A contribution towards New Zealand's tax reform

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Abstract

We use the work-leisure choice model to estimate equilibrium labour supply (hours-worked) in New Zealand over the period 2000 – 2008. We then stochastically solve the model over a future period from 2010 to 2050, and evaluate the New Zealand's new tax policy. We compare the welfare and relative productivity (i.e., relative to Australia) outcomes for several tax policy scenarios.

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1. Introduction

The newly-elected New Zealand government changed the tax policy recently, and advocated a “growth-enhancing tax system”. The new tax policy change includes an across the board reduction in the income tax rate, and an increase in the Goods and Services Tax (GST) from 12.5 to 15 percent.

Income (New Zealand Dollar)	Old tax rates (%)	New tax rates (%)
0 to 14000	12.5	10.0
14001 to 48000	21.0	17.5
48001 70000	33.0	30.0
Over 70000	38.0	33.0

The objective of this paper is to measure the effect of the reduction in the average marginal income tax rate combined with an increase in GST from 12.5 to 15 percent on average relative labour productivity (i.e., relative to Australia) and welfare of the average household.

We analyze macroeconomic aggregate data.[i] We use the work-leisure choice model, where the *effective marginal tax rate*, affects household's labour supply directly, which in turn affects the level of GDP per person via the production function. Then we stochastically simulate the model out-of-sample, and examine the welfare and productivity implications of the tax policy.

We compare welfare and relative productivity changes that result from the tax policies with the baseline solution of the model. Examination of "integrity" and "fairness" is beyond the scope of this paper. Public finance issues are also beyond this paper.

We calibrate the model for both New Zealand and Australia because economic growth is a relative issue. The model predicts that the labour supply curves for both New Zealand and Australia are reasonably elastic. The model's predicting factors (the share of capital in output and the consumption-output ratio) are quite close in the two countries, but the most significant difference is the effective marginal tax rate, which is significantly higher in New Zealand. We also find that the relative value of leisure is significantly lower in New Zealand.

The model predicts that (1) an across the board 3 percent reduction in the income tax rate along with an increase in GST from 12.5 to 15 percent has no significant impact on either productivity or welfare. (2) An increase in GST from 12.5 to 15 percent (without any other changes in taxes) reduces welfare by more than 5 percent and reduces relative productivity, i.e., productivity relative to Australia, from the baseline solution. (3) Significant increase in both welfare and productivity could be achieved by reducing the income tax rate by 5 percent across the board without any increase in other tax rates. (4) The productivity gap between New Zealand and Australia cannot be closed by *only* lowering the effective marginal rate in New Zealand to be equal to that of Australia because the productivity gap is a function of other variables. Closing the productivity gap requires more changes.

The model is presented next. In section 3 we estimate the labour supply for New Zealand and Australia. Section 4 describes the several tax policies, the experimental design, the stochastic simulations and discuss the policy outcomes and evaluation. Section 5 is a conclusion.

2. The Model

We begin with the work-leisure choice model found in Nickell (2003), Prescott (2004) and Shimer (2009) to derive the labour supply.[ii]

The utility function of a *stand-in household* who faces a work-leisure decision is give by: $U = E\left\{\sum_{t=0}^{\infty}\beta^t[\log c_t + \alpha\log(100 - h_t)]\right\}$ (1)

The utility function depends on the expected discounted sum of consumption c and leisure, where 100 is the number of hours available for individuals to work in a week and h is hours worked in "market activities". The expectations operator E does not necessarily mean rational expectations, and $0 < \beta < 1$ is the discount factor and specifies the degree of patience. A high value means more patience for consumption and leisure. The parameter α is > 0 and denotes the value of the non-market productive time per household. Maybe it is the relative value of the time spent in working at home. Typically, it is the relative value of leisure. The production using this time is untaxed. The utility function includes one consumption good, as in Christaino and Eichenbaum (1992). We find no contradiction of such assumption with reality in the Arab countries.

The stock of capital evolves according to:

$$k_{t+1} = (1-\delta)k_t + x_t \quad (2)$$

Where k is the stock of capital and x_t is gross investments. The depreciation rate is δ.

There is a *stand-in firm* with a Cobb-Douglas constant returns to scale technology of production:

$$y_{it} = A_t k_t^{\theta} h_t^{1-\theta} \geq c_t + x_t + g_t \quad (3)$$

where g is government expenditures.

Total factor productivity is exogenous and is given by A_t. The parameter $0 < \theta < 1$ is the share of capital.

It is argued that the technical progress is exogenous because it plays no role in the inference being drawn.

The household's date t budget constraint is:

$$(1+\tau_c)c_t + (1+\tau_x)x_t = (1-\tau_h)w_t.h_t + (1-\tau_K)(r_t-\delta)k_t + \delta k_t + T_t \quad (4)$$

Where w is the real wage, r is the real interest rate or rental capital and T is transfer payment. The tax rates of consumption, investments, labour and capital are given by τ with the subscripts c, x, h, k denote consumption, investments and capital respectively.[iii]

The aggregate effective marginal tax rate on labour income is derived from the tax rate on consumption τ_c and on labour τ_h. It is the fraction of additional labour income that is taken in the form of taxes, holding investments fixed.

$$\tau = \frac{\tau_h + \tau_C}{1+\tau_C} \quad (5)$$

It is important to note that the National Income Account is adjusted to fit with economics theory, where households pay the taxes. The major adjustment is to treat "indirect taxes less subsidy" as "net taxes on final product". It means "net indirect tax" is not a cost component of GDP. Indirect taxes include value-added taxes, sales taxes, excise taxes, property taxes…etc, which mostly levied on households. Some indirect taxes such as diesel fuel taxes, property taxes on office buildings and sales taxes on equipments…etc fall on all forms of products. It is assumed that 2/3 of the indirect taxes less subsidy fall directly on private consumption expenditures and the remaining 1/3 is distributed evenly over private consumption and private investment.

The net indirect taxes on consumption, is:

$$IT_c = [2/3 + 1/3\frac{C}{C+I}]IT \quad (6),$$

where C is private consumption expenditures, I is private investment, and IT is net indirect taxes. The model economy's consumption is $c = C + G - G_{mil} - IT_c$, where G is public consumption and G_{mil} is military spending. The model economy's output is given by $y = GDP - IT$.

The consumption tax rate is:

$$\tau_c = \frac{IT_c}{C - IT_c} \quad (7).$$

There are two taxes on labour income: the income tax with a marginal tax rate τ_{inc} (which we argued earlier in the paper that its estimation is highly controversial) and a social security tax. The social security marginal tax rate $\tau_{ss} = \frac{social\sec urity\ taxes}{(1-\theta)(GDP-IT)}$, where the denominator is labour income if labour is paid its marginal productivity. This is zero both in New Zealand and Australia.

The *average* income tax rate is

$$\bar{\tau}_{inc} = \frac{Direct\,Taxes}{GDP - IT - Depreciation} \quad (8),$$

where direct taxes are paid by households and do not include corporate income taxes. Prescott's estimate of the marginal labour income tax $\tau_h = t_{ss} + 1.6\bar{\tau}_{inc}$, where the magic number 1.6 reflects the fact that the marginal income tax rates are higher than the average tax rates. The number delivers a marginal income tax found in Feenberg and Coutts (1993) for the "US". Their calculation of the marginal income tax is based on a representative sample of tax records. They calculate by how much the tax revenue increases if every household labour income is increased by one percent. The total change in tax receipts divided by the total change in labour income is their estimate of the marginal income tax.

We conducted a sensitivity analysis to examine the effect of the scalar 1.6 on τ_h. At numbers larger than 1.6, the labour supply estimates become unreasonably small because the effective marginal tax rate becomes unreasonably large.

From the utility function we get the first order condition the marginal rate of substitution equals to the price ratios:

$$\frac{\alpha/(1-h_t)}{1/c_t} = (1-\tau)w_t \quad (9)$$

And from the production function we get, the marginal product of labour is equal to the real wage rate:

$$w_t = (1-\theta)k_t^{\theta}h_t^{-\theta} = (1-\theta)y_t/h_t \quad (10)$$

The equilibrium labour supply is solved for from the two FOC above,

$$h_{it} = \frac{1-\theta}{(1-\theta) + \frac{c_t}{y_t}\frac{\alpha}{1-\tau_t}} \quad (11)$$

The intertemporal substitution is captured by the ratio of consumption to GDP, c/y. The intratemporal substation is captured by the tax rate τ. If the effective tax rate on labour income is expected to be lower in the future, for example, people will increase their current consumption.[iv]

3. Estimating the labour supply

We use data from 2000 to 2008 to estimate the labour supply for New Zealand and Australia. Details of the data are found in the appendix. Table 1 reports our estimates of the predicting factors of the labour supply: τ_c; τ_{inc}; τ_h, which combined, give us an estimate of the aggregate effective marginal tax rate τ; c/y; θ; α; and the supply of labour h. We also report the Frisch elasticity and output per person of working age for both Australia and New Zealand. New Zealand has a relatively high effective marginal tax rate, 44 percent compared with 35 percent for Australia. New Zealand's consumption tax rate, income tax rate and the marginal labour income tax are all higher than Australia. The Internal Revenue Department Briefing of the Incoming Minister document (2010), which is posted on their website, acknowledges that New Zealander's are subject to a relatively high effective marginal tax rate. New Zealand's effective marginal tax rate is still higher than those of the G7.[v]

The relative value of leisure, α (relative to the price of consumption goods) which solves the equilibrium labour supply equation above is smaller in New Zealand than that of Australia, 1.3 compared with 1.9 in Australia. On average, New Zealanders work slightly longer hours than Australians.[vi]

The supply curves are elastic as indicated by the Frisch elasticity, which is consistent with international evidence.[vii] The level of GDP per person of working age is 0.70 of Australia, see Prescott (2002) and Razzak (2007) among others.

4. Six tax policy scenarios

We solve the model numerically over the period 2008 to 2050 using stochastic simulation with 10000 iterations.[viii] To simplify the solution of the model, we appeal to the stochastic implications of the lifecycle – permanent income theory of consumption, and assume that the conditional expectations of the future marginal utility of consumption follow a random walk (Hall, 1978). The model is solved using the historical parameters reported in table 1 to generate the baseline solution.

Then we solved the model six times under the different policy scenarios above. We examine six scenarios. For each tax policy scenario we measure the welfare and the relative productivity changes. Scenario I is where we examine the New Zealand's government tax policy of an across the board decrease in the income tax rate combined with an increase in GST from 12.5 to 15 percent. The other five scenarios are hypothetical. They are arbitrarily chosen. We compare these policy scenarios to the baseline model's outcomes.

Scenario II considers an across the board decrease in the marginal income tax by 3 percent without any change in other tax rates. Scenario III examines a policy where GST increases from 12.5 percent to 15 percent while all other indirect taxes are kept the same. In these scenarios we intend to show that hiking up the GST rate adversely affects welfare. Scenario IV shows the effect of a policy where the marginal income tax rate is cut by 5 percent across the board. Scenario V examines the effect of a tax policy where the marginal income tax rate of the top income earners only is decreased from 39 to 30 percent, and finally scenario VI, where we decrease New Zealand's effective marginal tax rate from 44 percent to be equal to Australia's rate of 35 percent.

These policy scenarios require recalculating the direct and indirect tax rates in the simulations. The new tax policy, where the income tax rate is reduced for every income bracket changes $\bar{\tau}_{inc}$ in equation (8) via changes in:

$Direct\ Tax = y_t * (a_1 z_1 + a_2 z_2 + a_3 z_3 + a_4 z_4)$ (12),

where y is real GDP, $a_1, \cdots a_4$ are the statutory tax rates corresponding to the proportions of taxpayers, $z_1 \cdots z_4$. The total number of taxpayers in March 2008 was 3423421. An across the board reduction of the income tax is a reduction of 3 percent *on average* (The simple average falls from 26 to 23 percent and the weighted average falls from 20 to 17 percent).

Income Brackets	Weights (% of taxpayers) z	%Average tax rate (a)	%New tax rate (new a)
0-14000	z_1 0.39	12.5	10
14001-48000	z_2 0.46	21	17.5
48001-70000	z_3 0.10	33	30
> 70000	z_4 0.06	39	33
Average		26	23
Weighted Average		20	17
$\bar{\tau}_{inc}$		0.20	0.16

The increase in GST from 12.5 to 15 percent affects the supply labour through the following:

$IT = GST + non - GST$ (13)

(i.e., $non - GST$ are taxes on specific goods and excise taxes)

and

$IT = y_t * 0.125 + (non - GST)$ (14)

Then we use equation (14) to solve for indirect taxes on consumption IT_c in equation (6) and consumption tax rate τ_c in equation (7) which affects the effective marginal tax rate τ in equation (5) and the supply of labour (weekly hours-worked) h in equation (11).

Note that a_4 in equation (12) also changes when the top income tax rate is reduced from 39 percent to 30 percent. We use the distribution of taxpayers by income band in the table above to calculate the changes in $\bar{\tau}_{inc}$ and τ_h (equation 8).

Reducing the average tax rate by 5 percent across the board reduces the a's in equation (12) to 7.5, 16, 28 and 34 percent for $a_1, a_2, \cdots a_4$ respectively. Note that all the income tax scenarios alter $\bar{\tau}_{inc}$, τ_c and eventually τ, the labour supply and output.

The tax scenarios were evaluated by computing the change in relative productivity to Australia over the average period 2012-2050. For welfare, we compute the average Lifetime Consumption Equivalent, which is the change in real consumption required to make the households indifferent to the policy; the standard Hicks compensation principle.[ix]

The quantitative results reported in table 2 are intuitive and are as predicted by the model. The current new policy of reducing the income tax rate across the board by 3 percent and increasing GST from 12.5 to 15 percent has no significant effect on either welfare or relative productivity. This finding contradicts the government's objective of adopting a growth-enhancing tax policy. It is quite clear that the policy of reducing the income tax rate across the board without any increase in GST has superior outcomes. It increases both welfare and relative productivity significantly. The government's desire perhaps was to keep revenues intact, i.e., keep the government budget constraint unchanged. By doing so, the growth objective and the welfare implications could not be achieved.

A reduction of the income tax rate across the board brings about the best outcome. It turned out that a 5 percent reduction in the income tax rate for every taxpayer would eventually increase the labour supply significantly, by two hours a week per person; increase relative productivity from 72.3 percent to more than 76.5 percent; and increase welfare as measured by the Lifetime Consumption Equivalent per person by a significant 11.6 percent.

An increase in GST to 15 percent affects the average household. It increases the effective marginal tax rate τ (see equation 5) and reduces the supply of labour by one hour a week per person (see equation 11). This reduction amounts to a reduction in output and output per person of working age relative to Australia (*via* the production function). It reduces New Zealand's productivity by a small amount from about 72.3 to 70.6 of Australia's level. Most importantly is that the increase in GST reduces welfare measured by the Lifetime Consumption Equivalent; we estimate that change from baseline to be -4 percent on average over the period 2010 to 2015.

A reduction in the top income tax rate to 30 percent would increase labour supply slightly and improve relative productivity to Australia by a very small amount; labour supply increases from 72.3 percent to 72.7 percent of Australia's level. Welfare increases by a small amount. The high income bracket represents only 6 percent of the total number of taxpayers.

Finally we reduced the effective marginal tax rate in New Zealand from 44 percent to Australia's level of 35 percent. Welfare increases by 17 percent in terms of Lifetime Consumption Equivalent. Relative productivity is 78.2 of Australia's level, which is an increase by more than 6 percentage points from baseline. This is a very significant increase; however, it demonstrates that the productivity gap between New Zealand and Australia could not be closed by making the effective marginal tax rate equal to that of Australia.

There are two important additional differences between New Zealand and Australia in the model, which affect the level of productivity. First, Australia's stock of capital is several times larger than New Zealand's, see Razzak (2007) and Hall and Scobie (2005) for example. The stock of capital is key in the Solow (1957) growth model and many endogenous growth models. Second, population is different, so GDP per capita is different. Population has a scale effect, whereby it affects the probability of producing "new ideas" *a la* Jones (e.g., Jones, 2002) that drives the growth rate of technical progress.

5. Conclusion

We used the work-leisure model to estimate the labour supply for New Zealand and Australia over the period 2000 to 2008 as a function of the effective marginal tax rate, consumption- output ratio, and the share of capital in production. We calculated New Zealand's productivity level relative to Australia. We found that New Zealand's effective marginal tax rate is significantly higher than Australia's, 44 percent compared with 35 percent. Average weekly hours-worked per person in New Zealand is just slightly higher than that of Australia; the Frisch elasticity suggests that both schedules are elastic; but the relative value of leisure, which solves the model is much higher in Australia than in New Zealand. The productivity gap is wide. New Zealand's level is 70 percent of Australia's as shown earlier in Prescott (2002) and Razzak (2007) among others.

We then solved the model stochastically 10000 times over the period 2010 to 2050 to obtain a baseline solution, i.e., without any policy, for the labour supply and the productivity level relative to Australia's. Then, we evaluated a number of policy scenarios by, first, comparing the change in the relative productivity level that results from each policy with the baseline solution, and second, by computing the change in welfare of New Zealanders induced by the policy. Welfare was measured by the standard Lifetime Consumption Equivalent, which is the change in real consumption required to be given to or taken away from households to keep them indifferent to the policy.

We examined the new tax policy of the reduction of the income tax rate by 3 percent across the board along with an increase in GST from 12.5 percent to 15 percent. The welfare and productivity outcomes of this policy are insignificant. It produces no significant change in either outcome, and seems contradictory to the government's claim that the policy is growth-enhancing.

We also examined a number of tax scenarios for comparison. An increase in GST from 12.5 percent to 15 percent reduces both welfare and productivity. Importantly, the reduction in welfare is quite significant, more than 4 percent. The effective of an increase in GST on welfare and productivity dominates the effect of a decrease in income tax rate effect.

A reduction in the income tax rate of 3 percent across the board without any other changes is a superior policy. It increases welfare to 6.65 percent and relative productivity from 0.72 to 0.75 relative to baseline. In fact, the best outcomes are associated with a policy that reduces the income tax rate across the board by 5 percent without any change in GST or other tax rates. This increases welfare to 11.6 percent and productivity relative to Australia rises from 0.723 to 0.765. A tax policy to reduce the income tax rate of the top earners from 39 to 30 percent produces a welfare outcome slightly better than those of the new tax policy. A small increase in welfare of 1.14 percent is still preferred to an increase of 0.6 percent associated with the new tax policy.

Finally, we demonstrated that even if New Zealand dropped its effective marginal tax rate to the level of Australia, i.e., from 44 to 35 percent, the productivity gap between the two countries would not be eliminated because the level of productivity depends on other variables in addition to the effective marginal tax rate. New Zealand lacks adequate levels of physical capital, see Hall and Scobie (2005) and Razzak (2007). The stock of capital is a driving variable in the Solwo (1957) exogenous growth theory, and the population of New Zealand is relatively small. Population drives productivity growth up in Jones's (2002) endogenous growth model. The scale effect works through the generation of "new ideas," which are proportional to population. That said, the increase and welfare and productivity are substantial.

While changing the "household" tax policy is necessary to ignite economic growth in New Zealand, capital taxation policies are equally important. Policies which provide incentives for savings and the capital accumulation are imperative. An R&D capital strategy, where commercialization is at its heart is also necessary (Johnson *et al.*, 2007). And finally a growth-oriented immigration policy, which is independent of the government and based on satisfying the country's needs on economic basis, is vital.

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Table 1: Average Labour supply over the period (**Average** 2000-2008)

	New Zealand	Australia	New Zealand relative to Australia
θ	0.45	0.41	1.09
τ_h	0.32	0.25	1.28
τ_c	0.23	0.16	1.43
τ	0.44	0.35	1.25
c/y	0.71	0.69	1.02
α	1.30	1.90	0.68
h	26.96	25.12	1.07
Frisch elasticity	2.70	2.98	0.91
Output per person	29749.05	42256.41	0.70

- θ share of capital in production measured by gross operating surplus / GDP
- τ_h the marginal labour tax rate
- τ_c the consumption tax rate
- $\tau = \frac{\tau_h + \tau_C}{1 + \tau_C}$
- c/y the consumption / output ratio. The data are for 2000 – 2007
- α the relative value of leisure
- $h = (1-\theta)/[(1-\theta) + c/y(\alpha/1-\tau_h)]$, equilibrium hours - worked
- Frisch elasticity of the labour supply
- Output per working age population (15-64)
- Data are in PPP (US dollars) 2005

Table 2: Tax Policy Simulations (**average** 2010-2015)

	Baseline	Policy I	Policy II	Policy III	Policy IV	Policy V	Policy VI
θ	0.45	0.45	0.45	0.45	0.45	0.45	0.45
τ_h	0.32	0.28	0.26	0.32	0.24	0.31	-
τ_c	0.23	0.27	0.23	0.27	0.23	0.23	-
τ_{inc}	0.20	0.17	0.168	0.20	0.15	0.19	-
τ	0.443	0.489	0.404	0.467	0.380	0.438	0.35
c/y	0.71	0.71	0.71	0.70	0.71	0.71	0.71
α	1.3	1.3	1.3	1.3	1.3	1.3	1.3
h	24.87	25.04	26.26	24.07	26.98	25.11	27.87
Frisch elasticity	3.02	2.99	2.80	3.15	2.70	2.98	2.58
GDP per person Relative to Australia	0.723	0.728	0.751	0.706	0.765	0.727	0.782
5Lifetime Consumption Equivalent %		0.0066	0.0665	-0.0407	0.1157	0.0114	0.1697

- θ share of capital in production measured by gross operating surplus / GDP
- τ_h the marginal labour tax rate
- τ_c the consumption tax rate
- α the relative value of leisure fixed to 1.3 for NZ and 1.9 for Australia
- $h = (1-\theta)/[(1-\theta) + c/y(\alpha/1-\tau_h)]$, equilibrium hours - worked
- Frisch elasticity of the labour supply
- Output per working age population (15-64) relative to Australia
- Lifetime Consumption Equivalent is the measure of welfare. It is the amount of consumption that should either increase or decrease to make the household indifferent to policy
- Policy I : A decrease in marginal income tax rate by 3 percent across the board along with an increase in GST from 12.5 to 15 percent.
- Policy II : Decrease average (across the board) income tax rate by 3 percent
- Policy III: Increase of GST from 12.5 to 15 %. Other Items in IT were Kept unchanged
- Policy IV: A decrease in the marginal income tax rate by 5 percent across the board
- Policy V : A decrease in the marginal income tax rate of the top income bracket from 39 to 30 percent
- Policy VI: Decrease New Zealand's effective marginal tax rate from 44 percent to Australia's 35 percent

Data Appendix

Average 2000-2008	Source	Australia	New Zealand
General government final consumption expenditure, %GDP	OECD	17.90	18.03
Consumption of fixed capital, % GDP	OECD	15.30	13.90
Household final consumption expenditure, % GDP	OECD	57.34	58.74
Working Age Population to Total Population	OECD	0.67	0.65
Employment to Age working population	OECD	0.72	0.75
Taxes individuals, % GDP	OECD	11.98	14.69
Social Security Contributions, Employees % GDP	OECD	0.00	0.00
Taxes on goods and services, % GDP	IRD	8.77	11.84
Military Expenditure, % GDP	World Bank	1.96	1.08
τ_c		0.16	0.23
τ_{ss}		0.00	0.00
Capital Share		0.41	0.45
τ_{inc}		0.14	0.20
τ_h		0.22	0.32
τ		0.35	0.44
c/y		0.69	0.71
k/y	Statistics New Zealand and ABS	2.325	2.86
GDP Per Person, GDP Less IT in PPP (US dollars) 2005 divided By Population aged 15-64		42256.41	29749.05

- The distribution of income tax payers is from the IRD.
- The net indirect taxes on consumption, is $IT_c = [2/3 + 1/3\frac{C}{C+I}]IT$, where C is private consumption expenditures, I is private investment, and IT is net indirect taxes.
- $\tau_c = IT_c /(C - IT_c)$
- Consumption is $c = C + G - G_{mil} - IT_c$, where G is public consumption and G_{mil} is military spending. The GDP is given by $y = GDP - IT$.
- Tax on labour income are: the income tax with a marginal tax rate τ_{inc} (which we argued earlier in the paper that its estimation is highly controversial) and a social security tax. The *average* income tax rate is $\bar{\tau}_{inc} = \frac{Direct\,Taxes}{GDP - IT - Depreciation}$, where direct taxes are paid by households and do not include corporate income taxes. Prescott's estimate of the marginal labour income tax $\tau_h = t_{ss} + 1.6\bar{\tau}_{inc}$
- τ_{inc} the marginal income tax rate.
- $\tau = \frac{\tau_h + \tau_C}{1 + \tau_C}$
- c/y the consumption / output ratio, where consumption is as above and y is deflated by the respective PPP price deflators (PWT 6.2).
- τ_{ss} is social security tax rate.
- The capital-labour ratio k/y in 1972 for New Zealand, and from 1970 for Australia are 2.286 and 2.35 respectively. We generate k_0 as $(k/y).y_t$. The depreciation rate is fixed equal the ratio of consumption of fixed capital to capital, 0.08 and 0.09 for New Zealand and Australia respectively. We use the perpetual inventory method to generate the stock of capital in PPP because the original data were not in PPP. For the out-of-sample stochastic simulation we fix

the depreciation rate equal to the average over the sample from 2000-2008 and for investment, we also use the fixed average of investments to GDP ratio over the sample from 2000-2008, and iteratively solve for the investment level $(x / y).y_t$. These ratios are 0.23 and 0.29 for New Zealand and Australia. Output is given by the production function in the model.

- Total hours enter the production function, equation (3), which is equal to weekly hours generated by the model times 52 weeks a year time employment. We assume that population grows at their historical growth rate using a linear trend over the period 2000-2008 and the employment and working age population are assumed to be fixed fraction of the population, also taken from data over the period 2000-2008. Employment to population ratio is 0.49 for New Zealand and 0.48 for Australia. Working age population ratio is fixed to 0.65 for New Zealand and 0.67 for Australia.

[i] We do not have data for “working for family” tax program. Our analysis focuses on the average household, where data are available.

[ii] Prescott cites a number of papers as the basis of this theory; business cycle literature Cooley (1995) and Cooley and Ohanian (1999); in the depression literature he cites Kehoe and Prescott (2002); in public finance, Christaino and Eichenbaum (1992), Baxter and King (1993); and in the stock market literature McGrattan and Prescott (2003) and Boldrin, Christian and Fisher (2001). The labour supply is consistent with Lucas and Rapping (1969), Lucas (1972), Kydland and Prescott (1982), Hansen (1985) and Auerbach and Kotlikoff (1987).

[iii] There is a literature on the methods of estimating average marginal income tax rates in the US, where differences in time series seem significant. Differences in the computation of income tax rates could affect the tax rate τ in model. For more on the debate, see Barro (1979), Seater (1982), Barro and Sahasakul (1983, 1986), Stephenson (1998), and Akhand and Liu (2002). We do not use time series and do not run regressions. Research which use such methodology should examine these issues.

[iv] In this model, the government budget constraint remains unchanged, hence not present in this model. When the tax rate changes because of a certain policy, expenditures must altered to the keep the budget constraint unchanged. Or if one tax rate changes other rate must offset that change to keep the budget constraint unchanged.

[v] Laabas and Razzak (2010) estimates of the G7 effective marginal tax rates over the same period are: 38, 37, 42, 40, 25, 38 and 30 for Canada, France, Germany, Italy, Japan, the UK and the US respectively.

[vi] Laabas and Razzak (2010) estimate the supply curves for the G7. The estimates of the relative value of leisure are: 1.6, 2.2, 2.1, 1.7, 2.1, 1.6, and 1.6 for Canada, France, Germany, Italy, Japan, the UK and the US respectively.

[vii] The microeconomics-level estimates are less than one.

[viii] When solving, an approximated Jacobian is used when linearizing the model. Then the approximation is updated each iteration by comparing the residuals, which result from the new trial value of the endogenous variables with the residuals of the linear equation. The method is not significantly different from Newton, but it runs faster. The innovations to stochastic equations are generated by drawing a set of random numbers from a standard normal distribution each period. These draws are scaled to match the variance-covariance system by multiplying the vector by its standard deviation because the covariance matrix is diagonal.

[ix] The simulation’s time horizon from 2015 to 2050 does not change the results.