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**Will a Rise in Consumption Tax Share Increase the
Effectiveness of Government Spending?**

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Abstract

The Australian tax reform in July 2000 gave heavier weights to consumption tax in the tax mix at the expense of the income tax. This paper shows that the trade off among the tax-mix policy parameters depends on the structure of the economy. Given that the reform is tax-revenue neutral and no change in monetary stance, a rise in the share of consumption tax in the tax mix may increase the effectiveness of government spending in stabilising the economy if certain conditions are fulfilled. A numerical example is included for illustration purposes.

JEL classification: E62, H29, H50

Key words: Tax mix; Consumption tax; Government spending; Tax revenue neutrality; Australian tax reform

1. Introduction

In the 1998 Federal election, the Coalition Government campaigned for re-election on the platform of a tax reform. The Coalition Government argued that the tax system then was outdated, complex, unfair, ineffective, penalising exports, and discouraging investment. All these problems could only be fixed once and for all by reforming the tax system. The centrepiece of its tax reform was to replace the wholesale sale taxes of six different rates, the financial institution duties, the debit tax, the conveyancing duties on business property, and five other stamp duties with a Goods and Services Tax (GST)—a credit value-added-tax (VAT) type of general consumption tax. To squash any speculation that the tax reform was a revenue-raising exercise, the Coalition Government (Commonwealth Government, 1998, p.10) stated that “The tax reform plan . . . is not aimed at additional revenue”. The additional revenue from the GST would be used to fund an increase in the income tax threshold, a reduction in the marginal income tax rates, and a one-off increase in certain welfare payments. The Coalition Government also ensured that the impact of the tax reform would be tax-revenue neutral for the States, Territories and Local governments for the three-year transition period (Commonwealth Government, 1998, p.104 and p.155). The Coalition won the re-election and the rest was history.¹

Theoretically, a general consumption tax should apply to all goods and services. For qualified welfare recipients, they can be reimbursed by further transfer payments. However, the compliance costs on the part of the retailers and the administration costs on the part of the government agency (CentreLink) of such a reimbursement scheme may be quite substantial, not to mention the issue of privacy. The outcome of the political process predictably produces a second-best solution: The Australian GST has exemption or zero rating on food, health, education, childcare services, hospitals and nursing homes, local government rates, water and sewerage charges, and charitable activities.² Readers who are interested in the issue of regressivity or a lack of progressivity of consumption tax can refer to Atkinson and Stiglitz (1987), Metcalf (1995), Krusell et al. (1996), and Creedy (1998, 2002). Interestingly, Freebairn (1999) found that the revised tax reform package did not make the post-reform tax system any more regressive than the pre-reform tax system.

This paper takes the discussion to a different direction.³ It examines a possible relationship between tax mix and effectiveness of government spending. Tax mix refers to the composition of total tax revenue from various sources of taxes, summarised by four tax-mix policy parameters: income tax rate, consumption tax rate, household income-tax free threshold, and consumption tax exemption proportion. In the recent tax reform, the change in the tax mix involved an increase in the share of the consumption tax in the total tax revenue. The question this paper would like to ask is: Whether such a change would impact on the effectiveness of government spending? This is a concern for economic policy makers especially those whose countries have adopted inflation targeting and flexible exchange rates. As far as the author is aware, the relationship between revenue-neutral tax mix and effectiveness of government spending, both belong to the realm of fiscal policy, has not been investigated in the economic literature. The author finds the IS-LM model, though rudimentary in nature and not without pitfalls, is capable to shed light on this issue, which makes the results more accessible to a wider audience.⁴ There are two findings in this paper. First, the effectiveness of government spending affecting output depends on a rather complicated condition depending on the structure of the economy and the four tax-mix policy parameters. Second, the six trade-off ratios among the four tax-mix policy parameters, including that of income and consumption tax rates, remain constant as long as the rest of the parameters in the model remain constant. Since there is a lack of Australian data to date to carry out any meaningful empirical study, the author resorts to a simple numerical example to illustrate his point.

The remainder of this paper is organised as follows: Section 2 presents a three-sector IS-LM model with both income and consumption taxes. Section 3 discusses the trade off among the various tax-mix policy parameters. Section 4 examines the impact of tax mix in particular an increase in the share of consumption tax on the effectiveness of government spending. Section 5 presents a numerical example. Section 6 is the conclusion.

2. A Simple Three-Sector IS-LM Model with Dual Taxes

This section presents a typical IS-LM model for a closed economy, which forms the basis of the discussion. The linear forms of the consumption function, the investment function, and the money demand function are specified as

$$C = C_o + cY^D \quad (1)$$

$$I = I_o - h r \quad (2)$$

$$\left(\frac{M}{P}\right)^d = m^d = fY - k r \quad (3)$$

where C is consumption, C_o is baseline consumption, c is marginal propensity to consume, Y^D is disposal (real) income, I is investment, I_o is baseline investment, h is interest sensitivity of investment, r is real interest rate, $(M/P)^d$ or m^d is demand for real balances, f is income sensitivity of demand for money, and k is interest sensitivity of demand for money.

There are two ways of modelling consumption tax depending on whether retail prices of goods and services are tax exclusive or inclusive. In case where the consumption tax is added onto the retail price, the prices are said to be tax exclusive. In case where the consumption tax is a VAT-type and the prices include the consumption tax (e.g., the GST), then the consumption tax is said to be tax inclusive. For convenience, the same tax revenue function for both versions of the consumption tax is written as:

$$T(C) = v C \quad (4)$$

where T is the tax revenue and v is consumption tax rate. When prices are tax exclusive, $v = z$ and z is the ad valorem tax rate. When prices are tax inclusive as in the case of the GST, $v = z/(1 + z)$.

In reality, goods and services may be classified into different categories and rated differently, then, equation (4) becomes $T(C) = \sum v_i C_i$. The simplest version of this complicated scheme is to divide all goods and services into two categories: Essentials with zero rating and non-essentials with positive rating.⁵ A roundabout way to present this dichotomous scheme is to introduce a consumption tax exemption proportion $0 \leq b \leq 1$ to approximate the part of zero-rated essential consumption. Consequently, the tax revenue from consumption tax is

$$T(C) = v(1 - b) C \quad (5)$$

As for the income tax, this paper follows the approach by Creedy (1998) to capture the progressivity nature of most income-tax systems. Each household has an income-tax free threshold $0 < a$. With N households in the economy the amount of income exempted from

income tax is $0 < aN < Y$. Putting the income tax revenue and consumption tax revenue together, the tax equation becomes

$$T = t(Y - aN) + v(1 - b)C \quad (6)$$

and t , v , a , and b are the four tax-mix policy parameters (hereafter policy parameters); their relationship to be examined in Section 3.

The solution of the model is complicated by the presence of the GST. Household consumption depends on the level of disposable income but the latter also depends on how much the households consume. This interdependence introduces a geometric series into the consumption equation

$$C = \frac{C_o + aNct - c(1-t)Y}{\beta} \quad (7)$$

and the dual-tax IS curve

$$r = \frac{(I_o + G_o)\beta + C_o + aNct}{h\beta} - \left[\frac{\beta - c(1-t)}{h\beta} \right] Y \quad (8)$$

where $\beta = 1 + cv(1 - b)$. Without further ado, the equation of the LM curve is

$r = -\frac{m_0}{k} + \frac{f}{k}Y$ where m_0 stands for real money balances. And the equilibrium value for real

GDPY is:

$$Y^* = \frac{\beta(m_0h + kI_o + kG_o) + kC_o + kaNct}{\beta(fh + k) - kc(1-t)}. \quad (9)$$

3. Trade Off Among Tax-Mix Policy Parameters

It is reasonable to argue that a new tax regime is at least tax revenue neutral or tax revenue enhancing in its inceptive year for the government to fulfil its financial commitments. It is more likely to be tax neutral to avoid the accusation of revenue grabbing. This is exactly what the Coalition Government pledged when it campaigned for its tax reform. Another reason that the government may prefer to maintain neutrality is that a depletion or enhancement may create an economic shock that the government has to handle on top of the administrative problems of changing the tax system. The immediate question is: What is the implication of tax neutrality in the context of this simple IS-LM model. As long as tax

revenue does not change, real GDP remains at the same level in the short run when prices are rigid. Since both consumption and saving are functions of disposal income, which in turn depends on tax given real GDP, a stable tax liability means stable consumption and saving, *ceteris paribus*. That is, tax revenue neutrality implies real-GDP neutrality.

The six trade-off ratios among the four policy-parameters— t , v , a , and b —is crucial to the study of the effectiveness of government spending. To obtain the equation for deriving the trade-off ratio, substitute the consumption equation (7) into the tax equation (6) and total differentiate, further setting $dT = dY = dC_o = dc = dN = 0$, yields

$$0 = \beta(Y - aN) dt - \beta t N da + (1 - b) B dv - v B db \quad (10)$$

where $B = C_o + c(1 - t)Y + aN ct$. Equation (10) describes the trade off among the tax-mix policy parameters under the condition of tax-revenue and real-GDP neutrality. The Australian tax reform represents a decrease in the exemption rate b and the adoption of a common consumption tax rate v for all categories of goods and services with a simultaneous decrease in income tax rate t and income tax-free threshold a . As a result, there is an increase in the share of consumption tax in the tax revenue with the increase to fund an increase in income tax threshold and lowering of marginal income tax rate. As for the issue of tax-revenue neutrality of Australian tax reform, recent statistics do show that the tax composition has not changed substantially; see Table 1. The percentage of the tax involved in the tax reform in terms of the total tax revenue has been steadily increasing over time irrespective of the occurrence of the tax reform. The sudden drop in the introductory year of the GST is likely to be the result of a drop in consumption due to the psychological impact of an imposition of a

Table 1: Tax Revenue Trade Off

Fiscal year	Tax revenue for all levels of government (in \$m)				
	98-99	99-00	00-01	01-02	02-03
Personal income tax	76,736	84,986	78,634	88,388	92,582
Sales tax	15,215	15,644	1,976	791	896
Goods & services taxes (GST)	-	-	23,854	27,389	31,257
Total tax revenue	181,498	196,390	213,997	217,239	227,668
Personal income tax as a percentage of total tax revenue	42.28%	43.27%	36.75%	40.69%	40.67%
Sales tax/GST as a percentage of total tax revenue	8.38%	7.97%	12.07%	12.97%	14.12%
The three tax as a percentage of total tax revenue	50.66%	51.24%	48.82%	53.66%	54.79%

new tax. The percentage of the personal income tax and sales tax/GST has actually increased over the period from 40% to 44%, which can be an indicator that the tax reform is not revenue neutral.

3.1 Trade-off Ratio for Income and Consumption Tax

Creedy (1998) suggested that the trade off between income and consumption tax rate is a function of the two tax rates, the income tax free threshold, and the arithmetic mean income. This sub-section addresses the same issue within the IS-LM framework. The tax-rate trade-off ratio for income and consumption tax α_{vt} is obtained by setting the changes in the income tax-free threshold a and consumption tax exemption proportion b equal zero in equation (10), which gives

$$\alpha_{vt} = \left. \frac{dv}{dt} \right|_T = -\frac{\beta(Y - aN)}{B(1-b)} < 0 \quad (11)$$

which turn out to be a function of the four tax-policy parameters, real GDP, numbers of households, marginal propensity to consume, and baseline consumption. The IS-LM framework employed here is able to give a more comprehensive picture of the determinants of the tax-rate trade-off ratio than Creedy (1998). By replacing the arithmetic mean income by real GDP, the latter can be further expanded using equation (9), which yields

$$\alpha_{vt} = -\frac{[1 + cv(1-b)](aNfh + aNk - m_0h - kI_o - kG_o) - aNkc}{[1 + cv(1-b)]c(1-b)(m_0h + kI_o + kG_o) + aNkc^2t(1-b)} < 0 \quad (12)$$

where the value of the tax-rate trade-off ratio is now determined by all the parameters in the economy. Additional comparative static analysis on equation (12) produces equation (13) which summaries the effect of a change in each parameter on the tax-rate trade-off ratio.

$$\alpha_{vt} = f(a, b, C_o, I_o, G_o, M_0, P_0, c, h, f, k) \quad (13)$$

There are five observations about the tax-rate trade-off ratio. Firstly, it is negative because consumption tax has a narrower tax base than income tax. Suppose there is a cut in the income tax by $\Delta t < 0$, the first round increase in disposable income is $\Delta Y^D = -Y\Delta t > 0$. This increase in disposable income is allocated to consumption and saving (or future consumption). To maintain revenue neutrality, that is, $-Y\Delta t = C\Delta v$, $-\Delta t < \Delta v$ must hold. Secondly, the “+” or “-” sign in equation (13) indicates a smaller or larger trade off between the two tax rates when there are changes in the values of other parameters. And the tax-rate

trade-off ratio is constant as long as the rest of the structure of the economy remains unchanged. Thirdly, except increases in money stock (nominal or real) and interest sensitivity of demand for money, increases in all parameters increase the trade off between the two tax rates. Fourthly, the trade off is also affected by the economic condition; any increase (decrease) in baseline or autonomous expenditure in an era of economic upswing (downswing) increases (decreases) the value of α_{vt} . Lastly, the approach used here are not able to throw light on the issue of the regressive nature of consumption tax.

3.2 Other Pair-wise Trade-off Ratios

The same procedure is applied to obtain the other pair-wise trade-off ratios:

$$\alpha_{ta} = \left. \frac{dt}{da} \right|_T = \frac{tN}{(Y - aN)} > 0 \quad (14)$$

$$\alpha_{vb} = \left. \frac{dv}{db} \right|_T = \frac{v}{(1-b)} > 0 \quad (15)$$

$$\alpha_{va} = \left. \frac{dv}{da} \right|_T = \frac{\beta tN}{B(1-b)} > 0 \quad (16)$$

$$\alpha_{tb} = \left. \frac{dt}{db} \right|_T = \frac{vB}{\beta(Y - aN)} > 0 \quad (17)$$

$$\alpha_{ba} = \left. \frac{db}{da} \right|_T = -\frac{\beta tN}{vB} < 0 \quad (18)$$

These trade-off ratios describe the trade off between any pair of tax-mix policy parameters with revenue neutrality. For example, the trade-off ratio α_{ta} describes the trade off between the income tax rate and the tax-free threshold to maintain constant income tax revenue; a higher tax-free threshold rate is compensated by a higher income tax rate. Similarly, a higher consumption tax exemption proportion has to be compensated by a higher consumption tax rate as illustrated by equation (15). After expanding Y , B , and β on the right-hand-side of equations (14) – (18), the various trade-off ratios can be expressed as functions of those parameters on the left-hand-side of equation (13). This operation is not performed here because it does not affect the discussion of the relationship between tax mix and effectiveness of government spending. Further, a numerical example is provided in Section 5 to help readers to visualise the magnitude of these pair-wise trade-off ratios.

4. Tax Mix and the Effectiveness of Government Spending

The examination of the impact of a shift in the tax mix from income tax to consumption tax on the effectiveness of government spending in stabilising the economy is of particular interest. It is argued by many economists that the ability of fiscal policy to influence output is largely militated against by (a) a inflation-targeting monetary regime (to provide a viable environment for economic growth), (b) the adoption of flexible exchange rate, and (c) increasing capital mobility across national borders.⁶ If an increase in the share of the general consumption tax in the tax mix may favourably affect the government ability to stabilise the economy, it adds to the argument from the government viewpoint for an increased share of the general consumption tax or a fundamental tax reform of replacing the income tax with a general consumption tax.

To facilitate the discussion here, the assumption of no change in monetary stance is retained. Differentiate equation (9) with respect to G_o yields the government expenditure multiplier Φ :

$$\Phi = \frac{\partial Y^*}{\partial G_o} = \frac{\beta k}{\beta(f h + k) - k c(1-t)} \quad (19)$$

Note that the household income-tax free threshold a does not affect the size of the multiplier, which in turn implies it has no impact on the effectiveness of government spending in stabilising the economy. The impact of a change in the tax mix on the effectiveness of government spending is examined by varying the values of the three policy-parameters v , t , and b while maintaining revenue neutrality. Total differentiate equation (19) and set $dc = df = dh = dk = 0$ yields

$$d\Phi = -\frac{\beta k^2 c}{H^2} dt - \frac{k^2 c^2 (1-b)(1-t)}{H^2} dv + \frac{k^2 c^2 v(1-t)}{H^2} db \quad (20)$$

where $H = \beta(f h + k) - k c(1-t)$. Equation (20) together with the six pair-wise trade-off ratios underpins the analysis of the impact of a shift in the tax mix on the effectiveness of government spending.

The scenario where an Δv accompanied by revenue-neutral changes in Δt and Δb is considered. Applying the definitions of the relevant trade-off ratios and consolidating terms, equation (20) can be rewritten as

$$d\Phi = -\frac{k^2 c}{\alpha_{vt} \alpha_{vb} H^2} \{ \alpha_{vb} c (1-b) [\alpha_{vt} (1-t) + v] - \alpha_{vt} c v (1-t) \} dv \quad (21)$$

And the condition for effectiveness of government spending is

$$\left. \frac{d\Phi}{dv} \right|_T \left\{ \begin{array}{l} > \\ = \\ < \end{array} \right\} 0 \text{ as } \alpha_{vb} (1-b) [\alpha_{vt} (1-t) + v] - \alpha_{vt} v (1-t) \left\{ \begin{array}{l} > \\ = \\ < \end{array} \right\} 0 \quad (22)$$

Condition (22) is too complicated to be explained in any economic meaningful way.⁷ Further analysis of condition (22) reveals that the sign of $d\Phi/dv$ is indeterminate. Nevertheless, a positive (negative) value indicates that government spending becomes relatively more (less) effective in affecting real GDP the higher the share of consumption tax in the tax mix. And despite its complexity, it gives us the condition of effectiveness of government spending and may provide an empirical means to shed light on whether Australian tax reform will make the government spending more effective on influencing the real GDP of the economy.

5. A Numerical Example

A Microsoft Excel spreadsheet model is constructed to carry out this exercise. Suppose $C_o = \$10b$, $c = 0.80$, $I_o = \$400b$, $h = \$400b$, $f = 0.9$, $k = \$900b$, $M_o = \$200b$, $P_o = 120$, $G_o = \$200b$, $a = \$6,000$, $N = 10m$, $t = 30\%$, $v = 5\%$, and $b = 30\%$.⁸ This set of numbers represents the baseline for this numerical example. The equilibrium values of the economy are calculated as: $Y = \$815.91b$, $T = \$243.16b$, $Y^D = \$572.75b$, $C = \$468.20b$, public saving $T-G = \$43.16b$, share of government = 24.51%, $r = 0.63\%$, $I = \$147.71b$, private saving = $\$104.55b$, national saving rate = 18.10%, income-tax share in total tax revenue = 93.26%, and consumption-tax share in total tax revenue = 6.74%. The tax rate trade off ratio α_{vt} is -2.3064 , and the other pair-wise trade-off ratios are $\alpha_{va} = 0.0092$, $\alpha_{vb} = 0.0714$, $\alpha_{bt} = 32.2900$, $\alpha_{ba} = -0.1282$, and $\alpha_{at} = 0.4064$. Their interpretations are tabulated in Table 2.

Table 2: Pair-wise Trade-off Ratios

Trade-off ratio	Value	Tax neutrality trade off
α_{vt}	-2.3064	A one percentage point reduction (rise) in income tax rate t requires a reduction (rise) of 2.3064 percentage point in consumption tax rate v .
α_{va}	0.0092	A \$1000 increase (decrease) in household income-tax free threshold a , tax neutrality requires a 0.92 percentage point increase (decrease) in consumption tax rate v .
α_{vb}	0.0714	A one percentage point rise (reduction) in consumption tax exemption proportion b requires a 0.0714 percentage point rise (reduction) in consumption tax rate v .
α_{bt}	32.2900	A one percentage point increase (decrease) in income tax rate t requires a 32.29 percentage point increase (decrease) in consumption tax exemption proportion b .

The condition of effectiveness for government spending, as represented by equation (22), turns out to be positive with $\alpha_{vb}(1-b)[\alpha_{vt}(1-t)+v]-\alpha_{vt}v(1-t)=0.0025>0$. This value indicates that with respect to this numerical example the effectiveness of government spending increases as the share of consumption tax in the total tax revenue increases. To ascertain the validity of this claim, a tax-revenue neutral shift toward consumption tax is generated by increasing the consumption tax rate from $v=5\%$ to $v=10\%$ and lowering the exemption proportion from 30% to 10%. Using the Solver program that is embedded in Microsoft Excel, the income tax rate is calculated to decrease by 3.4066 percentage point to 26.5934 per cent holding tax-free threshold constant. As a result, the consumption tax share in the total tax revenue has risen from 6.74% to 17.33%. Except the exemption proportion-income tax rate trade-off ratio remains constant, the values of the other pair-wise trade-off ratios assume new values: $\alpha_{vt}=-1.7939$, $\alpha_{va}=0.6311$, $\alpha_{vb}=0.1111$, $\alpha_{ba}=-5.6799$, and $\alpha_{at}=0.3518$.

For testing of the relative effectiveness of a change in government spending under different tax mixes, a target real GDP is set at \$856.71b, which is about five per cent above the baseline equilibrium real GDP of \$815.91b. It is found that the larger the share of the consumption tax in the tax revenue the relatively more effective is the change in government spending. The results are tabulated in Table 3.

Table 3: Effectiveness of Fiscal Policy

Tax Mix	ΔG_o for reaching target $Y = \$856.71b$	Percentage change in G_o
Consumption tax share in total tax revenue is 6.74% generated by $t = 30\%$, $v = 5\%$, and $b = 30\%$	\$34.89b	Increase by 17.45%
Consumption tax share in total tax revenue is 17.33% generated by $t = 26.5934\%$, $v = 10\%$, and $b = 10\%$	\$34.77b	Increase by 17.38%

6. Conclusion

A change in the tax mix involves a change in the composition of the tax revenue from income and consumption taxes. The Australian tax reform implemented in year 2000 gave heavier weighting to the consumption tax in its tax mix at the expense of the income tax. Numerous studies have been done to examine its impact on tax incidence and the overall progressivity of the post-reform tax system. This paper turns its attention to the interaction between components of fiscal policy. It asks the question: How does a change in tax mix affect the effectiveness of government spending in stabilising the economy?

This paper shows that with the precondition of tax-revenue neutrality, the condition that the larger the consumption tax component in the tax mix the more effective is the government spending in stabilising the economy. This finding contributes to the discussion of changes in tax mixes in the future and has some interesting implication for policy makers. With monetary policy largely sidelined for inflation targeting and diminished influence of fiscal policy under flexible exchange rate and capital mobility, a shift from income tax to consumption tax may allow a government to regain some of its short- to medium-term stabilising power though government spending provided the condition is satisfied. This adds to the debate for a fundamental tax reform of replacing the income tax with a general consumption tax. This paper also shows that the pair-wise trade-off ratio between the income tax rate and the consumption tax rate varies with the structure of the economy; a point worth noting by policy makers.

The paper can be improved in at least two aspects. Firstly, the IS-LM model is a short-run model, which presumed prices are fixed. In reality, the introduction of a general consumption tax creates a one-off direct effect on prices paid by consumers, which means that tax-revenue neutrality does not imply real-GDP neutrality. Secondly, the use of a model with an external sector may be able to examine how much of an increase in effectiveness of government spending via a shift in tax mix is offset by the elements of exchange rate system and capital mobility.

Notes

1. With Australia joining the rank of countries with a general consumption tax, general consumption taxes are now in place in 29 of the 30 OECD countries with the exception of the USA, which only has state and local sales taxes.
2. A glance at the OECD tax policy document for exemption in consumption tax, we find that all OECD countries allow for some sort of exemption; see OECD (2001, pp.13-24).
3. There are many issues covered in the economic literature such as revenue-maximising consumption tax (Matthews and Lloyd-Williams, 2000), the impact of consumption tax on capital investment (Davies et al., 2000), on savings and interest rates (Feldstein, 1995; Hall, 1997), trade balance (Auerbach, 1997), and on labour supply (McLure, 1987; Auerbach, 1997), to name a few.
4. The IS-LM model, though primitive and short-run in nature, has implications that are consistent with what we observe in the economy and is sufficient to throw light on the issues explored in this paper. Because of the short run nature, the extension of the three-sector model to one including the external sector only complicates the equations without changing the qualitative nature of the results.
5. Since the simplest interpretation of baseline consumption is the amount households would consume if their disposable income in the current fiscal year were equal to zero, we can interpret that it is likely to be that part of consumption related to necessity and is most likely exempted from a general consumption tax. To mitigate the regressivity of consumption tax, we argue that further exemption may be given to income-induced consumption, for example, education in Australia. So, consumption exempted from consumption tax is greater than autonomous consumption.
6. Pitchford (1995) argues that the offset is not complete.
7. The condition for the effectiveness of government spending is less complicated but no more economic meaningful in its interpretation if the Δv is only accompanied by a revenue-neutral change in Δt :

$$\frac{d\Phi}{dv}\Big|_T \begin{cases} > \\ = \\ < \end{cases} 0 \quad \text{as} \quad \alpha_{vb} c(1-b)[\alpha_{vt}(1-t) + v] + 1 \begin{cases} > \\ = \\ < \end{cases} 0$$

8. Matthews and Lloyd-Williams (2000) provided some empirical evidence about the optimal value for consumption tax rate v .

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