in the U.S. (country experiencing the reform) and in the euro area.

[15] All results of cross-country spillovers, with and without monetary policy accommodation, are are available upon request.

Table 9: Benchmark spillover multipliers to the euro area GDP of permanent and temporary consolidations in the US for the first year

	Spillovers to Euro Area of a US shock	
	Permanent	**Temporary (2 years)**
	Real GDP First year	Real GDP First year
Government consumption	-0.05	-0.06
Government investment	-0.07	-0.06
General transfers	-0.04	-0.01
Targeted transfers	-0.04	-0.04
Labor tax rates	-0.02	0.00
Consumption tax rates	-0.03	-0.03
Capital tax rates	-0.06	-0.02
Lump-sum rates	-0.04	-0.01

Table 10: Real effects on the euro area of the 3 budget-neutral experiments in the US

	Spillovers to the euro area					
Spillovers	Fiscal devaluation		Spending reform		Mixed budget composition	
	1 Year	10 Years	1 Year	10 Years	1 Year	10 Years
Real income	0.00	-0.01	0.01	-0.02	0.03	-0.04
Consumption	-0.02	0.01	-0.04	-0.03	-0.04	-0.01
Investment	-0.06	0.02	-0.06	-0.06	-0.09	-0.06
Exports	0.10	-0.04	0.15	0.00	0.27	-0.10
Imports	-0.03	0.06	-0.05	-0.01	-0.05	0.02

The mechanism explaining the spillovers is similar across all three budget-neutral reforms. When the incomplete fiscal devaluation (E1) is implemented in the US, spillovers to the euro area are practically zero. The depreciation of the nominal exchange rate in the euro area, related to the Federal Reserve monetary tightening, explains the increase in net exports. However it is entirely compensated by a fall in consumption and investment. When a budget-neutral increase in government investment (E2) is implemented in the US, spillovers are overall small but positive on euro area GDP. The channel is the same as seen before. The increase in net exports is largely driven by the depreciation of the euro and this explains why the positive effect on GDP is only temporary and reverts to negative in the long-run. A similar pattern happens in response to the mixed budget compositional reform (E3).

In case both the U.S. and the euro area monetary authorities are constrained, spillovers are even smaller. This is due to the inertia of nominal and real exchange rates. The euro, without the U.S. monetary tightening would not depreciate. This would dampen the only positive spillover for the euro area, which was coming from the increase in net exports (detailed results are available upon request).

To conclude, we ask whether there is scope for a collective action on both sides of the Atlantic

Ocean and in the entire world. The main idea is to check if a simultaneous implementation of budget-neutral fiscal policies is likely to generate additional growth in each area. In this respect, the IMF tends to insist on the gains from coordination putting emphasis on the increase in the multipliers following a collective fiscal stimulus package in all the G20 countries. It is important to stress that we will be focusing here on budget-neutral reforms for which a *priori* there could be no scope for international cooperation.

We start by looking at the effects on U.S. GDP to our three budget-neutral reforms when those are simultaneously implemented in the US and the euro area. Then we extend the analysis, considering how the results would change if the entire world would undertake the three considered reforms. First, we assume that the budget-neutral reforms are made in periods when monetary authorities respond flexibly to inflation movements. Then we assume that monetary and fiscal policies are coordinated and monetary policy constrains its reaction for two years. Table 11 summarizes the results on US GDP after one year.

Table 11: Effects on GDP after one year of the three budget-neutral scenarii, with and without monetary reaction and with and without collective action (in % vis--vis the baseline)

	United States					
	Real GDP - first year					
	With monetary reaction			No Monetary Reaction		
Permanent Reform	Baseline	US-EA	All world	Baseline	US-EA	All World
E1: Fiscal Devaluation	0.267	0.270	0.270	0.543	0.532	0.619
E2: Government investment	0.358	0.377	0.413	0.808	0.792	1.179
E3: Mixing spending and taxation	0.689	0.713	0.794	1.185	1.178	1.486

We point out two main results. First, and not surprisingly, a coordinated incomplete fiscal devaluation doesn't have positive spillovers, even if undertaken during periods of accommodative monetary policy. As shown in Table 11, U.S. GDP moves by the same amount independently if the fiscal devaluation is implemented by the U.S. alone or jointly with other countries. Second, budget-neutral reforms coordinated across the world (with the exclusion of fiscal devaluations), during periods of monetary accommodation, have indeed important positive spillovers. In fact, U.S. GDP increases by respectively 0.37 pp and 0.30 pp more when the budget-neutral spending (E2) and mixed reform (E3) is coordinated across countries. This is in line with IMF recommendation, supporting the idea that fiscal reforms boosting growth undertaken in periods of accommodative monetary policy are likely to be more expansionary if undertaken by all countries, generating positive spillovers.

7 Conclusions

This paper focuses on the domestic and foreign macroeconomic impact of budget-neutral reforms. More specifically, our aim is to assess (i) whether changes in the composition of government revenues and spending can effectively stimulate GDP growth while keeping neutral the fiscal budget, (ii) whether budget-neutral reforms interact with monetary policy and (iii) whether the economic consequences of these reforms spillover to foreign economies. We use simulation results from a three-

countries DSGE model, focusing on the US and the euro area. The paper investigates three types of fiscal composition measures: an incomplete fiscal devaluation, a rise in government investment compensated by a fall in government consumption and a rise in government investment compensated by a rise in consumption and labor taxes. We also consider dampening or amplifying effects due to coordination across policy instruments (monetary and fiscal) and across economic regions. Three main results stand out. First, an increase in government investment financed by rising less distortionary taxes appears to be an effective growth-friendly budget-neutral reform in the sense that it generates both short- and long-run GDP growth and improves fiscal sustainability. Second, benefits and costs of budget-neutral reforms are not equally distributed across agents, giving rise to an important policy trade-off between growth and distributional consequences. Third, budget-neutral reforms do not have large cross-border trade spillovers; however, budget-neutral fiscal policies coordinated across multiple countries in periods of accommodative monetary policy can have amplified effects.

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A Appendix

Table A1: Fiscal multipliers for permanent and temporary consolidation in the euro area

	Euro Area							
	Permanent				**Temporary (2 years)**			
	Real GDP			Gov. Debt/GDP	Real GDP			Gov. Debt/GDP
	First year	Second year	After 10y	After 2y	First year	Second year	After 10y	After 2y
Gov. consumption	-0.738	-0.534	-0.351	-2.167	-0.852	-0.745	-0.005	-1.537
Gov. investment	-1.170	-1.175	-3.005	-1.178	-1.078	-1.160	-0.432	-1.171
General transfers	-0.122	-0.058	0.199	-2.681	-0.114	-0.096	0.019	-1.786
Targeted transfers	-0.330	-0.330	-0.195	-2.418	-0.435	-0.387	0.004	-1.565
Labor tax	-0.412	-0.564	-0.707	-2.245	-0.205	-0.250	0.040	-1.725
Consumption tax	-0.280	-0.315	-0.228	-2.434	-0.292	-0.287	0.013	-1.645
Capital tax	-0.760	-0.938	-1.601	-1.484	-0.267	-0.256	-0.030	-1.582
Lump sum tax	-0.122	-0.058	0.199	-2.681	-0.114	-0.096	0.019	-1.786

Table A2: Benchmark multipliers at the ZLB for the euro area

	Euro Area							
	Permanent				**Temporary (2 years)**			
	Real GDP			Gov. Debt/GDP	Real GDP			Gov. Debt/GDP
	First year	Second year	After 10y	After 2y	First year	Second year	After 10y	After 2y
Gov. consumption	-0.738	-0.534	-0.351	-2.167	-0.852	-0.745	0	-1.537
ZLB	-0.880	-0.676	-0.361	-2.012	-1.068	-0.967	-0.019	-1.297
Gov. investment	-1.170	-1.175	-3.005	-1.178	-1.078	-1.160	-0.432	-1.171
ZLB	-1.589	-1.616	-3.038	-0.692	-1.209	-1.290	-0.440	-1.029
General transfers	-0.122	-0.058	0.199	-2.681	-0.114	-0.096	0.019	-1.786
ZLB	-0.131	-0.068	0.198	-2.669	-0.154	-0.137	0.017	-1.741
Targeted transfers	-0.330	-0.330	-0.195	-2.418	-0.435	-0.387	0.004	-1.565
ZLB	-0.376	-0.377	-0.198	-2.365	-0.568	-0.523	-0.004	-1.417
Labor tax	-0.412	-0.564	-0.707	-2.245	-0.205	-0.250	0.040	-1.725
ZLB	-0.463	-0.617	-0.710	-2.188	-0.166	-0.210	0.042	-1.771
Consumption tax	-0.280	-0.315	-0.228	-2.434	-0.292	-0.287	0.013	-1.645
ZLB	-0.316	-0.353	-0.231	-2.391	-0.377	-0.374	0.007	-1.549
Capital tax	-0.760	-0.938	-1.601	-1.484	-0.267	-0.256	-0.030	-1.582
ZLB	-1.150	-1.340	-1.628	-1.039	-0.357	-0.347	-0.036	-1.481
Lump sum tax	-0.122	-0.058	0.199	-2.681	-0.114	-0.096	0.019	-1.786
ZLB	-0.131	-0.068	0.198	-2.669	-0.154	-0.137	0.017	-1.741