On the Political Economy of Deficit Bias and Immigration

Short title: Deficit Bias and Immigration

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Abstract

I construct an optimal growth model with overlapping dynasties to investigate how much the rate at which an economy absorbs new immigrant dynasties could motivate current voters to favour greater reliance on deficit finance of government expenditures through intertemporal shifts in factor taxation. The model demonstrates that even if voters are altruistically linked to their descendants, rising immigration, coupled with declining birth rates may explain the growth in public debt and unfunded liabilities in the United States since the early 1980's, as well as the large increases in debt projected by the Congressional Budget Office over the next few decades.

JEL classification: E62, F22, H62

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Ordinarily, in an economy in which taxes are distortionary, heavy reliance on deficit finance to fund government expenditure combined with sustained increases in unfunded liabilities, relative to the size of the economy, might be hard to reconcile with the prescriptions of optimal fiscal policy. Yet it is precisely this type of fiscally imbalanced policy that both national and local governments throughout much of the developed world have been pursuing for decades.

This paper examines how though different generations may be altruistically linked, the existence of immigrant flows will encourage a government that represents the interests of today's population to favor deficit finance and low taxes for long periods of time, even if such policies will eventually necessitate far higher tax rates in the future, to finance the additional accumulated debt. The model I build to demonstrate and measure this bias in favour of deficits is an optimal growth model with overlapping dynasties, factor taxation and public debt, calibrated for the US economy.

In 1946, a year after the end of World War II, gross US federal debt reached 119.0% of GDP. For thirty-five years, the debt burden declined steadily, reaching only 31.0% in 1981. Since then, during the three decades that followed, the debt has more than tripled and has exceeded 100% since 2012. Publicly held, or net, debt has risen nearly as fast; from 24.6% of annual GDP in 1981, it reached 73.7% at the end of 2015.[1] All indications suggest the debt burden, by either measure, will continue to grow for the foreseeable future.

Each year, the US Congressional Budget Office produces two different estimates of future spending, revenue, and the predicted trajectory of US Federal Government publicly held debt for the decades to come. The first is the Extended Baseline Forecast, which is premised on four main assumptions: that the Federal Government will contain entitlement spending; that growth in non-entitlement spending will no longer keep pace with the growth in the economy as it has in the past; that temporary tax cuts which are set to expire will no longer be renewed

[1] Gross debt includes intergovernmental holding of debt, particularly in the Social Security Trust Fund, reflecting a portion of the unfunded liabilities of the Federal Government.

even if they have been renewed more than once in the past; and that future tax brackets will be automatically indexed to inflation, as they have been since 1985, but not adjusted to reflect real income growth in the economy. Though the population is aging and the bill for Medicare is driving total expenditure higher, the Extended Baseline Forecast for 2015 shows revenue growing as well (Figure 1), particularly because of its assumption of limited indexing. Meanwhile, Figure 2 shows publicly held debt as forecast in 2015, exceeding 100% of GDP by 2039, and 181% by 2090.

Along with the Extended Baseline Forecast, the CBO produces an Alternative Fiscal Scenario. Here the CBO assumes Medicare costs will rise much as they have in the past; that those temporary tax cuts which are typically renewed as a matter of course will again not be allowed to expire; and that other Federal spending will continue to grow at the same rate as the economy. Most important, it assumes that as incomes rise faster than prices, Congress will prevent so-called 'real bracket creep' from turning increasing numbers of people into high marginal rate tax payers. In this scenario, public debt grows along an explosive path. In 2010 the Alternative Fiscal Scenario had the debt burden reaching 233% of GDP by 2040, and 947% of GDP by 2084. In 2011, the CBO predicted the debt to GDP ratio would reach 195% by 2036, but declined to extrapolate any further, arguing that the economy could not sustain a debt burden any higher. By 2015 the predicted accumulation of debt in the Alternative Fiscal Scenario had slowed slightly, reaching 200% in 2047 and as debt service spirals higher, 250%—after 2054—the CBO's new threshold of unsustainability.

One way to distinguish between the two sets of predictions is that under the Extended Baseline Forecast, while tax revenue so far has proven inadequate to preclude the rise in debt over the previous thirty-five years, tax rates will rise in the near future in part to pay for entitlements and also to finance interest payments on the higher level of debt. Under the Alternative Fiscal Scenario, the rise in tax rates is postponed indefinitely. In either case, given the convex relationship between rates of taxation and the excess burdens they generate,

the current policy of maintaining relatively low taxation now, even as the liabilities that will necessitate far higher future taxes to finance them continue to mount, is a puzzle.

There is a wide-ranging literature exploring the many reasons why governments, even abstracting from distributional issues, might not adopt first or even second-best fiscal policies. If agents are indifferent to the next generation's welfare, they will of course support policies that shift the burden of funding government expenditure to the future. Even if agents are not indifferent to their childrens' welfare, but some are bequest-constrained, as in Cukierman and Meltzer (1989), a constituency in favour of deficit finance can emerge. Alternatively, political institutions may generate a whole host of external effects or principal-agent problems that yield suboptimal policies.[2]

Yet government budgets are not always in deficit. Why did the governments of advanced nations set about reducing the debt burdens incurred during World War II through a combination of primary surpluses, real growth, inflation and financial repression (Reinhart and Sbrancia, 2011) until sometime between the mid-1970's and the early 1980's? Buchanan and Wagner (1977) argued that the widespread adoption of Keynesian analysis provides intellectual cover for policy makers to indulge their inclination to spend but not to tax. An alternative explanation, popular with political commentators and journalists, combines intergenerational conflict and shifting cultural norms. According to this 'selfish generation' hypothesis, today's adults are less willing to sacrifice for the benefit of future generations, including their own children.[3] My explanation does not rely on intergenerational selfishness. Instead voters tolerate higher deficit spending only because they understand that their own children will not inherit the burden of it alone, but will share it with future immigrants.

During the 1970's, the rate of net migration to the United States averaged 1.9 per thousand. It rose to 2.8 during the 1980's, and then to 4.3 during the 1990's, before receding to 3.2 per

[2]See Persson and Svensson (1989), Tabellini and Alesina (1990), Rogoff (1990), Lizzeri (1999) and Battagliani and Coate (2008).

[3]See Brooks (2010), Howker and Malik (2010), Kotlikoff and Burns (2004) and Willetts (2010).

thousand. Net migration has been higher in the past, averaging 6.4 per thousand during the first decade of the twentieth century.[4] Yet the impact of immigration on the future composition of the population is a function not only of the rate at which new immigrants arrive, but also of the demographic characteristics of the society that absorbs them. Hence, the prevailing high birth rates between 1870 and 1910 meant that though the United States experienced rates of net migration that have never since been repeated, the share of the population that was foreign-born shrank over those four decades, from 14.4% to 13.3%.[5] A century later, the foreign-born share of the population rose from 4.7% in 1970 to 13.9% in 2015, and it is predicted to reach 17.7% by 2065.[6] By then the US population is projected to grow from 324 million to 441 million, with nearly the entire increase comprised of future immigrants or their descendants.

Others before have drawn a possible connection between growing intergenerational imbalances and immigration. Employing a generational accounting framework, Auerbach and Oreopoulos (1999) and Storesletten (2000) consider how immigration might ameliorate or exacerbate fiscal imbalances in the United States. Bonin *et al.* (2000) perform similar calculations for Germany, Storesletten (2004) for Sweden and Fehr *et al.* (2004) for the European Union, Japan and the United States. The best feature of these papers is the well-articulated age structures of the populations being modeled, something that the overlapping generations structure on which they are based easily accommodates. At the same time these models exclude intergenerational altruistic links. In essence everyone in an overlapping generations models begins life as an immigrant—the new born offspring of a native and newly arrived adult immigrants differ only in the shape and length of their earnings profile. Adopting Weil's (1989) overlapping dynasties approach, I assume that if members of one generation already resident in the country benefit from unfunded tax cuts, they can use bequests to share their gain with their descendents, and

[4]Calculations based on Gibson (1975) and United States Bureau of the Census (1975)

[5]Ruggles *et al.* (2015).

[6]Pew Research Center, 2015. "Modern Immigration Wave Brings 59 Million to U.S., Driving Population Growth and Change Through 2065: Views of Immigration's Impact on U.S. Society Mixed." Washington, D.C., p. 24.

also compensate them for both the higher tax burden and any additional dead weight losses that financing the additional debt might entail.

In Section 1, I present my model, which features a continuous inflow of infinite-lived optimizing agents. Government consumption, transfers, and debt service are financed by taxation on both capital and labor, as well as new bond issuance. In Section 2, I calibrate the model to match some of the main features of the US economy. In Section 3, I consider the simplest case, in which tax rates and government consumption as a share of output remains constant, similar to the experience of the United States during the last half century, but transfer payments increase, as they are expected to for the next several decades while public debt accumulates. The debt only stabilises when the tax on labour earnings is raised to service it. Here, in the absence of immigration, the intertemporal shifts in either the tax rate on wages or transfer payments is welfare neutral—i.e., Ricardian equivalence prevails.

Immigration alters these calculations. The anticipation that new people will join the economy in the future, and assume responsibility for financing a share of however much debt the government has accumulated in the interim, creates an incentive on the part of the initial population to postpone taxes for as long as possible. Indeed, this effect is expressed through the way higher public debt raises the rate of return on the economy's asset returns. Ben-Gad (2004), (2008) demonstrates how inflows of immigrants raise the rate of return for native-owned capital and generate immigration surpluses. Here, higher levels of debt amplify this effect.

In Section 4, I consider intertemporal shifts in the tax on asset income. First, any deviations from a policy that smooths a distortionary tax inflate its associated excess burden. Second, because the supply of capital is inelastic in the short run but infinitely elastic in the long run, immediate increases in tax rates can be welfare-improving, provided the subsequent surpluses are used to reduce public debt and facilitate lower rates of taxation in the future. The impact of immigration, even at very low levels, easily overwhelms both these effects. Policy makers focused on serving the interests of the people already resident in the country will balance the

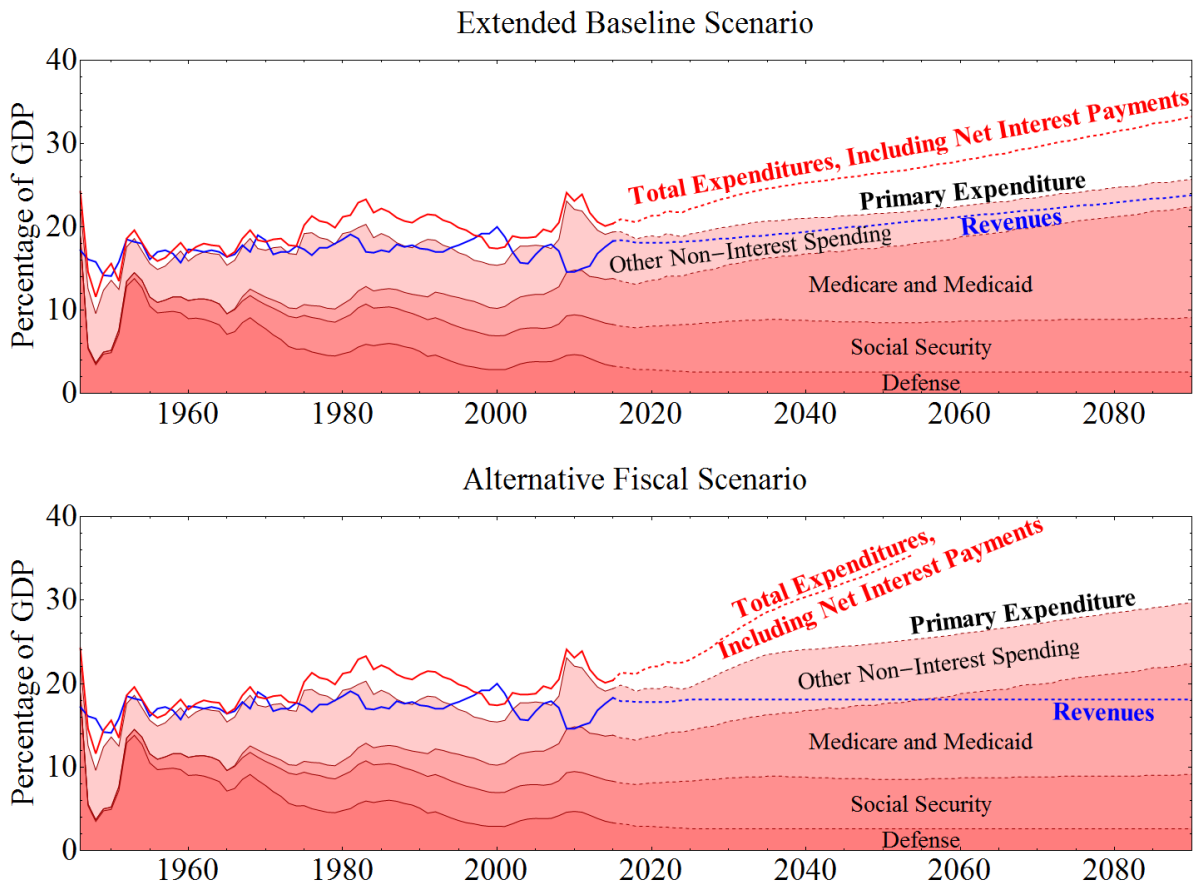

Figure 1: US federal budgets from 1946 to 2015 with forecasts using extended baseline and alternative fiscal scenarios generated by the Congressional Budget Office for 2016 to 2090.

desired shift in the tax burden towards future immigrants, against the efficiency losses generated by deviating from a policy of tax smoothing, or of forgoing the option to exploit the lump-sum nature of short-term capital taxation. These trade-offs mean that the scope for improving native welfare through this channel is more limited, though the optimal level of debt is still very high.

In Section 5, I consider the behaviour of the model when deficit finance is accompanied by a shift in the the tax burden between the two factors of production. First, cuts in the tax on labour or higher transfer payments generate prolonged deficits, but the government ultimately relies on higher taxes on asset income to achieve budget balance. I also consider the opposite—lower capital taxation is balanced by eventually higher taxes on wages. This not only shifts some of the tax burden from natives to immigrants, but generates for the former a secondary

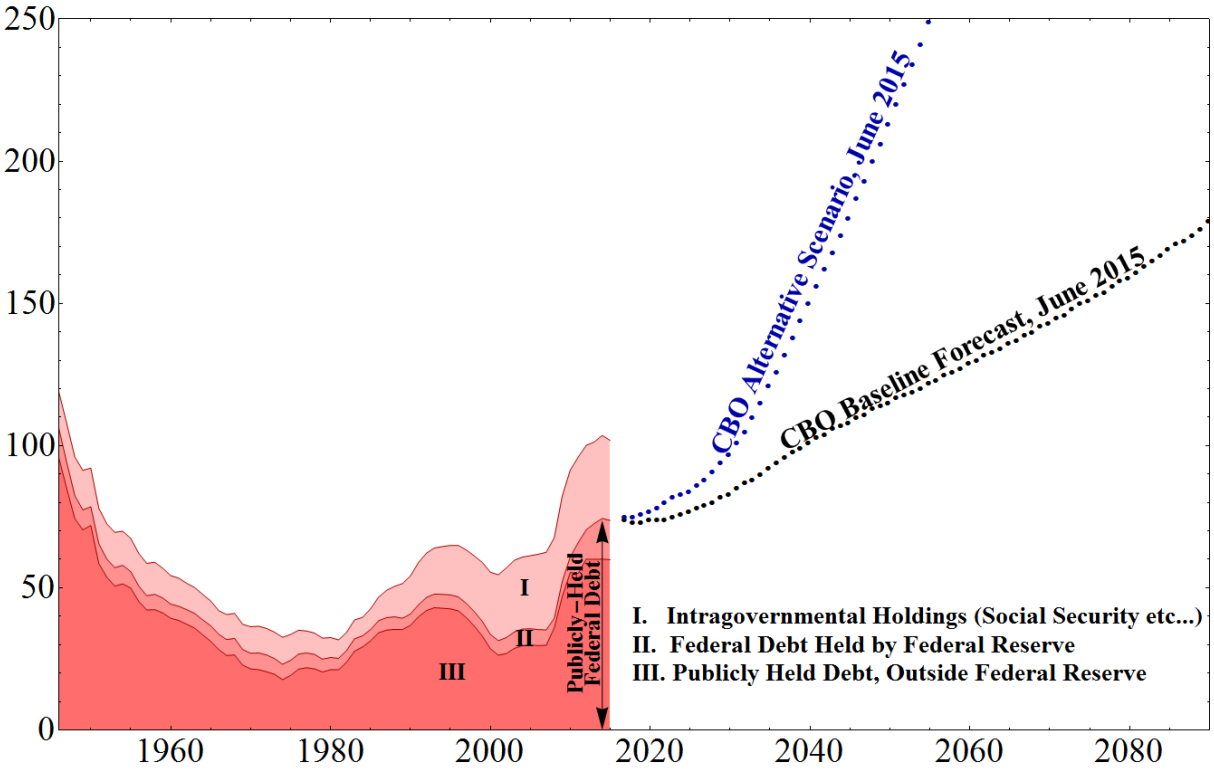

Figure 2: Breakdown of US gross federal debt from 1946 to 2015 (Office of Management and Budget) with forecasts using extended baseline and alternative fiscal scenarios for publicly held debt generated by the Congressional Budget Office for 2016 to 2090.

gain through the permanent reduction of a highly distortionary tax.[7]

1 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 $s \in \mathbb{R}$, the date at which the dynasties' founding members crossed the international frontier to instantaneously join the economy as workers, consumers, and savers. The economic environment is assumed to be deterministic, and the

[7] In the overlapping dynasty model presented below, the population absorbing new immigrants are themselves members of families that have accumulated through past immigration. I use the term natives to refer to all previous cohorts of immigrants and their descendants as distinct from new arrivals.

behaviour of each agent, including each new immigrant and all of his or her descendants, can be characterized as the maximization of a dynasty's 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:

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

and the transversality condition:

$$\lim_{t\to\infty} e^{-\int_s^t ((1-\tau_k(v))r(v)-n)dv} a(s,t) = 0\ \forall s,t \geq s, \tag{3}$$

where ρ is the subjective discount rate, n is the rate of natural population growth (the rate at which each dynasty itself is growing), $c(s,t)$, $q(s,t)$ and $a\,(s,t)$ are consumption, income received from government transfer payments, and holdings of assets for the members of dynasties of vintage s at time $t \geq s$, and $r(t)$ is the rate of return on assets at time t. The assets $a\,(s,t)$ for each household are the sum of holdings of physical capital $k(s,t)$ and government debt $b(s,t)$, and the returns on these assets are taxed at the rate of $\tau_k\,(t)$. Labour supply is inelastically supplied and normalised to one. It earns an economy-wide wage rate of $w(t)$ multiplied by $\phi\,(s,t)$ which represents the time t productivity of workers who are members of vintage s households. These earnings are taxed at the rate $\tau_h\,(t)$. Taxes as well as the proceeds from the sale of government debt, net of the payment of interest and principal, finance both the transfer payments and government consumption—the latter I assume to be a share $g(t)$ of domestic output, net of capital depreciation. The solution to the optimization problem yields the evolution of consumption for each individual dynasty s over time:

$$c\,(s,t) = c\,(s,s)\, e^{\rho(s-t)} e^{\int_s^t (1-\tau_k(v))r(v)dv}. \tag{4}$$

I assume that productivity is the product of two components, an economy wide trend growing at rate x, and a static term associated with the members of each dynasty of vintage s, so that

$\phi(s,t) = \xi(s)\, e^{xt}$. The economy-wide feasibility and government's budget constraints are

$$\dot{K}(t) = (1 - g(t)) \left(F\left(K(t), e^{xt}\Xi(t)\right) - \delta K(t)\right) - \delta K(t) - C(t) + P(t)\, m(t)\, k(t,t), \tag{5}$$

$$\dot{B}(t) = g(t) \left(F\left(K(t), e^{xt}\Xi(t)\right) - \delta K(t)\right) + Q(t) - \tau_h(t) w(t) e^{xt}\Xi(t)$$

$$-\tau_k(t) r(t) \left[K(t) + B(t)\right] + r(t) B(t) + P(t)\, m(t)\, b(t,t), \tag{6}$$

where $C(t) = e^{nt} \int_{-\infty}^{t} e^{\int_0^s m(v)dv} m(s)\, c(s,t) ds$ represents aggregate consumption, $B(t) = e^{nt} \int_{-\infty}^{t} e^{\int_0^s m(v)dv} m(s)\, b(s,t) ds$ publicly held government debt, $Q(t) = e^{nt} \int_{-\infty}^{t} e^{\int_0^s m(v)dv} m(s)\, q(s,t) ds$ aggregate transfer payments, $\Xi(t) = e^{nt} \int_{-\infty}^{t} e^{\int_0^s m(v)dv} m(s)\, \xi(s) ds$ a weighted aggregation of productivity across the different dynasties and $P(t) = e^{nt} \int_{-\infty}^{t} e^{\int_0^s m(v)dv} m(s)\, ds$ the size of the population. The function $F : \mathbb{R}^2_{++} \to \mathbb{R}_{++}$ is homogeneous of degree one, and describes how the inputs, aggregate capital $K(t) = e^{nt} \int_{-\infty}^{t} e^{\int_0^s m(v)dv} m(s)\, k(s,t) ds$, which depreciates at the rate δ, and aggregate effective labor $e^{xt}\Xi(t)$, produce a single good that is either consumed by households, or the government, or invested in the production of more capital. The terms $b(t,t)$ and $k(t,t)$ represent any assets, in the form of either bonds or capital, that new immigrants arriving at time t may import with them.

Assume transfer payments evolve over time according to $q(s,t) = \varrho(t)\, \xi(s)\, e^{xt}$ (transfer payments directly relate to the amount paid in contributions through the tax on labour earnings). Then, integrating the first order conditions of the individual maximization problem and the time t budget constraint over time, the consumption rule for dynasty s at time t is:

$$c(s,t) = \frac{\rho - n}{1 + \theta} \left(\xi(s)\, \omega(t) + a(s,t) \right) \quad \forall s, t \geq s, \tag{7}$$

where $\omega(t) = \int_t^{\infty} e^{xu - \int_t^u ((1-\tau_k(v))r(v) - n)dv} \left[(1 - \tau_h(u))\, w(u) + \varrho(u)\right] w(u) du$ is the component of households' present discounted value of net labor and transfer income from time t forward that is invariant to dynasty vintage.

Aggregating (7) over all dynasties that have arrived by time t, differentiating with respect to t, and substituting (5) and (6), aggregate consumption evolves according to:

$$\dot{C}(t) = [(1-\tau_k(t))\, r(t) - \rho + n]\, C(t) + \; m(t)\, P(t)\, \frac{C(t)}{\Xi(t)} \xi(t)$$
$$+ \frac{\rho - n}{1+\theta}\; P(t)\, m(t) \left[b(t,t) + k(t,t) - \frac{B(t)}{\Xi(t)} \xi(t) - \frac{K(t)}{\Xi(t)} \xi(t) \right]. \tag{8}$$

Rewriting (8), (5) and (6) in terms of stationary per-capita variables:

$$\dot{\tilde{c}}(t) = [(1-\tau_k(t))\, r(t) - \rho - x]\, \tilde{c}(t) - (\rho - n)\, m(t)\, \frac{P(t)\, \xi(t)}{\Xi(t)} \left(\beta(t)\, \tilde{b}(t) + \kappa(t)\, \tilde{k}(t) \right), \tag{9}$$

$$\dot{\tilde{k}}(t) = (1-g(t)) \left[F\left(\tilde{k}(t), 1 \right) - \delta \right] - (n+x)\, \tilde{k}(t) - \tilde{c}(t) - m(t)\, \frac{P(t)\, \xi(t)}{\Xi(t)} \kappa(t) \tilde{k}(t), \tag{10}$$

$$\begin{aligned} \dot{\tilde{b}}(t) \;\; &= \;\; g(t) \left[F\left(\tilde{k}(t), 1 \right) - \delta \tilde{k}(t) \right] + \tilde{q}(t) - \tau_h(t) w(t) - \tau_k(t) r(t) \tilde{k}(t) \\ &\quad + ((1-\tau_k(t))\, r(t) - n - x)\, \tilde{b}(t) - m(t)\, \frac{P(t)\, \xi(t)}{\Xi(t)} \beta(t)\, \tilde{b}(t), \end{aligned} \tag{11}$$

where $\tilde{c}(t) = \frac{C(t)}{e^{xt}\Xi(t)}$, $\tilde{k}(t) = \frac{K(t)}{e^{xt}\Xi(t)}$, $\tilde{b}(t) = \frac{B(t)}{e^{xt}\Xi(t)}$, $\tilde{q}(t) = \frac{Q(t)}{e^{xt}\Xi(t)}$, $\kappa(t) = \frac{k(t) - k(t,t)}{k(t)}$ is the fractional 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. Both input factors receive their marginal products:

$$r(t) = F_k \left(\tilde{k}(t), 1 \right) - \delta, \tag{12}$$

$$w(t) = F_\psi \left(\tilde{k}(t), 1 \right). \tag{13}$$

The present value of future government borrowing is limited by a transversality condition:

$$\lim_{t \to \infty} e^{-\int_0^t (1-\tau_k(v)) r(v) dv} B(t), \tag{14}$$

which implies that the time-discounted budget must remain balanced over the long run. In terms of per-capita stationary variables this is:

$$\tilde{b}(0) = \int_0^\infty e^{-\int_0^t (1-\tau_k(v)) r(v) dv} \left[\tau_h(t) w(t) + \tau_k(t) r(t) \tilde{k}(t) - g(t) \left[F\left(\tilde{k}(t), 1 \right) - \delta \tilde{k}(t) \right] \right] dt. \tag{15}$$

The system (9), (10) and (11), together with the government's long-run budget constraint (15), describes the behaviour of the economy, where the products of $m(t)$ with $\frac{P(t)\xi(t)}{\Xi(t)}$ and both

$\kappa(t)$ 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.

Finally, the production function takes the Cobb-Douglas form:

$$F\left(K(t), e^{xt}\Xi(t)\right) = K(t)^{\alpha}\left(e^{xt}\Xi(t)\right)^{1-\alpha}.$$

2 Calibrating the Model

Fifty years after its passage, the provisions of the Hart-Cellar Immigration Act of 1965 still form the basis of present US immigration policy. The act removed the country quotas first enacted in the Immigration Restriction Act of 1921, and made the category of family unification, first introduced in the McCarran-Walter Immigration Act of 1952, the main route for permanent settlement in the United States. Though it followed passage of the Civil Rights Act of 1964 and coincided with the largest expansion in the scope of the welfare state since the Great Depression, particularly the creation of the Medicare and Medicaid programmes, at the time Hart-Cellar was not perceived as a major shift in overall US policy. Indeed, if during the fourteen years from 1952 through 1965 annual net migration to the United States averaged 1.7 per thousand, during the subsequent fourteen-year period from 1966 through 1979 it was 2.0.

Beginning in 1980, immigration rose sharply, initially the result of a large increase in the number of refugees and asylum seekers from Cuba and Indochina, and passage of the Refugee Act that same year. Subsequent legislation, including the Immigration Reform and Control Act of 1986, provided an amnesty to three million undocumented aliens, and the Immigration Act of 1990 had the effect of increasing legal immigration by thirty-five percent.

Yet it is important to emphasise that it is not rising rates of immigration alone, but rather their juxtaposition against declining rates of natural population growth, as seen in Figure 3, that generates or reinforces a bias in favour of deficit finance. From its post-war maximum of just over 16.4 per thousand in 1947, the rate of natural increase had dropped to just under 5.5 by 1973,

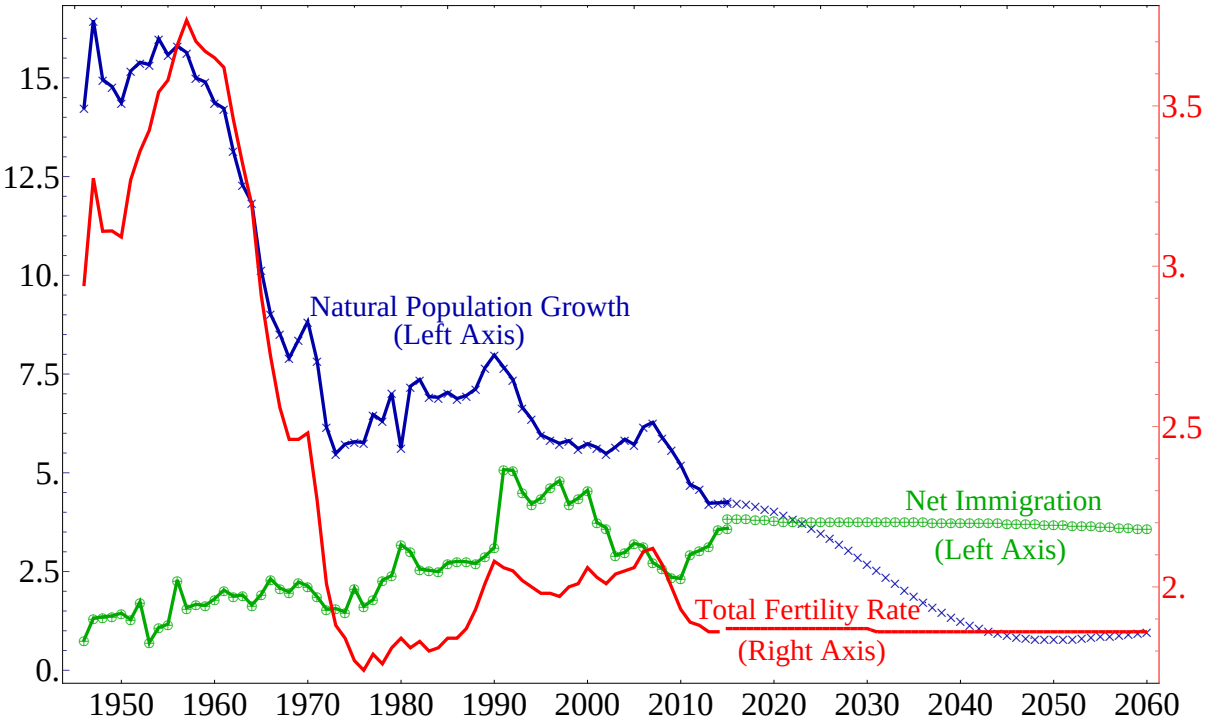

Figure 3: Left Axis: Annual rates of net immigration (marked by $\oplus$) and natural population growth (marked by $\times$) in the United States from 1946 to 2015 (connected by solid lines) and US Census projections for the components of change: 2016 to 2060. Right Axis: Total rate of fertility in the United States from 1947 to 2015 (marked by solid lines —) and US Census Projections for 2016 to 2060 (dashed lines ---). *Sources*: OECD and US Census.

and it is projected to continue to decline till the middle of the century. Immigration is already the direct source of nearly forty percent of US population growth, and it is projected to exceed fifty percent in 2023. Aside from the two year period during 2006 and 2007, since 1972 the total fertility rate in the United States has fallen below the replacement rate of 2.11 per thousand, and the projections prepared by the US Census suggest it will stabilise at 1.86 per thousand in 2031. Furthermore, these aggregate rates understate the full contribution immigration makes to long-run population growth and the future composition of the population, as they ignore the relative youth of new immigrants and abstract from differences in total fertility rates between them and their native counterparts. For example, new immigrants who arrived between 1965 and 2015 and their US-born descendants accounted for 55% of the 131 million additional people

added to the United States population during that period.[8] If, as predicted, over the next fifty years the population grows by only 117 million, but 88% of this growth is attributed to immigrants and their descendants, the equivalent rate of effective net migration will amount to 9.7 per thousand.[9] It is this rate, which reflects the impact of immigration on the future size and composition of the population, rather than the published annual rate of net migration, that is most relevant for determining what fiscal policy is most advantageous for the population already resident in the country.

It took time before the changes in immigration policy signified by passage of Hart-Cellar became apparent. The combined share of first and second generation immigrants declined in every census from 1910 at 34.7% to 16.5% in 1980. Only then does it begin to rise, reaching 25.8% in 2015 and according to projections will reach 36% by 2065.[10] Similarly, the passage of legislation that year which expanded the scope of welfare spending generated, along with changing demographics, a gradual rise in transfer payments over decades rather than one sharp increase. Indeed, the debt-to-GDP ratio continued its postwar decline before stabilising during the late 1970's. Furthermore, although the growing gap between expenditures on transfer payments and tax receipts on labour earnings is what largely drives projections of future exponential growth in the debt burden, until very recently, both rose in tandem. Instead, from the early 1980's onward, it is the decline in the tax rate on asset income that generated most of the increase in debt in Figure 2. Therefore, to calibrate the model, I use long-run averages for the years between 1966 and 2014, but to set the initial value of the tax rate on asset income, I average over the period between 1966 to 1980. As the aim of this work is to explain both the rise in public debt over recent decades, and its projected increase in the decades to come, I solve for steady state values that are consistent with the ratio of public debt to output during 1981, rather than taking an average across the entire period. Labour supply in the model is

[8] Pew Research Center, *op. cit.*, p. 24.

[9] *Ibid.* p.23.

[10] *Ibid.*

inelastic, so the value of transfers, net of tax receipts from labour earnings, serves as a residual, and is set to ensure that the government's budget is initially balanced.

I follow the procedure in Mendoza *et al.* (1994), Cooley and Prescott (1995) and Gomme and Rupert (2007) to calculate the tax rates on labour earnings (total compensation) and on the return to capital (which includes the implicit return on the stock of consumer durables), except the tax is imposed on returns net of depreciation. Output includes both gross domestic product and the imputed services from consumer durables, and between 1966 and 2014 was on average 8.06% higher than GDP alone. The growth rate of its per-capita value, x, averaged 0.018 per annum. The share of government consumption and investment g out of net output averaged 0.232. The share of capital income in output, α, including net interest payments, profits, and rental income, as well as the identical share of proprietors' income together averaged 0.377. In 1981, the stock of US public debt corresponded to 24.6% of GDP, which implies a debt-to-output ratio of 0.227, in terms of our more broadly defined output. Between 1966 and 1981 the imputed tax rates on asset income averaged 0.320. I fix the overall rate of population growth to its long-run average rate of 10.2 per thousand throughout, and vary the share of that growth generated by immigration. I assume κ=1 and β=1—immigrants arrive in the United States after having exhausted during their passage whatever assets they might have owned.

Finally, I assume the term $\xi(t)$ which captures the productivity of new immigrants of vintage t relative to the veteran population, evolves according to $\xi(t) = e^{-\int_0^t \gamma(v)dv}$. If both the rate of immigration $m\,(t)$ and the parameter $\gamma\,(v)$ are constant, the difference between the productivity of newly arrived immigrants and the average productivity of the current stock of workers is equal to $\gamma/\,(\gamma - m)$. To determine this value, I use the 5% public use micro samples for the years 1980, 1990 and 2000, and survey data from the American Community Survey for each of the years from 2001 to 2014, to estimate simple wage equations in semi-logarithmic form for people in the labour force between the ages of 16 and 64.[11] Controlling for age, and interpolating the

[11] Ruggles *et al.* (2015).

results for the years between 1980 and 1990 and then from 1990 to 2000, the imputed wage rate for newly arrived immigrants (five years or less in the United States) is on average 17.5% below that of all other workers. Rather than fixing the value of γ to one value, in each simulation, as the rate of net migration is varied, γ is set to match this finding.

3 Intertemporal Shifts in Labour Taxation and Transfers

I start with labour taxation and transfers because intertemporal shifts in either are the simplest to interpret. This is because transfer payments and tax revenue collected on labour earnings enter the model directly only through (11), and only affect the behaviour of the economy through the changes generated by the difference between them in the size of the public debt. In fact, only when the economy is absorbing new immigrants does the rate of tax on labour earnings, transfers or the size of the debt in (9) affect consumption, investment or the rate of return to capital.

Government spending on transfer payments has risen steadily for decades, tripling from 6.1% of GDP in 1966 to 18.3% in 2014. Yet only in recent years has the tax revenue collected on labour earnings failed to keep pace. Nonetheless, as the average age of the population continues to rise, it is the expectation that the gap between the two will continue to widen that drives projected future increases in debt in Figure 2. In all likelihood, any policy of fiscal consolidation designed to eventually stabilise the burden of debt will involve increases in the tax rate on wage income (through higher FICA contributions to stabilise the Social Security Trust Fund) rather than cuts to the overall amount spent on transfer programmes, so my analysis focuses on this scenario. However, unlike in the sections that follow, here this distinction is not economically meaningful.

In keeping with the time scales in Figures 1 and 2, I assume a very high degree of policy stickiness—the period between the initial rise in transfers until the moment of fiscal consolidations when taxes must rise to satisfy (15) lasts $T = 40$ years. This baseline case roughly matches

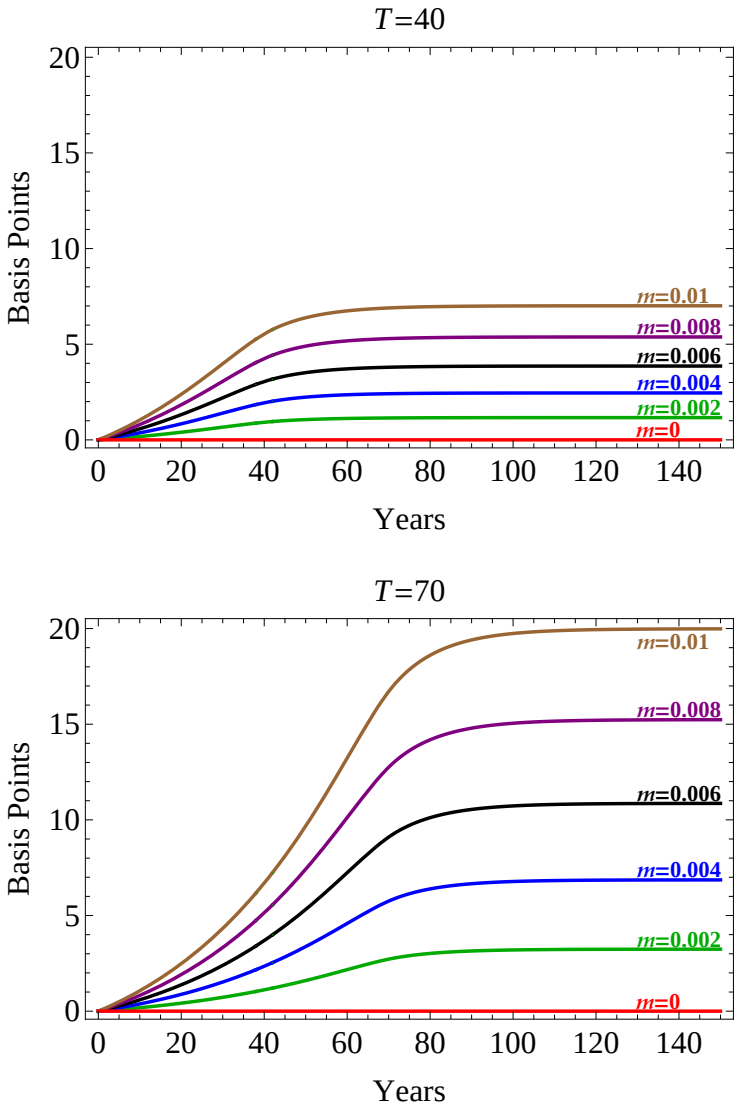

Figure 4: Impulse responses for the net rate of return, change in basis points, for different annual rates of immigration, after increasing transfer payments by 1.5% of output and then raising the tax rate on wage earnings in T=40 or 70 years.

a rise in transfer spending, net of labour tax receipts, that commence at the beginning of this decade, with debt accruing faster than the growth rate of the economy till around mid-century, when according to the Alternative Fiscal Scenario published by the CBO the debt will exceed what it deems to be the unsustainable level corresponding to 250% of output. I also consider larger values of $T = 55$ and $T = 70$, to enable ready comparisons with the policy of shifting the tax rate on capital income in Section 4—a policy that began in the early 1980's and was responsible for most of the increase in the debt so far.

To offer but one example, suppose spending on transfers in (11) permanently increases by the equivalent of one and a half percent of initial output. The payments accrue to the population already resident at the moment the policy changes, but in subsequent years, as new immigrants arrive, they too receive these payments, which increase at a fixed rate to keep pace with the growing population and the economy's exogenous long-run growth rate. The more time elapses before the tax on wages is raised to stabilise the debt, the more debt accumulates and the larger the corresponding tax increase necessary to exactly satisfy the transversality condition (3) and the government's intertemporal budget constraint (15). That means that after the fiscal consolidation in period T, the new long-run tax rate on wages is adjusted permanently to continue funding the higher transfer payments as well as the fixed share of government expenditure in net output, and to service both the stock of pre-existing public debt and any additional public debt that has accumulated in the interim.

For each value of T and rate of immigration m, the third column in Table 1 lists the changes to the debt burden by period T.[12] After $T = 40$ years, the additional accumulated debt is equivalent to 103.2% of output if the rate of immigration is zero, but climbs in small increments as the rate of immigration is increased to 105.3% if the rate of immigration is ten per thousand. The fourth column captures the small changes to the long-run debt burden, if any, that occur after T as the capital stock and output converge. The stabilisation of the debt burden is accomplished by raising the rate of tax on labour from its initial value of 0.242 from T onwards, and the new tax rates that accompany fiscal consolidation are listed in the fifth column and range from 0.306 to 0.31. If we raise the value of T to 55 years, so that the increase in transfer payments either commences fifteen years earlier or fiscal consolidation is postponed by an additional fifteen years, the economy accumulates additional long-run debt that range between 177.6% and 182.5% of output, and the corresponding labour tax rates necessary to

[12] To capture the non-linearities of the transition paths, I assemble Padé approximants of order (2,1) using first, second and third order perturbations of the dynamic system (9), (10) and (11) to generate all impulse responses.

service it ranges between 0.337 and 0.343. Increase the value of T to 70 and the corresponding increments to the debt burden and long-run tax rates range between 285.9% and 299.6%, and 0.381 and 0.395, respectively.

A country that receives no new immigrants is very different from one absorbing them at the rate of one percent per year. Yet those differences are hardly manifested in the behaviour of additional accumulation of debt or new tax rates presented above. Certainly in this example, it cannot be said that the flow of immigrants serves to dilute public debt. Yet though differences in rates of immigration barely alter the path of debt or subsequant tax rates on labour earnings, it is the rate of immigration that determines the impact upon the welfare of the population already resident in the country of a policy to permanently increase transfer payments for all, while resorting to deficit finance over a prolonged period to pay for them.

To demonstrate, I plot the impulse responses in Figure 4 for the rate of return on assets following the increase in transfer spending for both $T = 40$ and $T = 70$. Note how in each example the magnitude of the response directly relates to the rate of immigration. To see why, note that the last term in (9), $\kappa(t)\,\tilde{k}(t)$ where $\kappa(t) > 0$, multiplied by the rate of immigration $m(t)$ and corrected by the term that governs the relative productivity of new immigrants $\frac{P(t)\xi(t)}{\Xi(t)}$, captures the dynamic form of the immigration surplus—a measure of how the supply of labour provided by immigrant workers complements the stock of native-owned capital and raises its rate of return. For our baseline case, where $T = 40$, each unit increment in the underlying rate of immigration, from zero to ten per thousand, corresponds to between one and a half and two basis points in the long-run response of the rate of return on assets that follows the increase in spending of one and a half percent of output. These higher rates of return boost the growth rate of each household's consumption in (4). This effect might seem small, but it is cumulative, and generates a large enough wealth effect, that upon impact, consumption in the sixth (penultimate) column of Table 1 increases despite the anticipated rise in interest rates.

This does not mean that the boost to the immigration surplus is a Pareto improving shift

	New Immigrants Per Thousand	Δ Debt as Percent of Output at T : $100\times\Delta\frac{b(T)}{y(T)}$	Δ Debt as Percent of Output Long-Run $100\times\Delta\frac{b(\infty)}{y(\infty)}$	Labour Tax Rate after T $\tau_h(t>T)$	Initial Change in Native Consumption $100\times\left(\frac{c(0,0)}{\bar{c}(0,0)}-1\right)$	Welfare as Percent of Permanent Consumption $p_{m,T}$
$T=40$	0	103.2	103.2	0.306	0	0
	2	103.6	103.5	0.308	0.010	0.166
	4	104.0	103.8	0.308	0.021	0.322
	6	104.4	104.1	0.309	0.033	0.470
	8	104.9	104.4	0.309	0.046	0.611
	10	105.3	104.7	0.310	0.060	0.744
$T=55$	0	177.6	177.6	0.337	0	0
	2	178.8	178.4	0.338	0.013	0.226
	4	180.2	179.4	0.339	0.022	0.435
	6	181.7	180.3	0.340	0.034	0.629
	8	183.3	181.4	0.342	0.047	0.810
	10	184.9	182.5	0.343	0.061	0.979
$T=70$	0	285.9	285.9	0.381	0	0
	2	289.5	288.2	0.383	0.013	0.284
	4	293.4	290.7	0.386	0.022	0.544
	6	297.8	293.5	0.388	0.034	0.781
	8	302.5	296.4	0.391	0.047	0.998
	10	307.6	299.6	0.395	0.061	1.197

Table 1: Increasing transfer payments by 1.5% of output and then raising tax rate on wage earnings in T=40, 55 or 70 years.

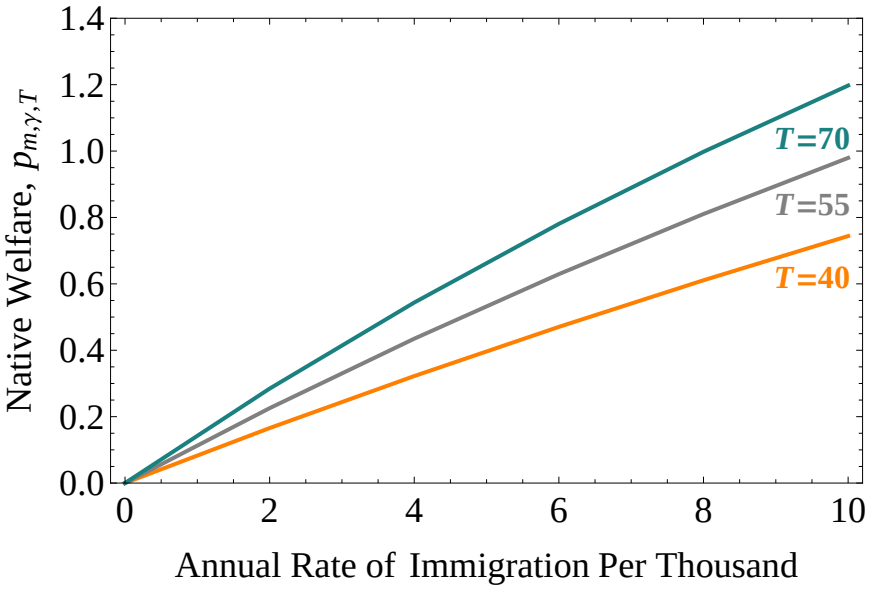

Figure 5: The values of the welfare measure for native households $p_{m,T}$ that correspond to different rates of immigration after increasing transfer payments by 1.5% of output and then raising tax rate on wage earnings in T=40, 55 or 70 years.

towards dynamic efficiency. The rate of return to capital is always higher than the growth rate of the economy. Instead, new immigrants pay higher taxes on their earnings to service the debt accumulated before they arrived. As public debt gradually crowds out some investment in physical capital, so pre-tax wages, upon which immigrants who arrive with few assets disproportionately rely, also decline.

By maximising the welfare of those resident at time t=0, I mean maximising the intertemporal utility of the infinite-lived dynasties. It must be emphasized that this is not a mechanism for intergenerational redistribution or conflict. Policy makers are implicitly concerned not only with the welfare of today's population but with the welfare of all of its descendants. The only people whose interests I assume are ignored are those of the future immigrants yet to arrive in the country at the time when the policy is determined, as well as their descendents.[13]

[13]Even if the policy were re-evaluated in each period, and immigration were the sole source of all population growth, it would take more than seventy years for the accumulated stock of new immigrants who arrive after t=0 to form a majority. Hence policies that serve the interests of the entire population when they are introduced, though not strictly time consistent because of the presence of capital in the economy, do benefit the majority of

To measure the welfare implications of these policies I compare the discounted welfare generated by the evolution of $c(0,t)$, the per-capita consumption of anyone already resident in the country at time t=0, against the discounted welfare generated by the analogous counterfactual consumption path $\overline{c}(0,t)$, were the initial policy of budget balance to remain in force:

$$\int_0^{\infty} e^{(n-\rho)t} \ln c\,(0,t)\,dt = \int_0^{\infty} e^{(n-\rho)t} \ln \left[\left(1+\frac{p_{m,T}}{100}\right)\overline{c}(0,t)\right] dt. \tag{16}$$

The difference between the two, the welfare effect, is measured as a compensating differential—a permanent percentage $p_{m,\gamma,T}$ of consumption sufficient to compensate native households for not deviating from the baseline fiscal policy. Inserting (4) into (16) and solving for $p_{m,T}$ yields:

$$p_{m,T} = 100 \times \left(\frac{c\,(0,0)}{\overline{c}\,(0,0)} e^{(\rho-n)\int_0^{\infty}\int_0^t e^{(n-\rho)t}((1-\tau_k(v))r(v))dvdt - \frac{(1-\bar{\tau}_k)\bar{r}}{\rho-n}} - 1\right). \tag{17}$$

The values of $p_{m,\gamma,T}$ that correspond to the policy of increased spending on transfers are listed in the last column of Table 1, and it is here where beyond the direct impact on native welfare of receiving higher transfer payments partly funded by taxes paid by future immigrants, the changes to the rate of return to capital associated with different rates of immigration also find their expression. For the case where the debt is stabilised after forty years, the benefit that accrues to the native population is equivalent to a permanent increase in consumption of 0.166% if the rate of immigration is two per thousand. Double the rate of immigration to four per thousand and the benefit nearly doubles as well to 0.322%. Figure 5 illustrates the near linear relationship between the rate of immigration and the value of $p_{m,T}$ associated with this particular policy. Increase the time span between the rise in expenditures and the rise in the taxes to pay for them by fifteen or thirty years, and the corresponding welfare benefit climbs to 0.226% and 0.435% or 0.284% and 0.544%. If as explained in Section 2, the rates of immigration that best capture the contribution of immigration to population growth are between eight and ten per thousand, then the welfare benefits natives enjoy approach the equivalent of permanently raising consumption by one percent.

the population for far longer than the highest value of T in my simulations.

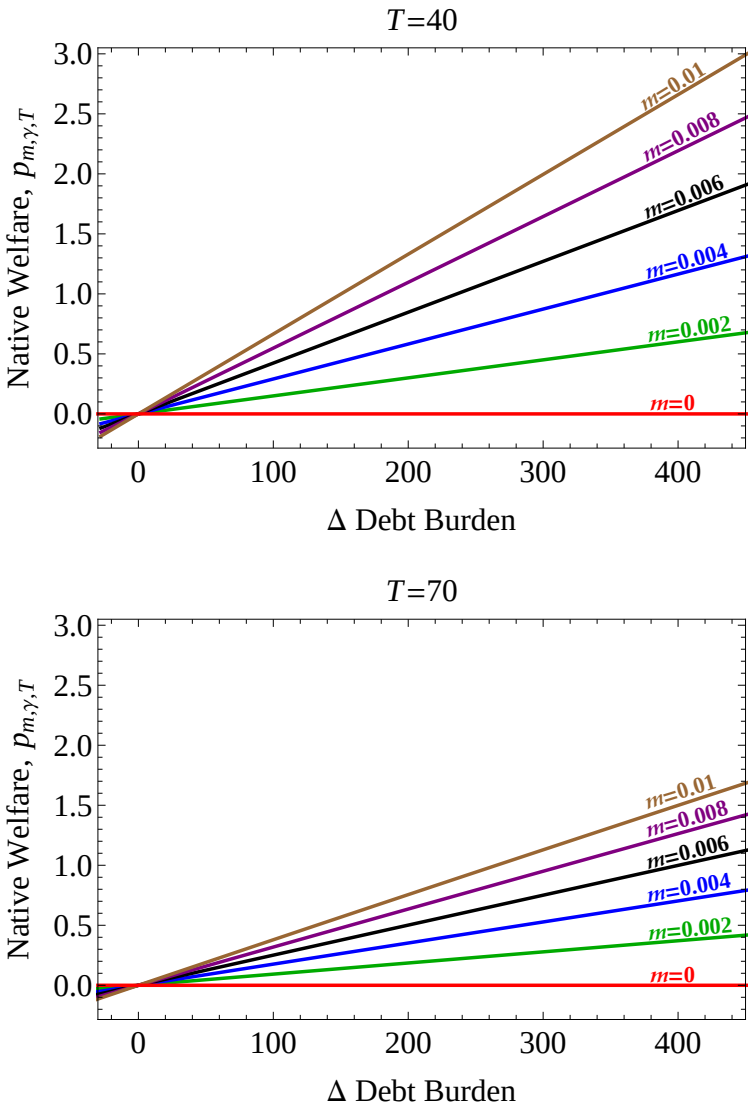

Figure 6: The values of the welfare measure for native households $p_{m,T}$ and the long-term debt burden generated by increasing transfer payments and then raising the tax rate on wage earnings in T=40 or 70 years, for different annual rates of immigration per thousand.

To achieve welfare gains significantly higher requires a far more aggressive degree of deficit spending. This is certainly a theoretical possibility—the curves, corresponding to annual rates of immigration of zero, two, four, six eight and ten per thousand, in both panels in Figure 6 illustrate that for a given value of T and rate of migration m, there is a nearly linear relationship between changes to the long-run debt burden and the corresponding welfare measure $p_{m,\gamma,T}$. The curves labeled m=0 are horizontal lines, as shifting transfers and labour taxes across time if the economy is not absorbing new immigrants is Ricardian neutral, but the slopes of the

remaining curves are positive and increasing in the rate of immigration. A permanent increase in transfer payments that causes the debt burden to climb by 195% of output in the space of seventy years, a trajectory that matches the predictions of the CBO's Alternative Fiscal Scenario, corresponds to a welfare gain equivalent to a 0.6% increase in consumption if the effective rate of immigration is eight per thousand, and 0.7% if the rate of immigration is ten. Assume the debt reaches 500% instead (setting aside the practical limitations of sustaining a debt of this magnitude), and the corresponding welfare measures are 1.5% and 1.8%. Note also that between 2007 and 2014, the gap between the wages of newly arrived immigrants and all other workers contracted from 23.2% to only 10.1%. Native workers would stand to benefit more if this improvement in the relative productivity of immigrant workers continues. Were there no productivity gap between new immigrants and native workers, the welfare measures associated with the debt burden rising 195% in seventy years are 0.7% and 0.9%, again for rates of migration equivalent to eight or ten per thousand. Finally, the longer a given tax cut prevails, the more natives benefit, but the larger the number of immigrant cohorts that arrive immediately after who also share some of the gains. This is why, as Figure 6 illustrates, natives benefit most from steeper tax cuts over shorter time spans. For a given long-run debt burden, the smaller the value of T, the higher values of $p_{m,T}$. We are left with a puzzle—from the perspective of the native population, the scope for increasing transfer payments and using deficit finance to enhance their own welfare is underutilised. There appear to be constraints on the accumulation of debt beyond the scope of the model.

4 Intertemporal Shifts in the Tax on Asset Income

In an optimal growth model, the long-run supply of capital is infinitely elastic, so fluctuations in the tax on income from capital have the greatest potential to increase excess burden. Nonetheless, when the economy is absorbing new immigrants the gains that accrue to the native population from shifting these taxes to the future will usually dominate the deadweight loss.

Consider the effect of lowering the tax rate on asset income from 0.32 (chosen to match the average rate that prevailed between 1966 and 1980) to 0.27 (the average rate from 1981 till 2014), for T=40, 55 or 70 years. This is equivalent to assuming that a policy of fiscal consolidation to stabilise the government budget will commence either at the end of this decade in 2020, fifteen years later in 2035, or mid-century in 2050, when again, according to the Alternative Fiscal Scenario published by the CBO, the debt will approach what it deems to be the unsustainable level corresponding to 250% of output.

Comparing the third and fourth columns in Tables 1 and 2, this policy generates changes in the debt burden that are roughly comparable to those associated with an increase in transfer spending of one and a half percent of output analysed in Section 3, particularly for higher values of T. However, there is an important difference: unlike the case of intertemporal shifts in transfers and wage taxation, here the rate of return on capital is not only gradually and indirectly affected by the accumulation of debt through (11), but immediately and directly through (9). Hence the impulse responses in Figure 4 describing the behaviour of the net rate of return on assets bear little resemblance to those in Figure 7. The after-tax rate of return rises by approximately 39 to 40 basis points on impact. From this moment it begins to decline, the effect of the lower tax rate on savings and the accumulation of physical capital initially dominating any crowding out from the growing burden of public debt, before reversing direction again and increasing as the date T draws closer, and agents reduce investment in new capital in anticipation of the higher taxes they will soon pay. Though difficult to discern given the scale of the shifts in the impulse responses over time, comparing any two, the one that corresponds to a higher rate of immigration dominates its counterpart at every point in time. Ultimately, in the very long run, after all the fluctuations, if the rate of immigration is positive, higher debt translates into permanently higher rates of return, even after accounting for the higher taxes paid on it (listed in the sixth column of Table 2), but only after a period of transition that lasts for decades long after T. In the initial response to this type of policy, in

contrast to cuts in labour taxes or increases in transfer payments, here the substitution effect dominates any income effect—natives immediately lower consumption by 3.052 to 3.307% to take advantage of the higher rates of return.

Using the formula (17) to compute welfare, in the absence of immigration, there would be no justification visible in the last column of Table 2 for the policy adopted in the early 1980's of lowering the rate of taxation on asset income, if in fact it is only to be raised sometime in the future. As the debt burden increases by 96.9%, 174.6% or 302.1% of output over the course of T=40, 55 or 70 years, the losses in welfare correspond to permanent drops of -0.187%, -0.313% or -0.523% in permanent consumption. Indeed, this particulary policy only generates positive values of $p_{m,T}$ in Figure 8 if the effective rate of immigration is higher than two to three per thousand. The distortionary effect of allowing this tax to fluctuate so much overwhelms the benefits of sharing the higher future tax burden with immigrants.

To illustrate this trade-off, I plot the values of $p_{m,T}$ in Figure 9 that correspond to different changes in the debt burden.[14] Unlike shifting the tax burden on labour earnings in Figure 6, here the relationship is no longer monotonic. Instead, for each length of time T and rate of immigration m, the value of $p_{m,T}$ increases the larger the long-term debt burden, but only to a point, after which the values decline and some eventually become negative. For the native population, temporary tax cuts are generally beneficial but only to a point. Table 3 lists the long-term change in the debt burden and welfare effects that correspond to the maximum compensating differentials $p^*_{m,T}$ for each curve in Figure 9 along with the change in debt at time T, the tax rates on capital that prevail both between time zero and T and after T, and the initial change in consumption chosen by natives on impact.

[14]The endogeneity of capital supply means there is a Laffer curve that determines the amount of revenue the government can raise through higher taxes on capital income, and this in turn implies an upper limit on the amount of debt the government can accumulate by shifting this tax rate alone across time. This means future tax rates can be set no higher than 0.79, a range sufficient to service maximum debts of between 576% (when immigration is ten per thousand) and 609% of output.

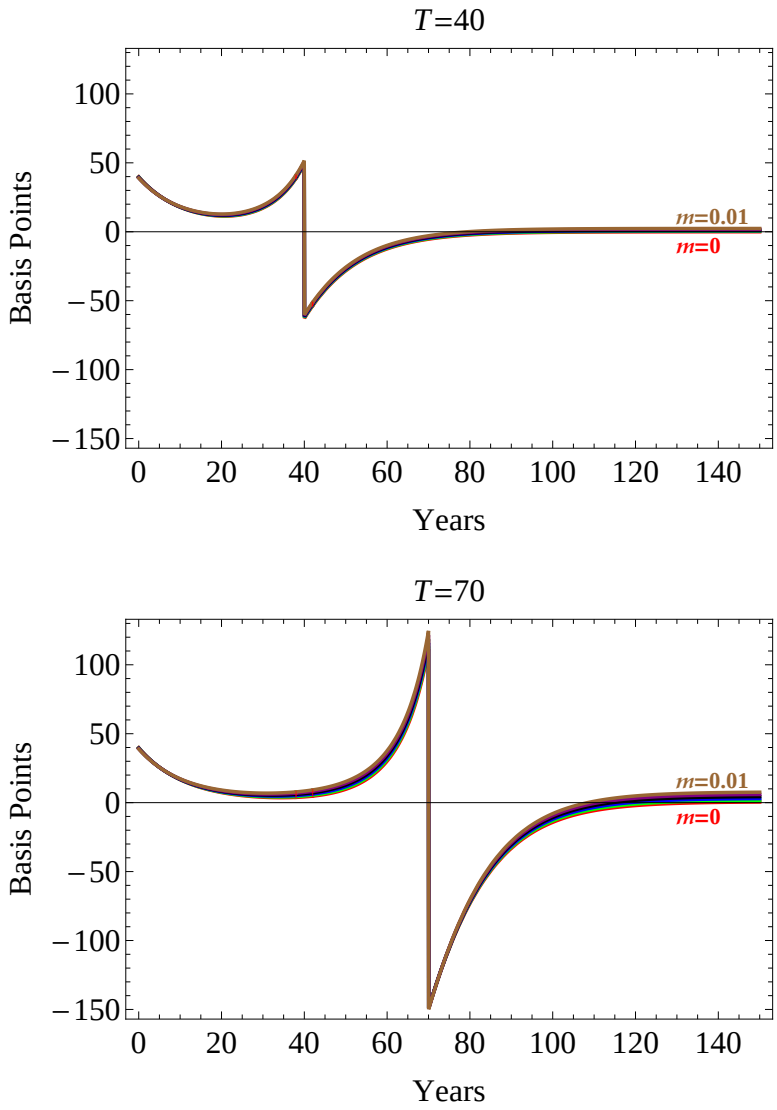

Figure 7: Impulse responses for the net rate of return, change in basis points, for different annual rates of immigration, after temporarily lowering the tax rate on asset income from 0.32 to 0.27, for T=40 or 70 years.

Once again the shapes of the curves labeled m=0, this time in Figure 9, tells us what would be the optimal policy if the economy were not absorbing any immigrants at all. The logic of Harberger's triangle nearly prevails—as in Lucas and Stokey (1983), in their model without capital, the convexity of the excess burden with respect to the tax rate implies the best policy is to smooth the tax rate over time, and not depart from steady state. However, there are two reasons why slight deviations from tax smoothing generate small welfare benefits here. First, the short-run supply of capital is inelastic, so the lump-sum property of taxing it immediately at a

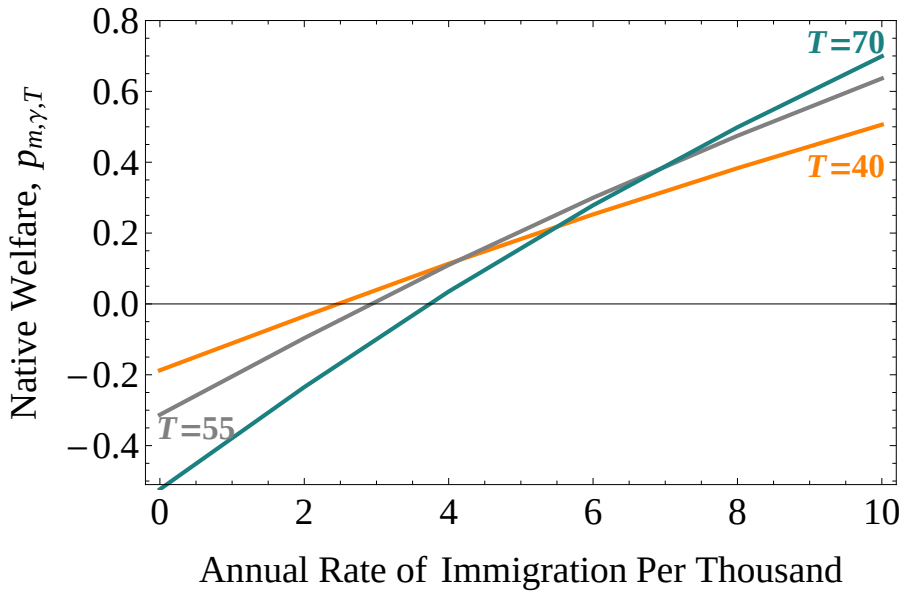

Figure 8: The values of the welfare measure for native households $p_{m,T}$ that correspond to different rates of immigration after temporarily lowering the tax rate on asset income from 0.32 to 0.27 and then raising it after T=40, 55 or 70 years.

higher rate is beneficial, particularly if the additional revenue is applied to a partial redemption of public debt, enabling lower taxes in the future.[15] Second, the model is not calibrated around the Ramsey second-best optimal policy—the tax rate on capital is higher than the share of government expenditure in output.[16] Raising the tax rate from period zero to T means that in the long run the economy will converge closer to a steady state that is Ramsey-optimal. These two reasons are why, in the absence of immigration, a policy that raises the tax on asset income in the short run to redeem part of the debt generates a very small welfare benefit.

As in Section 3, here too the lower the value of T, the smaller the number of immigrants who experience the period of lower taxation, which is why *ceteris paribus*, the quick accumulation of extra debt through steep cuts in labour taxation dominates a more gradual policy of longer duration. Here, however, there is a countervailing tax smoothing argument in favour of

[15] This is a direct implication of *Theorem* 3 in Chamley (1986).

[16] Because government expenditure in not a fixed amount but a fraction g of net output, the second-best long-run optimal policy is not the familiar Chamley-Judd result of eliminating the tax on income from capital and placing the burden of government finance on labor, but rather to set all taxes equal to g. See Ben-Gad (2014).

accumulating debt more gradually, through smaller tax cuts of longer duration. That is why for a given change in the long-run burden of debt, the value of $p_{m,T}$ in Figure 9 is much less sensitive to different values of T than it is in Figure 6.

Note also that the vertical scale for the panels in Figure 6 is about three times higher than in Figure 9, so overall there is far less scope for using deficit finance for the benefit of native households when policy makers are constrained to shifting the tax rate on asset income rather than labour earnings across time. If the rate of immigration is only two per thousand, and the fiscal gap is closed in T=40 years, then cutting the tax rate on capital income from 0.32 to 0.302 maximises the welfare of the native population. The debt burden increases by 31.7% of output to 54.4% from its initial value 22.7% of output once the economy has fully converged to its new balanced growth path. The welfare benefit is small, equivalent to permanently increasing consumption by only 0.009%. If the rate of immigration doubles to four instead of two per thousand, the maximum welfare benefit rises to 0.15%, which is attained by first lowering the tax rate to 0.271. If the rate of immigration is doubled once more to eight per thousand, then the value of $p^*_{m,T}$ climbs to 0.536%. Higher values of T mean the long-run debt rises more even though tax rates fluctuate less, but the magnitudes of $p^*_{m,T}$ do not change much.

Table 3 describes the particular intertemporal shifts in the burden of capital taxation that maximise the welfare of the native population across different values of m and T. The closest match between the tax policy of cutting the tax rate from 0.320 to 0.27, chosen as roughly analogous to one element of recent US fiscal history, and the welfare maximising policies described in Table 3, occurs when the rate of immigration is eight per thousand and fiscal consolidation is postponed till $T = 70$. To further illustrate this point, in Figure 10, I plot the behaviour of the debt burden, measured in terms of GDP (rather than output, which here includes services from consumption goods), that corresponds to each of the maximising policies in Table 3 for the case where T=70, against both the historical record and its predicted path according to the Alternative Fiscal Scenario produced by the CBO.

	New Immigrants Per Thousand	Δ Debt as Percent of Output at T : $100\times\Delta\frac{b(T)}{y(T)}$	Δ Debt as Percent of Output Long-Run $100\times\Delta\frac{b(\infty)}{y(\infty)}$	Capital Tax Rate after T $\tau_k(t>T)$	Initial Change in Native Consumption $100\times\left(\frac{c(0,0)}{\bar{c}(0,0)}-1\right)$	Welfare as Percent of Permanent Consumption $p_{m,T}$
$T=40$	0	96.9	90.9	0.408	−3.226	−0.187
	2	96.7	90.8	0.409	−3.195	−0.035
	4	96.6	90.6	0.409	−3.161	0.114
	6	96.5	90.5	0.410	−3.126	0.253
	8	96.4	90.4	0.410	−3.089	0.383
	10	96.3	90.3	0.411	−3.052	0.506
$T=55$	0	174.6	160.6	0.471	−3.290	−0.313
	2	174.9	160.7	0.472	−3.258	−0.097
	4	175.2	160.9	0.473	−3.223	0.110
	6	175.7	161.1	0.474	−3.186	0.300
	8	176.2	161.3	0.476	−3.148	0.475
	10	176.8	161.6	0.477	−3.108	0.636
$T=70$	0	302.1	272.1	0.561	−3.307	−0.523
	2	304.2	273.4	0.564	−3.274	−0.235
	4	306.7	274.9	0.567	−3.239	0.035
	6	309.5	276.7	0.570	−3.201	0.278
	8	312.5	278.7	0.573	−3.162	0.499
	10	315.9	280.8	0.577	−3.123	0.699

Table 2: The impact of temporarily lowering the tax rate on asset income by 5%.

	New Immigrants Per Thousand	Δ Debt as Percent of Output at T : $100\times\Delta\frac{b(T)}{y(T)}$	Δ Debt as Percent of Output Long-Run $100\times\Delta\frac{b(\infty)}{y(\infty)}$	Capital Tax Rate before T $\tau_k(t<T)$	Capital Tax Rate after T $\tau_k(t>T)$	Initial Change in Native Consumption $100\times\left(\frac{c(0,0)}{\tilde{c}(0,0)}-1\right)$	Welfare as Percent of Permanent Consumption $p_{m,T}$
$T=40$	0	−23.8	−24.1	0.334	0.295	0.929	0.009
	2	32.6	31.7	0.302	0.352	−1.166	0.015
	4	94.5	88.7	0.271	0.402	−3.099	0.114
	6	157.1	143.3	0.243	0.458	−4.757	0.292
	8	221.7	197.6	0.217	0.507	−6.217	0.536
	10	281.8	247.4	0.195	0.550	−7.380	0.833
$T=55$	0	−20.5	−20.7	0.327	0.299	0.472	0.005
	2	50.3	48.8	0.304	0.369	−1.058	0.022
	4	124.4	116.4	0.283	0.433	−2.398	0.127
	6	200.7	182.5	0.264	0.493	−3.559	0.304
	8	278.1	247.5	0.247	0.549	−4.550	0.536
	10	360.8	316.9	0.231	0.604	−5.440	0.812
$T=70$	0	−18.9	−19.0	0.324	0.301	0.270	0.002
	2	66.4	64.1	0.307	0.383	−0.864	0.025
	4	154.1	143.6	0.292	0.458	−1.830	0.128
	6	249.4	225.6	0.278	0.529	−2.698	0.292
	8	345.0	306.3	0.266	0.594	−3.410	0.502
	10	457.1	404.3	0.254	0.663	−4.093	0.747

Table 3: Temporarily lowering the tax rate on asset income to maximise welfare.

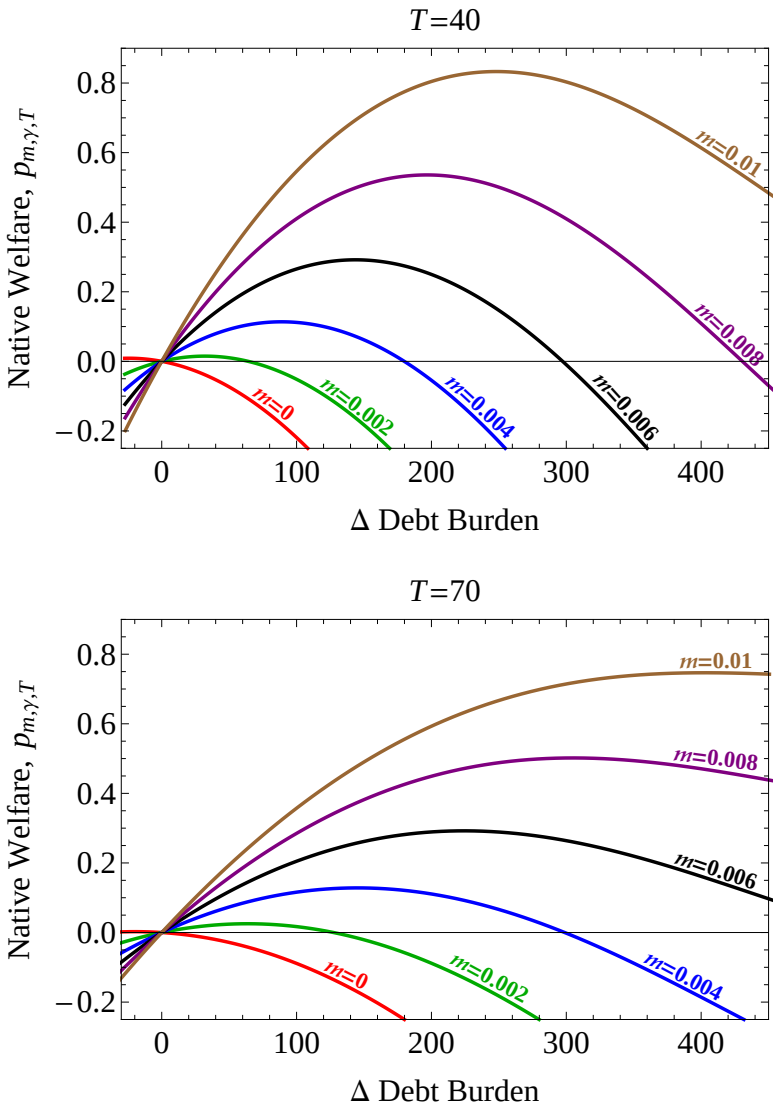

Figure 9: The values of the welfare measure for native households $p_{m,T}$ and the long-term debt burden generated by temporarily lowering the tax rate on asset income for T=40 or 70 years, for different annual rates of immigration.

Of course there is no reason to assume that if at a given moment policy makers choose to lower a particular tax, it is this same tax that decades later will be adjusted to ultimately stabilise the government's finances. In the next section, I analyse the degree to which the qualitative and quantitative results here and in Section 3 might be altered when the government switches between the two tax instruments.

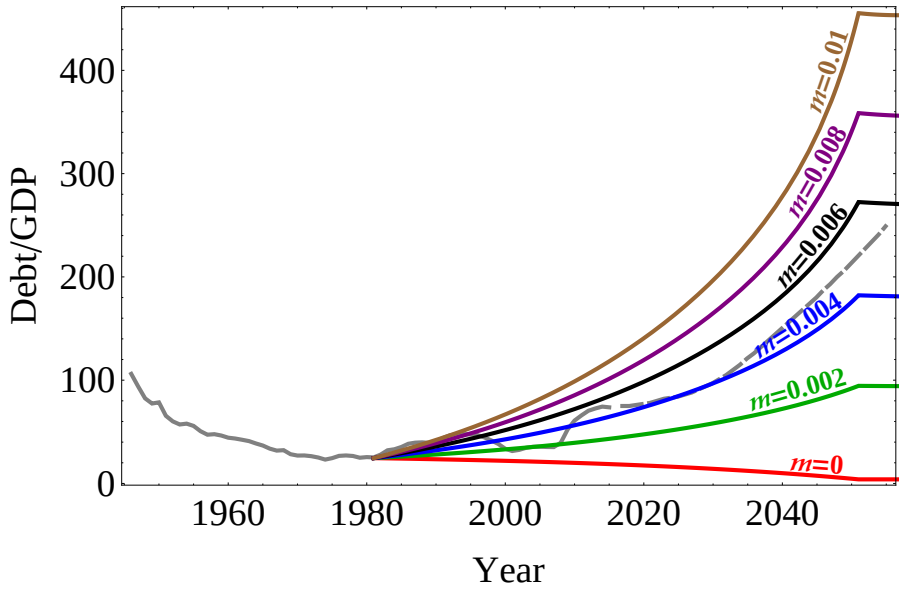

Figure 10: The trajectory of the ratio of bonds to GDP values generated by temporarily lowering the tax rate on asset income for T=70 years for different annual rates of immigration. In the background in grey is the ratio of publicly-held debt to GDP from 1946 to 2015, and the CBO's Alternative Fiscal Scenario from 2016 to 2054.

5 Shifting Taxes Between Labour and Asset Income

Just as in Figure 6, the panels in Figure 11 represent the relationship between changes in the long-run debt burden following a sustained period when spending on transfer payments changes. The only difference is that now, rather than shifting the tax on labour earnings after T to satisfy (15), at time T = 40, 55, or 70 it is the tax rate on capital that changes. Given the way I calibrated the model, setting κ=1 and β=1, the incidence of the tax on asset income falls most heavily on natives and the tax on labour earnings on new immigrants, so any shift in the burden from labour to capital clearly does not favour the interests of the native population. Furthermore, the shift to higher capital taxation in the future entails an increase in the excess burden borne by everyone. Yet, even under these circumstances, provided the rate of immigration is sufficiently high, the value of $p_{m,T}$ still increases if taxes on asset income ultimately rise to finance either more transfer spending or lower taxes on labour earnings, as

long as the two changes are separated by a prolonged period of deficit finance.

These caveats are important. If the rate of immigration is only two per thousand, lower spending on transfers and lower debt is the preferred policy; reducing excess burden dominates the small benefits that can be derived from shifting the tax burden to the future. Furthermore, the maximum values attained by $p_{m,T}$ in Figure 11 are much lower than in the previous examples in Sections 3 or 4. The highest possible value of $p_{m,T}$, equivalent to a 0.338% increase in consumption, is attained in the lowest right-hand panel of Figure 11, when transfer payments rise by 1.016% of output. After seventy years and after the debt burden has risen by 252.3% of output, the tax on capital must be raised to 0.574 to stabilise government finances. What if we reverse this sequence so that lower tax rates on asset income are eventually paid for with higher taxes on labour? Indeed, how much might natives stand to gain if sometime in the future, the instrument chosen to replace the revenue lost from the drop from 0.32 to 0.27 in the tax rate on capital since the early 1980's is an increase in the taxes on wages?

Even in the absence of immigration, shifting the burden of taxation from the infinitely elastic capital to inelastic labour—even if this is done with a very long lag and public debt accumulates in the interim—generates small reductions in the excess burden that yield welfare benefits equivalent to permanently increasing consumption between 0.193% and 0.198%. Both this effect and the shift in the incidence of the tax from native-owned assets reinforce the benefit that accrues to the members of native households when taxes are postponed to the future. This is why the curves in Figure 12 are uniformly higher than their counterparts in Figure 8. Comparing the third and fourth columns in Table 2 and 4, the same decrease in the tax on capital also implies a smaller increase in the debt burden, because the permanently lowered tax on capital income incentivises higher investment.

Suppose again the effective rate of immigration of between eight and ten per thousand. Assume as well that the current low tax rates on capital income introduced in the early 1980's are permanent. If the debt continues to rise until 2050, before the government stabilises its

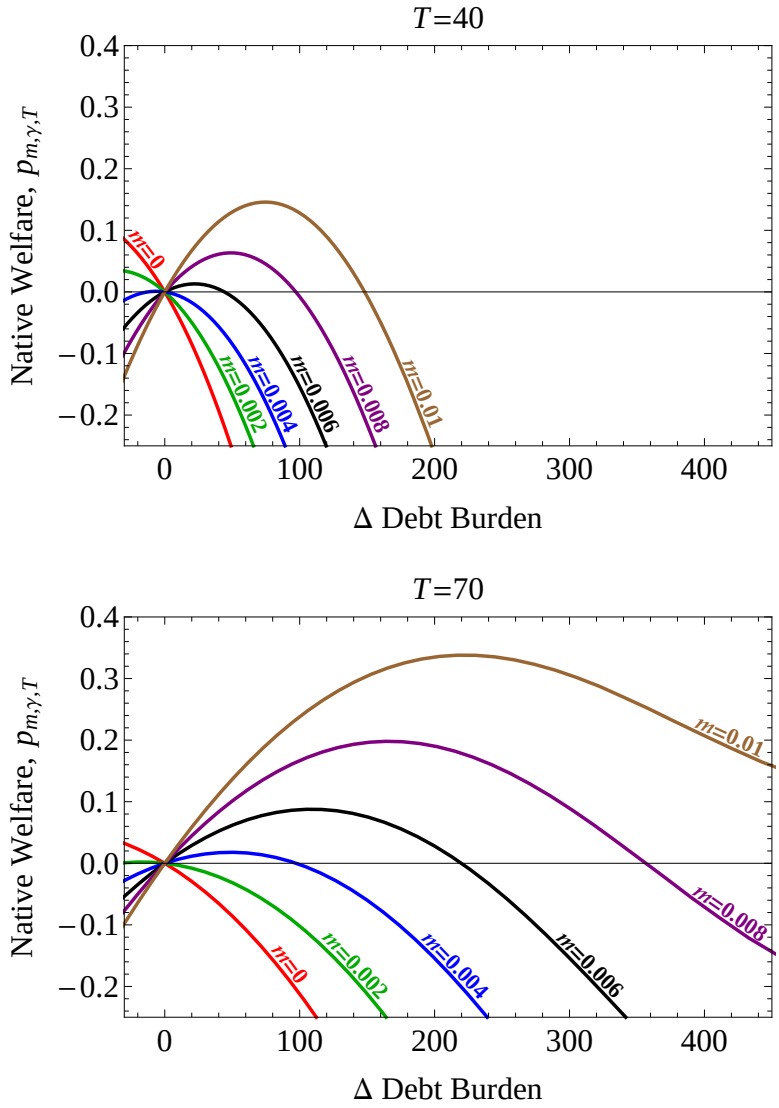

Figure 11: The values of the welfare measure for native households $p_{m,\gamma,T}$ and the long-term debt burden generated by increasing transfer payments and then raising the tax rate on asset income in T=40 or 70 years, for different annual rates of immigration.

finances and does so by raising the tax on labour earnings, the value of $p_{m,T}$ is between 1.026% and 1.195%, and possibly a bit more if the productivity of new immigrants continues to improve. From the perspective of the initial population, those whose families were already resident in the United States in 1981, this is a small but not inconsequential benefit. Along the way the debt burden grows between 237.8% and 239.2% of output, and when added to the initial debt burden of 22.7% is a fairly close match to the projections of the Extended Baseline Scenario in

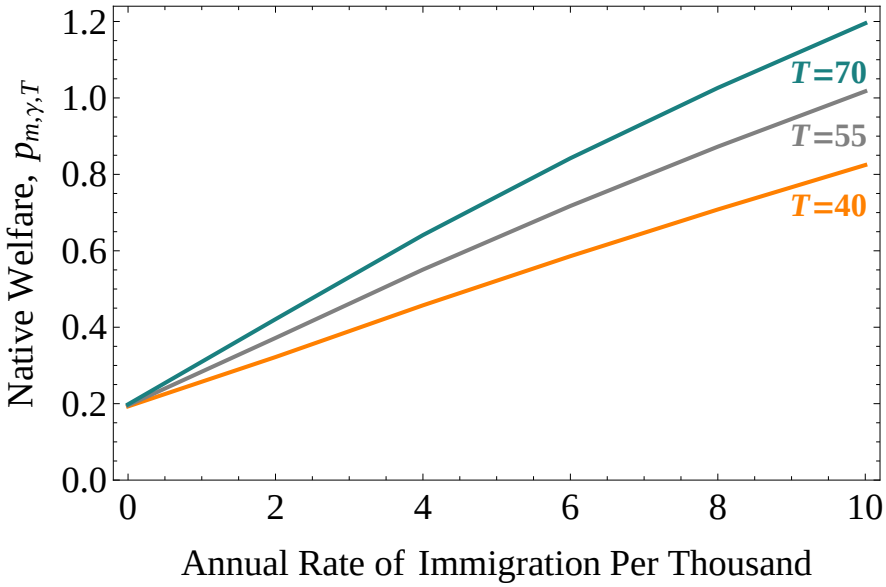

Figure 12: The values of the welfare measure for native households $p_{m,T}$ that correspond to different rates of immigration after lowering the tax rate on asset income from 0.32 to 0.27 and then raising the tax rate on wage earnings after T=40, 55 or 70 years.

Figure 2. Of course the monotonic relationship between more debt and higher values of $p_{m,T}$ in Figure 13 leaves us with the same question first raised in Section 3. What are the additional objectives or constraints, absent from the model, that prevent policy makers from relying even more heavily on deficit finance than is already the case?

Still, in Figure 13 we see once again a monotonic relationship between more debt and higher values of $p_{m,T}$ as in Figure 6 in Section 3. Unlike the temporary reductions in the tax rate on capital income in Section 4, the permanent reductions here mean that as in Figure 6, there is a positive monotonic relationship between the increase in long-run debt and the values of $p_{m,T}$ in Figure 13. In fact, because of the shift in incidence and the reduction in the excess burden of capital income tax, the slopes are steeper. As is Section 3, recent policy clearly benefits native households, but were this the only consideration for policy makers the debt would be climbing even faster.

	New Immigrants Per Thousand	Δ Debt as Percent of Output at T : $100\times\Delta\frac{b(T)}{y(T)}$	Δ Debt as Percent of Output Long-Run $100\times\Delta\frac{b(\infty)}{y(\infty)}$	Labour Tax Rate after T $\tau_h(t>T)$	Initial Change in Native Consumption $100\times\left(\frac{c(0,0)}{\bar{c}(0,0)}-1\right)$	Welfare as Percent of Permanent Consumption $p_{m,T}$
$T=40$	0	86.1	84.7	0.270	−0.033	0.193
	2	86.1	84.6	0.270	−0.033	0.322
	4	86.0	84.5	0.271	−0.032	0.457
	6	86.0	84.4	0.271	−0.032	0.586
	8	86.0	84.3	0.271	−0.032	0.708
	10	86.0	84.2	0.271	−0.031	0.824
$T=55$	0	147.7	145.4	0.295	−0.033	0.196
	2	148.0	145.4	0.295	−0.033	0.372
	4	148.5	145.6	0.296	−0.032	0.551
	6	149.0	145.8	0.296	−0.032	0.717
	8	149.6	146.0	0.296	−0.032	0.872
	10	150.3	146.2	0.297	−0.031	1.017
$T=70$	0	237.2	233.7	0.330	−0.033	0.198
	2	238.9	234.5	0.332	−0.033	0.421
	4	240.9	235.4	0.333	−0.032	0.641
	6	243.2	236.5	0.334	−0.032	0.842
	8	245.7	237.8	0.336	−0.032	1.026
	10	248.4	239.2	0.338	−0.031	1.195

Table 4: The impact of permanently lowering the tax rate on asset income by 5% and then raising the tax rate on wage earnings from year T on.

6 Discussion

In each panel in Figures 6 and 9 all the curves associated with strictly positive rates of immigration decline monotonically to the left of zero on the horizontal axis. This means that if the economy is absorbing even small numbers of immigrants, temporarily raising a particular tax rate to accumulate surpluses before lowering that same tax after time $t = T$ reduces welfare for the initial population. Indeed, the higher the rate of immigration, the more such a policy shifts the tax burden from future immigrants and towards the initial population. What this implies is that economies that are absorbing relatively larger numbers of new immigrants are unlikely to run sustained budget surpluses to enable future reductions in tax. Instead, we should expect to observe a bias in favour of postponing taxation and deficit finance.

In the aftermath of World War II, in every year but three (1949, 1954 and 1958), the debt-to-GDP ratio declined as the US government retired its wartime debt, until the end of 1974, when it reached a postwar low of 24.6%. The year 1981, the year President Ronald Reagan took office, was a turning point. In every one of the subsequent 13 years, the percentage of debt to GDP rose, until it had nearly doubled to 49.5% at the end of 1993. Increased spending on defense played a small role—it averaged 5.7% of GDP during the eight years of the Reagan administration, compared to only 5% during the eight years that preceded it. Still, as is readily apparent in Figure 1, the defense burden remained well below the average of 9.3% that prevailed during the 1950's and 1960's.

The attacks on the United States on September 11, 2001, and the subsequent wars in both Afghanistan and Iraq prompted quick increases in defense spending, though not a resumption of the rates of spending that preceded the end of the Cold War—from 2002 to 2015 spending on defense averaged 3.9% of GDP, compared to 3.6% that prevailed during the first decade that followed the dissolution of the Soviet Union.[17] At the same time revenue fell sharply, initially

[17]The CBO assumes the defense burden will decline until it stabilises to only 2.6% of GDP in 2025, but this does little to prevent the exponential growth of the debt in either of its forecasts.

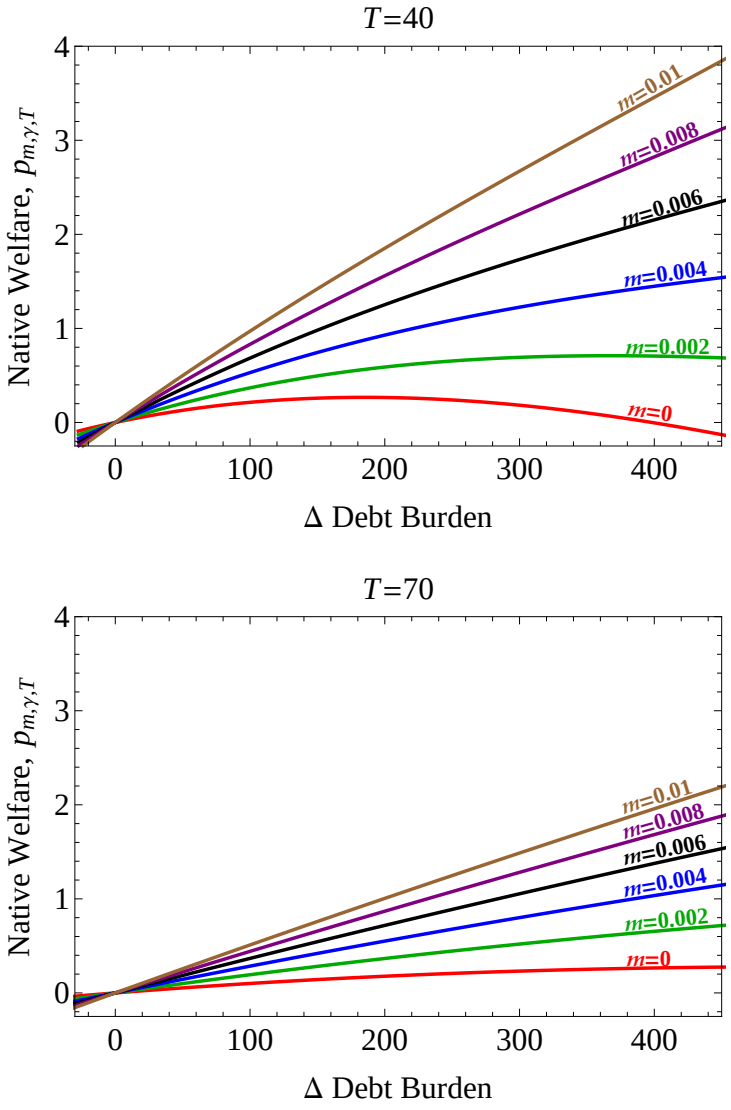

Figure 13: The values of the welfare measure for native households $p_{m,\gamma,T}$ and the long-term debt burden generated by permanently lowering the tax rate on asset income and then raising the rate of tax on wage earnings after T=40 or 70 years, for different annual rates of immigration.

because President George W. Bush lowered tax rates, but later as a consequence of the recession that began in 2008. By the end of 2015 publicly-held debt was 73.1% of GDP.

Yet beyond all this, the most important and consistent feature of the US Federal budget during the last few decades is the growth in spending on entitlement programmes, whose main beneficiaries are the elderly. This is particularly the case for Medicare; and unlike the vagaries of war and recession, this growth was completely predictable—a consequence of increasing life

expectancy and dropping fertility. Instead of accumulating sufficient surpluses to finance these liabilities we observe a shift towards deficit finance that immediately follows the rapid decline in both natural population growth and fertility in Figure 3. Passage of the Medicare Modernization Act at the end of 2003 extended coverage to include the cost of prescription drugs for the elderly from 2006 onward, and further exacerbated the fiscal gap.

Indeed, it bears emphasising that just as the debt first began to rise, in 1982 the US Census Bureau was warning that the population was ageing rapidly and would begin contracting by the year 2050—replacing earlier worries about overpopulation. A year earlier, the President and Congress appointed Alan Greenspan to chair The National Commission on Social Security Reform. The immediate task of the commission was to prevent the near-term insolvency of the Social Security Trust Fund, but also offered recommendations on how the programme could be stabilised for the long term, given the sharp drop in population growth. The commission's recommendations, which included a two-year rise in the retirement age to be implemented by 2026, were adopted in 1983, but did little to stabilise the programme's long-term prospects. This was also the last time major legislation was passed, despite the rising dependency ratio, that curtailed entitlement spending on the elderly.

The simulations and welfare calculations in Sections 3 to 5 demonstrate that the model can explain at least part of the motivation behind not only the accumulation of public debt in the United States so far but even the more rapid accumulation predicted in the CBO's Alternative Fiscal Scenario. Indeed, in the absence of immigration, it is hard to rationalise the implied shift of the tax burden, particularly on asset income, across time.

7 Conclusion

The decision to leave tax rates low, particularly the tax rate on asset income, and as a consequence to continue to accumulate both formal debt and unfunded liabilities, is a political choice. I believe my model offers at least some insight as to why for the first time in US history,

the debt burden has risen in a sustained manner during peace-time, and why there seems little immediate prospect of a change in direction. It is of course the case that the trajectory of public debt is the result of decision-making and political processes that are far more dynamic, and far more contingent on unforeseen circumstances, than I assume in my model. It is very unlikely that voters, or their representatives, deliberately choose policies that carefully weigh the costs and benefits of deficit finance, as rates of migration change, in the manner of the model. However, it is not too hard to imagine that concerns about the rising burden of debt, and its impact on the next generation, are likely to be less persuasive at a time when citizens experience the composition of their societies transforming so quickly. What my model demonstrates is that *ceteris paribus*, there is likely to be far greater willingness to defer taxes and rely on deficit spending during periods when immigration is a more prominent component of population growth.

That people voting for a set of tax policies in one period may not be exactly the same people who must pay these taxes in the next is not an uncommon feature in models associated with dynamic fiscal policy. What is different here is that by adopting the Weil (1989) framework, I provide an alternative to the strict dichotomy between models with overlapping generations, where agents disregard the impact of their choices on future generations, and the quasi-Ricardian world of infinite-lived dynasties in which agents are assumed to fully participate in both the economy and the political system in every period. In the case where taxation is distortionary, gone also is the option to simply choose the tax that redistributes the most income to those who can organize the most votes, while abstracting from deadweight loss. As recent experience has shown, prolonged reliance on deficit finance has real consequences. The higher rates of future taxation in my model are only one possible outcome, and clearly not the most dire.

The degree to which the policy choices made in any given period are informed by their effects on future generations is hardly straightforward, even if people never move between different political jurisdictions. Concern for one's own descendants is not the only form of intergenerational

altruism. People without children may care deeply about the welfare of future members of the society in which they live, and do not necessarily support policies that maximise their own welfare at the expense of the young and the unborn:

> Society is indeed a contract.....It is a partnership in all science; a partnership in all art; a partnership in every virtue, and in all perfection. As the ends of such a partnership cannot be obtained in many generations, it becomes a partnership not only between those who are living, but between those who are living, those who are dead, and those who are to be born. Each contract of each particular state is but a clause in the great primæval contract of eternal society,.....
>
> (Edmund Burke, 1790, pp. 143-144)

Yet most transfers between people, whether *inter vivos* or testamentary, take place between members of the same family. My contention is that immigration creates a certain bias in favor of deficit finance, though this argument could be turned on its head; deficit finance is what generates a preference for accommodating more immigrants. Indeed, perhaps one reason we do not observe developed countries absorbing yet more immigrants follows indirectly from the model—the faster immigrants arrive, the more natives may want the government to issue bonds to cover immediate government expenditure, but also the greater the risk that the immigrants will acquire the political power to repudiate that very same debt.

If immigration does indeed create a bias in favour of deficit finance, there is no reason to assume the phenomenon is isolated to the United States. In many developed countries, the transition from low rates of net migration and high rates of natural population growth to high net migration and low, even negative, rates of natural population growth has been far more extreme. So too has the accumulation of public debt and unfunded liabilities.

One last issue is emigration. At any given moment, migration flows at the national level tend to be one-way. Only occasionally do we observe so-called 'replacement migration' in which

a country absorbs significant numbers of new workers even as its own native-born workers move elsewhere. Emigration could create a bias in favor of surpluses—tax people before they leave—but only if the rate of emigration does not exceed a certain threshold. If enough people are leaving, or anticipate they will, they may opt to avoid taxing themselves, and leave behind their share of the public debt to those who remain. Of course, at the sub-national and local level, simultaneous flows of inmigration and outmigration are the normal consequence of churning in the labor market. One implication is that as people become more mobile, we may expect not only national governments, but the different regions within federal states and localities to acquire higher debt and unfunded liabilities.

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