Fiscal Reform, Growth and Current Account Dynamics

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Abstract

This paper examines the dynamic and long run effects of a shift from income taxes to consumption taxes in a growing small open economy. We extend the small open economy Solow-Swan model by introducing a government sector that maintains both a balanced budget and expenditure at a constant proportion of domestic income. Switching to lower income taxes promotes economic growth and improves the current account balance, despite an instantaneous drop.

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** The views expressed are those of the authors and not necessarily those of The Australian Treasury.
1 Introduction

The introduction of a Goods and Services Tax (GST) in Australia has brought to the forefront of policy debate the merits of a shift from a domestic tax system based on personal income taxation to one based on broad-based consumption taxation. According to its proponents, a shift to consumption taxation boosts domestic savings, thereby alleviating pressure on the current account and reducing the long run level of foreign debt.

The objective of this paper is to develop a model of growth in a small open economy that explains these stylised observations, and also gives a clear exposition of the dynamic path of real variables, principally the current account balance.

The growth effects of replacing income taxes with consumption taxes have been studied extensively in the theoretical literature, in terms of both qualitative changes (see Miles-Ferretti & Roubini (1998) for a generalization of previous contributions) and quantitative changes (Jones, Manuelli & Rossi 1993, Gomez 2003). Whether the growth model is neoclassical (King & Rebelo 1990) or endogenous (as driven by either human capital accumulation (Stokey & Rebelo 1995) or innovation (Zeng & Zhang 2002)), the consensus is that replacing income taxes with consumption taxes raises the growth rate by encouraging savings and/or labor supply.\(^1\)

Unfortunately, these are all closed economy models. In a closed economy, domestic income and domestic output are synonymous. However, in an open economy, domestic income and domestic output differ by the interest on net foreign liabilities and are distinctly determined. While Blanchard & Perotti (2002) estimate a positive effect of tax cuts on GDP for the United States (US), Perotti (2002) find smaller effects of tax cuts on GDP for a sample of five OECD countries. These estimates may be an overstatement and understatement, respectively (pp. 24, 25, Perotti (2002)). Nonetheless, a priori, income tax cuts affect GNP more directly than GDP in small open economies.

Whilst application of growth theory to small open economies has been a thriving area of research for nearly two decades, much of the literature on tax reform in a small open economy contrasts domestic taxes and tariffs, due to a predilection with developing economies (Leung 1999, Naito 2006). A notable exception is Turnovsky (1996), who contrasts the effects of a consumption tax, a tax on bond income and a tax on domestic output in an

\(^1\)Income taxes are in general growth reducing. The growth rate of the economy is typically neutral with respect to consumption taxes, although (Miles-Ferretti & Roubini 1998) demonstrates the effect of consumption taxes is sensitive to model specification.
endogenous growth\textsuperscript{2} model of a small open economy. In this model, the optimal savings rate is chosen by an infinite-lived, forward looking representative consumer. Accordingly, whether a change in tax policy is temporary or permanent, anticipated or unanticipated has distinct implications for the dynamic path of real variables. This complicates the analysis of transitional dynamics, obscuring the evolution of key real variables. Turnovsky (1996), for instance, does not analyze the intertemporal effects of taxes on the current account of the balance of payments. Also, analysis of transitional dynamics is more open to error. Schubert & Turnovsky (2002) recently corrected the flawed dynamic solution presented in Sen & Turnovsky (1990).

This paper introduces a government sector to the small open economy Solow-Swan growth model of Benge & Wells (2002) to contrast the effects of a consumption tax and an income tax. We differ from Turnovsky (1996) in our treatment of taxes and in our treatment of the savings rate.\textsuperscript{3} Analyzing a tax on domestic income, rather than domestic output, is a more realistic depiction of the tax system. Also, we develop the interrelationship between the consumption tax rate and the income tax rate, as implied by the government budget identity. It is traditional when analyzing taxes to assume that revenues are rebated in lump sum fashion, thereby enabling us to separate out the pure distortionary effects of taxes from any expenditure effects. We follow this tradition, by assuming a balanced budget. However, we deviate by allowing government expenditure to grow at a constant rate of domestic income. This assumption confers realism to the existing model and feasibility to the further extension of utility enhancing government expenditure.

The benefits of treating the savings rate as an exogenous constant are twofold. Firstly, we are able to provide a clear exposition of the intertemporal effects of tax reform on the growth rate of the economy and real variables, such as the current account balance (see Figure 1). The long run effects of tax reform are confined to level effects, consistent with recent empirical evidence. Secondly, if we were to endogenize the savings rate, Turnovsky’s (1996) assumption of an infinite-lived agent is restrictive to any welfare analysis of tax reform since it implies welfare maximisation

\textsuperscript{2}A simple linear production technology (i.e. constant returns to physical capital in the production of final output) gives the model the feature of endogenous growth.
\textsuperscript{3}Like Benge & Wells (2002), we also assume instantaneous adjustment of the stock of physical capital. Since a change in either the consumption tax rate or the income tax rate affect neither the return on capital or the marginal product, this deviation from Turnovsky (1996) is innocuous.
Figure 1: Current Account Balance as a percentage of GNP (5 year moving average dashed line)
and, in turn, dynamic efficiency. The alternative assumption of a finite-lived agent allows for the possibility of dynamic inefficiency. Whilst initial evidence for the OECD suggests these economies are dynamically efficient (Abel, Mankiw, Summers & Zeckhauser 1989), more recent evidence for East Asia suggests the small open economies of Taiwan and Korea are not dynamically efficient (Ahn 2003). Thus, we analyse the dynamic path of real variables without loss of generality to the further extension of welfare analysis.

2 The Model

2.1 Domestic Production

Consider a small open economy that consumes and produces a single traded good. Domestic output ($Y$) of this commodity is determined by the domestic stock of physical capital ($K$) and labor ($L$) that is augmented by technology ($A$), using the constant returns technology:

$$Y = Q(K, AL)$$  \hspace{1cm} (1)

where the Inada conditions are satisfied. The stocks of technology and labor accumulate over time:

$$A_t = A_0 e^{\mu t}; \quad L_t = L_0 e^{nt}$$  \hspace{1cm} (2)

where $\mu$ is the rate of technological progress and $n$ is the rate of labor force growth. Thus, technology augmented labor, or the stock of effective workers, accumulates over time at the exogenous rate of $(n + \mu)$. Denote $\tilde{y}$ and $\tilde{k}$ as real gross domestic product (GDP) and physical capital, per effective worker, respectively. In an open economy, the stock of physical capital does not accumulate with domestic savings. Rather, under competitive conditions, the stock of domestic physical capital is determined by equality of its net marginal product to the rate of return on foreign assets:

$$q'(\tilde{k}) = \delta + r$$  \hspace{1cm} (3)

where $\delta$ is a proportional rate of depreciation and $r$ is the exogenous world interest rate. Assuming perfect mobility and no adjustment costs\(^4\), the stock of physical capital adjusts instantaneously in response to shocks to world interest rates.

\(^4\)To fully analyse taxation of income from physical capital and foreign bonds, respectively, Turnovsky (1996) assumes convex adjustment costs. For the purposes of this paper, the absence of adjustment costs simplifies analysis without loss of generality.
2.2 Current Account and Domestic Income

Allowing international trade in both the final good and assets, it is possible for saving and investment not to be equal at any moment of time. Thus, we model the separate dynamics of investment and saving. Gross investment \((I)\) is given by the familiar identity:

\[
I = \dot{K} + \delta K
\]  

(4)

Temporary shortfalls in domestic savings, current account deficits, are financed by foreign borrowing. The current account balance comprises net exports \((Z)\) and interest on net foreign assets \((rF)\). Accordingly, net foreign assets evolve as

\[
\dot{F} = Z + rF
\]  

(5)

where a net debtor economy may continue to accumulate net foreign debt despite a positive trade balance \((Z > 0)\), because of interest payments on existing net foreign liabilities \((rF < 0)\).

A salient feature of this model is the distinction between production (GDP) and income (GNP). Domestic income is given by

\[
X = Y + rF
\]  

(6)

where the income available to domestic residents is less than output produced if there are net foreign liabilities \((F < 0)\). In this case, some of the domestic capital stock is owned by foreigners, implying a definition of wealth of the domestic economy:

\[
W = K + F
\]  

(7)

The GDP expenditure identity is given by

\[
Y = C + I + G + Z
\]  

(8)

where \(C\) and \(G\) denote private consumption and government consumption, respectively.

2.3 Government

The government budget identity is given by

\[
\dot{B} = rB + G - T
\]  

(9)

where \(G, T\) and \(B\) denote total transfers, total tax revenue and government debt, respectively. Under perfect capital mobility, the real interest rate on
government bonds equals the real interest rate on foreign bonds, \( r \). We assume that domestic income is taxed at the rate \( \tau_x \) and that domestic consumption is taxed at the rate \( \tau_c \): 
\[
T = \tau_x X + \tau_c C^c. \tag{5}
\]

Domestic residents save a constant proportion, \( s \), of disposable income. Referring to the appendix, aggregate savings is given by

\[
s (1 - \tau_x) X = \dot{W} + \delta K + \dot{B} - rB \tag{10}
\]

For the purposes of this paper, I assume that all government transfers to domestic residents are funded by revenues from all taxes on domestic residents. Under pure tax financing of transfers and in the absence of initial government debt, the last two terms of equation (10) drop out. Equation (9) reduces to the balanced budget condition: \( G = T \).

From equation (10), after substituting from equations (1), (6) and (7), wealth per effective worker evolves according to

\[
\dot{\bar{w}} = s (1 - \tau_x) \left[ q \left( \bar{k} \right) - r \bar{k} \right] - \delta \bar{k} - \left[ (\mu + n) - sr (1 - \tau_x) \right] \bar{w} \tag{11}
\]

### 3 Steady State Equilibrium

In steady state equilibrium, all per effective worker variables are constant or, equivalently, all per capita variables grow at the exogenous rate of technological progress. In this model, the steady state corresponds to \( d\bar{w}/dt = 0 \), which, from equation (11), implies the condition:

\[
s (1 - \tau_x) \left[ q \left( \bar{k}^* \right) - r \bar{k}^* \right] - \delta \bar{k}^* = \left[ (\mu + n) - sr (1 - \tau_x) \right] \bar{w}^* \tag{12}
\]

where asterisks denote steady state values and \( \bar{k}^* \) is determined by equation (3).

With \( \bar{k}^* \) fixed, the condition for stability of the dynamic adjustment of wealth is that \( [(\mu + n) - sr (1 - \tau_x)] > 0 \).

#### 3.1 Comparative statics

The comparative statics on all real variables follow from changes in \( \bar{k}^* \) and \( \bar{w}^* \). From equation (3),

\[
q'' \left( \bar{k}^* \right) d\bar{k}^* = d\delta + dr \tag{13}
\]
Taking the total differential of (12), noting that $\ddot{k}^* = 0$ provided $r$ and $\delta$ remain constant through time, yields
\[
d\ddot{w}^* = \frac{(1 - \tau_x) \dot{x}^* ds - \ddot{w}^* (d\mu + dn) - s\dot{x}^* d\tau_x}{[(\mu + n) - sr (1 - \tau_x)]}
\] (14)

This equilibrium has the feature that, with pure tax financed government transfers, it is neutral with respect to the consumption tax rate, $\tau_c$. Intuitively, aggregate savings implies a steady state stock of domestic wealth. In this model, domestic residents save a constant proportion of disposable income. Disposable income is affected by changes in the income tax rate, $\tau_x$, but is neutral to changes in the consumption tax rate, $\tau_c$. It is worth noting that this result is generalizable to a growth model with an endogenous, rather than exogenous, savings rate, where constancy of the savings rate is implied by an arbitrary condition, such as equality of the real return on foreign bonds and the rate of time preference, neither of which are influenced by the consumption tax rate (see Turnovsky (1996)).

### 3.2 Indirect Effect of Consumption Tax

Nonetheless, an indirect effect of consumption taxes is implied by the balanced budget condition. The government can return the additional revenue from an increase in the consumption tax rate to domestic residents through either increased transfers or lower income tax rates. Consider a government that sets its expenditure as a fixed proportion of GNP, namely $G = g_x X$ so that transfers grow with domestic income.\(^6\) The balanced budget condition is then given by
\[
g_x = \tau_x + \tau_c \frac{C}{X}
\] (15)
where $0 < g_x < 1$. We confine our attention to the case where the government maintains a constant $g_x$.\(^7\) An inverse relationship between $\tau_c$ and $\tau_x$ is implied. Taking the total differential of (15), recognizing that $C/X = (1 - s) (1 - \tau_x)$, yields
\[
\frac{\partial \tau_x}{\partial \tau_c} \bigg|_{dg_x=0} = - \frac{(1 - s) (1 - \tau_x)}{[1 - \tau_c (1 - s)]} < 0
\] (16)

\(^6\) Indexing government expenditure to GNP not only simplifies the exposition, it is also guarantees feasibility in an open economy with utility-enhancing government expenditure, as analyzed in a follow up paper.

\(^7\) An increase in $g_x$, due to an increase in $\tau_c$, is inconsequential for steady state equilibrium in this model. Also, the effect of changes in $g_x$ are best analyzed in a model with utility-enhancing government spending.
Example 1 If $s = 0.2$, $\tau_x = 0.3$ and $\tau_c = 0.1$, then $d\tau_x \approx -0.61.d\tau_c$.

To maintain a balanced budget and government expenditure as a constant proportion of income, the government will reduce the income tax rate by 61% of the rise in the consumption tax rate.

Thus, a government maintaining a balanced budget and confining expenditure to constant portion of domestic income will offset an increase in the consumption tax rate with a decrease in the income tax rate. It follows from condition (12) that the consumption tax rate has an indirect effect on the steady state equilibrium. Ceteris paribus,

$$
\frac{\partial \hat{w}^*}{\partial \tau_c} = \frac{\partial \hat{w}^*}{\partial \tau_x} \cdot \frac{\partial \tau_x}{\partial \tau_c} = \frac{s (1 - s)(1 - \tau_x) \hat{x}^*}{[(\mu + n) - sr (1 - \tau_x)] [1 - \tau_c (1 - s)]} > 0
$$

which yields the following proposition:

Proposition 1 Under a balanced budget, an increase in the consumption tax rate, if rebated through a decrease in the income tax rate, raises the steady state stock of domestic wealth.

4 Tax Reform in Australia

The introduction of a GST in 2000 represented a significant step forward for tax reform in Australia. The introduction of a GST not only supplanted indirect taxation of consumption, through wholesale taxes, it also increased the overall rate of consumption tax.

As established in the previous section, an increase in the consumption tax rate has an indirect effect on the steady state equilibrium when the government returns the additional revenue to domestic residents through a decrease in the income tax rate. Domestic income (GNP) comprises both labor income and gross capital income (or gross operating surplus) available to domestic residents. Accordingly, the income tax rate encompasses the rate of tax on both personal and corporate income available to domestic residents.

To illustrate the analysis of tax reform in our framework, consider the case of Australia. Assuming that the government allows its spending to grow at a constant portion of GNP. Under a balanced budget, the government may offset the increase in the consumption tax rate associated with introducing a GST with a reduction in the income tax rate.

Coinciding with the introduction of a GST, Australia enjoyed a reduction in its corporate income tax rate from 36% in 2000 to 34% in 2001, and to 30%
in 2002. In addition, since introducing a GST, Australia has consistently reduced its personal income tax rate through lower marginal tax rates, higher income tax thresholds and additional tax rebates. Tax cuts are considered an integral part of this tax reform package.

Figure 2 shows the cumulative change in the tax mix since the introduction of a GST. Overall, a rise in the rate at which consumption is taxed is associated with a fall in rate at which income is taxed. Equation (16) gives the level of income tax cuts permissible under a GST, assuming a balanced budget and constant government spending as a proportion of domestic income.

What would be the effect on Australia’s macroeconomic performance if income taxes are reduced so as to achieve a decrease in the income tax rate as suggested by equation (16)? To fully answer this question, we analyze the effect on both steady state levels and the dynamic paths of real variables.

Consider a decrease in $\tau_x$, proportional to the increase in $\tau_c$, as per (16), at time $t_0$. Up until $t_0$, the economy is in steady state. We assume the economy is a net debtor and runs a current account deficit, despite a positive trade balance.\(^8\)

\(^8\)Source: DX Data; 2007-08 Budget Papers; authors’ calculations.

\(^9\)These assumptions are made for illustrative purposes. Any or all may be altered without loss of generality. Re the latter assumption, steady state net exports per effective
Proposition 2 (Long run effects) In response to a decrease in the income tax rate, the steady state per effective worker level of:

- output is unaffected;
- income rises;
- consumption rises;
- net foreign debt falls; and
- the current account balance improves.

The decrease in $\tau_x$, by equation (13), affects neither capital per effective worker nor output per effective worker, $\tilde{k}^*$ and $\tilde{y}^*$, respectively. Both remain constant. However, the steady state value of domestic wealth per effective worker, $\tilde{w}^*$, rises as per equation (17). At the original value of $\tilde{w}^*$, the left hand side of equation (12) exceeds the right hand side and so, by equation (11), domestic wealth per effective worker accumulates over time.

Intuitively, a decrease in $\tau_x$ boost disposable income, enabling a level of aggregate savings that exceeds the level of savings required to keep domestic wealth constant in per effective worker terms. As $\tilde{w}$ rises, the gap between terms in the accumulation equation (11) narrows and the rate of growth in $\tilde{w}$ slows. Eventually $\tilde{w}$ converges to a new higher steady state value.

The effects, both qualitative and quantitative, on steady state levels of all other variables are readily obtained from the definitions in Section 2.2. Specifically,

$$d\tilde{f} = d\tilde{w} > 0; d\tilde{x} = r d\tilde{w} > 0$$

(18)

Intuitively, the growth in domestic wealth per effective worker alleviates the need for overseas borrowing to finance a constant level of domestic production per effective worker. Net foreign liabilities per effective worker decumulate. The economy converges to a new steady state with a lower level of net foreign liabilities per effective worker, and given reduced interest payments on net foreign liabilities, a higher level of domestic income (GNP) per effective worker. Aggregate expenditure per effective worker remains

worker are, from (5), $\tilde{z}^* = [(\mu + n) - r] \tilde{f}^*$. Thus, the assumption $r > (\mu + n)$ implies a strictly positive trade balance ($\tilde{z}^* > 0$) for a net debtor economy ($\tilde{f}^* < 0$).
constant, but its composition changes:

\[
d\bar{c} = -(1 - s) \tilde{x}d\tau_x + (1 - s)(1 - \tau_x) d\bar{x} > 0 \quad (19a)
\]

\[
d\bar{g} = g_x d\bar{x} > 0 \quad (19b)
\]

\[
d\bar{x}^* = 0 \quad (19c)
\]

\[
d\bar{z}^* = [(\mu + n) - r] d\bar{w}^* < 0 \quad (19d)
\]

\[
d\bar{y}^* = d\bar{c}^* + d\bar{z}^* + d\bar{g}^* + d\bar{w}^* = 0 \quad (19e)
\]

Domestic consumption per effective worker \((\bar{c})\) rises, due to rising disposable income which, in turn, is due to both the initial tax cut and growth in gross domestic income. Government transfers as a portion of domestic income \((g_x)\) are constant, so government transfers per effective worker \((\bar{g})\) grow with domestic income per effective worker. Growth in private and government consumption per effective worker is offset by a lower level of steady state net exports. However, the overall current account deficit improves, because the fall in the net interest income deficit, due to the reduction in net foreign debt, more than offsets the fall in the trade surplus. Substituting from (18) and (19d) yields

\[
\Delta\bar{a}^{cab} = d\bar{z}^* + rd\bar{f}^* = (\mu + n) d\bar{w}^* > 0 \quad (20)
\]

The long run effects of a decrease in the income tax rate are confined to level effects. That is, the tax cut shocks the economy onto a path to a new steady state, one in which the level of income per effective worker is higher, but the growth rate of income per worker is still the exogenous rate of technological progress, \(\mu\). It is therefore useful to examine how the decrease in \(\tau_x\) affects the growth rates of real variables through time, in transition to the new steady state. Since growth of the economy is traditionally measured by growth in income per capita, we indicate the growth effects by graphing the natural logarithm of per capita variables against time.

**Proposition 3 (Dynamic effects)** In response to a decrease in the income tax rate, the current account balance instantaneously worsens and then improves in transition to steady state.

Consider the transitional dynamics of the economy. Up until \(t_0\), all per capita variables grow at rate \(\mu\). At \(t_0\), disposable domestic income per capita \((x^d)\) rises by the amount of the decrease in \(\tau_x\). This causes an instantaneous jump in consumption per capita \((c)\) and savings per capita \((s)\). Since GDP per effective worker \((\bar{y})\) and the growth rate of GDP per
Figure 3: Income tax rate

\[ d\sigma = -\frac{(t_0^2 - 1)(1 - \tau)}{|t_0 - \tau|} d\tau \]
Figure 4: Dynamics of Current Account Balance per effective worker

capita \((y)\) are unchanged, by the GDP expenditure identity, equation (8), the instantaneous rise in consumption is exactly offset by an instantaneous fall in net exports per capita \((z)\). Thus, the paths of \(c, s\) and \(z\) are discontinuous at \(t_0\). As people save more and reduce net foreign liabilities, the growth rate of per capita domestic wealth and GNP, \(w\) and \(x\), respectively, initially rises. Eventually these growth rates converge back to the steady state value, \(\mu\).

The path of the per capita current account deficit \((cad)\) is particularly interesting and at first glance appears counter-intuitive. There are two effects on the \(cad\): a falling trade surplus, on the one hand, and a falling interest income deficit, on the other. A comparison of steady states show an unambiguous overall improvement in the \(cad\), due to a predominant fall in the net interest income deficit. However, the reduction in net foreign
liabilities, which accounts for lower interest payments, is not instantaneous: it takes time for additional domestic savings to reduce the stock of net foreign liabilities. Thus, the \textit{cad} instantaneously increases due to an instantaneous drop in the trade surplus and then gradually improves from \( t_0 \) onwards.

\section*{5 Conclusion}

The model of a growing small open economy presented in this paper predicts that a shift from income taxes to consumption taxes unambiguously improves the long run levels of domestic income, consumption, savings, current account deficit and net foreign debt, as a percentage of GNP.

Intuitively, lowering the domestic income tax rate boosts disposable income, generating a higher level of aggregate savings sufficient to raise the stock of domestic wealth per effective worker. Growth in domestic wealth per effective worker alleviates the need for overseas borrowing to finance production. Consequently, net foreign liabilities per effective worker fall. In steady state equilibrium, domestic income (measured by GNP) grows with the number of effective workers. Thus, the economy converges to a long run equilibrium with lower net foreign debt as a percentage of GNP and, given the predominance of the net interest income deficit, a lower current account deficit as a percentage of GNP.

The level of domestic production is unaffected to the extent that the net marginal product of domestic capital and rate of return on foreign assets is unaffected. Thus, while our theoretical results are consistent with Perotti’s (2002) conclusions for a small open economy like Australia, we would expect a positive effect of tax cuts on GNP.

Our results also offer insight into policy debate on tax reform in Australia. The balanced budget condition suggests scope for further cuts to the income tax rate and the unambiguous long run improvement in key real variables supports the case for further cuts to the income tax rate.

Recognising that convergence to long run equilibrium in a growth model is slow, we map the dynamic response of all endogenous variables to a decrease in the income tax rate. The dynamic path of the current account deficit is particularly interesting since a sustained, long run improvement more than offsets an instantaneous drop.

In analysing the transitional dynamics of the current account deficit, we do not suggest that the current account balance should be a policy target for a government of a small open economy. Debate on whether the level of net foreign debt and current account deficit is a concern of government
is outside the scope of this paper. And, whilst the post GST drop in the actual current account balance resembles the initial drop in Figure 4, we do not deny the importance of other factors, namely the terms of trade, in determining the actual path of the current account deficit.

Our dynamic effects do suggest that, ceteris paribus, a switch from income tax to consumption tax boosts growth rates in both income and consumption. Net foreign debt and the current account deficit fall over time.

Whilst the Solow-Swan model of a small open economy with government illuminates the dynamic response of real variables to tax reform, it is simple and lends itself to several extensions. Fortunately, few assumptions imply loss of generality. For instance, endogenising the savings rate, as in Turnovsky (1996), will alter neither the dynamic nor long run effects since constancy of an endogenous savings rate is implied by equality of the real return on foreign bonds and the rate of time preference, neither of which are influenced by the consumption or income tax rate.

Utility-enhancing government spending is a feasible and straightforward extension due to our assumption that government spending is proportional to domestic income. Although the overall income and production effects would not differ from those provided in this paper, such an extension would identify the welfare effects of returning additional revenue from consumption tax to residents in the form of government spending rather than income tax cuts.

Relaxing the assumption of a balanced budget allows a more sophisticated analysis of fiscal policy. Allowing for both debt and tax financed increases in government is an interesting extension since Ricardian equivalence does not hold in the Solow-Swan growth model.

It would be particularly interesting to explore the effect of a lower income tax rate on labor force participation. A priori, excepting a backward bending labor supply curve, a decrease in the income tax rate raises labor supply, which in turn raises the marginal product of domestic capital. For a given real return on foreign capital, domestic capital and production increases. The overall effect on net foreign liabilities is determined by the relative magnitude of the rises in domestic capital and domestic wealth. Endogenising the stock of technology attenuates the effect on domestic production. Nesting endogenous labor supply and a well-specified model of R&D within a small open economy growth model is therefore a feasible and challenging direction for further research.
A Appendix

A.1 Derivation of equation (10)

Since \( S \equiv X - C - T \), using (6), (8), (4), (5), (9) and (7):

\[
S = I + (Z + rF) + (G - T) \\
= \dot{K} + \delta K + \dot{F} + \dot{B} - rB \\
= \dot{W} + \delta K + \dot{B} - rB
\]

The first line yields the twin deficits theory.

A.2 Comparative Statics

\[
[(\mu + n) - sr (1 - \tau x)] d\tilde{u}^* = (1 - \tau x) \tilde{x}^* ds - (1 - s (1 - \tau x)) \delta d\tilde{k}^* - \tilde{k}^* d\delta + s (1 - \tau x) \tilde{f}^* dr - \tilde{w}^* (d\mu + dn) - s\tilde{x}^* d\tau x
\]

A.3 Comparative Statics (all variables)

\[
\begin{align*}
\, d\tilde{f} & = d\tilde{w} - d\tilde{k} = d\tilde{w} \\
\, d\tilde{x} & = dy + rd\tilde{f} + \tilde{f} dr = r d\tilde{w} \\
\, d\tilde{c} & = -(1 - \tau x) \tilde{x} ds - (1 - s) \tilde{x} d\tau x + (1 - s) (1 - \tau x) d\tilde{x} \\
\, d\tilde{t}^* & = \tilde{k}^* (d\mu + dn + d\delta) \\
\, d\tilde{z}^* & = [(\mu + n) - r] d\tilde{f}^* + \tilde{f}^* (d\mu + dn - dr) = [(\mu + n) - r] d\tilde{w}^* + \tilde{f}^* (d\mu + dn) \\
\, d\tilde{g}^* & = d\tilde{c}^* + d\tilde{t}^* + d\tilde{g}^* + d\tilde{z}^* = 0 \\
\, d\tilde{g}^* & = g_x d\tilde{x}
\end{align*}
\]
References


