On Deficit Bias and Immigration

Michael Ben-Gad
Department of Economics
City University
Northampton Square
London EC1V 0HB, UK*

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Abstract

How much can governments shift the cost of government expenditure from today's voters to tomorrow's generations of immigrants without resorting to taxation that is explicitly discriminatory? I investigate the behavior of an overlapping dynasties optimal growth model to quantify how much policy makers can shift the burden of taxation between the present-day inhabitants of a country and future immigrants, by altering rates of distortionary factor taxation or deficit finance. In a standard macroeconomic model with representative agents and inelastic labour supply, if government expenditure is a fixed share of net national product, policy-makers can minimize the deadweight loss of factor taxation by holding the tax rate on capital constant over time and equalizing the long-run tax rates on capital and labour income. Furthermore, fluctuations in the tax rate on labour income are neutral. By contrast, in a model of an economy without representative agents—here one that is absorbing a continuous stream of immigrants, debt is not neutral, and the potential for redistributing resources from future immigrants to natives by deviating from standard optimal policy outweighs losses in efficiency generating a bias in favour of deficit finance. I use data for the United States between 1980-2010 to calibrate the model and calculate the optimal fiscal policy from the perspective of the native population associated with a wide range of different rates of immigration and quantify the welfare gain that accrues to the members of the native population.

JEL classification: E62, F22, H62

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1 Introduction

Ordinarily, in the absence of immigration, a reliance on deficit finance implying distortionary taxation that rises over time is inconsistent with an optimal fiscal policy that minimise the excess burden. Yet it is precisely these types of policies that we consistently observe in much of the developed world. This paper examines how flow of immigrants to a country may encourage a government to pay for its expenditure through deficit finance. I illustrate the idea using a simple optimal growth model with overlapping dynasties and factor taxation and provide a framework for measuring this bias in favour of deficits.

Assume government expenditure is a fixed share of net national product. In the absence of immigration, policy-makers best serve the interests of the population by equalizing the long-run tax rates on capital and work, and absent any shocks, smoothing taxes by balancing its budget. If the economy is absorbing immigrants and is expected to continue absorbing them in the future, but policy-makers remain focused on serving the interests of today's residents, other considerations, particularly the desire to shift part of the burden of government expenditure to future immigrants may take precedence over the minimisation of the the deadweight loss from factor taxation. One method might be to levy special taxes on immigrants or sell residency permits. Putting this possibility to one side we focus on how in policy-makers may choose rates of factor taxation that balance the desired shift in the tax burden from natives to future immigrants against the efficiency losses generated by deviations from the prescriptions of Ramsey optimal tax policy.

In Section 2 I present the overlapping dynasties model, which features a continuous inflow of infinite-lived optimising agents. Government expenditure and debt service are financed by a combination of taxation on both capital and labour as well as new bond issuance. In Section 3 I calibrate the model to match some of the main features of the US economy.

The flow of most international migration is from low-income to high-income countries and migrants typically arrive at their destination with negligible amounts of capital—at least in comparison to the stock of capital owned by the typical established resident. In Section 5 we investigate how much a government might choose to shift the burden of taxation towards wages from which immigrants derive a disproportionate share of their income and lower the tax on capital while maintaining a balanced budget. I demonstrate that because of the steep dead weight loss incurred when factor taxes deviate from equality, the scope for shifting the burden of taxation away from the native population through intratemporal shifts from capital to labor is very small—the optimal tax on capital drops by approximately a percentage point for each percent inflow of immigrants. Furthermore the benefit that accrue to the native population from pursuing such policies are negligible and likely to be easily ovewhelmed by other considerations including distributional concerns within the native population. By contrast far higher gains can be achieved by shifting the burden across time through deficit finance, even if all the shifting of taxes is restricted to the highly distortionary tax on capital.

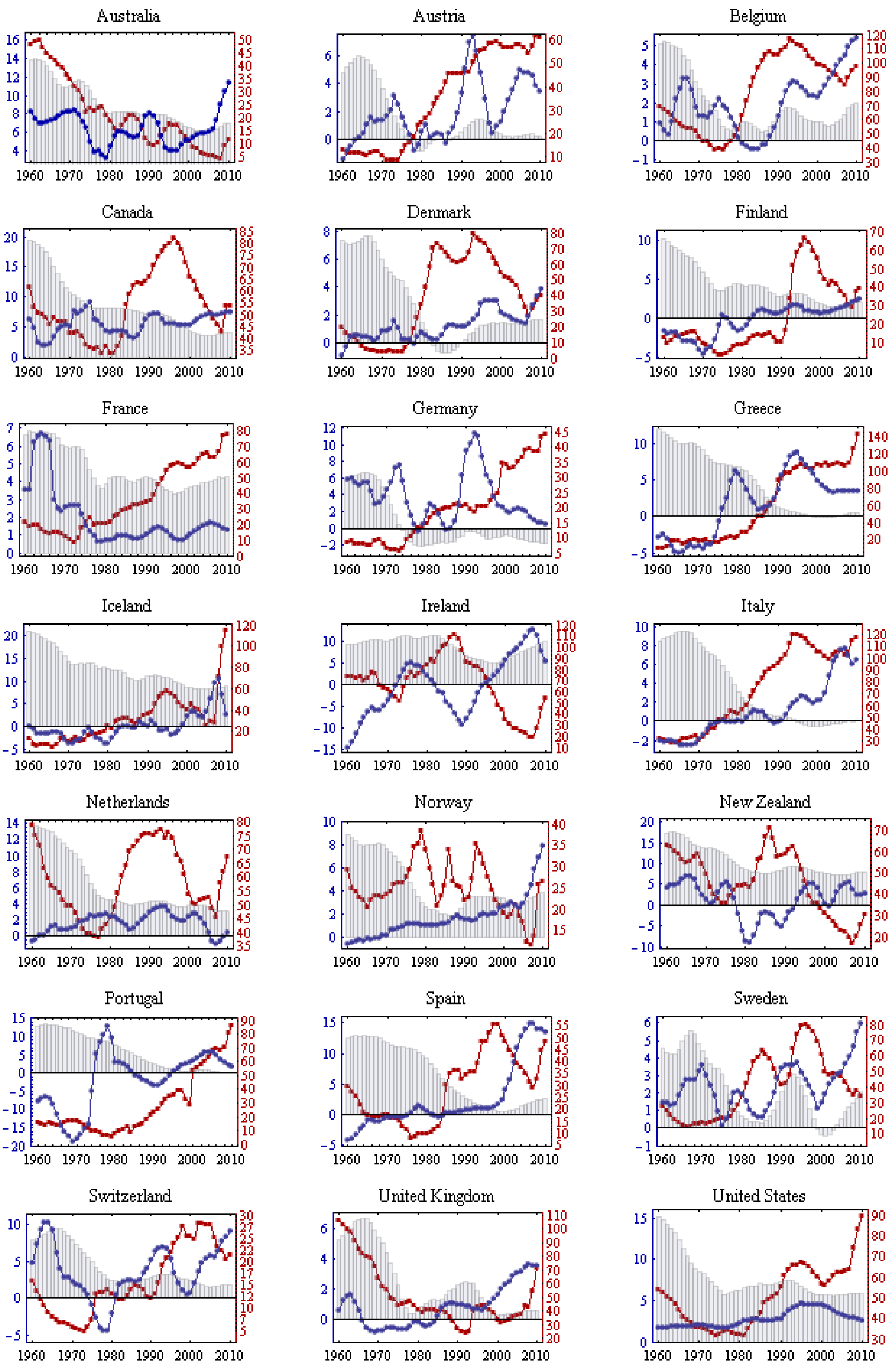

Figure 1: Birth rates, net international migration and public debt for 21 OECD countries. Five year moving average of net international migration represented by curve with circles in blue, left-hand scale, annual stock of gross public debt represented by curves with squares in red, right-hand scale. Five year moving average of birth rates represented by bars, also left-hand scale. Sources: OECD supplemented by Office of National Statistics (UK) and Statistics Denmark for birth and migration data. Debt data from Reinhart and Rogoff (2010).

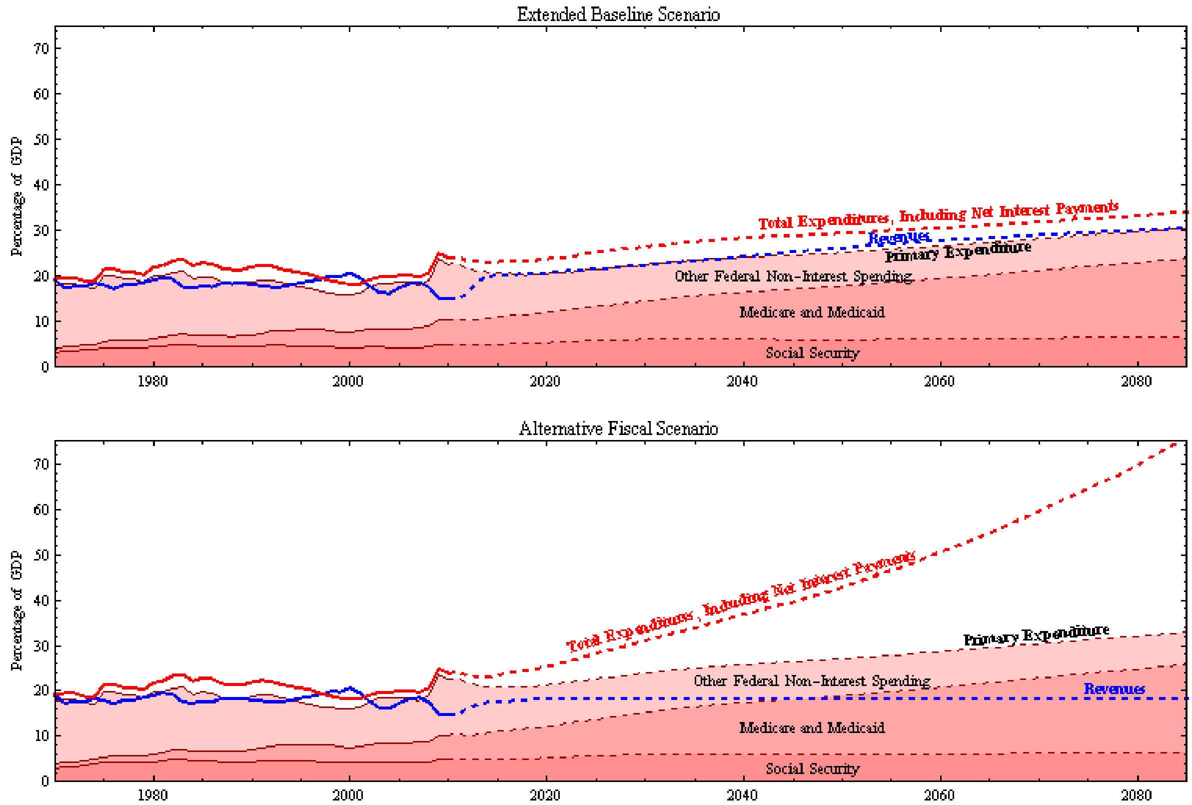

Figure 2: US federal budgets from 1970 to 2010 with forecasts using extended baseline and alternative fiscal scenarios generated by the Congressional Budget Office for 2011 to 2085.

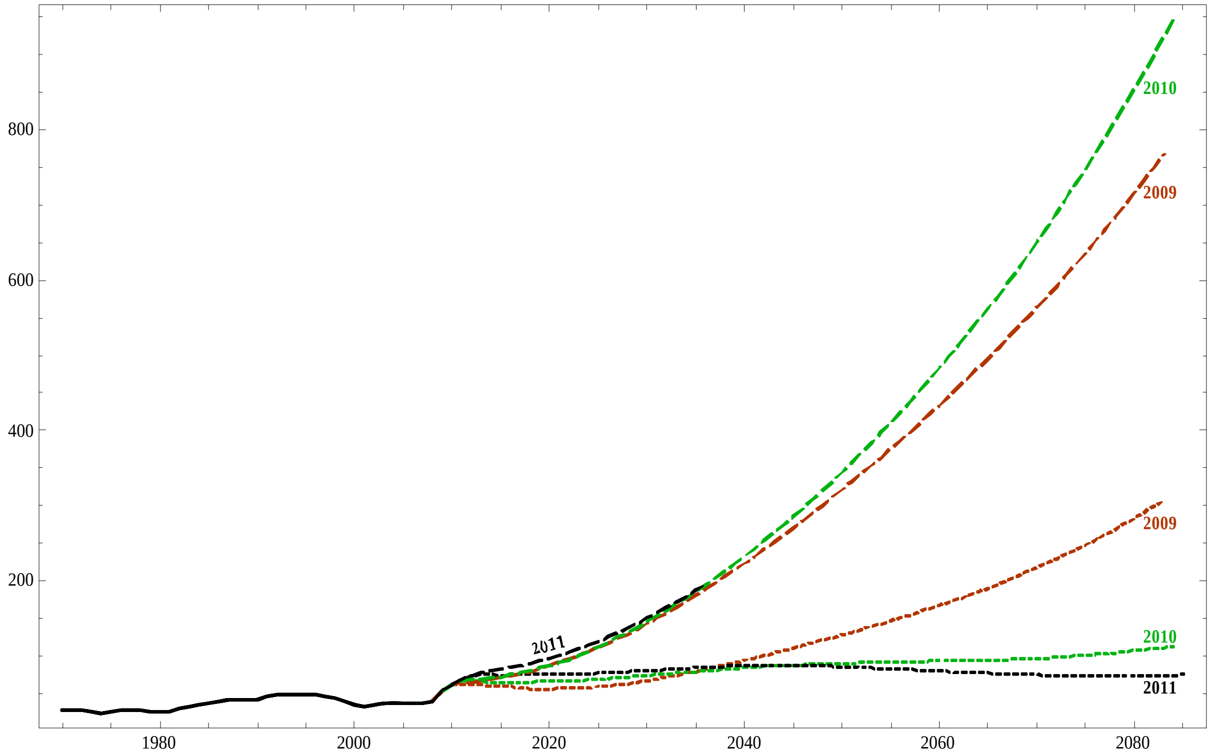

Figure 3: US federal debt from 1970 to 2010 with forecasts using extended baseline and alternative fiscal scenarios generated by the Congressional Budget Office for 2011 to 2085.

This last point is important—the long-run supply of capital is infinitely elastic and as the deadweight losses it generates are increasing and convex in the tax rate. A decision to lower the tax now and rely on deficit finance will require the government to service the additional debt by imposing higher taxes in the future. And yet unlike the intratemporal shift from capital to labour, the benefits accruing to the native population from these intertemporal shifts are sufficient to justify significant deviations from the Ramsey optimal policy and very large accumulations of public debt.

The observation that a consistent reliance on deficit finance is inconsistent with optimal fiscal policy is not new, but much of the previous work seeking to explain its prevalence relies on various degrees of policy uncertainty, imperfect information and political agency problems. An example of a 'Politcal Budget Cycle' perspective is Rogoff (1990) which incorporates imperfect information with a political agency problem. Prior to an election, leaders bribe their constituents with low taxes and higher spending within the context of a sequential game. Though voters understand the game, they cannot observe precisely how much reflects electoral politics and how much the competency of the leader.

Debt can also serve as a method of intergenerational transfer particularly if agents are either finite-lived or as in the case of Cukierman and Meltzer (1989) heterogenous with some bequest-constrained.

This still leaves the question of why has debt in recent decades increased. Why is it predicted to increase even further in the future? In the past only large wars led to such a reliance on deficit finance. What has changed?

We make no effort to model the migration decision itself. Because migration from the developing world to the developed world is highly regulated, we treat changes in the rate of immigration as perturbations to an exogenous underlying flow. For both Western Europe and North America, the marginal supply of potential immigrants from impoverished foreign countries is both very large and not very elastic. The number of legal immigrants is regulated by the rationing of visas, and illegal immigration is also controlled, by either the resources invested in its prevention, or by the costs and dangers imposed by the authorities on those attempting to cross the border without permission.[1] It is unlikely that the prospect of inheriting a portion of the national debt is likely to deter many people from the world's poorest countries from seeking a better life in the developed world.

2 The Basic Model

Consider an economy that is closed in every way but one: new people—adult immigrants—are arriving from abroad at a continuous rate of $m(t)$. These new immigrants are founding members of new infinite lived dynasties, each indexed by a value s, the date at which the dynasties' founding member disembarked from an ocean steamer or crossed an international frontier, to instantaneously join the economy as a worker, consumer, and saver. In the absence of uncertainty, the behavior of each new immigrant and all of his or her descendants can be characterized as the maximization of a dynasties' infinite horizon discounted utility function beginning at time s:

$$\max_{c,h} \int_s^\infty e^{(\rho-n)(s-t)} \ln c\,(s,t)\,dt \tag{1}$$

subject to a time t budget constraint:

$$\dot{a}(s,t) = (1-\tau_h(t))\,w(t)h + ((1-\tau_k(t))\,r(t)-n)\,a(s,t) - c(s,t)\ \forall s,t \tag{2}$$

where $c(s,t)$ and $a(s,t)$ are consumption and holdings of assets for the members of dynasty s at time t, and $w(t)$ and $r(t)$ are wages and returns on capital at time t.[2] The assets for each household are the sum of holdings of physical capital $k(s,t)$, and government debt $b(s,t)$. Hours worked h are assumed to be constant and common across all households. The solution to the optimisation problem yields the evolution of consumption for each individual dynasty s over

[1] See Galor (1986), Djajic (1989), Borjas (1994), and Zak et. al. (2002) for models with endogenously determined levels of immigration.

[2] We assume complete intergenerational altruism, but otherwise this is most similar to Canova and Ravn's (2000) framework for analyzing the impact of German reunification. By contrast in Zak et. al. (2002) agents live only two periods and in Storesletten (2000) agents enjoy long but finite-lives.

time:

$$c\,(s,t) = c\,(s,s)\,e^{\rho(s-t)}e^{\int_s^t (1-\tau_k(v))r(v)dv} \tag{3}$$

Integrating the first order conditions of the individual maximization problem and the time t budget constraint over time, we obtain the consumption rule for dynasty s at time t:

$$c\,(s,t) = (\rho - n)\,(\omega(t) + a(s,t)\ ) \quad \forall s,t. \tag{4}$$

where $\omega(t) = \int_t^\infty e^{-\int_t^u ((1-\tau_k(v))r(v)-n)dv}\,[(1-\tau_h\,(u))\,w(u)h]\,du$ is the present discounted value of all potential income from time t forward, for dynasty s. Aggregating (4) over all dynasties and differentiating with respect to t, aggregate consumption evolves over time according to:

$$\dot{C}\,(t) = (\rho - n)\left[m\,(t)\,\Omega\,(t) + (1-\tau_k\,(t))\,r(t)\,(\Omega\,(t) + A(t)) + e^{n(t-b)}m\,(t)\,M\,(t)\,a(t,t) - C\,(t)\right] \tag{5}$$

where $C(t) = e^{n(t)}\int_0^t M\,(s)\,m\,(s)\,c(s,t)ds + e^{nt}c(0,t)$, $A(t) = e^{nt}\int_0^t N\,(s)\,m\,(s)\,a(s,t)ds + e^{nt}a(0,t)$, and $\Omega\,(t) = e^{nt}\int_0^t N\,(s)\,m\,(s)\,\omega\,(s,t)\,ds + e^{nt}\omega\,(0,t)$, are aggregate consumption, aggregate assets, and the aggregate present value of future earnings at time t, and $M\,(s) = e^{\int_0^s m(v)dv}$, is the number of dynasties that have accumulated by time s. The initial size of the population is normalized to one, and $c(0,t)$, $a(0,t)$, and $\omega(0,t)$, are the time t consumption, assets, and discounted earnings of those dynasties resident in the country at time zero. We write equation (5) in terms of per-capita variables, distinguishing between physical capital and government debt:

$$\dot{c}\,(t) = (1-\tau_k)\,r(t)c(t) - \rho c\,(t) - (\rho - n)\,m\,(t)\,[b\,(t)\,\beta(t) + k\,(t)\,\kappa(t)] \tag{6}$$

where $c(t) = \frac{C(t)}{N(t)}$, $b(t) = \frac{B(t)}{N(t)}$, $k(t) = \frac{K(t)}{N(t)}$, and $\kappa(t) = \frac{k(t)-k(t,t)}{k(t)}$ is the percentage difference between per-capita physical capital and the physical capital owned by new immigrants at the moment of their arrival and $\beta(t) = \frac{b(t)-b(t,t)}{b(t)}$ the analogous terms for government debt.

The production function $F : \mathbb{R}^2_{++} \to \mathbb{R}_{++}$ is homogeneous of degree one in aggregate capital and effective labor—the aggregate supply of hours worked $H(t) = N\,(t)\,h$, multiplied by the level of labor augmenting technology $z(t)$. We assume that $z(t)$ is growing at the fixed rate x, and rewrite (6) and the per-capita feasibility constraint, in terms of the stationary variables $\widetilde{c}(t) = \frac{c(t)}{z(t)}$, $\widetilde{k}(t) = \frac{k(t)}{z(t)}$, $\widetilde{b}(t) = \frac{b(t)}{z(t)}$ and $\widetilde{w}(t) = \frac{w(t)}{z(t)}$:

$$\dot{\widetilde{c}}(t) = [(1-\tau_k)\,r(t) - \rho - x]\,\widetilde{c}(t) - (\rho - n)\,m\,(t)\left[\widetilde{b}\,(t)\,\beta(t) + \widetilde{k}\,(t)\,\kappa(t)\right], \tag{7}$$

$$\dot{\widetilde{k}}(t) = (1-g(t))\left(F\left(\widetilde{k}(t),h\right) - \delta\widetilde{k}(t)\right) - \widetilde{c}(t) - (x + n + m\,(t)\,\kappa\,(t))\,\widetilde{k}(t), \tag{8}$$

$$\dot{\widetilde{b}}(t) = g(t)\left(F\left(\widetilde{k}(t),h\right) - \delta\widetilde{k}(t)\right) - \tau_h\,(t)\,\widetilde{w}(t)h - \tau_k r(t)\left(\widetilde{b}(t) + \widetilde{k}(t)\right) - (n + x - r(t) + m\,(t)\,\beta\,(t))\,\widetilde{b}(t), \tag{9}$$

where δ is the depreciation rate of capital and factors receive their marginal products:

$$r(t) = F_K\left(\widetilde{k}(t),h\right) - \delta, \tag{10}$$

$$\widetilde{w}(t) = F_H\left(\widetilde{k}(t), h\right). \tag{11}$$

Finally the government's budget must remain balanced over the long run:

$$\widetilde{b}(0) = \int_0^\infty \psi(t)\left[g(t)\left(F\left(\widetilde{k}(t), h(t)\right) - \delta\widetilde{k}(t)\right) - \tilde{T}(t) - \left(n + x - r(t) + m(t)\beta(t)\right)\widetilde{b}(t)\right] dt, \tag{12}$$

where $\psi(t) = e^{\int_0^t \left((\rho - n)v - \dot{c}(v)/c(v)\right)dv}$ (See Judd 1987) and $\tilde{T}(t) = \tau_h(t)\,\widetilde{w}(t)h + \tau_k(t)r(t)\left(\widetilde{b}(t) + \widetilde{k}(t)\right)$ represents time t tax revenue. We assume the production function takes the Cobb-Douglas form:

$$F(K(t), z(t)H(t)) = K(t)^\alpha\left[z(t)H(t)\right]^{1-\alpha}.$$

The system (7), (8) and (9), together with the government's budget constraint (12) describes the behavior of the economy, where the products of $m(t)$ and $\kappa(t)$, and $m(t)$ and $\beta(t)$, regulate the impact of immigration on the economy. If $\beta(t)$=0 and $\kappa(t)$=0, new immigrants are identical to members of the already resident population, and changes in the rate of immigration have no effect on per-capita variables in this model.

3 Calibrating the Model

During the 1960's and 1970's immigration rates in the United States were relatively stable while natural population growth dropped dramatically. From 1961 to 1970 the net rate of migration to the United States averaged 2.01 per-thousand and from 1971 to 1980 it averaged 1.98. At the same time the rate of natural population growth nearly halved, from an average of 10.43 to 6.22. In the next decade the rate of natural population growth had increased slightly, averaging 7.20 between 1980 to 1990, but the net rate of immigration climbed averaging 2.75 per thousand. From 1991 to 2000 the average net rate of migration increased again, doubling to 4.58 per thousand while average natural population growth began receeding again to 6.28. In the last decade natural population growth has continued to decline, averaging 5.75 between 2001 and 2010 and immigration also decreased to an average of 2.96 per annum.

From its entry into World War II at then end of 1941 to a year after the end of the war in 1946, the U.S. Federal Government debt as a ratio of GDP climbed from 38.6% to 121.3%.[3] From then in ever year except 1954 and 1958, the debt to GDP ratio declined as the US government retired its wartime debt until 1974 when it reached a postwar low of 31.7% and then remained relatively stable till the end of the decade. From then till 1981 the debt rose and then declined by small amounts at which point it climbed in every one of the next 14 years having more than doubled to 67.1%. Unusually high rates of economic growth helped lower debt ratio to 56.5% in 2001. From that point the rise in defense spending prompted by the attacks on September 11, 2001 and the subsequant wars in both Afghanistan and Iran, together with the increasing cost of medicare combined with the decline in revenue that followed both a

[3] Debt to GDP ratiosfrom Reinhart and Rogoff (2010) http://www.reinhartandrogoff.com/data/browse-by-topic/topics/9/.

series of tax cuts enacted by President George W. Bush, lower growth and finally the financial crisis at the end of the decade have resulted in a rise of the federal debt to GDP ratio to 89.9% in 2010.

Our hypothesis is that the shift in the source of population growth has shifted from the excess of births to deaths in the native population to one driven by higher rates of immigration and subsequant above average birth rates among those newly arrived is creating a bias on the part of the native population in favour of deficit funding. Though such a change is inevitably driven by subtle shifts in attitudes and a consequant process of gradual adjustment, it will be convenient to choose a specific date as a starting point for this policy in our analysis and the decade beginning in 1981 is when the rise in the public debt burden coincided with a substantial increase in the rate of immigration. Hence to calibrate the model we use long-run averages for the United States economy over the thirty years from 1981-2010.

Following the example of Cooley and Prescott (1995) and Gomme and Rupert (2007) henceforth output includes both gross domestic product, and the imputed services from consumer durables—this measure of output was on average 8.345% higher than GDP alone. In steady state the relationship between investment flows I and capital stock K is:

$$\frac{I}{Y} = (x + \delta + n + m\kappa)\,\frac{K}{Y}$$

Real per-capita output x grew over the period 1981-2010 by an average of 0.017 per annum, the capital/output ratio averaged 3.028 and the share of investment flows in output averaged 0.226.

Over the period 1981-2010, the average rate of natural population increase n was 6.4 per thousand and the net rate of international migration m was 3.4 per thousand yielding an overall rate of population growth of 9.8 per thousand. However these numbers understate the contribution of immigration to the growth in the population as they abstract from differences in total fertility rates between natives and immigrants. For example, for the period from 2005-2050, new immigrants and their descendants are predicted to account for 82% of population increase.[4] Hence when determining the fiscal policy most advantageous for the population already resident in the country, the share of population growth that can be attributed to natural population growth is significantly lower than the official figures would indicate.

In our analysis we fix the overall rate of population growth at 9.8 per thousand throughout and vary the share of that growth generated by immigration. To calibrate the model we set the rate of migration m to 0.0057 and the rate of natural population growth n to 0.0041, which is consistent with new immigrants and their U.S.-born descendants accounting for 58% of the 68 million additional people added to the United States population between 1980 and 2005.[5]. Assuming κ=1 and $\beta = 1$—immigrants arrive in the United States after having exhausted

[4] Jeffrey S. Passel and D'Vera Cohn, "U.S. Population Projections: 2005–2050," *Pew Research Center, Social and Demographic Reports*, 2008, p. 2.

[5] *Ibid.*

whatever capital they may have owned and do not initially own U.S. government debt—the overall depreciation rate δ for the economy equals 0.0478.

Since explaining the rise of United States public debt motivates this work we solve for steady state values that are consistent with its ratio to output in 1981 rather than taking an average across the entire period. In 1981 the stock of US public debt corresponded to 26.2% of GDP and 24.12% of our more broadly defined output.

The share of government consumption and investment g out of net output (including services from consumer durables but excluding depreciation of fixed assets) averaged 0.203 between 1981-2010. The share of capital in output includes net interest, profits, rental income, as well as the identical share of proprietors' income and averaged over the period 0.362. We calculate the tax rate on capital income τ_k using a method similar to Mendoza *et. al.* (1994) or Gomme and Rupert (2007), except here the tax is imposed on returns net of depreciation. The tax rate on capital income averaged 0.315 in the 1960's and 0.322 in the 1970's and then dropped to an average of 0.265 during the 1980's 0.262 in the 1990's, and 0.250 in the first decade of the twenty first century. The average between 1981 and 2010 was 0.259, but for reasons that will become clear in the next section we will choose the slighltly higher value of 0.277 as the initial steady state value when calibrating the model. Setting (7), (8) and (9) equal to zero, and using (10) and (11), the subjective discount rate ρ is .0341 per annum and the steady state tax rate on labour earnings, net of transfer payments τ_h is 0.1873.

The parametisation here implies a share of consumption, including imputed services from consumer durables in output, $\widetilde{c}/\widetilde{y}$ of 0.6004 and the real net rate of return on private assets r of 0.0717. The corresponding values derived from US National Income and Products Accounts and US Flow of Funds Reports between 1980-2010 averaged 0.6186 and 0.0574 respectively.

4 Capital Taxation

4.1 Immigration and the Upper Bound on Debt

Before we consider the dynamic impact of changes in taxation on both the economy and the welfare of the native population, it is important to first consider what fiscal policies are actually feasible in the long-term, particularly in relation to shifts in capital taxation. When governments lower taxation for a given length of time they accumulate debt that must ultimately be financed by a future rise in the rate of taxation above its initial level. The steeper the cut in taxation, or the longer its duration, the larger the debt accumulated in the interim, and their is an upper limit to how much debt an economy can finance.

To calculate this upper limit I set (7), (8) and (9) equal to zero, and after setting all the parameters equal to their calibrated values, with the value of the tax rate on labour τ_h, varying slightly from 0.1879 if m=0, 0.1880 if m=0.0034, 0.1881 if m=0.008, as well as 0.18803 for the baseline case of m=0.0057 and calculate the combinations of the capital tax rate τ_k

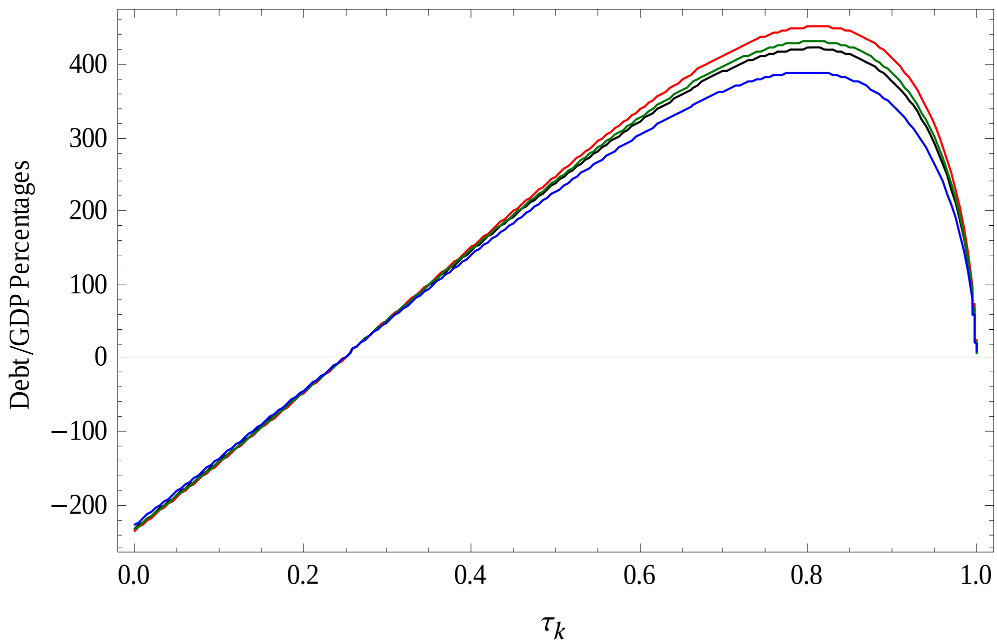

Figure 4: The Laffer curve for public debt is the steady state ratio of debt to initial GDP, for different values of capital taxation τ_k, with an overal rate of population growth rate set to 9.8 per thousand. The red curve corresponds to no immigration, m=0; the green curve to a per annum immigration rate of 3.4 per thousand, the black curve to a per annum immigration rate of 5.7 per thousand, and the blue curve to a per-capita rate of 8 per thousand.

and the steady state amount of debt relative to the initial level of output for each value of immigration. What emerges in Figure 4 are four Laffer curves corresponding to these different rates of immigration. All the curves cross at the point where debt is 26% of GDP and the tax rate on capital income equals 0.275, reflecting the initial calibration of the model. The curves cross the threshold of zero debt between tax rates of 0.2464 and 0.2564—setting the tax rate permanently lower than these values is only feasible if public debt is negative, so that the government is a net recipient of interest payments. Assuming both the government share of output and the tax rate on labour income remains constant, the higher the debt/GDP ratio, the higher the tax rate on capital necessary to finance it, though this tax rate also depends on the rate of immigration. Seen in the other direction, a given rate of capital taxation can sustain higher debt, the higher the rate of immigration.

Yet each curve has a rate of taxation corresponding to a maximum level of debt. Beyond the values of $\tau_k = 0.815$, 0.81, 0.805 and 0.8, corresponding to m=0, 0.0034, 0.0057, and 0.008 further increases in taxation shrink the tax base so severely that the debt that can be sustained begins to decline. Hence any positive level of debt corresponds to two different rates of capital taxation that can sustain it. Finally, and most importantly, the results in Figure 4 provide limits to short-term fiscal policy changes. For example temporary reductions in capital taxation that generate debt to GDP percentages beyond 452% if the immigration rate is zero, 432% if the immigration rate is 3.4 per thousand a year, 422% if the rate of immigration is 5.7 and 390% if the rate of immigration is eight per thousand cannot be sustained by future rises in capital taxation.

4.2 Deficit Spending and Welfare

For simplicity we assume a very high degree of policy stickiness—governments set the essentials of their fiscal policy at time zero for at least a generation if not much longer. Consider a decision to lower the tax rate on income from capital and bonds for a period of T years which we model as unit step perturbations to the values of $\tau_k(v)$ using an indicator function. Inserting into (7), (8) and (9) we solve the system to obtain second order approximations for the behaviour of the variables of interest, including consumption, the stocks of capital and public debt and the rates of return. A given cut in the value of $\tau_k(v)$ generates an increase in public debt that must be financed once the policy is suspended. We assume that the government accomplishes this by setting the same tax rate after T permanently higher to the value that satisfies (12). The impulse responses are used to determine the welfare implications of this policy for the population that is resident in the country at the time of the policy change.

The welfare effect is measured as a compensating differential—a permanent fraction p of consumption needed to compensate native households for not deviating from the baseline fiscal policy:

$$\int_0^\infty e^{(n-\rho)t} \ln c(0,t)\, dt = \int_0^\infty e^{(n-\rho)t} \ln\left[(1+p_{m,T})\,\overline{c}(0,t)\right] dt \tag{13}$$

where $c(0,t)$ is the consumption of the population present in the economy at t=0, when the new policy is announced at time period t, and $\overline{c}(0,t)$ is the analogous term for consumption corresponding to the counterfactual of no change in policy. Solving for $p_{m,T}$:

$$p_{m,T} = \frac{\overline{c}(0,0)}{c(0,0)} e^{(\rho-n)\int_0^\infty \int_0^t e^{(n-\rho)t}((1-\tau_k(v))r(v))dvdt - \frac{(1-\bar{\tau}_k)\bar{r}}{(\rho-n)}} - 1 \tag{14}$$

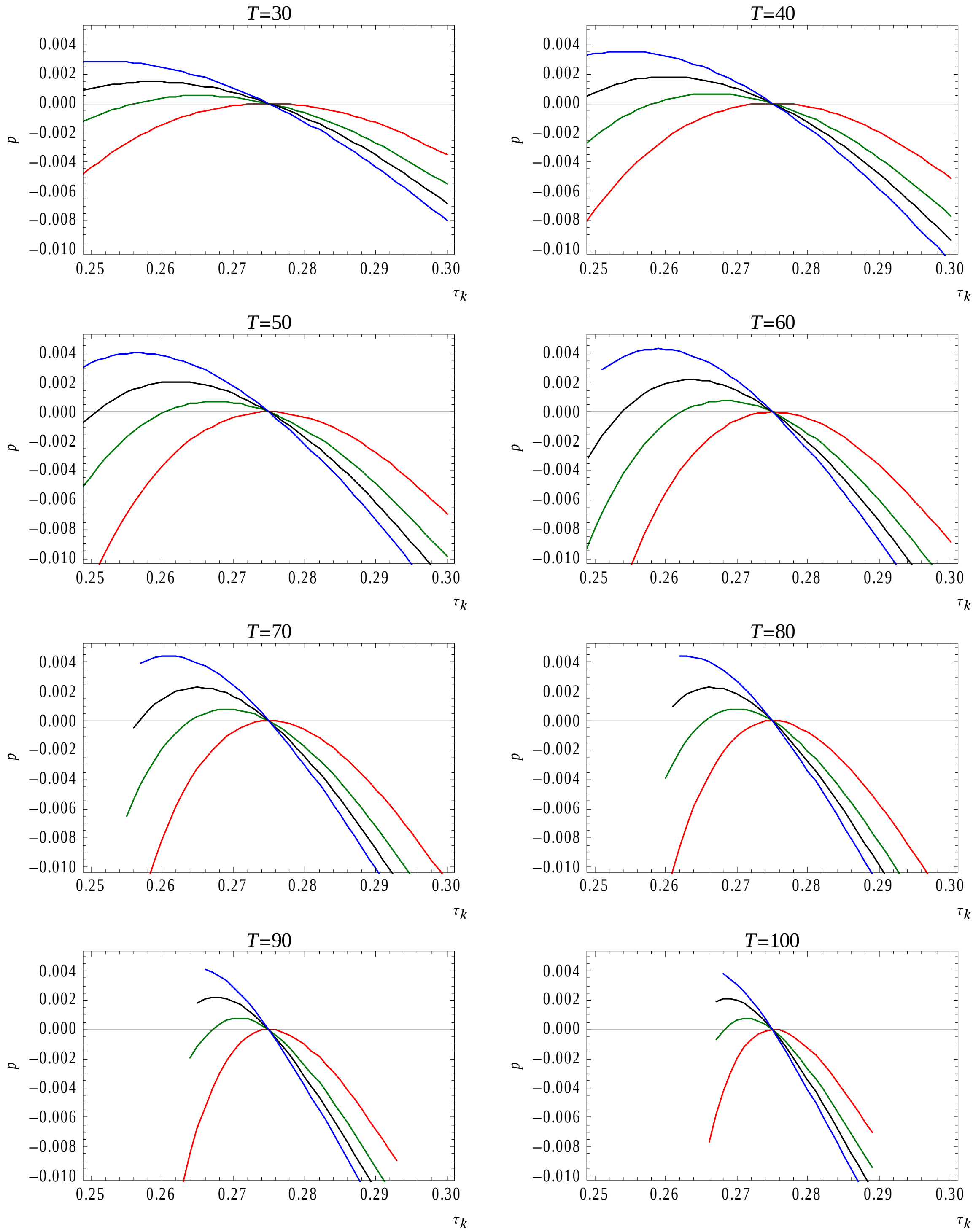

Figure 5: Welfare effects p for a change in the tax rate on capital income from 0.275 for T=30, 40, 50, 60, 70, 80, 90, 100 and the rate of immigration of zero (red), 3.4 per thousand (green), 5.7 per thousand (black) and 8 per thousand (blue). Results are only calculated for deficits that are sustainable.

$T \backslash m$	$\tau_k\,(t<T)$			$\tau_k\,(t>T)$			$\frac{b(T)}{y(T)}$			$p_{m,T}$			$p_{m,T}-p_{0,T}$		
	0.0034	0.0057	0.008	0.0034	0.0057	0.008	0.0034	0.0057	0.008	0.0034	0.0057	0.008	0.0034	0.0057	0.008
30	0.265	0.259	0.252	0.3181	0.3457	0.3796	0.6447	0.9049	1.2281	0.00052	0.00147	0.00286	0.00117	0.00319	0.00654
40	0.266	0.26	0.254	0.3345	0.3771	0.4224	0.8059	1.2235	1.6831	0.00064	0.00182	0.00354	0.00148	0.00424	0.00852
50	0.267	0.262	0.257	0.3516	0.4032	0.4587	0.9770	1.503	2.0977	0.00073	0.00206	0.00402	0.00171	0.00480	0.00954
60	0.268	0.264	0.259	0.3684	0.4268	0.5042	1.1516	1.7657	2.6537	0.00078	0.00221	0.00431	0.00186	0.00502	0.01070
70	0.269	0.265	0.261	0.3842	0.4637	0.5500	1.3183	2.1959	3.2614	0.00081	0.00228	0.00442	0.00190	0.00556	0.01139
80	0.27	0.266	0.263	0.3970	0.5034	0.5932	1.4578	2.6902	3.8829	0.00081	0.00226	0.00440	0.00184	0.00597	0.01154
90	0.271	0.268	0.266	0.4043	0.5112	0.5934	1.5400	2.7974	3.9068	0.00079	0.00220	0.00414	0.00167	0.00518	0.00943
100	0.271	0.269	0.268	0.4451	0.5422	0.6029	2.0052	3.2132	4.0658	0.00075	0.00208	0.00378	0.00195	0.00504	0.00799

Table 1: Changing the tax rate from its initial value of 0.275 to its welfare maximising value.

from its initial value of 0.277 for T= 30, 40, 50, 60, 70, 80, 90 and 100 years after which it rises to a higher level that satisfies (12). The red curves represent the effects when m=0—in the absence of immigration, any policy that deviates from perfectly smoothing taxes over time generates welfare losses. By not considering immigration, any deviation from this policy might seem inexplicable, but once we consider the effects of immigration—the blue curves correspond to the welfare effects of the temporary tax cut when the value of m is set to the baseline value of 5.7 per thousand—temporary tax cuts, provided they are not too big, generate a welfare benefit for the population present at the time the policy is announced and implemented. The tax rate that maximises native welfare when the value of T is set to thirty years is 0.259, the average observed value for the United States between 1980 and 2010. This is of course by design, the model was parameterised for the higher value of τ_k=0.275 to match this observation. Setting T to longer durations changes the maximising debt somewhat. Nonetheless the results demonstrate that even in this highly extreme case where all the tax changes are confined to the most distortionary tax—the tax on returns to capital and bonds—the model can justify significant deficits and accumulation of debt over time as seen in Figures 6 and **??** which in turn necessitates higher primary surpluses over time as in Figure 7.

5 Shifting the Tax Burden from Capital to Labor

Though this paper is mostly focused on determining the pattern of deficit finance likely to emerge for a country absorbing immigration it is useful to begin to consider how much scope there is to accomplish the same policy of benefiting the native population by simply shifting the tax burden from the capital that population owns and on to the labour that will be supplied by everyone. Consider what happens to factor returns and per-capita consumption, when the government announces that it plans to permanently lower or raise the tax rate on the net return on capital, all the while keeping the fraction of net output devoted to government expenditure fixed, and the budget balanced.

In a series of papers on optimal factor taxation in optimal growth models published during the 1980's Kenneth Judd and Christophe Chamley demonstrated that governments can minimize the welfare loss from distortionary taxation if the long run tax on capital income is zero and imposing the entire burden of funding a fixed level of government expenditure on labor income. If however government expenditure is a fixed portion of the net product, the zero tax on capital income is no longer optimal and governments will optimize by setting the tax rate τ_k equal to the share of government expenditure g.

Proposition 1: In an economy without immigration and where government expenditure is a fixed portion of the net product, the welfare optimizing long-run policy is to equalize tax rates.
Proof: See appendix.

Proposition 1 is relevant when there is a representative agent whose welfare is maximized. When immigrants are arriving, policies that may minimize distortions may not serve the inter-

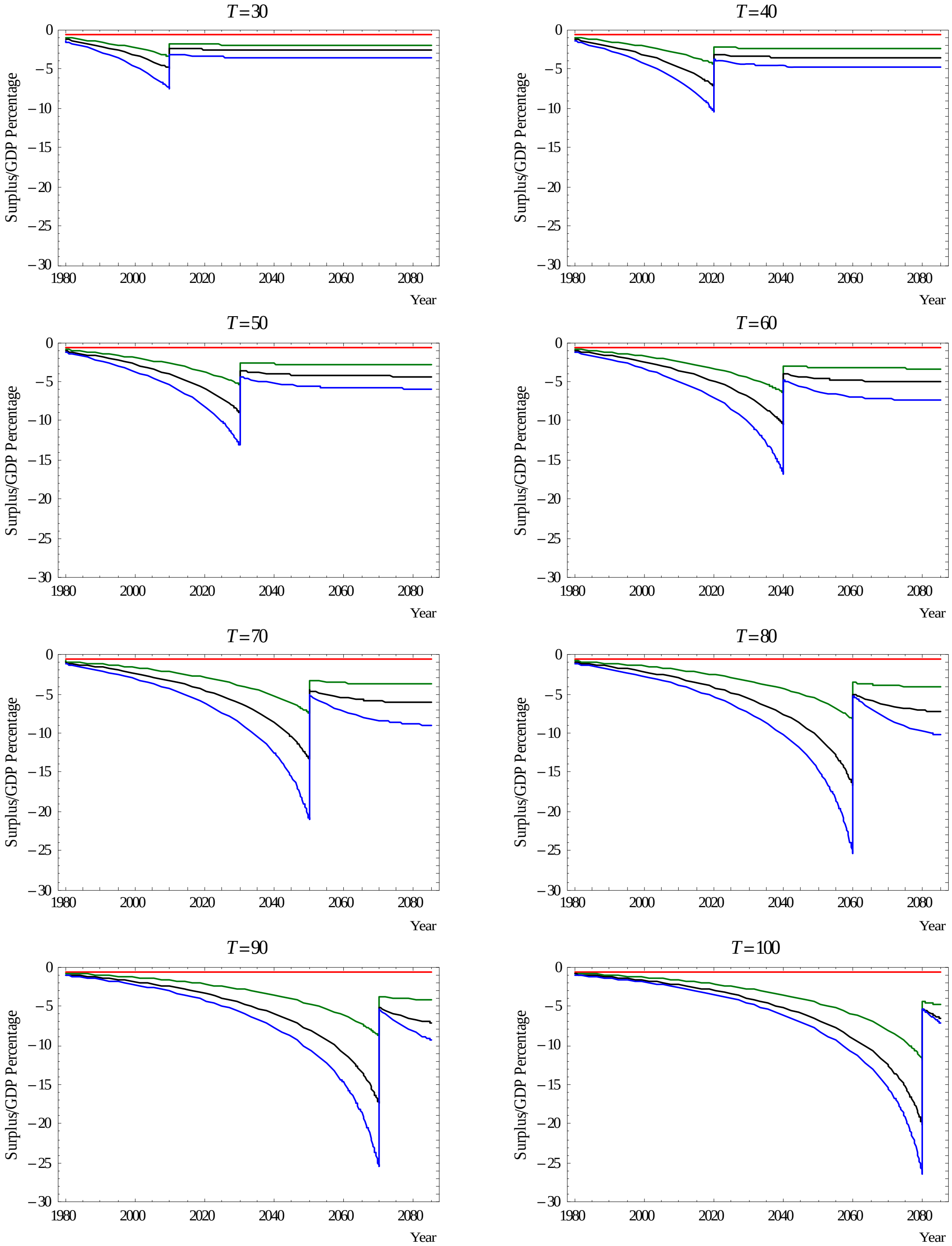

Figure 6: Percentage of the public surplus to GDP following a cut in the tax rate on income from returns to capital and bonds from 0.275 to the rate of taxation that maximises welfare for T=30, 40, 50, 60, 70, 80, 90, 100 and the rate of immigration of zero (red), 3.4 per thousand (green), 5.7 per thousand (black) and 8 per thousand (blue). Results are only calculated for deficits that are sustainable.

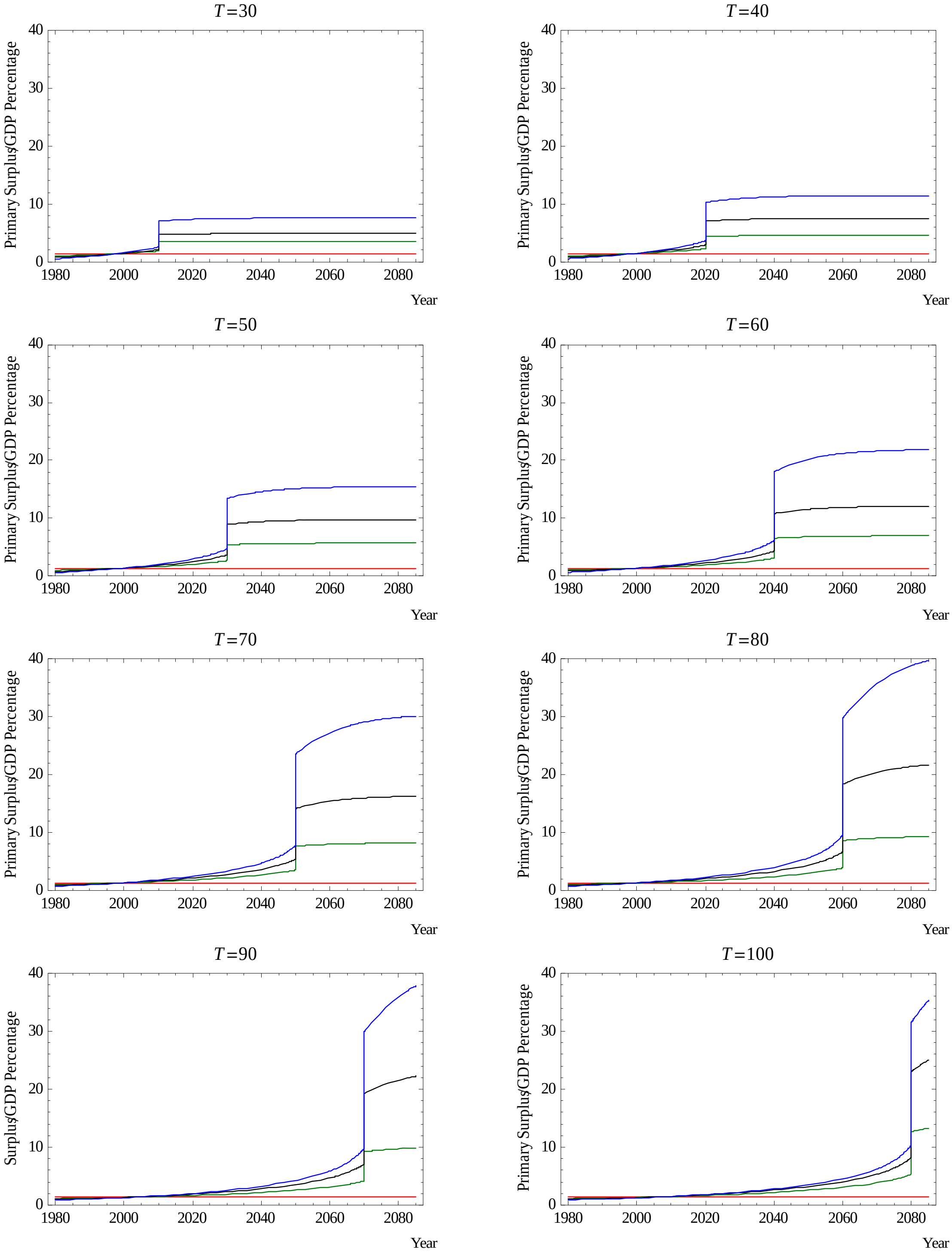

Figure 7: Percentage of the primary public surplus to GDP following a cut in the tax rate on income from returns to capital and bonds from 0.275 to the rate of taxation that maximises welfare for T=30, 40, 50, 60, 70, 80, 90, 100 and the rate of immigration of zero (red), 3.4 per thousand (green), 5.7 per thousand (black) and 8 per thousand (blue). Results are only calculated for deficits that are sustainable.

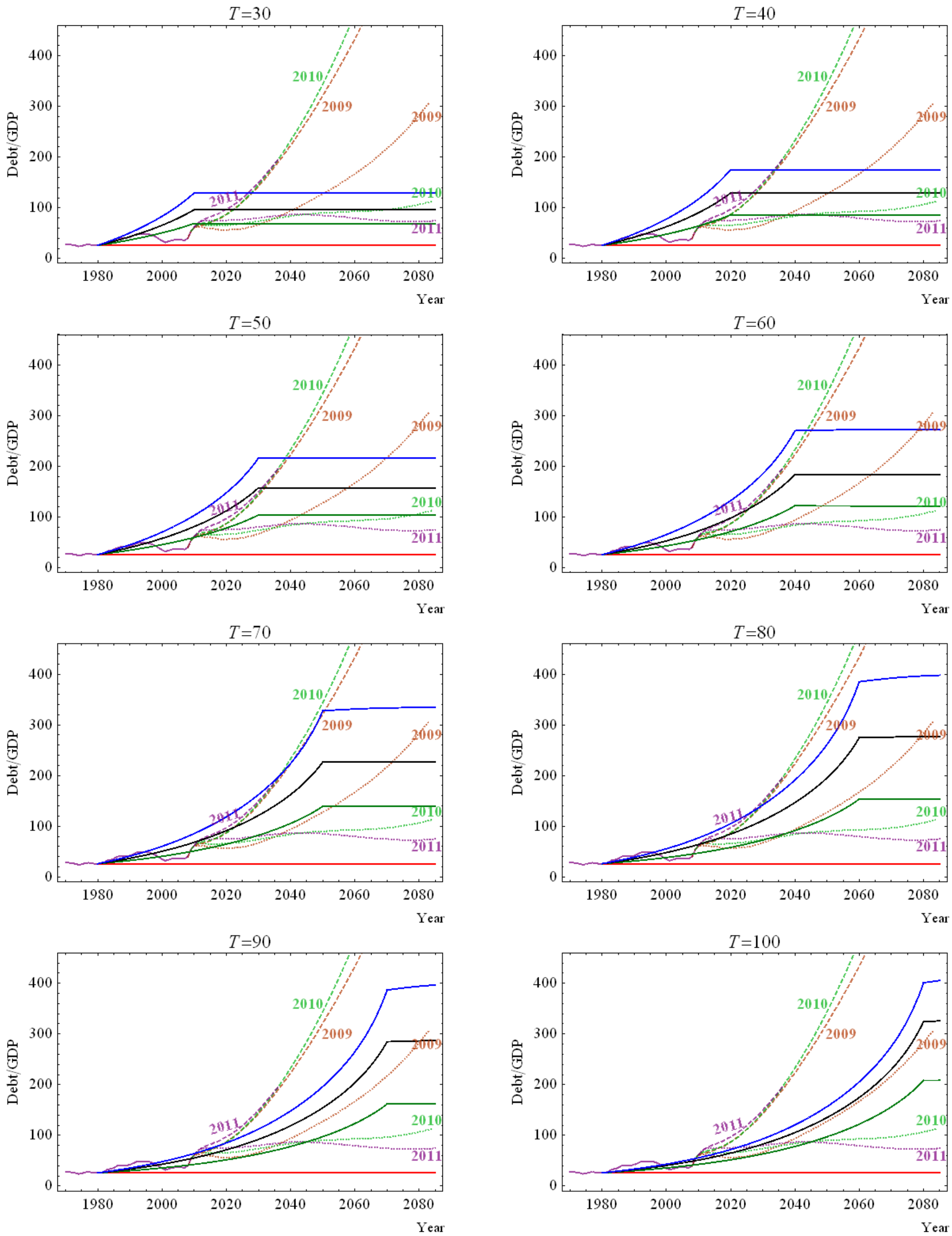

Figure 8: Government debt following a cut in the tax rate on income from returns to capital and bonds from 0.275 to the rate of taxation that maximises welfare in Table for T=30, 40, 50, 60, 70, 80, 90, 100 and the rate of immigration of zero (red), 3.4 per thousand (green), 5.7 per thousand (black) and 8 per thousand (blue). Results are only calculated for deficits that are sustainable.

ests of the population already present and vice-versa. More specifically, the resident population already owns capital while future immigrants will rely solely on labor income. A decision to immediately and permanently shift some of the tax burden away from capital and towards labor will also redistribute some portion of the tax burden away from residents and towards those households that have not yet arrived from abroad. Of course these present-day residents or natives will also rely on labor income and will bear some welfare loss from the distortion any reduction in the capital tax will imply. How much these natives will choose to deviate from the policy in Proposition 1 will depend of course on the rate of immigration they anticipate, and how much if any capital the immigrants import with them.

Consider the behaviour of the economy initially in steady state, after the government announces that it is to immediately lower the tax on capital income and raise the tax on labour to ensure the budget remains balanced. Consumption immediately drops and savings increase. Figure 9 traces the behaviour of $\tau_h(t)$ as the rate of capital taxation declines from a baseline rate of 0.295 over the course of one hundred years.[6] If the shift in taxes is sufficient to raise the tax on labour above the tax rate on capital the initial increase of the former will be slightly ameliorated by a gradual decline as the accelerated accumulation raises wages. Does this mean that the distinction between countries absorbing many immigrants and those not absorbing any is not relevant when considering fiscal policy? Consider instead the tax burden for each cohort s at time t:

$$TB(s,t) = \frac{\tau_h(t)\, w(t)h + \tau_k(t)\, r(t)a(s,t)}{w(t)h + r(t)a(s,t)}$$

In Figure 10, I trace the evolution of the tax policy for $TB(0,t)$, the population resident in the country at the time the policy is announced. From an initial value of 0.212 the net burden gradually declines if the economy is absorbing immigration and the cut in the rate of taxaion on capital is sufficiently high. Why does the tax burden decline? Though in each panel of Figure 9, I trace out the behaviour of $\tau_h(t)$ for the model with rates of immigration of zero, five and ten per thousand, the differences between these curves are trivial. The shift in the tax burden is not a function of these differences, but in the rate of capital accumulation that accompanies immigration.

In an economy with a static population or a population that is only growing through natural increase, steady state gross investment merely serves to conpensate for depreciation, and the gap between the rate of return to income from capital, net of taxes, and the subjective discount rate is only the per-capita growth rate of the economy. Here there is an additional factor identifiable in the extra term in (7), $(\rho - n)\, m(t) \left[\widetilde{b}(t)\, \beta(t) + \widetilde{k}(t)\, \kappa(t)\right]$. Assuming either $\beta(t)$ and/or $\kappa(t)$ are greater than zero as each fresh cohort of immigrants arrives it slightly dilutes the stock of financial assets in the economy and this term slightly raises the net rate of return, generating an incentive for all of the existing cohorts to accumulate extra capital to offset the dilution

[6] The impulse responses following the change in policy are calculated using the perturbations method, calculated to a fourth order.

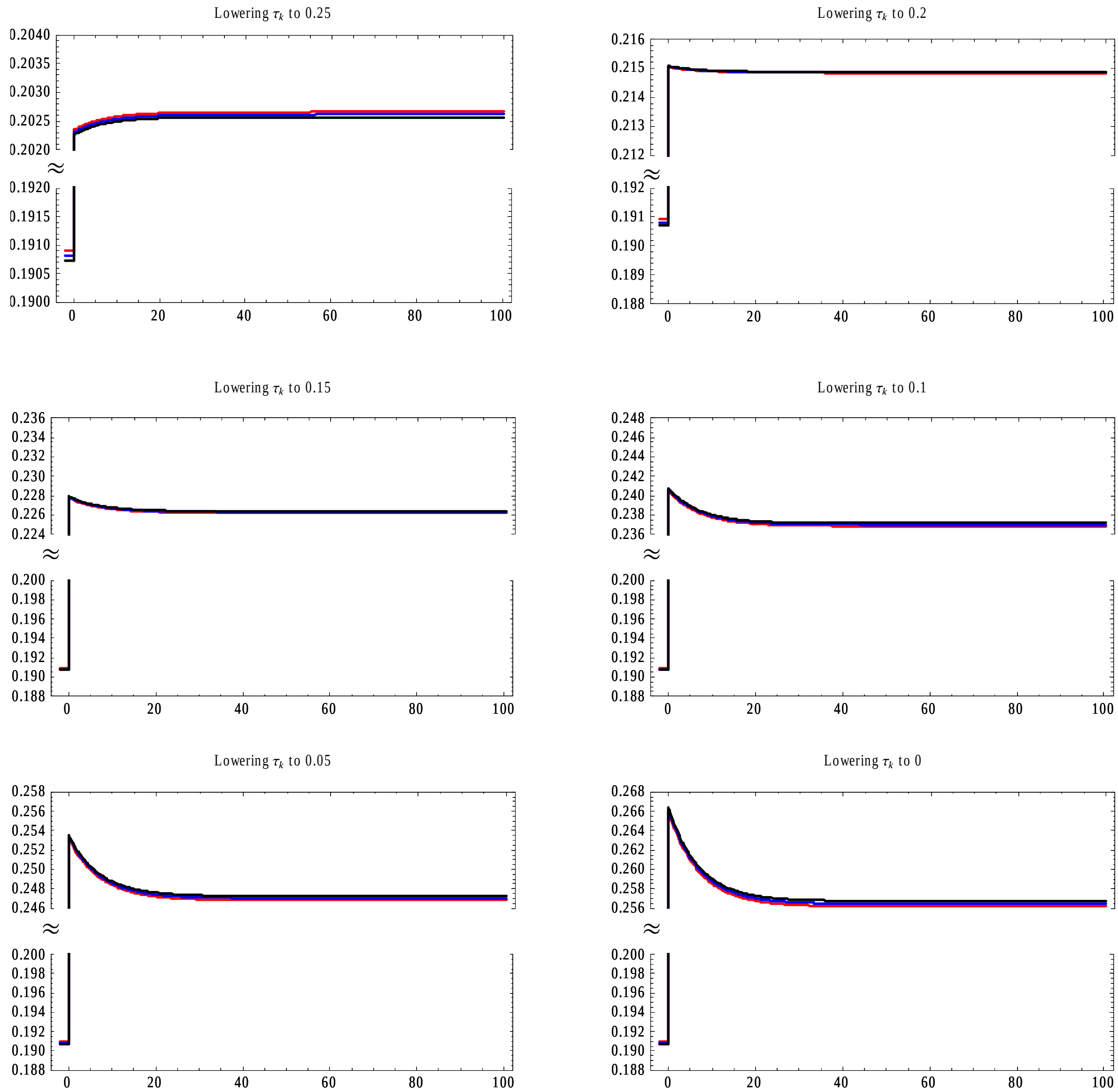

Figure 9: The tax rate on labour $\tau_h(t)$ following a decrease in the tax on income from capital $\tau_k(t)$ from a baseline rate of 0.295. The red curve corresponds to no immigration, m=0; the blue curve to a per annum immigration rate of 5 per thousand, m=0.005; the black curve to a per annum immigration rate of 10 per thousand, m=0.01.

the new immigrants induce. A dynasty arriving without any assets will initially derive all its income from labour, but over time it will gradually acquire assets until as its wealth grows in the limit it is wholly dependent on income from capital. This means that over time, unless the tax rate on labour is sufficiently lower than the tax rate on capital income, each cohort will experience a gradual increase in the share of income it pays in taxes until again in the limit, all its income is taxed at the higher rate associated with the tax on capital. If for example the tax rate is lowered from its initial value of 0.295 to 0.25 or 0.2 the tax burden still increases for the native population as indicated in the upper panels of Figure 10, but this occurs at a slower pace.

What then is the impact of the shifts in the tax burden on the resident population? In steady state, consumption for this population is growing faster than the per-capita growth rate of the economy as a whole, so the relevant comparison is how consumption for these people evolves compared to how it would behave if the policy remains as before. The immediate impact of the policy announcement is to induce higher savings and lower consumption, for s=0 the value of $c\,(0,0)$ in (3), drops below its initial steady state value. Subsequant values of $c\,(0,t)$ rise in response to the higher net rate of return on capital. Define the evolution of consumption for each dynasty s at time t in the absence of any change as $\overline{c}(s,t)$. Figure 11 shows the fractional deviation of $c\,(0,t)$ from $\overline{c}(0,t)$. Initially there is little difference between the behaviour of the curves in each panel. However, over time the higher the rate of immigration, the more $c\,(0,t)$ diverges from $\overline{c}(0,t)$. This is the effect of the shift in the tax burden in Figure 10.

In Figures 12 and 13 I present the values of p for different immigration rates and new tax rates. Lowering the tax rate on capital from its initial value of 0.295, welfare improves. In the absence of immigration the lower curve reaches its apex at approximately $\tau_k = 0.212$, the value of g as consistent with Proposition 1. The welfare improvement generated by adopting this policy is encapsualte by the value of p, here to 0.0008. This implies that in the absence of immigration, once we factor in the transition costs the value of moving to a Ramsey optimal policy is equivalent to a permanent increase in consumption of only 0.08%. If the rate of immigration is five per thousand a government interested in pursuing the policy most advantageous to the native population it will set the rate of capital taxation slightly lower—to 0.2 so as to generate a welfare benefit equivalent to a slightly larger 0.1% permanent increase in consumption. This is the combined effect of the efficiency gain lowering the tax rate generates and the shift in the tax burden in Figure 10.

There may be many reasons why policy makers are resistant to following the prescriptions to exchew all taxation of capital. First, those results derived in the 1980's assumed that government expenditure was exogenous and not tied to the size of the economy.[7] Once that assumption is jettisoned the optimal policy is no longer to set capital taxation to zero and present day policies appear closer to being optimal policy and the potential welfare gains are a even smaller. that available must be weighed agains the distributional issues within the native population from

[7]Setting g=0, the welfare gain from eliminating capital tax in this economy without is only 0.68%.

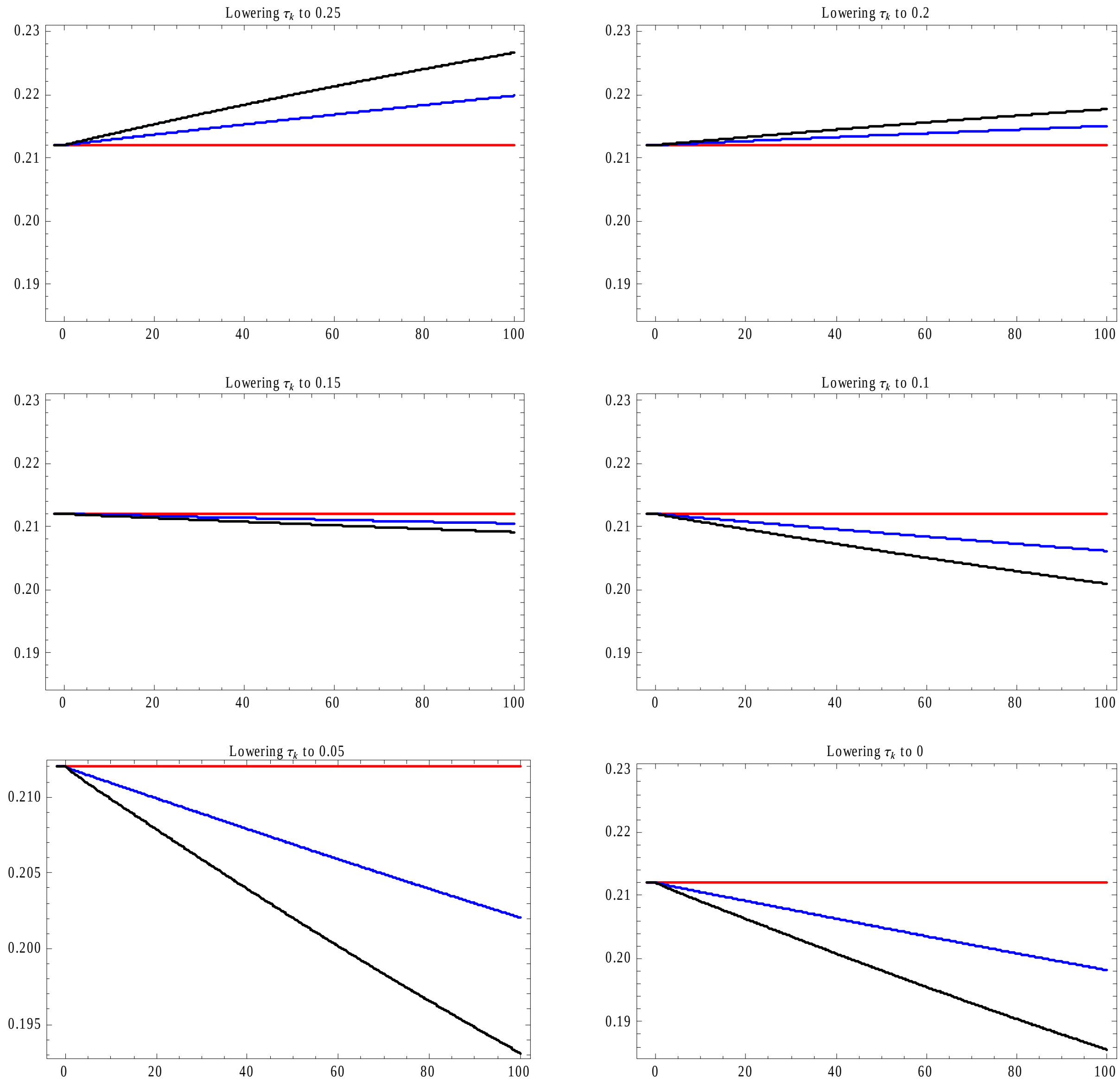

Figure 10: The evolution of the tax burden for the resident population following the drop in the capital tax rate from a baseline rate of 0.295. The red curve corresponds to no immigration, m=0; the blue curve to a per annum immigration rate of 5 per thousand, m=0.005; the black curve to a per annum immigration rate of 10 per thousand, m=0.01.

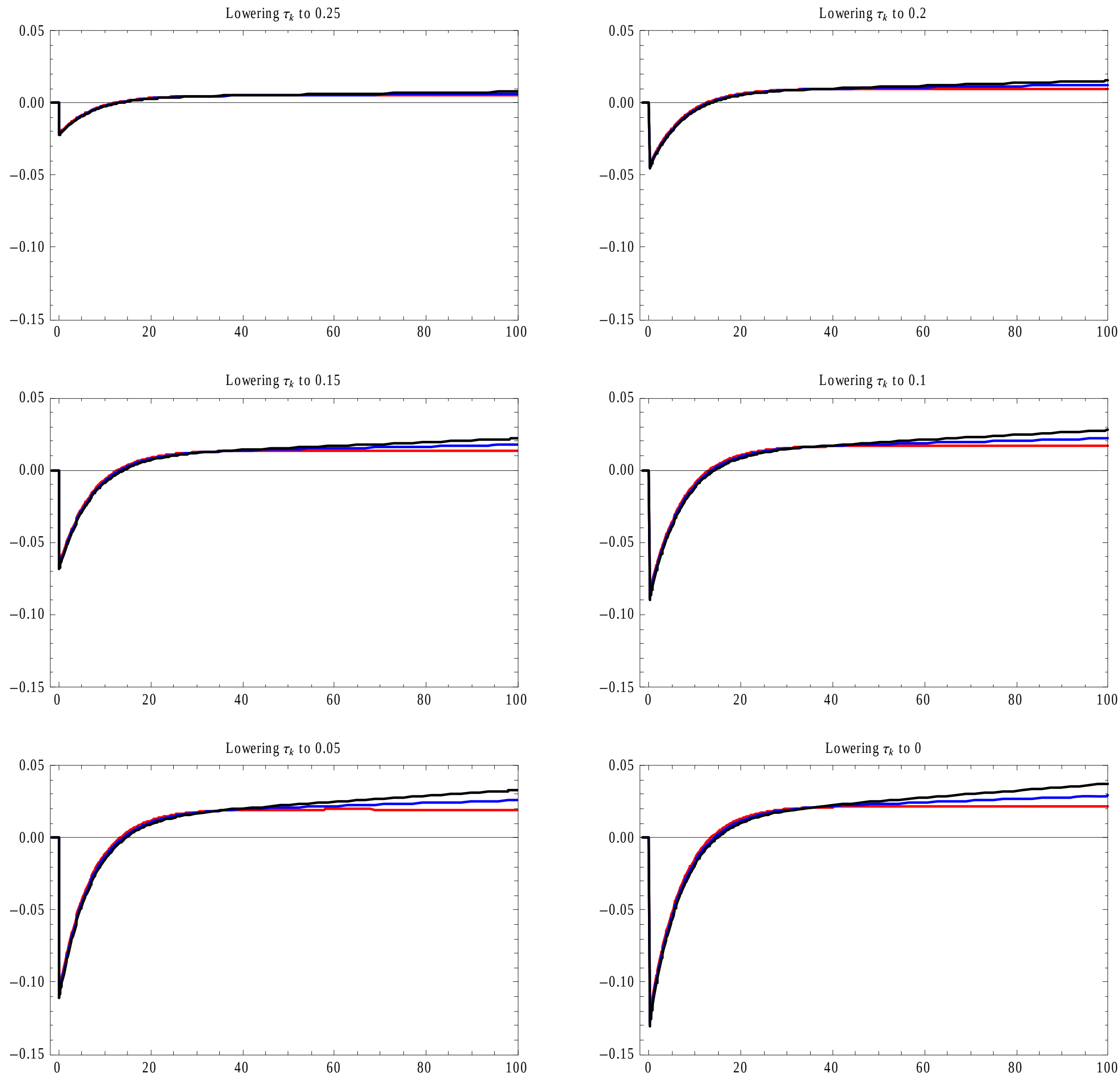

Figure 11: The fractional difference between the evolution of consumption for the resident population $c(0,t)$ following the drop in the capital tax rate from a baseline rate of 0.295 and the evolution of consumption in the absence of a change in policy $\bar{c}(0,t)$. The red curve corresponds to no immigration, m=0; the blue curve to a per annum immigration rate of 5 per thousand, m=0.005; the black curve to a per annum immigration rate of 10 per thousand, m=0.01.

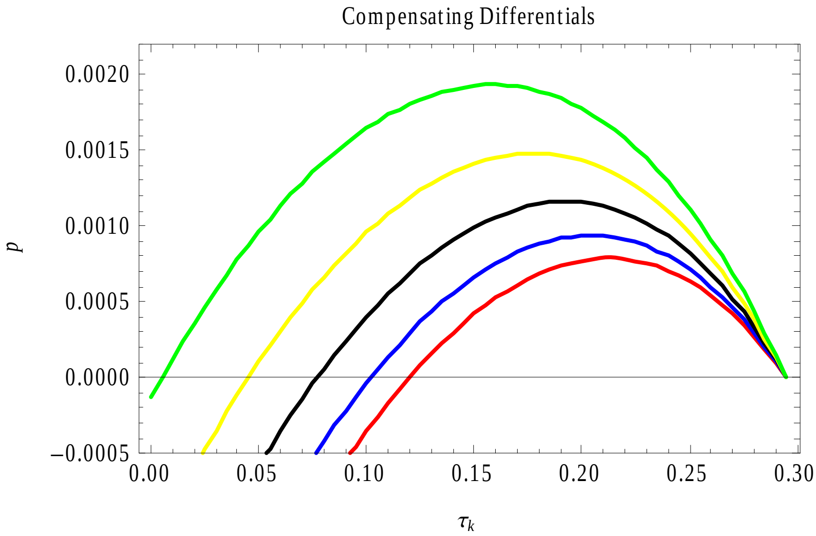

Figure 12: The value of the compensating differentials p following the drop in the capital tax rate from a baseline rate of 0.295. The red curve corresponds to no immigration, m=0; the blue curve to a per annum immigration rate of 5 per thousand, m=0.005; the black curve to a per annum immigration rate of 10 per thousand, m=0.01; the yellow curve to a per annum immigration rate of 15 per thousand, m=0.015 and the green curve to a per annum immigration rate of 20 per thousand, m=0.02.

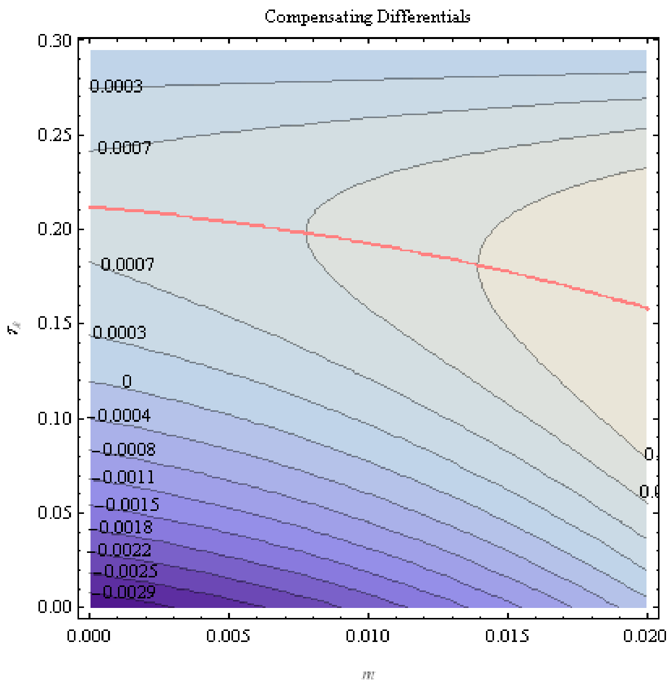

Figure 13: Each contour traces the combinations of immigration rates m and to an new rate of capital tax rates τ_k that corresponds to a compensating differential p following the shift from a baseline capital tax rate of 0.295.

which we abstract. Even if we assume a willingness to use tax policy to shift resources from future immigrants, this policy reveals itself to be largely innefective. The distortionary effects quickly limit the efficicy of this approach, leaving the net benefit to the current population fairly small. Does this mean that immigration is not likely to influence decisions on fiscal policy? Not at all—we now turn our attention to deficit finance where the opportunities for the native population to achieve substantial welfare gains are much harder to ignore.

6 Conclusion

Looking at the results from the shifts in income taxes or labour taxes alone, it is hard to understand why the debt has not climbed even more steeply.

The results in this paper suggest that given the prospect of a continuing inflow of immigrants, policymakers can generate a small surplus for the country's already resident population, by shifting the burden of taxation from capital to work. Far greater scope to benefit this population is available to a government that temporarily postpones taxation, covering its ongoing expenditures in the meantime, by issuing public debt. The potential for redistribution from immigrants to the local population is limited by the excess burden such policies impose.

Raising the debt and unfunded liabilities with relative alacricity and not because people have lost concern for their own progeny.

Hence it is not unrealistic to assume that the country's capital stock is largely owned by natives, a more subtle method will be to shift the burden of taxation further towards wages from which immigrants derive a disproportionate share of their income. Furthermore as immigrants arrive, they immediately inherit a portion of the public debt. Hence as long as the debt is not so large it deters future immigration, we should expect a bias in favour of deficit finance. However these considerations must be weighed against the efficiency losses generated by any deviation from Ramsey optimal taxation. Fiscal policy will favour low taxes or subsidies for capital and deficit finance, but not infinitely so. For a given rate of immigration, a policy maker will choose to shift the tax burden from capital to labour, or permit the public debt only so far. Indeed our calculations demonstrate that shifting the tax burden between factor payments will generate only minor welfare gains for the native population, far higher gains can be achieved by shifting the burden across time through deficit finance, even if all the shifting of taxes is restricted to the distortionary tax on capital.

minimize the deadweight loss from factor taxation by equalizing the long-run tax rates on capital and work.[8] However when a government representing the interests of the present-day population expects immigrants to arrive in the future, they can choose to shift some of the

[8] See also Proposition 2 in Ben-Gad (2003).

tax burden away from their own sources of income, and on to the income of future immigrants without explicitly imposing discriminatory taxes. Typically, because natives are owners of capital, but immigrants usually arrive with little or no capital, there is an incentive to shift some of the burden of taxation from capital to labor. Alternatively, by temporarily lowering taxes governments can shift the burden of present day public consumption to future immigrants that are yet to arrive. Our results suggest that because of the steep dead weight loss incurred when factor taxes deviate from equality, the scope for redistribution through intratemporal shifts from capital to labor is very small—the optimal tax on capital drops by approximately a percentage point for each percent inflow of immigrants. Much greater benefits are achieved by shifting taxes across time.

an anticipated flow of immigrants may cause policy makers to pay for government expenditure with a mix of factor taxation and deficit finance that deviates from the usual prescriptions of Ramsey optimal taxation. I consider an optimal growth model with overlapping dynasties, of the type first introduced by Weil (1989) to examine deviations from Ricardian Equivalence and later used by Ben-Gad (2004) (2008) to measure immigration surpluses.

There is a broad consensus that a government that seeks to minimise the excess burden its tax regime generates must consider two elements that feature prominently most dynamic macroeconomic models—that the long-run supply of capital is infinitely elastic and that the excess burden is an increasing and convex function of any given tax. These two features imply that governments should neither tax or subsidise income from capital and that tax rates should remain constant over time implying a policy of balancing the primary budget. Santos et. al. .... calculate the welfare gains associated with moving to a Ramsey optimal policy in the context of a standard optimal growth model.

Of course many considerations feature in the design and implementation of fiscal policy beyond the desire to minimise deadweight losses, including issues surrounding the distribution of income as well as macroeconomic stabilisation. However, it would seem at a time when international migration is accelerating, that this will influence how governments choose to tax. On a qualitative level the answer is not hard to guess—a government that represents the best interests of its current citizens will choose to shift part of the tax burden to future immigrants. One method might be to levy special taxes on immigrants or sell residency permits. Putting this possibility to one side, if we assume the country's capital stock is largely owned by natives, a more subtle method will be to shift the burden of taxation further towards wages from which immigrants derive a disproportionate share of their income. Furthermore as immigrants arrive, they immediately inherit a portion of the public debt. Hence as long as the debt is not so large it deters future immigration, we should expect a bias in favour of deficit finance. However these considerations must be weighed against the efficiency losses generated by any deviation from Ramsey optimal taxation. Fiscal policy will favour low taxes or subsidies for capital and deficit finance, but not infinitely so. For a given rate of immigration, a policy maker will choose to shift the tax burden from capital to labour, or permit the public debt only so far. Indeed our calculations demonstrate that shifting the tax burden between factor payments will generate only minor welfare gains for the native population, far higher gains can be achieved by shifting the burden across time through deficit finance, even if all the shifting of taxes is restricted to the distortionary tax on capital.

A simple model where the only distortionary tax is the tax that is most distortionary—the tax on capital.

In an economy in which government expenditure is a fixed share of net national product, policy-makers can minimize the deadweight loss from factor taxation by equalizing the long-run tax rates on capital and work.[9] However when a government representing the interests of the present-day population expects immigrants to arrive in the future, they can choose to shift some of the tax burden away from their own sources of income, and on to the income of future immigrants without explicitly imposing discriminatory taxes. Typically, because natives are owners of capital, but immigrants usually arrive with little or no capital, there is an incentive to shift some of the burden of taxation from capital to labor. Alternatively, by temporarily lowering taxes governments can shift the burden of present day public consumption to future immigrants that are yet to arrive. Our results suggest that because of the steep dead weight loss incurred when factor taxes deviate from equality, the scope for redistribution through intratemporal shifts from capital to labor is very small—the optimal tax on capital drops by approximately a percentage point for each percent inflow of immigrants. Much greater benefits are achieved by shifting taxes across time.

7 Appendix

Proof of Proposition 1: Follow Chamley (1986) we define the second best Ramsey problem as a current value Hamiltonian in which the government chooses the after-tax wage $\bar{w} = (1 - \tau_h)\tilde{w}$ and rate of return to capital and government debt $\bar{r} = (1 - \tau_k)r$.

$$\begin{aligned} H &= V(\tilde{c}) + \xi(\rho - \bar{r})\tilde{c} + \lambda\left((1-g)\left(F\left(\tilde{k}, h\right) - \delta\tilde{k}\right) - \tilde{c} - (n+x)\tilde{k}\right) \\ &\quad + \mu\left(\bar{w}h + \bar{r}\left(\tilde{k} + \tilde{b}\right) - (n+x)\tilde{b} - (1-g)\left(F\left(\tilde{k}, h\right) - \delta\tilde{k}\right)\right) + \nu(1-\tau_k)\bar{r} \end{aligned}$$

Differentiating with respect to k and b. First order conditions are:

$$\lambda(1-g)\left[F_k(k,h) - \delta\right] + \mu(1-g)\left[F_k(k,h) - \delta\right] + \lambda(n+x) - \mu\bar{r} = (\rho - n)\lambda - \dot{\lambda}$$

$$(\bar{r} - n - x)\mu = (\rho - n)\mu - \dot{\mu}$$

along the balanced growth path: $\dot{\lambda} = \dot{\mu} = 0$ and $\bar{r} = \rho + x$ and $r = F_k(k,h) - \delta$. Combining:

$$\lambda(1-g)r + \mu(1-g)r - \lambda\bar{r} - \mu\bar{r} = 0$$

[9] See also Proposition 2 in Ben-Gad (2003).

Therefore $\bar{r} = (1 - g)\, r$. See also Ben-Gad (2003).

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