Fiscal deficits and current account deficits

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1. Introduction

In response to the 2008 financial crisis many governments announced sizeable expansionary fiscal stimulus packages. As documented in Freedman et al. (2009), the sizes and compositions of these packages differed greatly across countries, but almost all of them were large as a share of GDP. The initial policy debate mainly concentrated on their short-run efficacy in stimulating output and preventing the tax base from collapsing, with much less attention devoted to long-run fiscal sustainability issues. But it is becoming increasingly clear that sustainability will be a real concern in many countries. Specifically, a significant share of the initially envisaged increases in government deficits may represent not just a temporary spike to cope with the crisis, but rather a permanent drifting up to what are perceived to be unsustainable levels. The consequences of these permanent deficit changes are the main concern of this paper.

Recent fiscal stimulus packages depend for their effectiveness on the assumption of non-Ricardian savings behavior. We show that, under the same assumption, higher fiscal deficits can have problematic implications if they turn out to be permanent. First, if they occur in large countries they significantly raise the world real interest rate. Second, they cause a short-run current account deterioration equal to around 50% of the fiscal deficit deterioration. Third, the longer run current account deterioration equals almost 75% for a large economy such as the United States, and almost 100% for a small open economy.

As the global economy recovers and trade volumes rebound, however, global imbalances may reassert themselves. As national leaders have emphasized in recent meetings of the G-20, policymakers around the world must guard against such an outcome. We understand, at least in principle, how to do this. The United States must increase its national saving rate. Although we should deploy, as best we can, tools to increase private saving, the most effective way to accomplish this goal is by establishing a sustainable fiscal trajectory, anchored by a clear commitment to substantially reduce federal deficits over time. (Ben Bernanke, 19 October 2009, Federal Reserve Bank of San Francisco’s Conference on Asia and the Global Financial Crisis, Santa Barbara, California).

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A prominent example is the United States, whose fiscal outlook just after the outbreak of the crisis is examined in detail in Auerbach and Gale (2009). One of their main concerns is that the baseline fiscal projection in Congressional Budget Office (2009) may be far too optimistic because it assumes that the provisions of the stimulus package are allowed to expire. The authors emphasize that a drift towards making higher deficits permanent would not be at all unprecedented, in that the major share of the current decade’s deficit deterioration relative to the very favorable 2001 CBO baseline projection can be attributed to the extension of Bush tax cuts that were originally billed as temporary. Auerbach and Gale (2009) find that the combined effects of further extending the Bush tax cuts and of accounting for the stimulus package would result in deficits that by 2019 would be worse than the official CBO baseline deficit projection (2% of GDP) by almost 5% of GDP, and that even this may be too optimistic. This view is more pessimistic than the baseline projection in the IMF’s 2009 World Economic Outlook (4.9% deficit by 2019) and with the CBO projection of the President’s 2010 budget proposal (5.5% deficit by 2019), which are both shown in Fig. 1. That figure also shows that according to the IMF WEO projection the U.S. debt-to-GDP ratio is expected to reach 100% over the next decade.

All of the more recent problems are of course in addition to longer-run concerns such as demographics and medical costs that have been emphasized for years, and which meant that the United States faced the prospect of large and persistent future deficits even before the onset of the crisis. Fig. 2 shows longer term CBO projections of deficit and debt dynamics until 2080. They are highly unstable, with debt reaching between 300% and 700% of GDP depending on assumptions. Finally, it should be emphasized that since the onset of the crisis debt projections have also become subject to another serious risk, increased uncertainty about the long-run sustainable growth rate of potential output.

In an age of increasing macroeconomic interdependence across countries, the interest in the longer-run consequences of fiscal deficits is no longer exclusively motivated by the study of individual economies, but also by spillovers between multiple economies, specifically by global current account imbalances. The concern with U.S. twin (fiscal and external) deficits has probably been the most pressing example until recently, but there are now numerous other examples of smaller open economies implementing very sizeable increases in fiscal deficits. The question we ask in this paper is whether such deteriorations in fiscal deficits can be a major contributing factor to deteriorations in their current account deficits. Or conversely, would an eventual fiscal consolidation among major deficit spenders make a sizeable contribution to the resolution of global current account imbalances?

The empirical literature has mostly concluded that the link between fiscal deficits and current account deficits is weak or non-existent. However, this literature faces at least two difficult problems. First, while fiscal deficits may have some immediate impact on the current account, the full effect of permanent deficit shocks may take years or even decades to arrive, making it difficult to correctly capture and distinguish it from other shocks in reduced-form empirical work. The main response to this problem has been the use of multi-year averages or filters to cyclically adjust fiscal data. However, this

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does not fully address the second problem, which is that cyclically adjusted fiscal data are not fully purged of the effects of other developments, such as countercyclical fiscal policies, that simultaneously affect public and private saving, investment, imports and the current account balance, giving rise to omitted variable problems. Furthermore, reverse causality can be at work when fiscal policy is deliberately tightened to reduce external sustainability problems. These problems have been addressed by Bluedorn and Leigh (2011), who use the action-based fiscal policy measures of Devries et al. (2011) in their current account regressions. By carefully studying the historical record, action-based measures identify periods of fiscal consolidation motivated by budget deficit reductions, and not by restraining domestic demand or by reducing the current account deficit. Bluedorn and Leigh (2011), who identify a total of 173 such episodes worldwide, list a number of persuasive historical examples where action-based fiscal deficits differ from the conventionally used cyclically adjusted primary balances, in each case because the latter uses a statistical filtering procedure rather than examining the historical origin and intent of the policy measures. Bluedorn and Leigh (2011) conclude that action-based fiscal deficits have a powerful effect on current account deficits. Specifically, a 1% of GDP fiscal consolidation improves the current account-to-GDP ratio by about 0.6 percentage points. Because most of the policy actions identified in their paper are of a permanent nature, they also find that the current account effects are close to permanent.

Our paper contributes to the theoretical rather than the empirical literature. The theoretical literature has typically also concluded that the link between fiscal deficits and current account deficits is weak. A prominent example is Erceg et al. (2005a), who use an open economy dynamic general equilibrium model to simulate the effects of fiscal deficit shocks, and who explore the sensitivity of their simulations to key model assumptions. We adopt the same approach in this paper. The difference to Erceg et al. (2005a) is that they focus on short-run current account effects, while we focus on medium- to long-run effects.

The appropriate tool for studying open economy business cycle issues is the new generation of DSGE models that are being constantly refined in academia, and that are being deployed rapidly in policymaking institutions. Such models are well suited to address many important short-run business cycle issues, especially concerning monetary policy. However, they have limitations when applied to the analysis of longer-run fiscal issues such as the crowding-out effects of a permanent increase in fiscal deficits and public debt. Standard monetary business cycle models such as the Fed’s SIGMA and the IMF’s GEM predict that fiscal deficits must, by design, have small medium-run and zero long-run effects on the current account balance. The critical assumption behind this result is that all households have infinite planning horizons, augmented by an economically essentially arbitrary assumption that the economy’s net foreign assets have to return to their steady state value.

Fig. 2. 2009 CBO long-term projections for U.S. deficits and debt.

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4 As argued in Fatas and Mihov (2001), Blanchard and Perotti (2002), and Gali et al. (2007), these models also face difficulties in adequately replicating the dynamic short-run effects of fiscal policy. That however is not the main concern of this paper.

5 For documentation on SIGMA see Erceg et al. (2005b) and for GEM see Faruque et al. (2005). Both are medium to large scale models, and take many of their modeling elements from benchmark closed economy models such as Christiano et al. (2005).
in the very long run. While these assumptions are generally considered innocuous for temporary shocks, their implications for permanent saving shocks are extreme. They imply that when a government issues additional debt due to higher deficits, exactly 100% of this debt will eventually be acquired by domestic residents without recourse to foreign financing, even if the country is extremely small and perfectly integrated into world financial markets. We will show in this paper that if the assumption of infinite horizons is replaced with finite horizons, even if they are as long as 50 years, the results are radically different. Moreover, the predicted magnitude of the current account response is very close to that found by Bluedorn and Leigh (2011).

In this context it is important to point out that the fiscal stimulus packages that motivate this study are based on the notion that households exhibit significant non-Ricardian saving behavior, in other words that they do not behave as though they were infinitely lived. Many of the fiscal measures lower taxes, rather than increasing spending on goods and services. For their efficacy such measures depend critically on the assumption that households will not raise their saving rates to fully offset lower government saving rates. A study of the long-run implications of permanently higher deficits should therefore also allow for the possibility of non-Ricardian saving behavior.

This paper embeds the finite-horizon setup of Blanchard (1985) in a fully specified open economy business cycle model. The model has several features that are standard in the business cycle literature, but that have so far not been incorporated into finite-horizon models due to difficulties in aggregating over generations. This includes endogenous capital accumulation, endogenous labor supply, and a CRRA utility function that allows us to highlight the critical role of the intertemporal elasticity of substitution in the propagation of fiscal shocks. A fiscal policy reaction function stabilizes the government deficit and therefore government debt. To keep the analysis as simple as possible, our model has neither nominal nor real frictions. While this has drawbacks in terms of the realism of the short-term impulse responses, it greatly simplifies the model structure and the interpretation of the results, and in any event our focus is on the medium- to long-run effects of fiscal policy.

Apart from the finite-horizon (overlapping generations) model of Blanchard (1985), the literature has also employed the non-Ricardian model of Gali et al. (2007). This is an infinite-horizon model with a subset of liquidity-constrained agents, who have a horizon of zero. Both model classes are capable of producing powerful short-run effects of fiscal policy. But only a finite-horizon setup allows for longer-run crowding-out effects of permanent increases in the stock of government debt, including an endogenous determination of the stock of net foreign liabilities. This behavior of stocks is critical to understanding the longer-run connections between the corresponding flows, fiscal deficits and current account deficits, that are the object of our study.

Gali et al. (2007) interpret the complete inability to smooth consumption of their model’s liquidity-constrained households as (among other possible interpretations) extreme myopia, or a planning horizon of zero. We adopt the same interpretation for the average planning horizon of the finite-horizon model. We therefore allow for the possibility that agents may have a shorter planning horizon than what would be suggested by their biological probability of death. As we will discuss below in more detail, the finite-horizon model can then be seen as the intermediate case that spans all planning horizons between those of the liquidity-constrained households and infinite-horizon models.

Bringing a finite-horizon setting into an open economy monetary business cycle model has been undertaken by Ghironi (2006, 2003) and by Ganelli (2005). The former does not consider the effects of government debt, but shows that a finite-horizon setup following Blanchard (1985) ensures the existence of a well-defined steady state for net foreign liability positions (see also Butler, 1981). Our model is closer to Ganelli (2005), which is in turn related to the work of Frenkel and Razin (1992). Our model differs from these studies in that it embeds the finite-horizon setup in a fully specified open economy business cycle model, with a more flexible specification of preferences and technologies.

We find that a permanent increase in a country’s fiscal deficit equal to 1% of its GDP leads to a short-run current account deterioration of around 0.5% of GDP, and to a long-run deterioration of between 0.75% for a country the size of the United States, and 1% for a small open economy. The model approaches the extreme long-run Ricardian predictions of conventional models when the planning horizon approaches infinity. But when horizons are even moderately finite, any permanent change in deficits and debt has very significant immediate effects on the current account, and even larger effects in the long run. The long-run effects are almost completely independent of whether lump-sum taxes, labor income taxes, capital income taxes or government spending are used as the fiscal instrument.

These results are in striking contrast to the infinite-horizon model. In a version of our model that replaces finite-horizon agents with infinitely lived agents, but that is otherwise identical to our baseline, the same shock causes small short-run and zero long-run current account deteriorations. These results are similar to those of Erceg et al. (2005a), but there are some differences due to the fact that these authors employ a setup with a 50% share of liquidity-constrained agents.

The remainder of the paper is organized as follows. Section 2 summarizes the theoretical structure of the model, leaving some of the details to Technical Appendix. Section 3 discusses calibration. Section 4 analyzes the model’s predictions for the
consequences of permanently higher government deficits, with particular attention paid to the roles of households’ planning horizon and of the fiscal instrument used. Section 5 concludes.

2. The model

The world consists of 2 countries, Home (HO) and the rest of the world (RW). When the interaction between two countries is discussed we identify HO by an asterisk. Our main tool of analysis is a finite-horizon model (henceforth FIN). But for comparison with the recent literature we will also consider an infinite-horizon model (henceforth INF). Because the critical effects of permanent saving shocks stressed in this model arise over the longer run, we work with an annual version of the model.

In the FIN model each country is populated by households with finite planning horizons as in Blanchard (1985) who consume final retailed output and supply labor. In each period, \( N(1-\theta) \) and \( N^*(1-\theta) \) of such individuals are born in RW and HO, where \( N \) and \( N^* \) are population sizes and \( (1-\theta) \) is the constant probability of death faced by each agent in each period. The latter implies an average planning horizon of \( 1/(1-\theta) \).

Firms are managed in accordance with the intertemporal preferences of households, and they therefore also have finite planning horizons. Each country’s primary production is carried out by manufacturers who produce tradable goods using inputs of labor and capital. Their sales go to distributors, who assemble domestic and foreign goods, and who sell to consumers, investors and the government.

Asset markets are incomplete. There is complete home bias in the ownership of domestic firms. Households receive firms’ cashflow distributions by way of lump-sum dividend payments. There is also complete home bias in government debt, which takes the form of one-period bonds denominated in units of domestic goods. The only asset traded internationally is a one-period bond denominated in units of HO goods. The reason for choosing this denomination is that in our main simulations HO will represent the United States.

In our derivations per capita variables are only used for disaggregated households. All aggregate variables represent absolute quantities normalized by labor-augmenting world technology \( T_o \) which grows at the constant rate \( g = T_1/T_{-1} \). For any growing variable \( x \), we use the notation \( x_t = x_t/T_t \), with the steady state of \( x_t \) denoted by \( \bar{x} \).

We consider the consequences of a single policy shock, a permanent 1 percentage point increase in the government deficit-to-GDP ratio. We use the perfect foresight rather than the log-linearized stochastic version of the model to do so (see Armstrong et al., 1998).

2.1. Households

A representative household of age \( a \) derives utility at time \( t \) from consumption \( C_{at} \) and leisure \( (1-L_{at}) \) (where 1 is the time endowment). Lifetime utility has the form

\[
\sum_{s=0}^{\infty} (\beta \tau)^s \left( \frac{1}{1-\gamma} \left( C_{a+t+s}^{\ast} \right)^{1-\gamma} \right),
\]

where \( \beta \) is the discount factor, \( \theta < 1 \) determines the planning horizon, \( \gamma > 0 \) is the coefficient of relative risk aversion, and \( 0 < \gamma < 1 \). Preferences (1) are consistent with balanced growth and allow aggregation across generations of households.\(^9\)

A household can hold domestic government bonds \( b_{at} \) denominated in units of domestic goods, and foreign bonds \( f_{at} \) denominated in units of HO goods. In each case the time subscript \( t \) denotes financial claims held from period \( t \) to period \( t+1 \). Gross real interest rates on RW and HO financial assets held from \( t \) to \( t+1 \) are \( r_t \) and \( r^*_t \), respectively. The latter implies an average planning horizon of \( 1/(1-\theta) \).

Apart from returns on financial assets, households also receive labor and dividend income. After-tax labor income equals \( w_t L_{at} (1-\tau_{l,t}) \), where \( w_t \) is the real wage and \( \tau_{l,t} \) is the tax rate on labor income. Dividends are received in a lump-sum fashion from all firms in the manufacturing \( (H) \) and distribution \( (D) \) sectors, with real dividends received denoted by \( d^H_{at} \) and \( d^D_{at} \). Finally, households are subject to lump-sum taxes \( \tau_{a,t} \). We choose the price of final goods as our numeraire. The relative prices of other goods \( x \) are denoted by \( p^x_t \), and the real exchange rate vis-a-vis HO by \( e_t \). The household’s budget constraint is

\[
C_{at} + b_{at} + ef_{at} = \frac{1}{\theta} \left[ r_{t-1} b_{a-1,t-1} + r^*_t f_{at} \right] + w_t L_{at} (1-\tau_{l,t}) + d^H_{at} + d^D_{at} - \tau_{a,t}.
\]

For future reference, the multiplier of the budget constraint (2) in the household’s optimization problem is \( \lambda_{at} \). The household maximizes (1) subject to (2). The derivation of the first-order conditions for each generation, and aggregation across generations, is discussed in Technical Appendix. Aggregation takes account of the size of each age cohort at the time

\(^{9}\) There are several other preference specifications that are consistent with balanced growth. But none of them allows for the aggregation of optimality conditions across generations.

\(^{10}\) The turnover in the population is assumed to be large enough that the income receipts of the insurance companies exactly equal their payouts.
of birth, and of the remaining size of each generation. For consumption we have

$$C_t = N(1-\theta) \sum_{a=0}^{\infty} \theta^a C_{a:t}. \quad (3)$$

The first-order condition for the consumption/leisure choice is, after normalizing by technology, given by

$$\frac{\dot{C}_t}{N-L_t} = \frac{\eta}{1-\eta} w_t (1-\tau_{L:t}). \quad (4)$$

The arbitrage condition for foreign bonds (the real interest parity relation) is given by

$$r_t = r^*_t \frac{\epsilon_{L:t+1}}{\epsilon_t}. \quad (5)$$

Optimal aggregate consumption $\hat{C}_t$ is a function of households’ real aggregate financial wealth $fw_t$ and human wealth $hw_t$, with the marginal propensity to consume of out of wealth given by $1/\Theta_t$. Human wealth is composed of the expected present discounted value of households’ time endowments evaluated at the after-tax real wage, plus the expected present discounted value of dividend income, minus lump-sum taxes. After normalizing by technology we have

$$\hat{C}_t \Theta_t = f w_t + \hat{h} w_t, \quad (6)$$

where

$$\Theta_t = \frac{1}{\eta} + \frac{\theta_t}{r_t} \Theta_{t+1}. \quad (7)$$

$$fw_t = \frac{1}{g} [r_{t-1} b_{t-1} + r^*_t \epsilon_{L:t-1} \epsilon_{f_{t-1}}]. \quad (8)$$

$$\hat{h} w_t = (N \hat{w}_t (1-\tau_{L:t}) + d_t^H + d_t^D - \tau_t) + \frac{\theta g}{r_t} \hat{h} w_{t+1}. \quad (9)$$

$$j_t = (\beta r_t)^{1/\gamma} \left( \frac{w_{t+1} (1-\tau_{L:t+1})}{w_t (1-\tau_{L:t})} g \right)^{(1-\eta)(1-1/\gamma)}. \quad (10)$$

The implication of this set of equations is that government debt adds to agents’ net worth, and that the timing of tax changes affects consumption. The intuition is as follows.

Financial wealth (8) is equal to the domestic government’s and foreign households’ current financial liabilities. For the government debt portion, the government services these liabilities through taxation, and these future taxes are reflected in human wealth (9). But unlike the government, which is infinitely lived, an individual household’s planning horizon is finite, so that he attaches less importance to tax payments that fall due in the distant future. Hence, a household discounts future tax liabilities by a rate of $r_t/\theta$, which is higher than the market rate $r_t$, as reflected in the discount factor in (9). The implication is that government debt is net wealth to the extent that households do not expect to become responsible for the taxes necessary to service that debt. The shorter households’ planning horizon, the greater the portion of outstanding government debt that they consider to be net wealth.

A permanent increase in the fiscal deficit through initially lower taxes represents a tilting of the tax payment profile from the near future to the more distant future, so as to effect an increase in the debt stock. The government has to respect its intertemporal budget constraint in affecting this tilting, and this means that the expected present discounted value of its future primary deficits has to remain equal to the current debt $r_{t-1} b_{t-1}$ when future deficits are discounted at the market interest rate $r_t$. But when individual households discount future taxes at a higher rate than the government, the same tilting of the tax profile represents an increase in human wealth because it decreases the value of future taxes for which the household expects to be responsible. For a given marginal propensity to consume, this increase in human wealth leads to an increase in consumption.

The marginal propensity to consume $mpc = 1/\Theta_t$ is, in the simplest case of logarithmic utility and exogenous labor supply, equal to $(1-\beta t)$. For the case of endogenous labor supply, household wealth can be used to either enjoy leisure or to buy goods. The main determinant of the split between consumption and leisure is the consumption share parameter $\eta$, which explains its presence in the marginal propensity to consume (7).

Two magnitudes, the intertemporal elasticity of substitution $1/\gamma$ and the planning horizon $1/(1-\theta)$, are critical for the long-run interest rate response to higher deficits. By combining (7) with (10), we obtain the following steady state relationship between $mpc$, $r$ and $\theta$:

$$mpc = \eta (1-\theta)^{1/\gamma} g^{(1-\eta)(1-1/\gamma)} r^{(1-1/\gamma)}. \quad (11)$$

A higher real interest rate has a substitution and an income effect, the former reducing the marginal propensity to consume and the latter increasing it, with the two exactly offsetting each other for the log utility case of $\gamma = 1$. The conventional assumption is that $\gamma > 1$, and we will consider a benchmark of $\gamma = 4$. In that case the income effect is stronger, and the increase in the marginal propensity to consume due to a higher $r$ partly offsets the contractionary consumption effect of a
higher $r$ on human wealth $\hat{hw}_t$ in (9). The consequence is that for high $\gamma$ real interest rates have to increase by more to clear markets following an increase in deficits.

A shorter planning horizon, or lower $\theta$, increases the level of the marginal propensity to consume. But it also decreases its sensitivity to the real interest rate, because agents with a short planning horizon care less about the future effects of real interest rate changes. This is illustrated in Fig. 3, which for simplicity depicts the closed economy case. Starting at a saving-investment equilibrium at point A, the government exogenously reduces its saving to take the economy to point A’. When households have long planning horizons (the dashed saving schedules), their saving is highly sensitive to the real interest rate. As a consequence the economy ends up at point B, with an only slightly higher real interest rate and only slightly lower saving and investment. The infinite-horizon model is the limiting case, where the saving schedule becomes horizontal and the economy returns to point A. When households have short planning horizons (the solid saving schedules), their saving is not highly sensitive to the real interest rate. The economy therefore ends up at point C, with much higher real interest rates and much lower saving and investment. If in addition leftward shifts in the investment schedule due to non-interest factors, such as lower aggregate demand, are taken into account, the overall equilibrium reduction in saving could well exceed the government’s own reduction in saving. We will in fact observe this for sufficiently low values of $\theta$. A model with liquidity-constrained agents, as in Gali et al. (2007), is the limiting case of short planning horizons, where the saving schedule for this group of agents becomes vertical. This illustrates that the finite-horizon model spans all possible planning horizons between the two limiting cases.

In our policy simulations we will compare the finite-horizon (FIN) model to an infinite-horizon (INF) representative agent alternative that is identical in all but two respects. First, the parameter $\theta$ is assumed to be equal to one, so that households are infinitely lived. Second, negative deviations from a long-run net foreign assets-to-GDP ratio $\overline{nfa}$ raise the external interest rate faced by the country due to a risk premium $\xi_t$, while in our simulations of the FIN model we will assume that $\xi_t$ is constant and equal to one. We assume the following simple specification for this risk premium $\xi_t$,

$$\xi_t = 1 - \zeta \left( \frac{ed_t}{gdp_t} - \overline{nfa} \right),$$

where $\zeta$ is very small. The alternative model gives rise to a mostly identical system of equations, except for a modification of the real interest rate parity condition to include $\xi_t$, and more importantly for a replacement of the consumption system (6)–(9) with the equation

$$\dot{C}_{t+1} = \frac{\delta}{g} C_t.$$  \hfill (13)

2.2. Firms

Manufacturing and distribution firms are perfectly competitive in their input and output markets. Both sectors pay out each period’s net cash flow as dividends to households and maximize the present discounted value of these dividends. In the FIN model the discount rate they apply in this maximization includes the parameter $\theta$ so as to equate the discount factor of firms $\theta/\tau_r$ with the pricing kernel for nonfinancial income streams of households, which equals $\beta(\lambda_{a+1,t+1}/\lambda_{a,t})$. This equality follows directly from households’ Euler equation $\lambda_{a,t} = \beta(\lambda_{a+1,t+1}/\lambda_{a,t})$. 

![Fig. 3. Dissaving and the role of the planning horizon.](image-url)
2.2.1. Manufacturers

Manufacturers produce output $Y^H_t$ and sell it at the relative price $p^H_t$. Their technology is given by a Cobb–Douglas production function in capital $K_t$ and labor $L_t$, with labor share parameter $\alpha_t$:

$$Z^H_t = (K_t)^{(1-\alpha_t)}(T_t L_t)^{\alpha_t}. \tag{14}$$

The law of motion of capital is given by

$$K_{t+1} = (1-\delta)K_t + I_t, \tag{15}$$

where $\delta$ is the depreciation rate of capital. Dividends $d^H_t$ equal revenue $p^H_t Z^H_t$ minus cash outflows. The latter include the wage bill $w_t L_t$, investment $I_t$, and capital income taxes $\tau_{kt}(r_{kt}-\delta)K_t$, where $r_{kt}$ is the capital income tax rate, and $r_{kt}$ is the physical return to capital. The optimization problem and first-order conditions for the optimal choice of labor and capital are standard except for the presence of the term $\theta$ in the discount factor. They are shown in Technical Appendix.

2.2.2. Distributors

Distributors produce final output. Their technology is given by a CES production function in domestic and foreign manufactures $Y^D_t$ and $Y^F_t$, with elasticity of substitution $\xi_D$.

$$Z^D_t = ((\alpha_D)^{1/\xi_D}(Y^D_t)^{\xi_D/(\xi_D-1)} + (1-\alpha_D)^{1/\xi_D}(Y^F_t)^{\xi_D/(\xi_D-1)})^{\xi_D/(\xi_D-1)}. \tag{16}$$

The relative prices of $Y^H_t$ and $Y^F_t$ are given by $p^H_t$ and $p^F_t$. Dividends $d^D_t$ equal revenue $Z^D_t$, minus input costs $p^H_t Y^H_t + p^F_t Y^F_t$. The price of foreign inputs is given by purchasing power parity as

$$p^F_t = p^H_t e_t. \tag{17}$$

The optimization problem and first-order conditions for input demands are standard, and are shown in the Technical Appendix.

2.3. Government

2.3.1. Budget constraint

The government issues non-contingent one-period debt $b_t$ at the gross interest rate $r_t$, levies lump-sum taxes $t_t$, taxes labor and capital incomes at the rates $\tau_{L,t}$ and $\tau_{K,t}$, and determines government spending $G_t$. Letting $b_t = b_t/T_t$, the real normalized government budget constraint therefore takes the form

$$\hat{b}_t = \frac{r_t-1}{g}\hat{b}_{t-1} + \hat{G}_t - \tau_{L,t}w_t L_t - \tau_{K,t}(r_{K,t}-\delta)K_t. \tag{18}$$

2.3.2. Fiscal policy

Fiscal policy specifies a target $gd^at_{tgt}$ for the government deficit-to-GDP ratio $gd^at_t$:

$$\hat{gd}^at_{tgt} = 100 \frac{(r_t-1)\hat{b}_{t-1}}{g} + \hat{G}_t - \tau_{L,t}w_t L_t - \tau_{K,t}(r_{K,t}-\delta)K_t \frac{b_t}{gd^at_t} = \hat{gd}^at_{tgt}. \tag{19}$$

where $\hat{gd}^at_t$ will be defined below. Lump-sum taxes, labor income taxes, capital income taxes or government spending adjust endogenously to ensure that the deficit target is met. Schaechter et al. (2012)\(^{11}\) provide an extensive overview of fiscal rules being used throughout the world today. Their most important conclusions, as far as our paper is concerned, are twofold. First, there has been a very rapid increase in the use of formal numerical rules. Second, balanced budget rules like (19), either cyclically adjusted or not,\(^{12}\) are the most frequently used type of rule, followed by debt rules. Eq. (19) implies the following relationship between $\hat{gd}^at_{tgt}$ and the long-run government debt-to-GDP ratio $b^rat_{tgt}$:

$$b^rat_{tgt} = \frac{\hat{gd}^at_{tgt}}{g-1}. \tag{20}$$

This implies that a target for the government deficit ratio automatically ensures a non-explosive government debt ratio, with the ratio between the two given by the economy’s net growth rate.\(^{13}\) But the autoregressive coefficient on debt, at $1/(g-1)$, is very close to one, which implies that following a permanent change in the deficit target debt takes several decades to reach its long-run value.

\(^{11}\) See also Wyplosz (2012).

\(^{12}\) For simplicity we ignore cyclical adjustment, because our concern is mostly with medium- to long-run dynamics.

\(^{13}\) In a monetary model that ratio is determined by the larger nominal growth rate. This explains the smaller long-run debt growth in the IMF Working Paper version of this paper (Kumhof and Laxton, 2009) compared to the present paper.
2.4. Equilibrium and balance of payments

In equilibrium households maximize lifetime utility, firms maximize the present discounted value of their cash flows, the government follows its fiscal rule, and the following market clearing conditions for manufacturing output and final output hold:\(^\text{(20)}\):

\[
\begin{align*}
\dot{Z}_t^H &= \dot{Y}_t^H + \dot{f}_t^*, \\
\dot{Z}_t^D &= \dot{C}_t + I_t + G_t,
\end{align*}
\]

Furthermore, the net foreign asset evolution is given by

\[
e_{df} = \left(\frac{(r_t + \delta_{t-1} - 1)e_{f} - p_t^{Hf} - p_t^{Ff}}{g_{df}}\right) - e_{df} \dot{f}_t,
\]

the market clearing condition for international bonds is

\[
\dot{f}_t + \dot{f}_t^* = 0,
\]

and the level of GDP is given by

\[
gdp_t = \dot{C}_t + I_t + \dot{C}_t + p_t^{Hf} - p_t^{Ff}.
\]

We now derive a long-run relationship between the current account deficit-to-GDP ratio \(\text{cad}_t\) and the net foreign liabilities-to-GDP ratio \(\text{nfl}_t\) that parallels the long-run relationship between fiscal deficits and public debt in Eq. (20). The current account deficit-to-GDP ratio is given by

\[
\text{cad}_t = \frac{(r_t + \delta_{t-1} - 1)e_{f} - p_t^{Hf} - p_t^{Ff}}{g_{df}} - e_{df} \dot{f}_t.
\]

We replace the time subscript \(t\) with \(LR\) to denote long-run values. Then Eq. (26) implies the following relationship:

\[
\text{nfl}_{t,LR} = \text{cad}_{t,LR} \frac{g_{df}}{g_{df} - 1}.
\]

3. Calibration

In our baseline economy HO represents the United States and accounts for 25% of world GDP. In one of our alternative scenarios RW represents a small open economy and accounts for 0.5% of world GDP. Country sizes are calibrated by adjusting the population size parameters \(N\) and \(N^*\). Time periods represent years.

The denomination of international bonds is in terms of HO goods. In the baseline both countries have initial government debt-to-GDP ratios of 60%, and the United States has an initial net foreign liabilities-to-GDP ratio of 40%. The trade share parameters \(\alpha\) and \(\beta\) are set to produce a U.S. imports-to-GDP-ratio of 15%, which is in line with recent historical averages.

We fix the world technology trend growth rate \(g\) at 3% per annum. The long-run HO real interest rate \(\kappa\) equals 4% per annum. We find the values of \(\beta\) and \(\beta^*\) that are consistent with these and the following assumptions.

The planning horizon \(1/(1 - \theta)\) is critical for the non-Ricardian behavior of the model, and we therefore evaluate a number of alternatives for \(\theta\), ranging from \(\theta = 0.86\) (7-year horizon) to \(\theta = 0.98\) (50-year horizon). One possible criterion for choosing this parameter is the empirical evidence for the effect of government debt on real interest rates. A number of papers have found that a 1 percentage point increase in the U.S. government debt-to-GDP ratio leads to an approximately 1–6 basis points long-run increase in the U.S. real interest rate, see Laubach (2009), Engen and Hubbard (2004), and Gale and Orszag (2004). We will show that our model would require values of \(\theta\) between 0.86 and 0.9 to be consistent with real interest rate effects of between 1 and 3 basis points.\(^{15}\)

Household preferences are further characterized by an intertemporal elasticity of substitution of 0.25, or \(\gamma = 4\). In our sensitivity analysis we will also briefly consider the case of \(\gamma = 2\). With preferences (1) the labor supply elasticity depends on the steady state value of labor supply, which is in turn determined by the leisure share parameter \(\eta\). We adjust this parameter to obtain an elasticity of 1, in line with much of the business cycle literature.

The elasticity of substitution between domestic and foreign goods, \(\delta_D\), which corresponds to the long-run price elasticity of demand for imports, is assumed to be equal to 1.5. We calibrate the technology share parameter \(\alpha_t\) and the initial level of government spending to obtain initial shares of labor income, investment spending and government spending in GDP of 60%.

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\(^{14}\) Only the market clearing conditions for RW are listed. HO conditions are symmetric.

\(^{15}\) This is also consistent with the evidence of Bayoumi and Sgherri (2006). Based on U.S. annual data starting in 1955 they decisively reject the infinite horizon model and estimate a planning horizon that is significantly shorter than 10 years.
18%, and 18%, respectively. The annual depreciation rate is 10%. The ratios of labor and capital income tax revenue to GDP are calibrated based on historical averages. The implied tax rates for HO in the initial steady state are \( r_L = 0.293 \) and \( r_k = 0.130 \).

Calibration for the INF model is almost identical. The two differences are that we set \( \theta = 1 \), and that there is a risk premium function for RW with \( \zeta = 0.01 \) and \( \rho = 0.1333 \), corresponding to the assumed 40% U.S. net foreign liabilities–GDP ratio.

4. Permanent increases in fiscal deficits

In this section we simulate the effects of a permanent 1 percentage point increase in the targeted fiscal deficit-to-GDP ratio \( gd_{tgt} \), with an initial (first year only) smaller increase of 0.5 percentage points. By Eqs. (20) and (27), and under our assumption of a 3% annual real growth rate, a permanent 1 percentage point increase in the fiscal deficit-to-GDP (current account deficit-to-GDP) ratio corresponds to a 33 percentage point increase in the long-run government debt-to-GDP (net foreign liabilities-to-GDP) ratio.

INF models assume that in the long run additional saving of consumers perfectly offsets reduced government saving, with zero effects on national saving. Fiscal deficits can therefore have short-run effects on current account deficits, but by design they are much smaller, and they must die out over time. The long-run net foreign liabilities position in such models must then be specified independently of the level of government debt, by way of the risk premium function.

By contrast, in FIN models all consumers are disconnected from future generations and do not save sufficiently to offset fiscal deficits. Instead their increased investment in government debt is partly financed by liquidating (crowding out) other forms of investment, specifically physical capital and, crucially for this paper, foreign assets. And because of the stock-flow relationships (20) and (27), the latter directly implies a long-run causal relationship from higher fiscal deficits to higher current account deficits.

Another important difference between FIN and INF models concerns the long-run equilibrium real interest rate. In the INF model this rate is tied down by the rate of time preference \( \beta \) and trend productivity growth \( g \), while in the FIN model it is related to the same fundamental parameters that affect the saving-investment relationship. These include not only \( \beta \) and \( g \) but also government debt, the planning horizon, the intertemporal elasticity of substitution, and the manufacturing technology.

4.1. U.S. fiscal deficits and the planning horizon

We start with our baseline calibration for the U.S. economy, and assume that the increase in the fiscal deficit is accomplished by adjusting lump-sum taxes \( \tau \). Figs. 4–6 illustrate. In each case we show simulations for 50 years, because changes in deficits affect debt stocks with very long lags, so that the new long-run equilibrium takes several decades to be reached. To illustrate the importance of the planning horizon, we compare model versions with a 7-year, 10-year and infinite planning horizon.

Fig. 4 shows the fiscal accounts. On impact tax revenues are reduced by 1% of GDP without simultaneous adjustments in government spending. The primary and overall deficits therefore also increase by 1% of GDP. This begins to drive up debt, so that interest expenditure on government debt starts to rise over time. To finance the interest charges while remaining within the targeted increase in the overall fiscal deficit-to-GDP ratio, the primary deficit has to start falling. In the long run, that is after more than 25–30 years, the additional interest charges exceed one percent of GDP and the primary deficit has to contract below its initial value. Debt keeps rising until it reaches its long-run value of 93% of GDP, which represents an increase of 33 percentage points.

Fig. 5 shows how this profile of taxes affects the main macroeconomic variables. For the INF model the effect is exactly equal to zero because households are Ricardian, while in the FIN model, given that taxes drop on impact, households increase consumption over the first years of the tax cut. However, higher debt levels lead to a sustained increase in real interest rates, which reduces investment and appreciates the real exchange rate. Output therefore starts falling immediately, and the more so the larger is the eventual increase in interest rates. The real appreciation increases imports and depresses exports, so that the current account deteriorates by around 0.4% of GDP on impact. The subsequent evolution of the current account and the real interest rate is driven by saving and investment dynamics, which is analyzed in Fig. 6.

The left column of panels in Fig. 6 shows the sources and uses of saving, namely public saving, private saving, investment and the current account deficit as shares of GDP, while the right column of panels shows how these flows cumulate into stocks of government debt, financial wealth (government debt minus net foreign liabilities), physical capital and net foreign liabilities.
Fiscal Accounts
Planning Horizon: - - - = 7-years, ___ = 10-years, . . . = Infinite

Tax Revenue/GDP
Gov. Spending/GDP
Primary Deficit/GDP
Interest Expenditure/GDP
Government Deficit/GDP
Government Debt/GDP

Fig. 4. One percentage point deficit shock, instrument = lump-sum taxation.
The right column of panels in Fig. 6 shows how higher government debt, through higher real interest rates, crowds out other forms of household investment. First, it crowds out domestic private capital, especially if planning horizons are short. For a 7-year horizon the capital stock drops by over 2.5% of GDP. And second, it crowds out net holdings of foreign assets equal to around 25% of GDP in the very long run, the stock counterpart of the 0.75% of GDP current account deterioration.

Fig. 7 illustrates that, as far as the current account is concerned, this result is very robust to varying the length of the planning horizon. It plots the evolution of the current account-to-GDP ratio at five different time horizons, between the very short run (2 years) and the very long run (50 years), and for seven different planning horizons. The long-run current account deficit does drop as the planning horizons lengthens, but even at a very long 50-year horizon it still equals around 0.4% of GDP. From this perspective the infinite-horizon model is extreme, as only planning horizons equal to hundreds of years get close to replicating its predictions.

Fig. 5. One percentage point deficit shock, instrument=lump-sum taxation.
One criterion by which to judge a realistic length of the planning horizon is the implied prediction for real interest rates. The above mentioned empirical literature implies that a 33 percentage point increase in the U.S. government debt-to-GDP ratio should, assuming the conservative lower end of the estimates, lead to a 33–100 basis points increase in real interest rates, and correspondingly less for the shorter run while debt builds up to its long run level. Fig. 8 shows that the 10-year planning horizon is precisely at the lower end of that range, and the 7-year planning horizon close to the upper end. Longer planning horizons imply negligible real interest rate effects despite the very large increase in debt. It is for this reason that we have chosen the 7- and 10-year horizons for our exposition in Figs. 4–6.

Fig. 9 explores the sensitivity of our results to using government spending $G$ rather than lump-sum taxation as the fiscal instrument. The main difference is a short-run stimulus effect on GDP, which lies between 0.4% for the INF model and 0.25%
for the FIN model. But longer-run real interest rates and current accounts in the FIN model behave virtually identically to the baseline case. The main change is in the current account behavior of the INF model, where the current account now deteriorates by almost 0.3% of GDP on impact. The very slow reversion to zero thereafter is due to the small calibrated value of the risk premium term \( \zeta \).

We have also simulated a scenario, in the FIN model, where both the HO and RW governments increase their fiscal deficits by 1% of GDP. The short-run stimulus effect of such a measure on GDP is stronger when the fiscal instrument is government spending. But because the reduction in worldwide saving is four times larger, the longer-run increase in world real interest rates, and the decrease in worldwide investment and GDP, is also roughly four times larger. The current account effects are of course very small when all countries run equal fiscal deficits.

In the FIN model the magnitude of real interest rate changes and therefore of crowding-out effects on the capital stock depends critically on how sensitive saving is to the real interest rate. This sensitivity is increasing in the planning horizon \( 1/(1-\theta) \), which has already been analyzed. It is also increasing in the intertemporal elasticity of substitution \( 1/\gamma \), so that changes in real interest rates and crowding-out effects diminish for lower \( \gamma \). To confirm this we resimulate the government deficit shock under the assumption \( \gamma = 2 \). We find that the increase in the real interest rate is roughly half of the baseline, and likewise for the drop in investment. But, at least at the 7-year and 10-year planning horizons, the change in the current account-to-GDP ratio is virtually identical to that of the baseline. By contrast, the long-run predictions of INF models for real interest rates and real activity are not sensitive at all to assumptions about parameters such as \( \gamma \), since the basic long-run predictions are fixed by the assumption that net foreign liabilities positions and world real interest rates are independent of government debt.

4.2. U.S. fiscal deficits and the fiscal instrument

Figs. 10–12 illustrate that the choice of fiscal instrument has only minimal effects on the long-run effects of higher fiscal deficits on real interest rates and, especially, on the current account. Only the shorter-run dynamics differ. The figures are all based on a calibration with a 10-year planning horizon, so that for the case of lump-sum taxes they repeat the simulations shown in Figs. 4–6.

Fig. 10 shows the fiscal effects, which are very similar across instruments. Fig. 11 shows the main macroeconomic aggregates. While the crowding-out effects of higher debt and real interest rates immediately reduce GDP when lump-sum taxes are cut, cuts in distortionary taxes have a short-run stimulative effect on wealth, consumption, investment and thus GDP, while an increase in government spending also stimulates output but less so. These short-run effects are significantly affected by the flexible price real business cycle features of the model, where supply side effects on output dominate while increases in demand, such as in government spending, mainly result in price increases. The supply side effects of lower
Macroeconomic Aggregates
Planning Horizon: - - - = 7-years, ___ = 10-years, . . . = Infinite

Fig. 9. One percentage point deficit shock, instrument = government spending.

capital income taxes are particularly pronounced, as they lead to an immediate investment boom, accompanied by an initial upward spike in the real interest rate and downward spike in the current account. But beyond these short-run effects, the long-run increase in real interest rates, and the long-run deterioration in current account balances, is virtually identical across instruments, given that these are driven by the effects of identical fiscal deficits on saving and investment.

This is illustrated in Fig. 12. In each case an initial increase in private saving does not fully offset the decrease in government saving. Net saving increases the most for cuts in capital income taxes, but this is more than offset by a strong increase in investment, with the current account deteriorating by almost a full percentage point over the first few years. The longer-run evolution of saving and investment, and thus of the current account, is almost identical across instruments, again with the exception of capital income taxes, where both saving and investment decline far more in the long run. But even here the long-run current account-to-GDP ratio is virtually identical to the other cases, at around 0.75% of GDP.
4.3. Small open economies

We have also simulated a permanent 1% of GDP increase in fiscal deficits for a small open economy, in this case implemented through an increase in government spending as in Fig. 9. The assumptions are that the country accounts for 0.5% of world GDP, has zero net foreign assets, and an imports-to-GDP ratio of 30%. Impulse responses for the main macroeconomic aggregates are reported in Fig. 13. The main difference to Fig. 9 is that the real interest rate does not change significantly, because small countries' deficits do not account for a significant share of world saving.

In the INF model, the behavior of consumption is even more strikingly different from the FIN model than in Fig. 9, it contracts by around 0.6% on impact, rather than increasing as in the FIN model. The reason is that Ricardian households immediately start to save to acquire virtually all of the additional government debt, with long-run net foreign assets unchanged by assumption. Due to this collapse in consumption demand the real exchange rate remains virtually flat despite the increase in government demand. The corollary of this small change in the real exchange rate is a very small deterioration...
in the current account of around 0.2% of GDP on impact, and a fairly large 0.5% increase in output, as it is mostly domestic rather than foreign goods that satisfy the government’s additional goods demand.

In the FIN model consumption rises on impact, as agents do not save significantly to acquire the additional government debt. The combination of stronger private and public demand leads to a sizeable real appreciation, and to a much larger current account deterioration than in Fig. 9, with an immediate deterioration of over 0.8% of GDP, and eventual deterioration of almost exactly 1%, equal to the fiscal deficit deterioration. The main reason is that real interest rates do not change significantly, which means that the marginal propensity to consume out of wealth is nearly unchanged, and so is wealth. Approximately constant real interest rates therefore imply that neither the private saving ratio, nor of course investment, change significantly in the long run. The fiscal deficit therefore translates virtually one for one into a current account deficit.
In other words, foreigners acquire practically all of the additional government debt. This reflects the fact that foreigners account for 99.5% of the world’s population, and world capital markets are assumed to be perfectly integrated.

These results would change if there were frictions in international capital flows whereby changes in net foreign liabilities positions led to sizeable changes in foreign borrowing interest rates. In that case higher fiscal deficits would increase domestic real interest rates, which would raise private saving and reduce investment, thereby reducing the current account deficit. We do not pursue this alternative here.

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19 We reiterate that our model’s risk premium (12) is not operative in the FIN model.
5. Conclusion

This paper discusses the current account implications of the fiscal stimulus packages recently announced in many major regions of the world economy. Our main concern is not with temporary and quickly reversed stimulus measures, but with the potential for a significant share of the increases in deficits to remain permanent. We therefore analyze current accounts not just at short horizons, but also at medium and very long horizons.

To address this question we develop an open economy business cycle model with finite-horizon households, and subject it to a permanent increase in fiscal deficits equal to 1% of GDP. Consistent with the empirical evidence of Bluedorn and Leigh (2011), we find that this leads to a current account deterioration of around 0.5% of GDP in the short run, and to a long-run
deterioration of between 0.75% for a country the size of the United States. For a small open economy that is perfectly integrated into world financial markets, the current account deterioration equals almost 1% of GDP. By contrast, the conventional infinite-horizon model predicts small short-run and zero long-run effects of higher fiscal deficits on current accounts.

We find that, to obtain current account implications even close to those of the infinite-horizon model, the planning horizon of households in the finite-horizon model would have to equal several hundred years. But in that case the effect of much higher debt on real interest rates would be essentially zero. This is at odds with the recent empirical literature, which has found that real U.S. interest rates rise by at least 1 basis point for every one percentage point increase in the U.S. government debt-to-GDP ratio. The finite horizon model is able to generate this result by assuming planning horizons of 10 years or less.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jedc.2013.05.001.

References