

Twin Deficits: Squaring Theory, Evidence and Common Sense¹

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This version: March 2006

First Draft: November 2005

Abstract

Appealing to the twin deficit hypothesis, according to which shocks to the government budget move the current account in the same direction, many observers call for fiscal consolidation in the US as a necessary measure to reduce the large external imbalance of this country. We reconsider the international transmission mechanism in a standard two-country two-good business cycle model, and find that fiscal expansions have no effect on the trade balance and thus on the current account i) if the economy is not very open to trade and ii) if fiscal shocks are not too persistent. Under these conditions, the crowding out effect of fiscal shocks on private investment is stronger than conventionally believed. We take this insight to the data and investigate the transmission of fiscal shocks in a VAR model estimated for Australia, Canada, the UK and the US. For the US and Australia, which are less open to trade than Canada and the UK, we find that the external impact of shocks to either government spending or budget deficits is limited, while private investment responds significantly – in line with our theoretical prediction. The reverse is true for Canada and the UK. These results suggest that a fiscal retrenchment in the US may have a limited impact on its current external deficit. However, our results do not weaken the case for fiscal consolidation: by crowding in investment, a fiscal correction will strengthen the ability of the US to generate resources required to service future external liabilities.

Keywords: twin deficits, budget deficits, trade deficits, home-bias, openness, crowding out, international transmission of fiscal policy, current account adjustment.

JEL classification: E62, E63, F32, F42, H30

¹Preliminary version of a paper prepared for the 43rd Panel Meeting of *Economic Policy* in Vienna. We thank Giuseppe Bertola, four anonymous referees, Keith Küster, Rick van der Ploeg, Morten Ravn, and seminar participants at the European University Institute and Goethe University Frankfurt for helpful comments as well as Larry Schembri for help with the Canadian data. Zeno Enders provided excellent research assistance, Lucia Vigna invaluable help with the text. Corsetti's work on this project is part of the Pierre Werner Chair Programme on Monetary Union of the Robert Schuman Centre at the European University Institute. Financial support by the programme is gratefully acknowledged. The usual disclaimer applies.

1. Introduction

The fiscal deterioration in the US during the first George W. Bush administration, coupled with persistent US trade deficits, focused renewed attention on the twin deficit hypothesis. According to this hypothesis, fiscal shocks which cause a deterioration of the government's budget also worsen a country's current account balance. Over time the hypothesis has found empirical support in informed analyses of specific episodes of fiscal reforms, such as the Reagan tax cuts, which were associated with a sharp decline in the current account. Currently, policy circles and institutions strongly advocate domestic fiscal consolidation as a necessary measure to correct the US current account deficit, and as a crucial contribution to managing global imbalances (e.g. IMF WEO (2004, 2005), The Economist (2005)). How strong is the evidence for the twin deficit hypothesis, and the theoretical case for it? While fiscal consolidation may be desirable in the US regardless of its external implications, recent work has strengthened doubts about the quantitative relevance of fiscal policy for the current account, at least in the short run, e.g. Kim and Roubini (2003), Erceg, Guerrieri and Gust (2005), Bussière, Fratzscher and Müller (2005). To some extent, these results are consistent with a larger body of evidence, suggesting a weakening of the overall macroeconomic effects of fiscal policy in the last two decades (Perotti (2005)).

By national accounting a fall in national saving due to a government deficit translates - *other things equal* - into a fall in the current account balance. However, there are different mechanisms through which the private sector may partially offset the consequences of a loose fiscal policy on the external account. First, private savings will typically increase in response to fiscal shocks raising public debt, as a higher debt generates expectations of higher taxes in the future. The strength of this mechanism depends on the extent to which households internalize the government's intertemporal budget constraint (a point stressed by proponents of Ricardian Equivalence). Second, to the extent that a loosening of fiscal policy raises interest rates, a fall in public saving may crowd out investment. However, it is usually thought that these mechanisms cannot 'undo' the negative impact of budget deficit on the external account.

In this paper, we argue that the response of private investment to fiscal shocks may actually be stronger than conventionally believed. Our argument focuses on the implications of fiscal shocks for the real return to capital and for the cross-border differentials in real interest rates, via movements in international relative prices (terms of trade). We find that, because of these differentials, fiscal expansions need not lead to external deficits: they can even induce a trade surplus. Specifically, we show that a fiscal deficit resulting from a temporary increase in

government spending is likely to be accompanied by no external trade deterioration if i) the economy is sufficiently closed and if ii) the increase in government spending is not too persistent. Conversely, twin deficits are likely to be observed if the economy is relatively open, i.e. highly integrated into world markets, and if the increase in government spending is expected to last for an extended period of time.

We derive these results in a standard general equilibrium model, drawing on two distinct ways of thinking about the link between fiscal policy and the current account. According to the Mundell-Fleming model, with flexible exchange rates, fiscal deficits appreciate the currency: a higher relative price of domestic goods crowds out net export. If fiscal deficits also raise the interest rate, the resulting external imbalance may be mitigated because of a simultaneous fall in domestic investment. This model stresses changes in terms of trade and interest rates, but abstracts from intertemporal consumption smoothing and treats the rate of return to investment as exogenous. Conversely, the so-called intertemporal approach to the current account emphasizes consumption smoothing and optimal intertemporal investment decisions, but typically assumes a high degree of world market integration. Most models in this area either assume only one homogenous tradable good or disregard the equilibrium implications of relative price changes for the return to investment and the real interest rate. This is where our general equilibrium analysis brings in most novel insights.

These insights concern the international transmission of fiscal policy to private investment and, through this, to the trade balance. It is well understood that government spending may crowd out private investment. However, if goods are not homogenous and government spending falls mostly on domestically produced goods, a government spending shock raises the price of these goods relative to foreign goods. For a given marginal product of capital in physical terms, then, the return to domestic investment rises with the appreciation of the domestic goods, which makes the output of domestic capital more valuable in terms of consumption. This effect on the rates of return counteracts crowding out effects of fiscal policy on investment via higher interest rates.

Shock persistence is a key factor for the transmission process, because the longer the shock is expected to last, the more persistent the improvement of the terms of trade. Openness is the other key factor, because in relatively closed economies, the terms of trade are of little importance for investment decisions. At the same time, the domestic interest rate increases substantially relative to the rest of the world in response to a domestic fiscal expansion. Therefore, for a given shock persistence, private investment is crowded out to a large extent in

relatively closed economies, leaving the external balance unaffected. The reverse is true for relatively open economies.

By emphasizing the role of openness in the international transmission of fiscal shocks, we share the view of the international economy that many authors --- most notably Obstfeld and Rogoff (2001) --- place at the heart of policy analysis in general equilibrium. These authors argue that, despite globalization, national economies remain quite ‘insular’, in the sense that international real and financial markets remain segmented along national borders for a variety of reasons. These include trade costs, distribution, price discrimination, and preferences generating a substantial degree of home bias in consumption and portfolio decisions. As a result, production, consumption and investment decisions respond to a set of prices that may be quite different from the set of prices abroad --- although the two are related in general equilibrium at the world level. While presenting an articulated analysis of insularity is beyond the scope of this paper, one way to interpret our results is that the degree of ‘insularity’ (reflected in low openness) has significant effects on the international spillovers from fiscal policy. Policy analysts must place this dimension at the heart of their models.

To assess our theoretical findings, we reconsider a recent VAR study by Kim and Roubini on the US, which identifies spending and budget shocks by restricting their short-run effects on output (see Kim and Roubini 2003). Since in our view the response to fiscal shocks depends on structural features of the economy, we revisit the main findings of these authors in a comparative perspective. Thus, in addition to the US, which is a large and relatively closed economy, we include in our sample three medium-sized OECD economies --- the UK, Canada and Australia --- which differ with respect to their degree of openness. For the US we corroborate earlier findings that a typical fiscal expansion has a negligible or even positive effect on the external balance. We thus do not find twin deficits. At the same time spending shocks substantially depress investment. Conversely, for Canada and the UK, economies which are considerably more open than the US, we find that the effects of fiscal shocks on investment are contained, while the external balance declines substantially. For these relatively open economies we thus do find twin deficits. The evidence for Australia, which is less open than Canada and the UK, is instead similar to the US. We also compute different measures for the persistence of the fiscal shocks identified in the estimated VAR models. Our estimates suggest that a typical government spending shock is relatively persistent in Canada and much less so in Australia. Our empirical results thus underscore our theoretical argument, that the presence and magnitude of twin deficits induced by fiscal shocks depend crucially on the degree of openness and the persistence of the fiscal shock.

These findings provide a way to reconcile the existing empirical evidence with the received wisdom and common sense in policy making, according to which prudent budget policies are desirable when the external deficit is excessive. Even for the US, where we find that fiscal shocks have small contemporaneous quantitative effect on the external balance on average, a fiscal correction is likely to crowd in domestic capital. By raising the stock of capital, a fiscal correction will increase the ability of the US to generate the resources required to meet its external obligations in the future.

This paper is organized as follows. In Section 2 we start with a short discussion of the joint behaviour of the budget balance and the trade balance for the four countries in our sample. In Section 3, we develop our theoretical argument for why openness and shock persistence are key determinants for the response of private investment. We also state conditions under which twin deficits are likely to result from temporary increases in government spending. In Section 4, we investigate to what extent fiscal shocks drive trade movements in our sample of OECD countries. We specify and estimate a VAR model where spending shocks are identified following the approach suggested by Blanchard and Perotti (2002), and deficit shocks are identified following Kim and Roubini (2003). In Section 5 we discuss the policy implications of our result. Section 6 concludes. Two boxes provide analytical and technical details on our quantitative and empirical models.

2. A first look at the evidence

2.1 Basic accounting

Virtually all analyses of the twin deficit hypothesis begin with a review of a basic national accounting identity. We stick to this well-established tradition, and begin by relating the external deficit to the difference between national investment and national saving, which in turn is the sum of private and public saving. By definition, the current account balance, hereafter CA, is equal to the value of net exports, NX, plus the interest payments earned on net foreign assets. Equivalently, the CA balance equals private disposable income (the sum of GDP, Y, plus income on net foreign assets, less taxes net of transfers, T) minus private consumption and investment expenditures (denoted C and I, respectively), plus taxes net of transfers T, less government spending denoted G:

$$CA = NX + rB = (Y+rB-T) - C - I + (T-G),$$

where B denotes the stock of net foreign assets and r denotes the average interest rate earned on them. Now, define private saving as disposable income net of consumption expenditure, i.e. $(Y+rB-T) - C$; by the same token define government saving as $T-G$, in practice, the negative of the budget deficit. After changing sign, we can rewrite the basic identity above as:

$$\text{Current Account Deficit} = \text{Investment} - \text{Private Saving} + \text{Budget Deficit}.$$

From an accounting perspective, holding investment and private saving constant, a deterioration of the fiscal position (an increase in the budget deficit) worsens the external balance. From an economic perspective, however, private saving and investment will also adjust in response to changes in the fiscal stance.

The twin deficit hypothesis is formulated with reference to policy innovations whereby a government changes its fiscal stance; say, by reforming the tax code and/or by altering spending policies which generate an increase in the budget deficit. The fiscal initiatives by the George W. Bush administration upon coming to power in 2000 provide a good example of the kind of shocks proponents of the hypothesis have in mind. Naturally, fiscal policy innovations are likely to affect households' consumption and firms' investment behaviour. Tax cuts may stimulate domestic demand via their effects on disposable income, or the price of consumption (e.g. the government implements a temporary reduction in indirect taxes), or via their effects on investment. However, forward-looking households may also react to temporary tax reduction by increasing private saving, as they forecast higher tax liabilities in the future. The literature has long made clear that, if there are no financial frictions, if taxes are not distortionary, and if higher future taxes entirely fall on those who benefit from the current tax cuts (in other words, if Ricardian equivalence holds), private saving will completely offset any change in public saving resulting from changes in tax policies. Similarly, an unexpected increase in government spending may raise households' disposable income in the short run, but lower their permanent income in proportion to the present discounted value of the additional spending. Government spending also affects relative prices, including the real interest rate, and the price of domestic goods in terms of foreign goods (the real exchange rate and the terms of trade). In a nutshell, the twin deficit hypothesis stipulates that, whatever the fiscal transmission channel, the endogenous response of the private sector to fiscal shocks will not completely offset the effect of public dissaving on the external balance: the current account ends up deteriorating together with the government budget.

Before proceeding, we state upfront that, in our theoretical and empirical analysis below, we will use the trade balance (or net exports), instead of the current account, as a measure of a country's external position. Using the definitions reported above, net exports (NX) differ from the current account because they do not include interest payments on national debt (rB). Early literature, e.g. Baxter (1995), argues that, at business cycle frequencies, the two measures tend to move closely together since the stock of debt adjusts very slowly. Hence, unless interest rates are very volatile, the difference between net exports and the current account can be observed mostly in the low-frequency components of the data.² For the purpose of this paper, focusing on the trade balance rather than the current account has the advantage that net exports always have a well defined counterpart in theoretical models, independently of specific assumptions regarding the structure of international financial markets. Consequently, in our analysis below we will exclude interest payments also from our measure of a country's fiscal position. In other words, we will use the primary budget balance.³

2.2 A systematic co-movement of budget and trade deficits?

In specific episodes of fiscal loosening, notably in the US, budget policies have been accompanied by substantial external trade deterioration. These episodes are often taken as evidence in support of the twin deficit hypothesis. Figure 1 displays the *primary budget balance* and the *trade balance* for the US, the UK, Australia and Canada.⁴

< Figure 1 about here >

The reason why the twin deficit hypothesis gained popularity at certain times, and less so in others, is apparent. The US budget balance and trade balance move closely together in the mid-

² With the rapid growth of the stock of foreign assets and liabilities in countries' portfolios, capital gains and losses on these assets, including those attributable to exchange rate movements, can be quite sizeable. Hence, the effective return on net foreign assets may be quite volatile, even when the official balance of payment statistics, which record only payments of dividends and coupons, are not. A reconsideration of twin deficits using a dataset allowing for capital gains and losses is an interesting direction of research that we intend to pursue in the future. For the time being, however, data availability on a cross-country basis limits our ability to do so.

³ We normalize both the primary budget balance and net exports by GDP to allow cross-country comparisons. To the extent that fiscal shocks raise the risk premium on sovereign debt, twin deficits may emerge from rising cost of internal and external borrowing.

⁴ While the joint evolution of the budget and the trade deficit in the US has traditionally been the focus of the policy debate, we analyze the time series of three additional countries. Here, our sample choice is largely determined by considerations regarding the feasibility of the VAR analysis in section 4 below.

1980s and after the year 2000. As both periods are characterized by considerable fiscal expansions, many observers have pointed to these policies as an important factor driving the US trade deficit. However, there is also a remarkable divergence of the two time series during the late 1990s. The pattern is even less clear-cut for the UK and Australia, for which one can spot several periods of twin divergence. In Canada the two time series appear to move closely together since the early 1990s.

The main lesson from Figure 1 is that the correlation between the budget balance and the trade balance is not necessarily positive. To explore this issue further, we isolate the short-run fluctuations at business cycle frequency from long-run movements by applying the Hodrick-Prescott-filter to the series displayed in Figure 2. We then compute the correlation of budget and trade balances using their cyclical components. The correlation coefficient turns out to be negative in all four countries: -0.24 in the US, -0.26 in the UK, -0.16 in Canada and -0.37 in Australia --- meaning that budget deficits are systematically associated with trade surpluses, i.e. the opposite of twin deficits.

This statistical result is sometimes used as the basis for a crude argument, stating that ‘twin deficits do not exist in the data.’ Such argument is faulty, since it fails to recognize the obvious cyclical nature of the fiscal stance and the trade balance. Typically, an economic boom will improve the budget balance: for given fiscal rules, tax revenues rise with income and some categories of spending fall with the level of economic activity. At the same time the external position deteriorates as the trade balance is generally found to be countercyclical. This argument applies whether the expansion is associated with a supply (technological) shock or a nominal shock. To the extent that these shocks (other than of a fiscal nature) can account for most macroeconomic fluctuations,⁵ a negative correlation between government budgets and external trade at business cycle frequencies may not tell us much about the response of these two aggregates to spending and tax shocks --- which is the essence of twin deficits.

To explore further the joint cyclical behaviour of the trade and the budget balance, we also compute the correlation between the budget balance and future realizations of the trade balance as a synthetic representation of the joint dynamic of these two variables.

< Figure 2 about here >

⁵ This interpretation is also supported by results in Kollmann (1998) and Freund (2000), which suggest that the trade balance is mostly driven by technology shocks or, more generally, moves with the business cycle.

The results are shown in Figure 2. For each country, we plot the correlation between the current value of the primary government balance, bb , and current and future realizations of the trade balance, nx , for up to two years. All countries display a broadly similar pattern: the contemporaneous correlation is negative, but the correlation between future realizations of the trade balance and the current budget balance becomes positive at some point. The pattern turns out to be quite robust to changes in the sample size, to the filter applied to the raw data, or to the inclusion of more countries in the analysis.⁶

The correlation patterns displayed in Figure 2 provide a summary of the joint dynamics of the budget balance and the trade balance over the business cycle, in response to the many factors, which drive a typical business cycle movement. This is novel evidence that we explore further in related work (Corsetti and Müller (2005)). For the purpose of this paper, the main conclusion from Figure 2 is that evidence in support of the twin deficit hypothesis is not easy to detect. It requires identifying fiscal shocks, isolating these from other shocks which generate cyclical movements of the economy, and testing whether these shocks move the two deficits in the same direction, thus overturning the typical correlation pattern detected at business cycle frequencies.

A large body of empirical literature has addressed this problem by using single equation techniques, see e.g. Summers (1986), Bernheim (1988) or Roubini (1988). Within this strand of the literature there is considerable disagreement on the quantitative effect of fiscal deficits on trade deficits. Nonetheless, some studies have succeeded in establishing the notion that about a third of the increase in the budget deficit is reflected in the trade deficit, e.g. Chinn and Prasad (2003). More recent studies have reported somewhat lower estimates for the twin deficit relationship. Bussière et al. (2005), Gruber and Kamin (2005) and Chinn and Ito (2005) find that only some 1 to 20 percent of the increase in the public deficit is reflected in the trade deficit, whereas the effect is statistically significant only according to the last study.

These results suggest that the response of private saving and investment to changes in fiscal stance are substantial, motivating a careful re-consideration of the different channels through which fiscal policy affects the private sector's consumption and investment decisions. This is the task we pursue in the next section.

⁶ When applying the HP-filter, we use a smoothing parameter of 1600. We also applied the Band Pass Filter suggested by Christiano and Fitzgerald (2003) instead of the HP filter, and extended our analysis by using data from the earliest available data point, 1964Q1, without significant effect on the shapes of the cross-correlation functions. By the same token, using the current account instead of net exports does not affect the results.

3. A new perspective on fiscal policy transmission in open economies: the role of openness

The twin deficit hypothesis raises fundamental issues regarding the transmission of fiscal policy in the open economy: how do saving and investment rates respond to a domestic fiscal shock in the domestic economy and abroad? In this section we reconsider this question in detail, taking a specific angle. Namely, starting from the empirical evidence on the import content of national expenditure, we explore the implications of varying the degree of a country's openness and fiscal shock persistence for the international transmission of fiscal policy. We proceed as follows. First, we review the traditional debate on fiscal transmission and on twin deficits, highlighting an area where we find traditional analyses insufficiently developed; second, we provide some evidence on the import content of GDP, motivating our assumption of home bias in spending; third, we develop our main theoretical argument shedding light on how home bias affects the international transmission mechanism via investment decisions, and support our analytical results with quantitative experiments. We close this section with an extension of our results to the case of tax shocks and a summary.

3.1 The traditional focus of the debate

The traditional debate on fiscal transmission and twin deficits emphasizes two distinct transmission mechanisms. One stresses relative price movements, the other intertemporal (borrowing and lending) decisions. The first transmission mechanism is central to the Mundell-Fleming model. Here, an expansionary fiscal shock raises disposable income and internal demand. Part of the higher consumption demand 'leaks abroad' in the form of higher imports, deteriorating the trade balance. Moreover, with flexible exchange rates a stronger domestic demand also appreciates the exchange rate, crowding out foreign demand. Because of differences in the multiplier, the impact is stronger for spending hikes than for tax cuts. The increase in the external deficit is somewhat mitigated to the extent that the upsurge in domestic demand raises the domestic interest rate, and thus crowds out domestic investment. Overall, however, the emphasis is on the static transmission mechanism, linking fiscal deficits to excess demand and relative price movements.

In contrast, the so-called intertemporal approach to the current account emphasizes that shocks to government spending cause external deficits depending on their persistence. In the baseline dynamic small open-economy model, the interest rate is assumed to be constant and labour supply is fixed. In the extreme case in which the level of government spending increases

permanently, households lower their consumption by the same amount. Here the basic principle is that, irrespectively of the timing of the tax incidence, households will have to carry the burden of the increase in public spending. When the increase in government spending is initially financed through debt, private saving rises enough to offset entirely the government's budget deficit: there is no impact on the current account. In the other extreme case in which the increase in government spending is transitory, permanent income and thus consumption plans of domestic households are hardly affected. When the upsurge in spending is financed through debt, domestic private savings will not rise much, and the current account will fall almost one-for-one with the increase in the government budget deficit: transitory increases in government spending thus induce twin deficits. For later reference, we note that allowing for elastic labour supply strengthens the external effects of fiscal shocks: in response to a lasting government spending shock (which eventually lowers household wealth), or an unexpected temporary tax cut, households supply more labour, affecting total private saving but also raising the marginal product of capital (under standard assumptions about the production function). A higher return on capital drives up investment and therefore tends to lower the trade balance. This mechanism runs counter to possible changes in the real interest rate, which tend to discourage investment.⁷

The static and intertemporal considerations identified by the traditional debate on the transmission of fiscal policy are essential building blocks for an analysis of twin deficits. We will draw extensively on them below. However, traditional explanations miss an important element, insofar as they disregard the interaction between relative price movements and intertemporal investment and saving decisions. This interaction, in turn, depends on the degree of openness, i.e. the degree to which good markets are integrated across national borders.

3.2 Globalization and insularity of national economies

In a well-known contribution, Obstfeld and Rogoff (2001) present a host of theoretical and empirical arguments showing that, despite ongoing 'globalization,' there are many dimensions in which markets remain quite 'insular' along national borders. For instance, the literature has provided ample evidence on persistent cross-border price differentials for identical goods, suggesting barriers to trade and frictions of different nature. Perhaps thanks to The

⁷ See Ahmed (1986) for an exploration of government spending shocks in the baseline intertemporal small open-economy model and Baxter (1995) and Kollmann (1998) for an extensive numerical analysis within the one-good two-country model.

Economist's regular reporting on the price of the Big Mac in different markets, there is wide awareness of the importance and pervasiveness of such price differentials.

Barriers and frictions in international trade may be expected to play an important role in explaining why the import content of consumption and investment expenditure remains quite limited. Table 1 shows the import content of GDP and its components for the four countries in our sample. In the more open of our countries, such as the UK, imports account for over 30 percent of investment and more than 40 percent of the change in inventories, but the import content in private consumption is only 20 percent.⁸ In the least open of our economies, the US, the import content of different categories of spending is approximately one half of the corresponding figures for the UK.

< Table 1 about here >

As a way to capture the economic factors determining a low import content in domestic expenditure in an analytically tractable way, the literature often refers to the idea that domestic spending is 'biased towards home goods.' Other things equal, households and firms have a preference for domestically produced goods. As home bias is reflected in the import content of private expenditures and thus in the share of imports in total GDP, it is closely related to the degree of openness of an economy. In our standard model of the global economy outlined in Box 1 below, home bias is just the negative of openness (measured by the import-GDP ratio): the same parameter determines both. In what follows we will use either term to refer to the same phenomenon: that the typical consumption and investment basket contains more domestically produced than imported goods.

In the presence of home bias, the price of national consumption baskets typically differs across countries (the purchasing power parity condition does not hold), even if the law of one price holds for all individual goods. This is because the consumer price index (CPI) in each country gives a large weight to the prices of domestically produced goods. Because of home bias, inflation rates are not necessarily the same, and the domestic real interest rate (which by definition is the price of consumption at different dates) needs not be equal across borders.

While the evidence in table 1 shows that domestically produced goods clearly dominate imports in investment and consumption expenditure, it also suggests that the strongest home bias

⁸ Erceg, Guerrieri and Gust (2005b) argue that the high import content in investment relative to private consumption should be taken into account in assessing different scenarios of trade adjustment. Our analysis, in contrast, focuses on the fact that the import content of government spending is particularly low and that the import content in overall private absorption remains limited.

is in government spending, which to a large extent consists of the wage bill of government employees. The question as of whether and to which extent government demand falls on foreign produced goods, rather than domestic goods, is important for understanding twin deficits. To the extent that government spending falls on foreign goods, a positive fiscal shock would have a direct and immediate effect on imports. For instance, if the import content of public spending were as high as 20 percent, other things equal, a 1 dollar increase in spending would deteriorate the trade balance by 20 cents. However, in light of our evidence, this direct transmission channel is not very strong: the import content ranges between 6 and 12 percent. As a way to focus on the transmission of fiscal shocks to net exports via changes in consumption and investment, we abstract from the import content in government spending and assume that government demand falls entirely on domestically produced goods.⁹

Home bias in public and private spending and the resulting differentials of CPI-inflation and the real interest rates, are two characteristics of the world economy which are crucial when it comes to understanding the effects of fiscal expansion on the trade deficits. We will explain the reason why in the next subsection.

3.3 Fiscal policy, terms of trade, and the return on investment in partially integrated economies

We are now ready to reconsider the international transmission of fiscal shocks, specifically focusing on the consequences of fiscal expansions for the trade balance. Taking a new perspective relative to models assuming an idealized one-good world, we place limited good markets integration at the heart of our argument: because of home bias, fiscal shocks drive a wedge between the return on domestic investment and the return earned on investment in the rest of the world, as well as between domestic and foreign interest rates. These wedges govern the domestic investment decisions relative to those abroad and eventually drive the response of the domestic trade balance.

To illustrate how this works, recall that government spending mostly falls on domestically produced goods (or domestic labour services). A sustained increase in public demand thus has a lasting, positive effect on the price of these goods relative to foreign goods,

⁹ Backus, Kehoe and Kydland (1994) analyze the transmission of fiscal shocks in a two-country model where the import content is assumed to be 15 percent. Therefore, this model provides a suitable starting point for our analysis of how goods market fragmentation affects the private sector's response to government spending shocks. More recently, Erceg, Guerrieri and Gust (2005a) analyze fiscal transmission in a two-good model which also features nominal frictions and non-Ricardian households.

leading to a lasting terms of trade appreciation. In the tradition of the Mundell-Fleming analysis reviewed above, a terms of trade appreciation crowds out net exports via a static, relative-price effect: consumers switch away from domestic goods which are now more expensive. However, the Mundell-Fleming model ignores the repercussions of this relative price change on the rate of return to capital.

These repercussions are at the core of general equilibrium dynamics. A lasting terms of trade appreciation means that, other things equal, the revenues earned from domestic investment projects are more valuable in terms of domestic consumption. In other words, the fiscal expansion raises the expected return to domestic investment in real terms. At the same time, a fiscal expansion is also likely to raise the domestic real interest rate. The overall effects on capital accumulation will depend on the relative strength of these two effects.¹⁰

The effect of the terms of trade on the return to capital is decreasing in the degree of home bias (i.e. the effect is stronger in more open economies). Intuitively, holding the price of imports constant, an increase in domestic good prices which appreciates the terms of trade, also raises the CPI. But with a strong home bias, the price of domestically produced goods *in terms of domestic consumption* does not change much. If home bias is pervasive, for a given marginal product of capital in units of domestically produced goods, a lasting appreciation of the terms of trade has a limited effect on the *marginal revenue* of capital in units of consumption goods, i.e. a limited effect on the real return to domestic projects.

To see this, consider a simple definition relating the real return to investment to the price of domestically produced goods (denoted P_d , as opposed to import prices P_f), the consumer price index (CPI) and the marginal product of capital. Ignoring depreciation for simplicity, we can write:

$$\text{Real return to investment} = \frac{P_d}{CPI} \text{ (marginal product of capital in physical units).}$$

The CPI is a weighted average of domestic good prices P_d and import prices P_f . Denote the corresponding weights with ω and $1 - \omega$, respectively, so that ω is the measure of home bias and $1 - \omega$ provides a measure for openness, i.e. the share of spending that falls on imported

¹⁰ In our analysis we calculate the return to capital from the perspective of domestic household, thus implicitly assuming that a country's capital stock is not owned by foreigners. This simplifies the analysis and is consistent with the idea that market segmentation matters in financial markets as well as in good markets. Evidence on the strong positive correlation between home bias in consumption and equity portfolios, and a model rationalizing this correlation, is provided by Heathcote and Perri (2004). Our argument would go through, however, also in an economy with some diversification of equity portfolios.

goods. Then, any change in the P_d -CPI ratio can be approximated by the following expression involving only changes in the terms of trade:

$$\text{Change in } \frac{P_d}{CPI} = (1 - \omega) \text{ Change in } \frac{P_d}{P_f}$$

For a given marginal product of capital in physical units, an appreciation of the terms of trade (P_d increases relative to P_f) improves the rate of return on domestic investment by $(1 - \omega)$: the more open an economy, the stronger the improvement of the real return on investment. Put differently, the larger the home bias (ω going to 1), the weaker the improvement of the real return on investment. Clearly, the degree of home bias will also influence the magnitude of the terms of trade response to shocks. In our analysis, however, we find that the overall return on capital systematically falls with ω .

Together with home bias, the second crucial element is the degree of persistence of fiscal shocks. A persistent increase in spending raises the tax burden of the private sector. For our argument, however, there is another effect which is relevant. If the shock to government spending is persistent the public demand for domestic goods remains relatively high in the future and so will the relative price of domestic goods, raising the expected return on domestic capital. Thus the improvement of the domestic terms of trade tends to be stronger, the longer the spending shock lasts. Consequently, all else equal, domestic investment increases in the degree of persistence of the fiscal shock.

The above arguments apply to foreign investment demand as well, but with the opposite sign. A fiscal expansion in the domestic country worsens the terms of trade abroad and reduces the return to foreign capital in terms of foreign consumption, thus discouraging capital accumulation abroad.

In equilibrium the rate of return on investment must be equal to the real interest rate. In each country, the real interest rate measures the relative price of consumption in the future relative to consumption today. With no home bias and no deviation from the law of one price, the price of consumption and therefore the real interest rate is equalized across countries: via the interest rate channel, a fiscal shock would affect investment symmetrically in all countries. With home bias, instead, an appreciation of the terms of trade will drive the domestic and foreign real interest rate apart. Fiscal shocks thus generate positive differentials in the real rate of interest, which discourages investment in the domestic economy more than abroad.

Given a domestic fiscal expansion, home bias is therefore key to understanding the response of domestic investment relative to investment in the rest of the world. A stronger home bias tends to reduce the equilibrium impact of terms of trade movements on the return to capital, but increases the differentials in the real rate of interest. Crowding out effects of fiscal shocks are therefore larger in economies which are less integrated in the world markets. In more open economies, instead, fiscal shocks improve the return to capital, while having a contained effect on real interest differentials. In the next section, we show that investment differentials are quantitatively relevant in driving the response of the external balance to fiscal shocks.

3.4 Openness and shock persistence: some quantitative results

In this section, we use a general equilibrium model to quantify the insights on the transmission channel discussed above. Our quantitative assessment is based on the two-country, two-good model described in detail in Box 1. Note that, following our discussion in section 3.2, we assume that government spending falls entirely on domestic goods.

< Box 1 about here >

To start with, reconsider the definition of the current account (given in Section 2). In a world economy consisting of two countries, the deficit in the home country is equal to the current account surplus by the other country. Denoting the latter ROW, standing for ‘rest of the world’ we can write:

$$\begin{aligned} \text{Current account deficit} = & .5 * [(\text{Investment} - \text{Investment}_{\text{ROW}}) - \\ & (\text{Private Saving} - \text{Private Saving}_{\text{ROW}}) + \\ & (\text{Budget Deficit} - \text{Budget Deficit}_{\text{ROW}})] \end{aligned}$$

The home current account deficit results from a difference between home and foreign in (a) investment, (b) private saving, and (c) the government budget deficit. To quantify the interaction of openness and the degree of shock persistence in shaping the international transmission of fiscal shocks, we focus on the *differential* between home investment and investment in the rest of the world, the first term on the right hand side of the above identity.

Figure 3 plots the combinations of openness (measured by the import content of GDP) and shock persistence which would generate *no change* in domestic investment relative to foreign investment, i.e. such that $I - I_{ROW} = 0$. The different lines in figure 3 correspond to different assumptions about international financial markets and the elasticity of labour supply. In the baseline case we assume that international financial markets are complete and labour supply is inelastic (solid line); in the two other cases we assume that international financial markets are incomplete: the dashed line corresponds to the case of inelastic labor supply; the dotted line corresponds to the case of elastic labour supply.¹¹ For each of these lines, the area above the line is one of *relative crowding in* of domestic investment, the area below the line one of *relative crowding out*.¹²

< Figure 3 about here >

Consider first the line drawn for the baseline case of complete markets and inelastic labour supply. Start from a point *on* the solid line: raising shock persistence for a given degree of openness leads to relative crowding in; conversely, lowering the degree of openness, i.e. increasing home bias, for a given degree of shock persistence, leads to a fall in domestic investment relative to foreign investment.

In order to gain further insight in the logic of the argument, consider the extreme case of fiscal shocks with no persistence at all --- government spending is raised exclusively in the current period. Without home bias in private consumption and investment (imports account for 50 percent of private spending but for only 40 percent of GDP since government spending falls

¹¹ Formally, the assumption that international financial markets are complete can be implemented by assuming that there exists a complete set of state-contingent securities which are traded across countries. As a consequence, country-specific shocks such as a shock to government spending are fully insured and their financial burden is equally shared between domestic households and the households in the rest of the world. Under incomplete international financial markets, in contrast, only trade in non-contingent bonds is assumed to take place across countries.

¹² We omit from the main text an analysis of consumption and saving. In our model the overall tax burden from the expanded government spending (irrespectively of when lump-sum taxes are levied) lowers current consumption. For given taxes, this raises private saving, offsetting in part the fall in public saving. The magnitude of the impact on private wealth and thus on consumption depends on the degree to which households share idiosyncratic risk across countries. Under complete international financial markets, households in the home and foreign country would equally share the burden of the domestic fiscal expansion. However, we should observe here that, even in the absence of efficient portfolio diversification, a terms of trade improvement in response to government spending shocks would tend to transfer some of the burden from the domestic fiscal shock onto foreign households. This is because a home appreciation reduces the value of foreign output relative to the domestic one, depressing foreign consumption. Overall, consumption falls in both countries.

entirely on domestic goods and services), there will be no change in relative investment. This is so because a temporary shock has no lasting sizeable effects on the terms of trade, so that there is little or no impact on expected return to capital. The interest rate will increase. However, with no home bias in private spending, the interest rate will be identical at home and abroad. As a result, investment will respond negatively, but symmetrically, in the two countries. If, with temporary shocks, we allow for some home bias in private spending (the import share in GDP less is than 40 percent), we are located somewhere in the area below the solid line. The real interest rate increases more in the domestic economy than abroad: investment thus falls more at home than abroad (corresponding to relative crowding out).

Now, start again from the extreme case of no home bias, and consider a lasting spending shock. As argued above, without home bias, the real interest rate increases identically in both countries. However, the expected return on domestic investment is now higher, because a lasting fiscal shock at home induces a lasting terms of trade appreciation which raises the return to domestic capital. This is why domestic investment increases relative to foreign, i.e. there is *relative* crowding in.

Figure 3 suggests that the degree of risk-sharing does not impinge on the main transmission mechanism discussed above (dashed line). The locus of ‘no-relative investment changes’ is almost identical in the cases of complete and incomplete markets. This result should not come as a surprise, as the core of our analysis consists of relative price changes reflecting the elasticity of substitution across goods, and relative preferences for a class of goods. These changes occur to a large extent independently of the degree of consumption insurance in the economy.¹³

Relative to the baseline scenario (inelastic labour supply), the results obtained under the assumption of endogenous labour supply are particularly interesting. As shown in the graph (dotted line), allowing for elastic labour supply raises the area of relative crowding in of domestic investment: the locus corresponding to ‘no-relative investment changes’ shifts inwards. We have already discussed the reason for such a result in section 3.1. A lasting government spending shock corresponds to a negative wealth shock to households: facing a higher tax burden, they reduce their consumption of goods and leisure (thus work more). Insofar as labour and capital are complements in production, a higher labour supply raises the marginal return to capital and hence the incentive to invest. To capture this consideration, we amend our formulation of the return to

¹³ See however Corsetti, Dedola and Leduc (2004), for an analysis of the model with low price elasticities of import demand, which induce large differences in allocations with complete and incomplete markets.

capital above by writing the marginal product of capital in physical units, MPC, explicitly as a function of employment:

$$\text{Real return to investment} = \frac{P_d}{CPI} (\text{MPC}[\text{employment}])$$

A positive labour supply response to fiscal shocks tends to work in favour of twin deficits, as it raises the incentive to invest in domestic capital and thus partially offsets the increase in the domestic interest rate.

We close this subsection by emphasizing that *relative* crowding in of investment (which is the relevant variable to assess the transmission of fiscal shocks to the external trade) does not necessarily translate into an increase in the *level* of investment in the home country. Figure 4 shows impulse responses to a government spending shock, generated by our model under the assumption of incomplete markets and elastic labour supply. The figure presents two sets of impulse responses, one for an economy with a relatively small import content of spending where imports account for only 10 percent of GDP, the other for a more open economy where imports account for 30 percent of GDP. In response to a shock to domestic government spending (panel a), the stock of domestic capital falls in either simulation (panel b), but the fall is much more marked in the case of pronounced home bias (imports 10 percent of GDP). In this case, domestic investment falls also relative to foreign investment (panel d). As a consequence, net exports are hardly affected by the fiscal expansion (panel f). This is not true for the relatively more open economy: here domestic investment increases relative to foreign, and a trade deficit results.¹⁴ Figure 4 thus illustrates that (the sign of) the response of the external balance is largely determined by the sign of the investment response in *relative* terms.

< Figure 4 about here >

¹⁴ In addition to their effects on the demand level, terms of trade movements will also determine the composition of spending. A domestic appreciation temporarily raises the import content of domestic consumption and investment, while the reverse occurs in the foreign country. This composition effect tends to lower the domestic trade balance, depending on the price elasticity of imports. At the same time, there is a ‘valuation effect’: the domestic appreciation will tend to improve the trade balance, by raising the value of exports relative to imports. In our numerical analysis, the substitution effect dominates the valuation effect: *ceteris paribus* an appreciation (of the terms of trade) will reduce the trade balance as the equivalent of the Marshall-Lerner-Robinson (MLR) conditions is assumed to hold in general equilibrium, see Tille (2001) and Müller (2004) for further analysis.

3.5 An extension of the argument to tax cuts

Would the same transmission mechanism generalize to the case of a tax cut? To answer this question, we distinguish between the wealth effects of a cut, and the effects of altering tax rates on labour and capital income, which may directly affect agents' incentive to work and save. To analyze the former, consider an economy similar to the one in our model (Box 1), but in which infinite-horizon households are replaced with overlapping generations of finite-horizon agents with no inter-generational altruism, so that Ricardian equivalence does not hold. Although we do not perform a formal analysis of this case, in what follows we sketch an answer by drawing on the main building blocks of our argument: a reduction of lump-sum taxes increases the permanent income of currently active households (at the expense of future generations) and thus raises domestic consumption. This has a direct negative implication for the trade balance proportional to the import content in private spending. For instance, if the import content of consumption is 20 percent, other things equal, a tax cut would worsen the trade balance by 20 percent of the change in consumption. In equilibrium, however, the external balance will also reflect the indirect effects of the reduction of lump-sum taxes, via adjustment in saving and investment rates. In particular, the degree of home bias in domestic spending and the persistence of the shock would still determine the strength and dynamics of the terms of trade appreciation induced by the increase in domestic consumption expenditure, and thus the return to domestic capital. By the same token, they will determine the movements in real interest rates at home and abroad. The transmission mechanism is identical to the one discussed in the previous section. Hence, we expect openness to be an important feature also for the international transmission of a reduction of domestic lump-sum taxes: the stronger the home bias in private spending, the smaller the deterioration of the trade balance.

The mechanism underlying the international transmission of a tax cut via a reduction of distortionary tax rates is somewhat different. Using the model in Box 1 appropriately amended, we nonetheless find that openness matters also in this case. For simplicity, we consider a temporary reduction in income taxes, financed through Ricardian debt, i.e. debt that will be repaid by an increase in (future) lump-sum taxes.¹⁵ A temporary reduction in the domestic tax rate on income from labour and capital directly raises the incentives for households and firms to work

¹⁵ Specifically, we assume that steady state government spending is financed through taxing a fixed proportion of labour and capital income or, equivalently, intermediate goods. Shocks to government spending or temporary changes in the tax rate induce an increase (fall) in tax revenues relative to government spending. To balance the budget, the government adjusts lump-sum transfers (taxes) accordingly. Following Baxter (1995), these lump-sum transfers (taxes) can be interpreted as a surplus (deficit) of the government budget.

and invest. But the resulting increase in domestic output over time *depreciates* the terms of trade of the country: this reduces the incentive to invest. This effect is relatively stronger, the smaller the home bias. In our quantitative experiments, however, we find that the terms of trade response to a temporary cut in tax rates is quite contained relative to their response (with an opposite sign) to an increase in government spending (driving up demand for domestic goods). What drives the relative investment change is mainly the short-run real rate differential, whose size is a function of home bias. Higher domestic interest rates counteract the positive effect of a country-specific tax rate cut on investment decisions: domestic investment increases less in economies where home bias is pervasive than in very open economies.

3.6 Summing up

In this section, we have analyzed in detail a mechanism through which fiscal shocks which reduce public savings translate into changes in private investment and saving and thus ultimately affect the external balance (see the accounting identity in section 2.1). A useful way to synthesize this mechanism consists of emphasizing the trade offs between borrowing from abroad, involving some degree of substitution away from domestic goods into foreign goods, and reducing the rate of capital accumulation. Intuitively, borrowing from abroad is attractive when there is no strong preference for the home good, so that the economy is relatively open to trade. By raising their demand for foreign goods, domestic households can prevent a fall in consumption below their permanent income, as well as a fall in the domestic capital stock. If the government spending shock is persistent enough, it is efficient to *raise* the domestic capital stock, against higher future demand for domestic output, as well as to service foreign debt incurred in response to the shock. This is clearly the scenario underlying twin deficits.

When there is a strong preference for the home goods, instead, the economy is relatively closed: in response to fiscal shocks which reduce the amount of domestic goods available for private use, borrowing from abroad is less attractive, as it implies consuming foreign goods instead of the much preferred domestic goods. A temporary contraction of investment is an efficient strategy to prevent a fall in consumption. This is true as long as the fiscal shock is not too persistent. If the shock is persistent, however, running down domestic capital may not be efficient vis-à-vis the need to sustain high future government claims on domestic output.

These insights are useful in addressing differing results in the literature. The net effect of a fiscal expansion on the external trade of a country depends on several factors, many of which oppose each other. Among these we have singled out home bias and shock persistence, driving

crowding out vs. crowding in of investment. These factors shape not only the size, but even the sign of the trade response to shocks. In contrast to the conventional wisdom, it cannot be ruled out that fiscal expansions temporarily improve the external balance.

4. Twin deficits and the transmission of fiscal shocks: time series evidence

As discussed above, the idea of twin deficits is traditionally illustrated by pointing to historical episodes of fiscal easing. The question we address in this section is whether one can find any statistical evidence in support of the hypothesis that fiscal innovations systematically move the budget deficit and the trade deficit in the same direction. To address this question, we employ structural vector autoregression (VAR) techniques. These techniques are well established in the analysis of monetary policy and have been recently extended to analyze the dynamic effects of fiscal policy, see e.g. Blanchard and Perotti (2002) and Fatás and Mihov (2001). Within this literature, a few studies have focused on the effects of fiscal policy on foreign trade, including Clarida and Prendergast (1999), who analyze the effects of budget deficits on the real exchange rate, Canzoneri, Cumby and Diba (2003), who focus on output spillovers of US fiscal policies on foreign GDP and Giuliodori and Beetsma (2004), who use European data to investigate of the effects of government spending on imports, and especially Kim and Roubini (2003).

Kim and Roubini (2003) is the first study to address the twin deficit issue explicitly within a VAR framework. Using US data they find that a negative innovation to the budget balance increases the current account. That is, they find ‘twin divergence’ instead of twin deficits. This finding is shown to be qualitatively similar in response to tax and spending shocks, in addition to budget shocks (i.e. when they identify tax and spending innovations, instead of innovations to the budget balance). Twin divergence is also obtained by Müller (2004), who identifies spending innovations in US time series. In what follows, we will build on the same approach.

Different from Kim and Roubini we will analyze possible cross-country variations in the external effects of fiscal policy by extending the analysis to a sample of four countries, Australia, Canada, the UK and the US. The composition of this sample is the same as in Perotti (2005), who

applies the VAR approach to fiscal policy of Blanchard and Perotti (2002) to closed-economy issues.¹⁶

We proceed as follows. We first outline the basic ideas underlying the application of VAR techniques. Second, we motivate our comparative study on four countries in light of the main results from our theoretical analysis. Next, we focus on innovations to government spending as possible sources of budget deficits and their transmission through the global economy via investment and net exports. Finally, we also consider the international transmission of deficit shocks, i.e. the effects of negative innovations on the budget balance.

4.1 Structural Vector Autoregressions

Adopting a structural VAR model allows us to capture the dynamic interdependence of macroeconomic aggregates within a linear model, where the value of each variable is expressed in terms of its own past values, past values of all the other variables in the VAR and an error term. While serially uncorrelated, the error terms associated with each variable are likely to be mutually correlated, as long as contemporaneous relationships between variables are not taken into account. Structural VAR models therefore are explicit about contemporaneous relationships between variables in order to ensure identification.

In light of the transmission mechanism analyzed in the previous section, we proceed by identifying government spending shocks. Following Blanchard and Perotti (2002), we assume that government spending does not contemporaneously respond to changes in the other variables. These other variables, however, can be immediately affected by government spending. In a later subsection, we will also consider the fiscal transmission mechanism focusing on deficit shocks directly. As in Kim and Roubini (2003), we will then assume that the budget balance responds contemporaneously to changes in output, but not to changes in the other variables; at the same time we will posit that changes in the budget balance possibly affect output only after one quarter.

Once we have identified a typical fiscal innovation (either to spending or directly to the deficit), we track the dynamic effects of such an innovation on the other variables in the VAR controlling for other changes in the economic environment which may also induce co-movements between fiscal and other macroeconomic variables. Like all statistical techniques, the quality of our results depends on their correct application. An important issue in identification is that fiscal

¹⁶ Different from Perotti (2005), we focus on external trade, rather than pursuing a complete and exhaustive characterization of the macroeconomic effects of fiscal policy. We should note here that Perotti also considers time series for West Germany for up to 1989.

policy changes are usually announced before effective implementation and therefore may affect behaviour through expectations before the fiscal shock shows up in fiscal data --- one of the points stressed by Mountford and Uhlig (2004). Perotti (2005) takes up this and other possible complications, providing arguments to support the application of structural VAR models to identify the effects of fiscal policy. We discuss technical aspects of our approach in Box 2.

< Box 2 about here >

4.2 From theory to data

Before turning to our estimated VAR model, we emphasize the benefits of carrying out our empirical analysis of twin deficits in a comparative perspective, focusing on four countries which differ in the degree of openness. In light of our theoretical analysis in the previous section, we bring to the data a *refined twin deficit prediction*: the extent to which a temporary increase in government spending reduces the trade balance depends on the degree of i) openness of the economy and ii) persistence of fiscal shocks. Provided that shocks are persistent enough, and/or the economy is quite open, a temporary increase in government spending will have a limited effect on investment, but a relatively strong effect on net exports. On the other hand, when shocks are not very persistent, and/or the economy is rather closed, investment will fall strongly and mute the effects of the fiscal expansion on the trade balance.

The empirical counterpart of openness can be easily computed from the data and is displayed in the first row of table 1 above. We observe a considerable degree of heterogeneity: while Canada and the UK are characterized by a high degree of openness (the ratio of imports to output is 0.30 and 0.27, respectively), the weight of US imports in output is only 0.11. Australia, with a value of 0.19, is characterized by an intermediate degree of openness.

The degree of persistence of fiscal shocks cannot be observed directly. However, as we identify fiscal shocks using our VAR model, we can use the same model to compute a measure of their persistence. Specifically, we approximate the response of government spending to a one-time impulse to government spending by an AR(1) process.¹⁷ We find that a typical government

¹⁷ Letting ρ denote the degree of autocorrelation of government spending following an exogenous AR(1) process, we proceed by computing ρ for each horizon k using the following formula (the shock occurring at horizon zero): $\rho_k = (\text{response of government spending at horizon } k)^{(1/k)}$. Finally, we compute ρ as the average over ρ_k for $k=1\dots 10$.

spending shock displays the highest persistence in Canada (0.93) and the lowest persistence in Australia (0.69). For the U.S. (0.85) and the U.K. (0.77) we find intermediate values.¹⁸

Overall, Canada and the UK are the countries with the highest degree of openness in our sample; Canada is also the country where we find the highest degree of fiscal shock persistence. In light of our theory, for these countries we expect that a typical expansionary fiscal shock would have a relatively large negative impact on external trade, and a relatively low crowding out effect on domestic investment. Conversely, Australia and the US are relatively closed, and, according to our estimates, have a low or intermediate degree of fiscal shock persistence. In the case of these countries, we expect a relatively strong negative effect on investment, and only a mild effect on the trade balance.

4.3 The international transmission of spending shocks

We begin our empirical study by analyzing the dynamic effects of a government spending innovation equal to one percent of GDP. We thus rely on the first specification of the VAR model discussed in Box 2. Specifically, we focus on the dynamic adjustment process, i.e. the impulse responses of the variables of interest triggered by these shocks. Figure 4 displays the responses of the budget balance and the trade balance together with the response of investment in the four countries in our sample. In this figure, impulse responses are measured in percentage points of trend output (vertical axis), while the horizontal axis gives the time horizon in quarters. Each straight line displays the point estimate, while the shaded areas display the two symmetric one standard error bands, computed by bootstrapping based on 1000 replications.

The first row of Figure 5 shows the response of the budget balance to a spending innovation. Spending innovations lead to a budget deficit in all countries: to a considerable extent government spending innovations are thus debt financed everywhere in our sample. However, the magnitude of the effect differs across countries. The effect of the spending shock on the budget deficit is particularly strong for Canada and the UK and quite limited for Australia, in line with the results reported by Perotti (2005) for a post-1980s sample.¹⁹

¹⁸ Other measures of persistence lead to a similar ordering, e.g. adding up the coefficients on the coefficients on the lagged values of government spending obtained from estimating the first equation of our VAR model also gives the highest persistence for Canada and the lowest for Australia.

¹⁹ In the theoretical analysis we focused on the transmission mechanism via the effect of terms of trade movements on the return to investment, abstracting from the consequences of failures of Ricardian equivalence, i.e. from specific macroeconomic implications of debt financing. Of course, in a non-Ricardian world the extent of debt financing also matters. However, Erceg et al. (2005a) calibrate a DSGE

< Figure 5 about here >

The second row of Figure 5 displays the response of the trade balance. The figure shows significant effects of fiscal loosening on the trade balance for the UK and Canada: in the UK the impact effect is about -0.5 percent of trend output and a maximum effect of -0.8 is reached after five quarters; in Canada the impact effect is about -0.17 and the trade balance remains depressed for an extended period (reaching 1 percent of trend output). Given that the spending innovation is one percent of trend output, these effects are quantitatively substantial if compared with results reported in the empirical literature adopting a single equation approach (see section 2.2).

Turning to the response of the trade balance in the US and Australia, there are, in fact, no significant effects. While for the US the point estimates are negative between the third and the eight quarter after the shock, in both countries the trade response is mildly positive at some point over time. This confirms earlier findings by Kim and Roubini (2003) and Müller (2004) for the US. Relative to these studies, we find a somewhat weaker response of the trade balance.²⁰

The last row of Figure 5 shows the response of investment. In our sample, the economies with a relatively high degree of openness are Canada and the UK. Consistent with our hypothesis, the capital stock of these countries is hardly affected by fiscal expansion: investment does not fall significantly. In fact, investment is found to increase for an extended period in Canada, the country where we find the highest degree of fiscal shock persistence. In contrast, the US, which is less open to international trade, experiences less persistent shocks. As suggested by our hypothesis we see a substantial decline in US investment: it falls by about 0.8 percent of trend output. In the case of Australia, on the other hand, we find neither a decline in investment nor a decline in the trade balance. Note that also the budget balance seems to be hardly affected by the spending shock.

The three rows of Figure 5 together suggest that, consistent with our ‘refined twin deficit prediction’, spending shocks generate twin deficits in countries which are quite open to trade, especially when spending shocks are relatively persistent. In more closed economies, instead, there is no systematic evidence in favour of twin deficits. Actually, one may even observe twin divergence.

model with non-Ricardian households to the US and find that the effects of government spending shocks are only mildly affected by the share of non-Ricardian households in the population.

²⁰ Further experiments (not reported) suggest that these differences are likely to result from different sample periods, notably, from changing the starting date. Kim and Roubini start in 1975, Müller in 1973. Perotti (2005) suggests a break date in fiscal policy transmission around 1980. Consistently, we use 1980Q1 as the first observation for the dependent variable.

We complete our analysis by briefly discussing the responses of the other variables included in our VAR model. To give a concise summary of our results, we compute cumulated impulse responses for the first year and for three years after the spending shock. Table 2 displays the results for all nine variables included subsequently in our VAR model.

< Table 2 about here >

The first line reports the cumulative response of government spending to an innovation in government spending. It therefore provides yet another measure of how long a fiscal expansion lasts in each country; again, we find the highest persistence for Canada and the lowest for Australia. The second line reports the response of output: hardly any significant effect is observed - broadly in line with the results by Perotti (2005), who argues that the overall macroeconomic effect of fiscal policy tends to fall in the post-1980 period relative to a pre-1980s sample.

As shown in the fourth and fifth line the responses of inflation and interest rates are either positive or negative depending on the horizon. This has been noted by several authors, e.g. Mountford and Uhlig (2004) and Perotti (2005), and is yet to be fully understood. In light of theory, we would generally expect a positive response of inflation and interest rates.²¹

The sixth line of the table shows that the terms of trade generally tend to increase, i.e. to depreciate, following a fiscal shock, although they initially appreciate in the case of the US and three years after the shock in the case of Canada. The response of the terms of trade does not square well with our theoretical model, according to which an appreciation of the terms of trade is an important component of the international transmission of fiscal shocks. However, we should note here that the terms of trade response is not very robust across various specifications of our empirical VAR analysis.²² In this sense, our empirical analysis of the international transmission of fiscal shocks adds a new dimension to the list of open issues in related analyses of fiscal transmission in closed economies. Further analysis is needed to understand not only the response of inflation and the interest rate, but also the behaviour of the terms of trade. Finally, the last row of Table 2 gives the cumulative response of private consumption. In none of the countries we find a strong or significant response to the spending shock. This finding confirms the importance of

²¹ Regarding the effects of fiscal policy on interest rates, a large literature has documented difficulties in detecting a positive effect of fiscal innovations on interest rates. A recent counterexample is Laubach (2005) who finds a substantial and significant effect of the debt-to-GDP ratio on interest rates using data on expectations of future long-term interest rates as well as on debt and deficit projections.

²² Müller (2004) finds an appreciation of the terms of trade in the US using data from 1973-2003 and a similar identification scheme than the one employed in the present paper.

focusing on investment in understanding the heterogeneity in the response of net exports to a shock to government spending in the four countries.

4.4 The international transmission of deficit shocks

In the subsection above, we have analyzed expansionary government spending shocks as a cause of twin deficits/twin divergence. Clearly, tax cuts are likely to also play an important role in determining the joint dynamics of the budget balance and the external balance. However, identifying tax shocks raises technical difficulties, in particular with respect to the estimation of the elasticity of tax revenues to output, see Blanchard and Perotti (2002). Leaving the analysis of tax shocks to future research, and for the sake of comparison with the results reported by Kim and Roubini (2003), we prefer to conclude our empirical investigation by looking at shocks to budget deficits. This corresponds to the second specification of the VAR model discussed in Box 2.

Specifically, we consider deficit shocks, defined as an unanticipated fall in the budget balance by one percent of GDP. Different from the analysis above, we follow Kim and Roubini and analyze the current account balance rather than the trade balance.²³ Figure 6 displays the results for the variables of interest (in percentage points of trend output). As in Figure 5, straight lines correspond to point estimates, while the shaded area gives the two symmetric one-standard error bands, computed by bootstrapping based on 1000 replications.

< Figure 6 about here >

The first row of figure 6 shows the response of the budget deficit, which displays a similar shape and persistence in all countries. In contrast, the response of the current account (second row) is markedly different across our countries. On impact, the current account improves in the US and Australia, which are the least open economies in our sample; it deteriorates in Canada and the UK, which are the most open economies in our sample. In line with our theoretical discussion we find that investment falls markedly in the case of the US and Australia (third row). It falls much less, or insignificantly, in the case of Canada and the UK.

Figure 6 also reports the response of household saving (fourth row), which follow a remarkably similar pattern across countries: household savings increase on impact. While the response is not negligible, it is, however, insufficient to offset the negative shock to public

²³ Using the trade balance instead of the current account gives very similar results.

savings.²⁴ A summary of the dynamic effects of a deficit shock for our second VAR specification is given by table 3. Overall, the results in this subsection suggest that the transmission mechanism identified in the case of a government spending shock is also at work in the case of direct shocks to the budget deficit.

< Table 3 about here >

5. Fiscal and global imbalances

For relatively closed economies such as the US, our study confirms an important policy-related finding of the literature, namely, that the effects of fiscal shocks on external trade are quite contained. Does it follow that fiscal policy would not play any significant role in correcting the unprecedented stream of large current account deficits run by the US in recent years? In other words, can the US fiscal authorities be relieved from the responsibility of contributing to rebalancing the US external account, simply because fiscal instruments would not have a strong effect on net exports? We believe that such a conclusion would be a severe misreading of our results.

Both theoretical analysis and the empirical evidence show that the fiscal transmission channel has either an external or an internal intertemporal component. Facing an increasing claim by the government on domestic resources, households can choose to sustain their consumption plans at their optimal level by either borrowing from abroad, or by reducing investment. The second option is more attractive, the more domestic households prefer domestic goods over foreign goods and the more persistent the fiscal shock. In this case, the contemporaneous impact of fiscal shocks on the current account is limited.

Hence, even if the external balance does not deteriorate on impact, fiscal expansions are by no means irrelevant for external solvency, because of their crowding out effects on investment. Everything else equal, a lower capital stock in the future means that the US is pledging future resources at the expense of future consumption. Unless the differential in the rate of growth of productivity between the US and the rest of the world is bound to remain large, delaying a fiscal correction may create macroeconomic and political risk.

²⁴ In the analysis we use gross investment. Thus the response shown in the graph abstracts from changes in the depreciation rate. Household savings, on the other hand, are net savings, i.e. disposable income less consumption expenditure. As a result, we are not in a position to analyze the proper components of the current account in isolation.

In addition, there may be reasons for a large fiscal correction in the US to have stronger effects than we find in our study. One cannot exclude that the average macroeconomic impact of fiscal shocks picked up by VAR analysis be magnified when fiscal authorities takes drastic measures.²⁵

In conclusion, our analysis suggests that a US fiscal correction is called for in light of sustained global imbalances. According to our results, however, the transmission mechanism is mainly intertemporal via investment, rather than intratemporal through foreign trade.

6. Conclusions

The budget balance and the trade balance have a very strong cyclical component, which induces a negative correlation between the two variables over the business cycle: economic expansions tend to improve the budget balance, but worsen the trade balance. However, according to the twin deficit hypothesis, fiscal innovations which are not systematically related to the cyclical conditions of the economy reverse the sign of this correlation. Namely, fiscal shocks generating budget deficits also worsen external trade.

In this paper we reconsider the twin deficit hypothesis both from a theoretical point of view and by analyzing data for Australia, Canada, the UK and the US. At theoretical level, we show why openness and the persistence of fiscal shocks are major determinants of the magnitude (or even the sign) of the response of the trade balance to fiscal shocks. Our emphasis is on international relative price movements, and their repercussion on the rate of return and real rate of interest across borders. We have shown that, for a given persistence of the fiscal shock, the crowding out effect on investment is stronger in a relatively closed economy. In this case, the deterioration of the trade balance is contained. Given openness, crowding out of investment is stronger when the fiscal shock is persistent. We can thus qualify the twin deficit hypothesis by relating the effects of fiscal shocks on the external balance to i) openness and ii) shock persistence. The mechanism underlying our result highlights a macroeconomic trade-off of great policy relevance – we find that fiscal expansions either reduce domestic capital or the external balance.

At an empirical level, we assess our analytical and quantitative insights by investigating the transmission of fiscal shocks in a VAR framework in the four OECD countries, differing in

²⁵ Would this argument rescue a strong version of the twin deficit hypothesis for large spending corrections? An element raising doubts regarding this possibility is that previous studies analyzing substantial current account adjustments fail to find any significant impact of fiscal policy, see e.g. Freund (2000).

their degree of openness. Our empirical findings support our argument. In the US and Australia, which are relatively less open than Canada and the UK, and where government spending shocks are less persistent, we find that the external impact of fiscal policy is rather limited. Instead, private investment responds substantially. The reverse is true for Canada and the UK. These findings confirm and put into perspective earlier results, whereby fiscal expansions in the US have on average a negligible effect on the country's trade balance.

We emphasize that our main result, that twin deficit effects may be small in relatively closed economies, are by no means a critique of the call for a US fiscal retrenchment to address global imbalances. Our main point is that the impact of budget cuts on the current US external balance is going to be muted by their positive effects on domestic investment. Building a higher capital stock cannot but strengthen the ability of the US to generate the resources required to service this country's external liabilities in the future.

Appendix

Data Definitions

Except for table 1, all data are obtained from the OECD Economic Outlook database. OECD mnemonics are given in capital letters. Our sample is based on quarterly data for Australia, Canada, the UK and the US, starting in the first quarter of 1979 and ranging up to the third quarter of 2005 for the US, to the second quarter of 2005 for Canada and the UK, and to the second quarter of 2004 for Australia.

While the budget balance is already scaled by GDP (NLGXQ: Primary government balance, percent of GDP), we calculate the net export-GDP ratio by scaling FBGS (Net exports of goods and services, value) by GDP (Gross Domestic Product, market prices, value). Also the current account is available as percentage of GDP (CBGDPR: current account, as percentage of GDP).

Real government spending is CGV (Government final consumption expenditure, volume) plus IGV (Government fixed capital formation, volume). Real private investment is IPV (private total fixed capital formation, volume). Real private consumption expenditures is CPV (private final consumption expenditure, volume).

The savings ratio is SRATIO (Household savings ratio, percent). The interest rate is IRL (long-term interest rate on government bonds, percent). To compute inflation rates, we compute the GDP deflator, dividing GDP by GDPV (Gross Domestic product, volume) and take four times the log difference of the GDP deflator (to obtained annualized inflation rates). To compute the terms of trade we take the log of the ratio of the deflator for imports to the deflator for exports, i.e. PMGS (Imports of goods and services, deflator) and PXGS (Exports of goods and services, deflator), respectively. In the VAR model we scale quantity variables by POPT (population, total between 15&64 years old).

Table 1:

The data used to calculate the import content of GDP and its components reported in table 1 are drawn from various sources. For all four countries we compute the import content of GDP on the basis of OECD data by taking the mean of the ratio of imports (MGSV: imports of goods and services, national accounts basis, value) to GDP. To compute the import content of GDP components we use different sources.

For the US: computations are based on the assumption that the import content of a particular (intermediate and final) commodity for all final uses is equal to the economy wide average for this commodity. Direct imports are added from the supplementary 1997 Benchmark NAICS

Import Matrix (Source: 'Survey of Current Business Bureau of Economic Analysis', December 2002. Table 2 on p. 107). Government spending consists of consumption and investment of the federal and state governments.

For the UK: Import content in GDP components is taken directly from Herzberg, Sebastia-Barriel and Whitaker (2002), p. 204. The data refer to the year 1995.

For Canada: Import content in GDP components is taken directly from Dion, Laurence and Zheng. (2005), table 7, p. 13. The data refer to the year 2000.

For Australia: Own calculations based on Australian Bureau of Statistics, cat. no. 5209.0.55.001 Australian National Accounts: Input-Output Tables - Electronic Publication, Table 18. The data refer to 1998-1999.

We conclude by noting that, in table 1, government spending is public consumption and investment, except for UK and Canada where it is only government consumption.

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Boxes

Box 1. Theoretical Framework

Our theoretical discussion of the international transmission of fiscal policy is based on a stylized intertemporal two-country two-good model. It provides a framework for understanding the *interaction* of intertemporal and intratemporal considerations guiding saving and investment plans by the private sector. In what follows, we outline the basic structure of the model, which is similar to those analyzed in Backus, Kehoe and Kydland (1994) or Heathcote and Perri (2002).

The world economy consists of two countries, labeled country 1 and 2. In the main text, we refer to country 1 as the home country and to country 2 as the rest of the world.

Through the allocation of consumption expenditure, c_1 , and labor n_1 , the representative household in country 1 maximizes:

$$E_0 \sum_{t=0}^{\infty} \beta(\{c_1\}_t, \{n_1\}_t) \frac{1}{1-\gamma} \left[c_{1,t}^{\mu} (1-n_{1,t}^{1-\mu}) \right]^{1-\gamma},$$

where $\beta(\{c_1\}_t, \{n_1\}_t) = \exp \left[\sum_{\tau=0}^{t-1} -\ln \left(1 + \psi \left\{ c_{1\tau}^{\mu} (1-n_{1\tau}^{1-\mu}) \right\} \right) \right]$ is a so-called endogenous time

discount factor, which ensures the stationarity of bond holdings in case international financial markets are assumed to be incomplete. The same applies to the representative household in country 2. Regarding production, each country specializes in a single intermediate good – good a in country 1 and good b in country 2. Government spending, g , falls entirely on the intermediate domestic good. Total private absorption (by both countries) of home intermediate goods, $a_{1t} + a_{2t}$, is equal to home GDP, y_{1t} , net of government spending g_{1t} . Similarly, total absorption of the foreign intermediate goods, $b_{1t} + b_{2t}$, is equal to GDP net of government spending in the rest of the world:

$$a_{1t} + a_{2t} = y_{1t} - g_{1t}$$

$$b_{1t} + b_{2t} = y_{2t} - g_{2t}$$

In each country, intermediate goods are produced by combining capital, k , and labor, n . In the home country, we have $y_{1t} = k_{1t}^{\theta} n_{1t}^{1-\theta}$. Production functions are identical in the two countries.

Consumption, c , and investment, x , are composites of the domestic and foreign intermediate goods:

$$c_{1t} + x_{1t} = \left[\omega^\sigma a_{1t}^{\frac{\sigma-1}{\sigma}} + (1-\omega)^\sigma b_{1t}^{\frac{\sigma-1}{\sigma}} \right]^{\sigma/(\sigma-1)}$$

$$c_{2t} + x_{2t} = \left[(1-\omega)^\sigma a_{2t}^{\frac{\sigma-1}{\sigma}} + \omega^\sigma b_{2t}^{\frac{\sigma-1}{\sigma}} \right]^{\sigma/(\sigma-1)}$$

The parameters σ and ω measure the intratemporal elasticity of substitution between the domestic and foreign intermediate good and the home bias in private expenditure, respectively. At the same time $1-\omega$ measures the degree of openness, i.e. the ratio of imports to net output.

The dynamic behavior of the economy is determined by the evolution of the capital stock. Let δ denote the depreciation rate of capital. The capital stock grows with investment net of depreciation. For the home country, we can write

$$k_{1t+1} = (1-\delta)k_{1t} + x_{1t}$$

We are interested in the dynamic adjustment of the world economy to a country-specific temporary increase in government spending. We assume that home spending shocks follow an AR(1) process: $g_{1t} = \gamma g_{1t-1} + \varepsilon_{1t}$, while foreign government spending remains constant.

To close the model, we need to specify the structure of international asset markets. In our numerical experiments, we will analyze our model both under complete and incomplete asset markets.

Letting p_{dt} and p_{ft} denote the price of intermediate good a and b, respectively, both measured in units of the composite good in country 1, so that the terms of trade are defined as $p_t = p_{ft} / p_{dt}$.

The domestic trade balance is defined as the net exports-output ratio $nx_t = (a_{2t} - p_t b_{1t}) / y_{1t}$. To solve the model numerically around a symmetric steady state, we choose the parameter values as in the baseline calibration of Backus, Kehoe and Kydland (1994).

Box 2. Structural Vector Autoregressions

Our empirical results are based on estimated structural VAR models. We estimate two specifications on quarterly time series, one identifying shocks to government spending (which in turn generate a budget deficit), the other identifying shocks to the government budget directly. In the first specification, we set up a VAR model including seven variables: government spending, g_t , and output, y_t , both in logs of real per capita terms; the primary budget balance scaled by GDP, bb_t , inflation, π_t , the long term nominal interest rate, r_t , the log of terms of trade, p_t , and the trade balance scaled by GDP, nx_t . In the second specification, we drop real government spending, and replace the trade balance with the current account scaled by GDP, ca_t . Further details on the construction of the variables are provided in the appendix. In both specifications, we allow for linear and quadratic terms in time as well as for quarterly dummies in each equation, but omit them in the discussion below.

Letting Z_t denote a vector which contains these variables in the same order as they were introduced above, i.e. in the first specification $Z_t = [g_t \ y_t \ bb_t \ \pi_t \ r_t \ p_t \ nx_t]'$ while in the second specification $Z_t = [y_t \ bb_t \ \pi_t \ r_t \ p_t \ ca_t]'$, we consider the following structural model

$$A_0 Z_t = \sum_{i=1}^4 A_i Z_{t-i} + \varepsilon_t,$$

where ε_t is a vector of mutually uncorrelated innovations. The coefficient matrix A_0 reflects contemporaneous relationships among the variables in Z_t . It is not possible to estimate A_0 and therefore identify the innovations ε_t without further assumptions. Therefore we assume that A_0 is a lower triangular matrix. This is equivalent to estimating a reduced form VAR model and computing the Choleski factorization of the VAR covariance matrix, see Stock and Watson 2001. In the first specification, given that government spending is the first variable in Z_t , this boils down to the assumption that government spending responds to the other variables with a delay of one quarter. In the second specification, given that the budget balance is the second variable in Z_t , this boils down to the assumption that the budget does respond to changes of y_t , but not to changes in the other variables – *within* a quarter. Under these assumptions, we can estimate both specifications of the VAR consistently by applying OLS recursively.

Once the structural VAR is estimated, we generate impulse response functions on the basis of its reduced form. These responses provide a convenient way to summarize the macroeconomic dynamics triggered by fiscal innovations. More precisely, an impulse response at horizon k is the difference between the expected value of a variable in period $t+k$ conditional on a spending innovation in period t and its expected value in the period before the shock. We also report cumulative impulse responses at time horizon k by simply adding up the impulse responses up to this horizon. We compute standard errors for the impulse response functions by bootstrapping based on 1000 replications.

Finally, we reestimate the VAR models, replacing the trade balance, in turn, with investment, x_t , and private consumption, c_t , both in logs of real per capita terms (first specification); and the current account balance with the household savings ratio, s_t (second specification). Thereby we try to gain further insights into the transmission of fiscal shocks, while keeping dimensions manageable. We report the impulse responses of these additional variables together with the results for our baseline specifications.

Tables and Figures

Table 1. Import content of GDP and GDP components

	US	UK	Canada	Australia
GDP	11.7%	27.3%	30.4%	19.0%
Government spending	5.8%	11.5%	10.9%	10.4%
Private consumption	11.6%	20.3%	8.7-20.3%	16.8%
Private investment	15.8%	35.9%	21.0-71.7%	25.8%
Change in inventories	21.8%	45.6%	35.0%	35.7%

Source: import content in GDP is average import–GDP ratio from 1980:1 to date, according to OECD outlook database. Import content in GDP components: various sources, see appendix

Table 2. Cumulative response to a government spending shock

	Horizon	US	UK	Canada	Australia
Government spending	4	0.72*	0.64*	0.82*	0.55*
	12	1.6*	1.15*	2.55*	0.85*
GDP	4	0.53	0.00	0.32	0.42*
	12	0.07	0.08	1.37	0.91
Budget balance	4	-0.95*	-0.83*	-2.11*	-0.22
	12	-2.53*	-3.51*	-5.46*	0.19
Inflation	4	0.01	-0.37*	-1.29*	-0.29
	12	0.50	0.71*	-0.37	0.91*
Nominal interest rate	4	-0.09	-0.18	-0.45*	0.21
	12	-0.95*	0.04	0.04	0.64
Terms of trade	4	-0.79*	1.13*	0.85	0.22
	12	1.97*	2.17*	-0.86	2.94*
Trade balance	4	0.07	-0.61*	-0.65*	0.04
	12	-0.15	-1.15*	-1.84*	0.14
Investment	4	-0.28*	-0.17	0.18	-0.04
	12	-1.78*	-0.9*	-0.26	0.69
Consumption	4	0.24	-0.06	0.11	0.00
	12	0.47	-0.12	0.68	-0.38*

Notes. Annualized responses - cumulative responses are expressed in yearly rates (i.e. cumulative responses are divided by 4); all quantities are expressed in percent of GDP; Horizon is in quarters. Sample starts in 1980:1 (dependent variable), see Box 2 for details.

An asterisk "*" indicates that zero is outside the region between the two one-standard error bands obtained by bootstrap based on 1000 replications.

Table 3. Cumulative response to a deficit shock

	Horizon	US	UK	Canada	Australia
GDP	4	-0.14*	-0.02	0.01	-0.5*
	12	-0.69*	-0.45*	0.13	-1.47*
Budget deficit	4	0.83*	0.72*	0.82*	0.96*
	12	2*	1.96*	1.9*	2.04*
Inflation	4	0.12*	0.08	-0.37*	-0.07
	12	0.42*	0.31*	-0.25	-0.71*
Nominal interest rate	4	-0.19*	0.09	-0.07	-0.13*
	12	-0.47*	0.25*	-0.05	-0.57*
Terms of trade	4	-0.02	0.17	0.25	0.36
	12	1.6*	0.16	-0.05	2.49*
Current account	4	0.03	-0.18	-0.10	0.3*
	12	0.17*	0.09	-0.41*	0.62*
Investment	4	-0.23*	-0.06	-0.09	-0.5*
	12	-0.91*	-0.4*	-0.29	-1.03*
Household savings	4	0.21*	0.05	0.21*	0.09
	12	0.26*	0.46*	0.34	0.04

Notes. Annualized responses - cumulative responses are expressed in yearly rates (i.e. cumulative responses are divided by 4); all quantities are expressed in percent of GDP; Horizon is in quarters. Sample starts in 1980:1 (dependent variable), see Box 2 for details. An asterisk "*" indicates that zero is outside the region between the two one-standard error bands obtained by bootstrap based on 1000 replications.

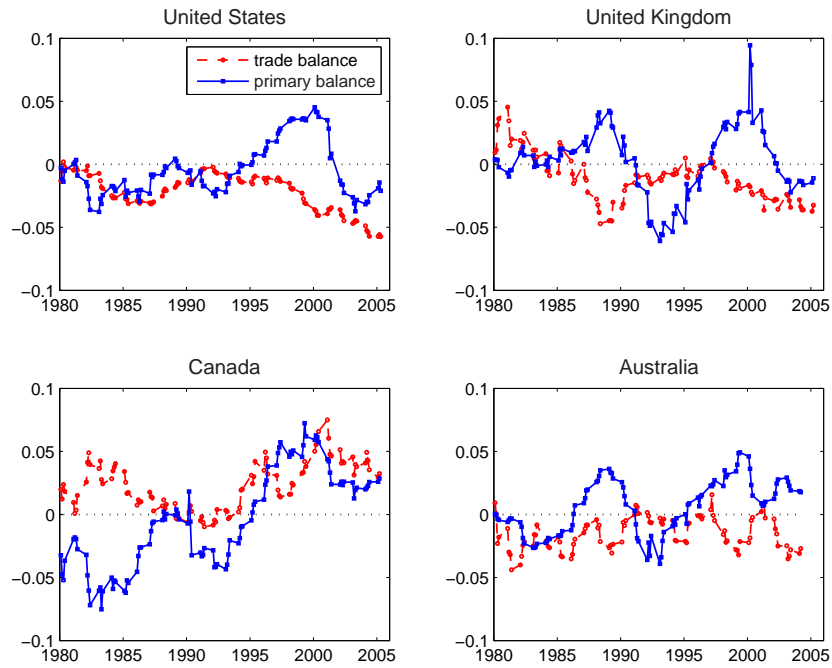


Figure 1: Primary budget balance and trade balance (scaled by GDP) in four OECD countries (1980 to date).

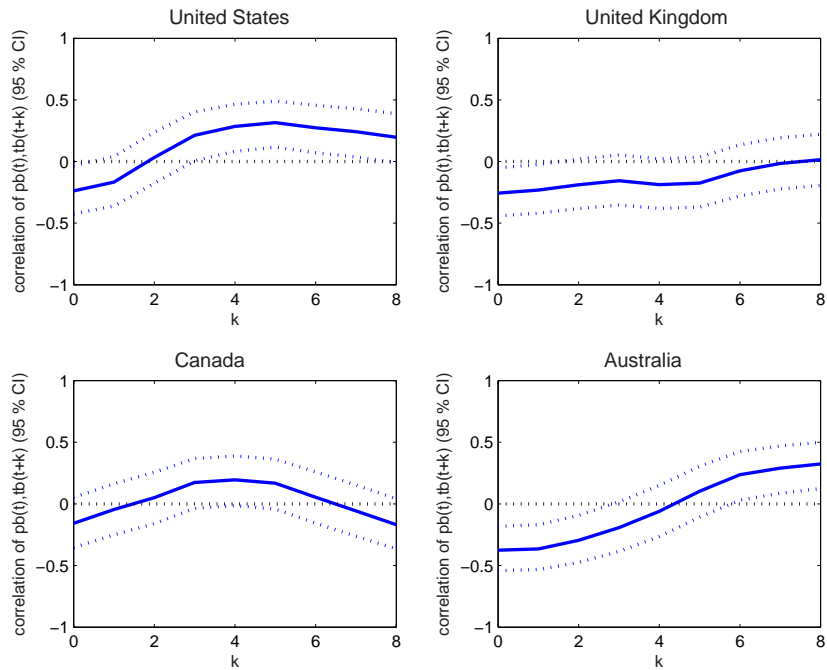


Figure 2: Cross-correlation of business cycle component of the current realization of the primary balance and current and future realizations of the trade balance (95 percent confidence intervals).

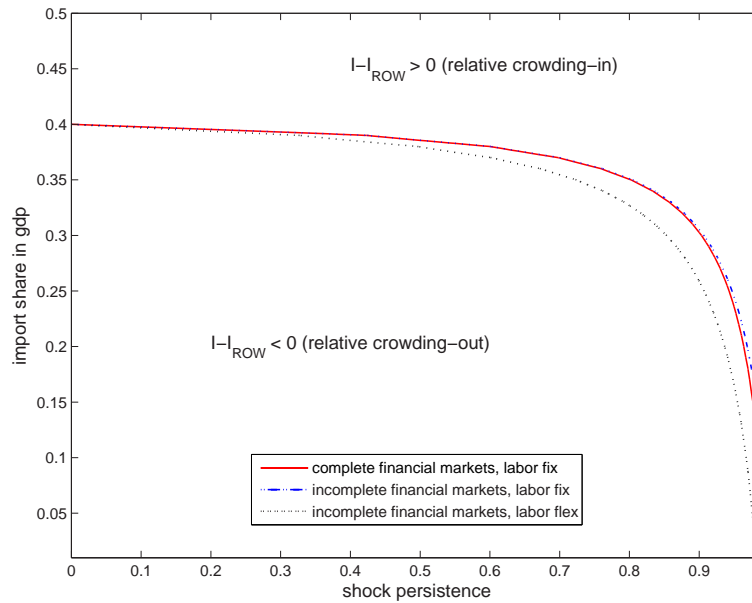


Figure 3: Impact response of relative investment to government spending shock - lines give parameter combinations of openness and shock persistence for which the $I - I_{ROW} = 0$ on impact in response to domestic government spending shock for three specifications of the model.

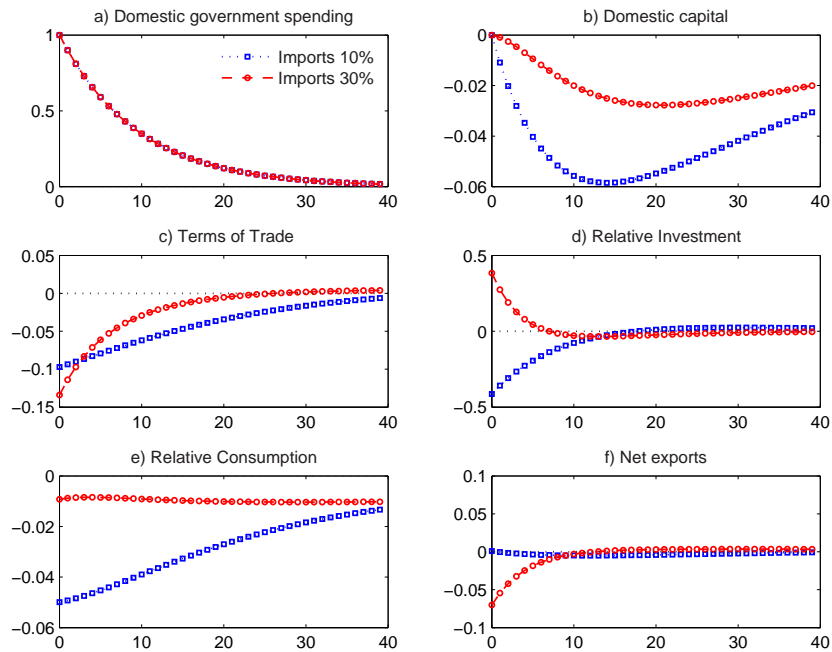


Figure 4: Selected impulse responses to government spending shock for two economies differing in the degree of openness (import content in GDP), see Box 1 for details of model and parametrization. Vertical axes indicate percentage deviations from steady state, horizontal axes indicate quarters.

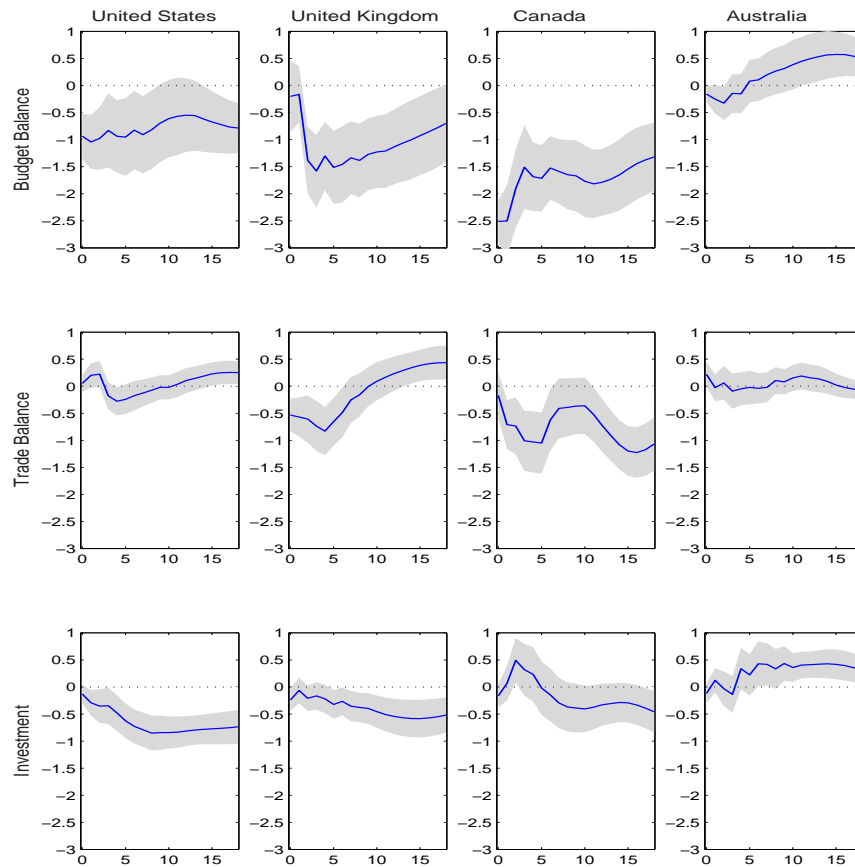


Figure 5: Selected responses to government spending shock. Sample 1980:1 to date. The solid line gives the point estimate. Shaded areas indicate bootstrapped two one-standard error bands. Vertical axes indicate deviations from unshocked path measured in percentage points of GDP. Horizontal axes indicate quarters.

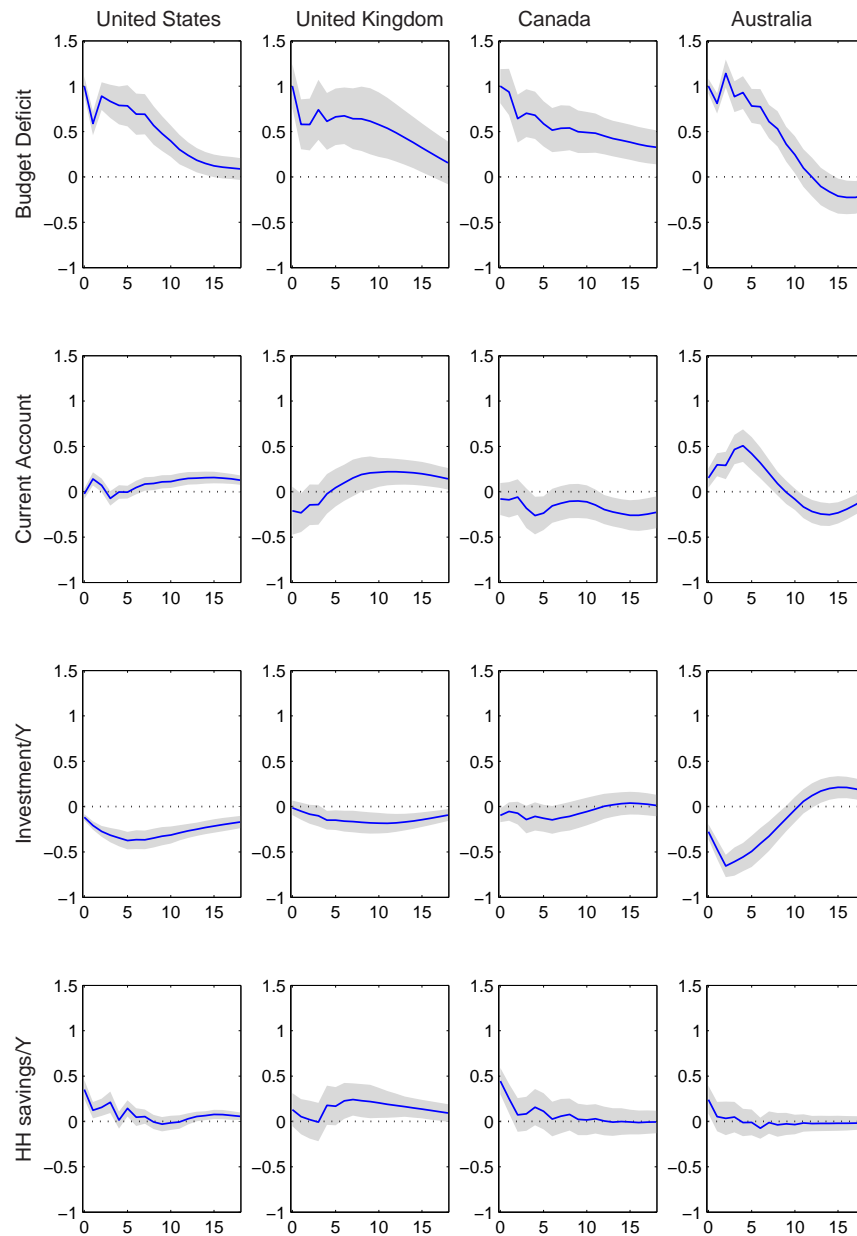


Figure 6: Selected responses to deficit shock. Sample 1980:1 to date. The solid line gives the point estimate. Shaded areas indicate bootstrapped two one-standard error bands. Vertical axes indicate deviations from unshocked path measured in percentage points of GDP. Horizontal axes indicate quarters.