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IMMIGRATION AND THE MACROECONOMY

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ABSTRACT

In a general equilibrium, overlapping generations model with heterogeneous agents and stochastic labor productivity, we account for differences between immigrants and natives to investigate the macroeconomic effects of immigration to the United States. Including household labor productivity transitions jointly with legal status transitions, we model policies which change the size and composition of the immigrant population and analyze implications for government spending and tax revenues. Temporary increases in legal immigration rates lead to long term fiscal benefits, in aggregate and on a per capita basis, in part because of decreases in the old-age dependency ratio. These policies produce long lasting, multi-generational effects, as the children of new immigrants enter the workforce. A six year increase in legal immigration by 25% is predicted to lead to a 0.08% increase in per capita GDP and a 0.41% decrease in total government debt in 2032, but, by 2052, the policy increases per capita GDP by 0.30% while government debt is 1.34% lower than in the baseline. Policies which legalize unauthorized immigrants imply a trade-off between higher wages for newly-legalized workers and increased government debt through additional spending on social programs for those same immigrants. A full legalization policy leads to a 0.02% increase in government debt by 2032 and a 1.26% increase by 2052. Per capita GDP, meanwhile, is 0.01% lower than baseline in 2032 and 0.37% lower in 2052.

Keywords: Immigration, exogenous state transitions, labor productivity
JEL Classification Numbers: J18, H55, J11

1 Introduction

An aging population in the U.S. will strain the ability of the future economy to provide pension benefits without unduly burdening younger generations. The old-age dependency ratio, defined as number of people over age 65 divided by the number of working-age adults aged 20 to 64, stands at 0.312 in 2020, but is expected to grow to 0.434 in 2040, and 0.520 in 2060[1]. Since immigrants arriving in the U.S. tend to be younger than the average of the domestic population, immigration policies which increase immigration flow may relieve some of the burden on current younger workers in having to provide for older retirees, but only if immigrants provide a net growth to the economy.

Individual labor productivity determines the macroeconomic value of immigration. Since lawful immigrants receive government transfers over the immigrant's lifetime, such as Social Security old age benefits, Medicaid, and the Supplemental Nutrition Assistance Program (SNAP), bringing in younger workers may not fix the retirement benefits imbalance unless those workers are sufficiently productive. Studies such as Storesletten (2000), Rowthorn (2008), Boeri (2010), and Akin (2012) have investigated the effects of skills-based immigration policies in restoring fiscal balance to the U.S. Social Security retirement system. Since additional high productivity immigrants are a clear benefit to the economy, for our experiments, we maintain the labor productivity distribution of current immigrants and look at the effects of changes in the size of flows.

In our overlapping generations, general equilibrium, incomplete markets model of the U.S. economy, we use the demographics of the population and the relationship between labor productivity and legal status in order to estimate macroeconomic effects of immigration and legalization policies. Individuals with different legal status—citizens, lawful migrants, and unauthorized migrants—draw from different distributions of labor productivity. An individual's labor productivity evolves stochastically over their lifetime following a joint distribution of labor productivity and legal status. By conditioning taxes paid and transfers received on legal status, income, and age, we model the budgetary impacts of various immigration policies. More refined tax treatments have been shown by Moore and Peco-

[1] According to Penn Wharton Budget Model (PWBM) microsimulation demographic projections.

raro (2020), in a model with state-specific taxation and heterogeneous households, to have significant macroeconomic differences as compared to averaged tax treatment.

Higher labor productivity generates higher income for those more productive individuals (and higher revenue for the government), but it also generates an indirect positive spillover effect. When effective labor supply rises due to rising average labor productivity, the return to capital also rises. Higher returns to capital incentivize more capital investment and thereby raise the average wage level for all workers. Our estimate of the effects of immigration accounts for these general equilibrium effects.

In an economy with frictions on capital formation, such as the partially open U.S. economy in the model, capital cannot immediately respond to the increase in labor supply. Since a lower capital-to-labor ratio reduces wages and income, additional immigrants begin to weigh on the fiscal balance and the economy in the near-term until capital investment catches up. Of course, geographically concentrated, large immigration inflows may produce other social and economic distortions and may be more disruptive at a local level; we abstract from those effects in the model.

Legalization of the current population of unauthorized immigrants in the U.S. may also affect labor productivity. According to Congressional Budget Office (2020), between 1998 and 2018, unauthorized immigrants earned, on average, 48% less than citizens and lawful immigrants[2]. The lower earnings of unauthorized immigrants are, in part, explained by their lower educational attainment—42% of them lacked a high school diploma, compared with 15% of authorized immigrants and 6% of citizens. But education alone does not explain the earnings differences as Congressional Budget Office (2020) documents that, even at each level of education, unauthorized immigrants had lower earnings than the other two groups. This disparity may be due to institutional factors which prevent unauthorized immigrants from participating in the job market to the extent of their underlying ability. Under this assumption, legalization leads to higher labor productivity.

Since unauthorized immigrants are not eligible for many governmental transfers, immigration policies that convert unauthorized immigrants to permanent legal status directly

[2]The cited figure is for male workers ages 25 to 54. For female workers in the same age range the figure is 42%.

increase federal spending. The rise in expenditures may be offset by higher rates of tax compliance by the newly lawful immigrants. Moreover, any manifested increase in labor productivity resulting from lawful status raises the individual's economic output. We model the effects of such a legalization policy for unauthorized immigrants.

In our analysis, we consider two different types of immigration policies–immigration policies that alter the inflow of legal immigrants and immigration policies that legalize unauthorized immigrants. These policies produce demographic shifts which affect the macroeconomy and the fiscal balance. Immigrants are more likely to be of working-age, leading to a larger labor force, labor income, and payroll taxes collected. They are also more likely to qualify (although, not necessarily, be eligible) for transfer programs. Children of immigrants will shape the future workforce, and immigrants themselves typically have lower mortality rates than natives as well.

The policy experiments which alter the inflow of legal immigrants assume inflow changes are temporary, occurring between 2022 and 2027, and anticipated. We run the following five experiments:

1. Almost zero legal immigration: This policy reduces the expected baseline inflows by 99%.

2. Half legal immigration: A reduction of 50% in the baseline inflow.

3. A quarter more legal immigration: A 25% increase in the baseline inflow.

4. Double legal immigration: A 100% larger immigration inflow.

5. Quadruple legal immigration: A four times larger than baseline immigration inflow.

These policies are meant as illustrations of a span of possible outcomes and are not attempts to find an optimal policy. Since the model's complexity produces various interactions, we do not, in general, expect a linear effect from immigration flow changes.

According to our projections, increasing the inflow of lawful immigrants improves the federal government's fiscal standing in the long-run since the average lawful immigrant contributes more in expected taxes than in expected transfers received. In our model, the experiment that increases lawful immigration by 25% finds that, after 10 years, government revenues per capita increase by 0.09% relative to the baseline, government spending per capita decreases by 0.33%, and government debt decreases by 0.84%. Barring immigration for 6 years (as in scenario 1) has the opposite effect on spending and debt: per capita revenues increase by 0.33%, but spending increases 1.32% and government debt increases by 3.35%. These policies also have opposite effects on wages. A modest increase in immigration decreases average wage by 0.08% by 2027 (when the immigration policy ends), while the immigration moratorium increases wages by 0.3%, due to lower average earnings among new immigrants. Over time, these effects reverse. Wages in 2045 are 0.12% higher under the 25% increase scenario, as opposed to 0.42% lower under the moratorium.

In the legalization policy experiments, legalization occurs in 2022. These experiments are as follows:

1. Full legalization, with a take-up rate of 70%, that is, 70% of all unauthorized immigrants present in the country in 2022 are granted legal status.
2. Half legalization, with a take-up rate of 35%.

For the full legalization policy, we use a take-up rate from a report[3] scoring a 2013-era immigration bill which included legalization, which estimates some unauthorized people will not be legalized for reasons such as:

- They have criminal records and are therefore ineligible.
- They arrived too recently in the country to be eligible, since many programs require a number of years of continuous residence.
- They do not have the money to pay for the fines or back taxes associated with the legalization process.
- They think the policy is a trick by the government and refuse to sign up and admit to being unauthorized.
- They do not know about the legalization possibility, do not get around to doing the paperwork, do not realize it applies to them, or some similar miscommunication issue.

[3] Congressional Budget Office (2013)

In our modeling, legalization increases the manifested labor productivity of legalized immigrants, increases tax compliance, and raises government spending on transfer programs. We find that a full legalization policy increases government spending, especially for social programs. By 2032, per capita government spending increases by 0.76% relative to the baseline, while Social Security payments, Medicare expenditures, Medicaid expenditures, and SNAP payments change by -0.11%, 1.16%, .94%, and 1.00% respectively. Increased costs are somewhat offset by increased government revenue generated by higher tax compliance and better employment opportunities for those granted legalization. Total revenue increases by 0.19% and payroll taxes increase by 1.02%, leading to a decrease in per capita government debt by 0.3% over the next ten years.

2 Demographics

We use the Penn Wharton Budget Model (PWBM) microsimulation in order to project demographics for our policy experiments and the baseline. These demographics provide transition tables for entry to and exit from the model's population. These tables are conditioned on age and legal status and account for fertility, mortality, immigration, emigration, and change in legal status.

The PWBM Microsimulation simulates the population across dozens of demographic and economic attributes and is constructed using a variety of survey micro-data, including the Current Population Survey (CPS), American Community Survey (ACS), Survey of Income and Program Participation (SIPP), and vital records from the Center for Disease Control's National Center for Health Statistics (CDC-NCHS). This model is calibrated to and validated against the motion of the U.S. population over time, beginning in the mid 1990s, before continuing the simulation forward to project demographic trends for the future. The model's initial population, as well as immigrants who arrive in the future, are bootstrapped on the household level using the CPS-ASEC and ACS. These households are then transitioned forward in time using models built to estimate marriage rates, fertility, mortality, employment, and other variables of interest.

The microsimulation immigration model includes separately scalable estimates for the number of immigrants who arrive each year with or without legal authorization. Immigration rates are estimated by using survey data combined with fertility, mortality, and emigration rate estimates. Fertility and mortality are modelled using NCHS Vital Statistics data, and emigration rates are modelled using a combination of literature, including Warren and Warren (2013) and tables published by Nowrasteh adapted from ICE data[4]. Mortality differs between natives and immigrants (see Singh and Miller (2004)), with Hispanic immigrants in particular showing much lower mortality than white natives, even of higher socioeconomic status, as part of a phenomenon termed the "Hispanic Paradox" (see Hayward et al. (2014)). Rates of out migration also differ by legal status. Immigrants are far more likely to exit the country than non-immigrants, and unauthorized immigrants are more likely still (particularly because of the impacts of deportation or other removals).

The legal status of immigrants in the US population is imputed in our datasets using a method adapted from Passel and Cohn in their reports published via Pew[5]. Non-citizen immigrants who are unambiguously legal are identified based on employment type (such as government work), year of admission (immigrants arriving earlier than 1980 are assumed to be legal), or receipt of some federal programs (including TANF, SSI, and Social Security). Remaining non-citizen immigrants have their legal status imputed based on country of origin and state-specific targets, with a multi-step rake algorithm used to maximize consistency with all targets.

The microsimulation uses its annual immigration targets to bootstrap immigrants from the CPS-ASEC and the ACS. This bootstrap creates separate targets among authorized and unauthorized immigrants, and bootstrapped households are drawn from among immigrants who arrived within 2 years of the target year and interviewed within 2 years of arrival. Any personal characteristics (*e.g.,* age) are updated to reflect their value at time of arrival. Each of these targets—authorized and unauthorized—can be scaled independently to match policies of interest. For this paper, per year authorized immigration targets were increased (or decreased) between 2022-2027 according to the policy experiments.

In our baseline, we estimate that the US population will increase to 356.5 million by

[4]See Nowrasteh (2019)

[5]Including Passel and Cohn (2009), Passel and Cohn (2011), Passel et al. (2014), Passel and Cohn (2016), and Passel and Cohn (2018)

2040, with a foreign born share of 14.5%. By 2060, the population increases to 375.8 million, with the foreign born share rising slightly to 15.6% (the foreign born share in 2020 is estimated at 13.99%). In general, the foreign born share of the population rises slightly over time. Over that same period of time, the average age of adults (anyone aged 18+) in the US population increases from 48.6 in 2020 to 51.7 in 2040 and 53.9 in 2060. While among adults, immigrants are not younger than natives (the average immigrant adult in 2020 was 49 years old, versus 48.6 years old among natives), the average adult immigrant arriving into the country is 36.1 years old[6]. This is the direct mechanism through which increased immigration reduces the old-age dependency ratio in the United States. Further, because these immigrants are younger, and therefore closer to prime childbearing age upon arrival[7], increased immigration also increases the number of newborns. After 2 to 3 decades, these immigration waves contribute to reducing old-age dependency a second time, as the children of arriving immigrants become old enough to contribute to the labor market themselves.

Because incoming immigrants are typically younger than already-present immigrants, immigration policy which changes immigrant inflows has a significant impact on the age distribution of immigrants. The six charts below show the age distribution of immigrants under each policy in 2027 (the last year with changed immigration), as well as 2045 and 2060.

[6] We measure the age of adults here rather than the full population to avoid a skew when discussing age of immigrants versus natives. Because any child born in the United States is native-born, including children of immigrants, the average age of all natives versus all immigrants overstates the relative age difference of the immigrant-derived population. For example, in 2020 the average age of all immigrants is 47.3 versus 38.9 for natives.

[7] The literature reports mixed results regarding immigrant fertility compared to natives. Wilson (2020) finds higher fertility, whereas Parrado (2011) attributes the difference to life cycle patterns.

Figure 1: Total Population by Age, 2027 (in millions)

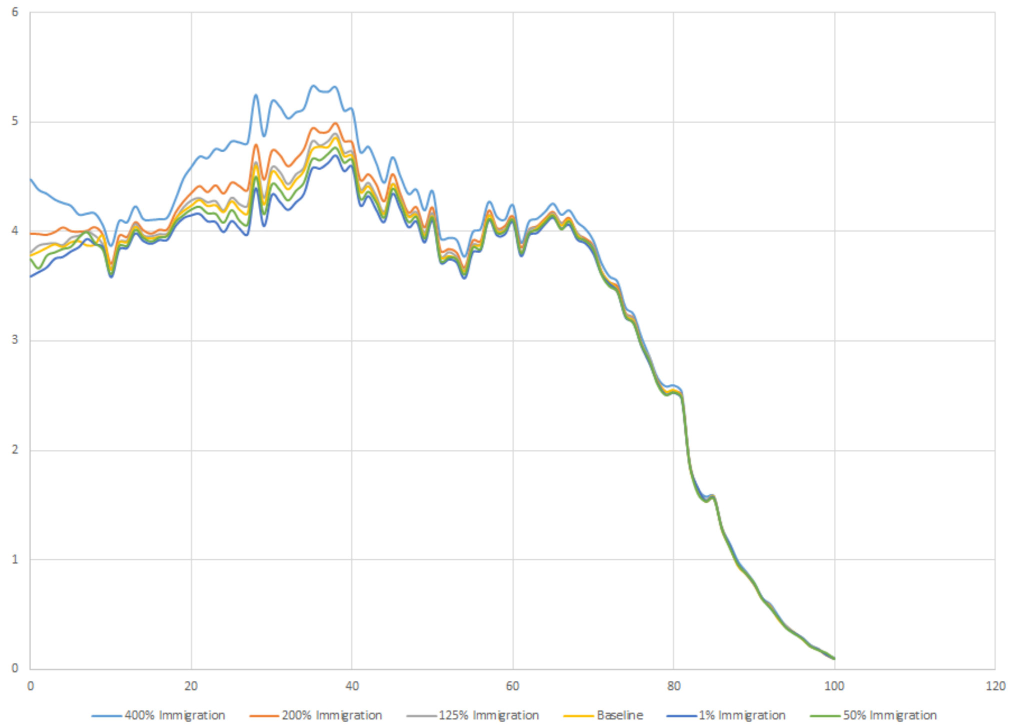


Figure 2: Total Population by Age, 2045 (in millions)

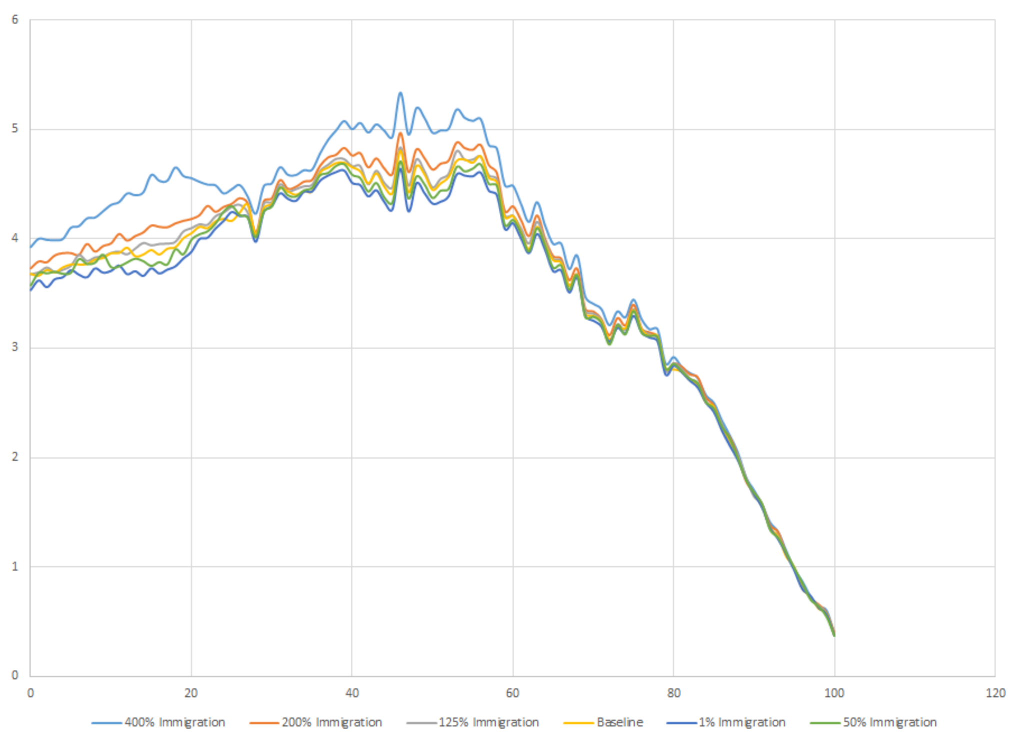


Figure 3: Total Population by Age, 2060 (in millions)

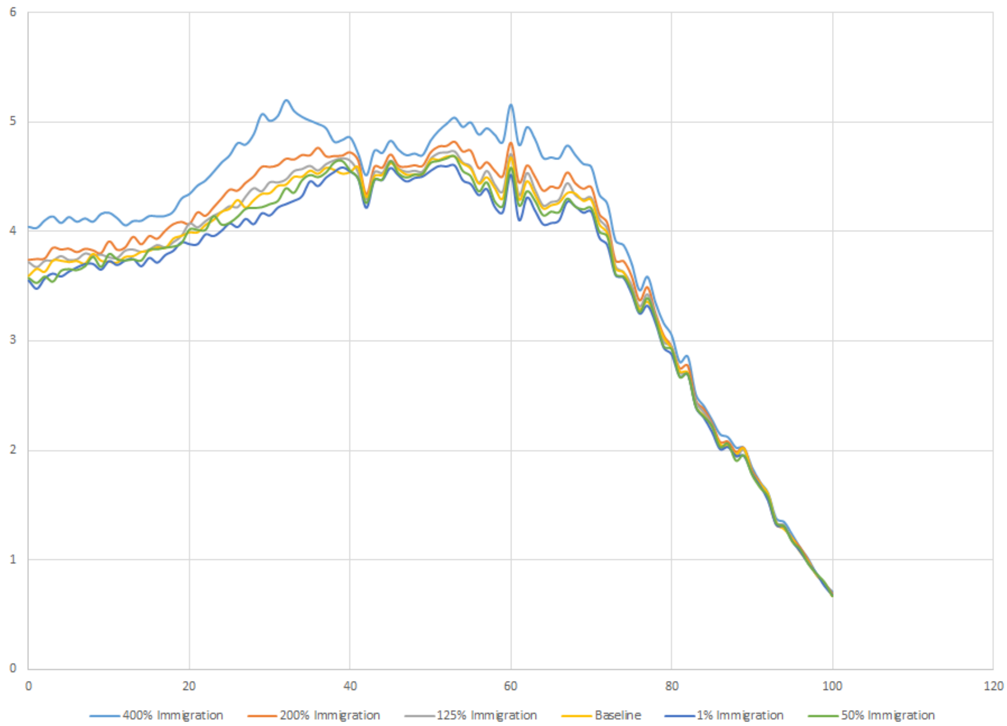


Figure 4: Immigrant Population by Age, 2027 (in millions)

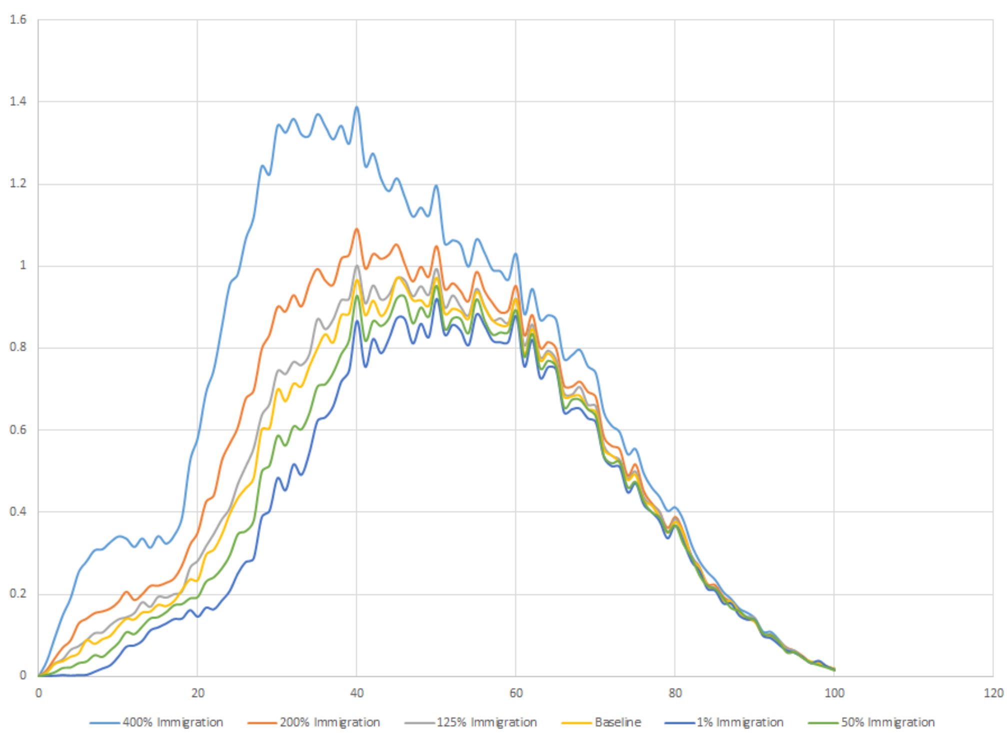


Figure 5: Immigrant Population by Age, 2045 (in millions)

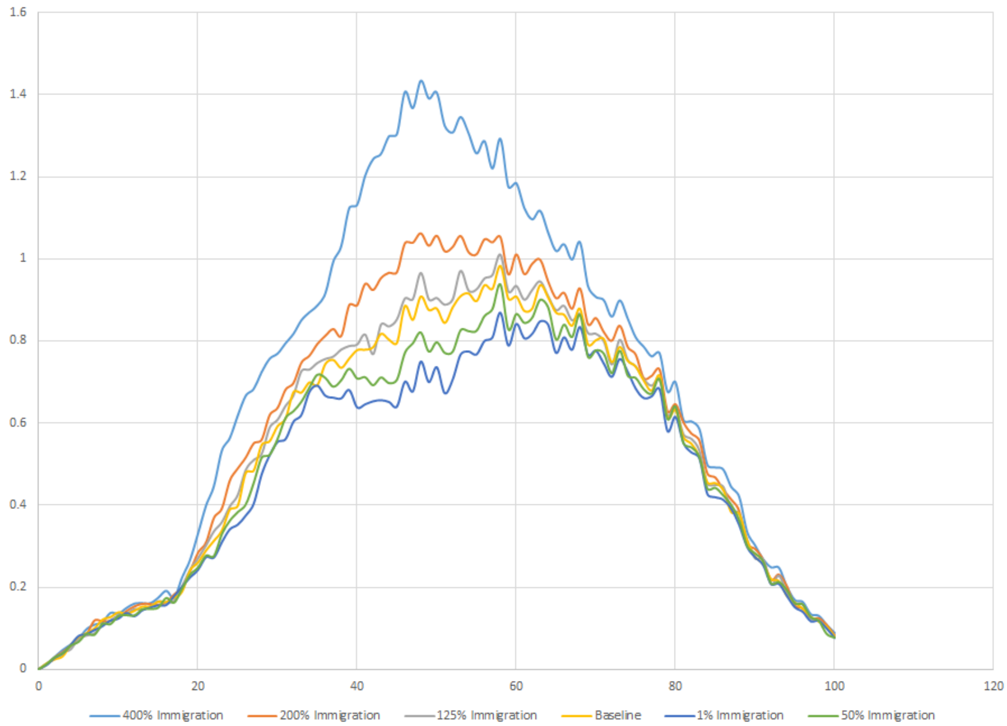
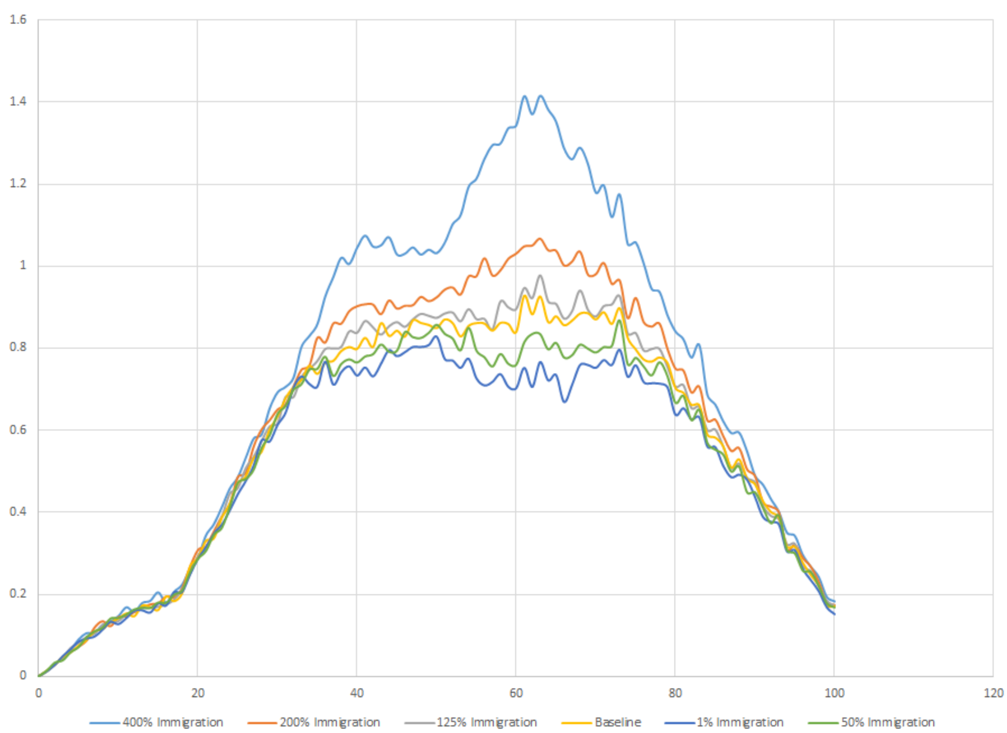


Figure 6: Immigrant Population by Age, 2060 (in millions)



The investigated immigration policies affect the working population in two distinct waves over the next several decades. The immigrant-specific charts, beginning with Figure 4, show the change in the old-age dependency ratio among immigrants soon after arrival; high immigration scenarios increase the working age population, while low immigration scenarios decrease this proportion. In later years, we see the opposite effect - immigration booms in the 2020s cause an `increase` in the number of retiree immigrants by the 2060s as those same immigrants eventually age out of the workforce.

Because of the increased number of newborns following waves of immigration, immigrants from the 2020s contribute disproportionately to the labor force even after their retirement. In Figure 3, showing the total population in 2060, we see that the 400% immigration scenario has two spikes - one among ages 55+, representing the 2020s era immigrants themselves, and another spike in the age range of 25 - 35, representing the children of those immigrants, who have entered their own prime working years. This effect is discussed in more detail in section 4.

Another important dynamic effect of changing legal immigration quotas is changes in the naturalized and unauthorized population. While each legal immigration inflow policy modelled holds the unauthorized immigration rate and naturalization rate constant, these populations are still sensitive to the choice of policy because of legal status transitions among legal immigrants. Some portion of immigrants admitted in the 2022-2027 period eventually gain lawful permanent resident status and later choose to naturalize, and others overstay their visas and become unauthorized immigrants. A larger (or smaller) base of recently-arriving immigrants therefore increases (or decreases) both these populations because of these transitions. The dynamics of these changes can be seen in the below charts.

Figure 7: Naturalized Population by Year (in millions)

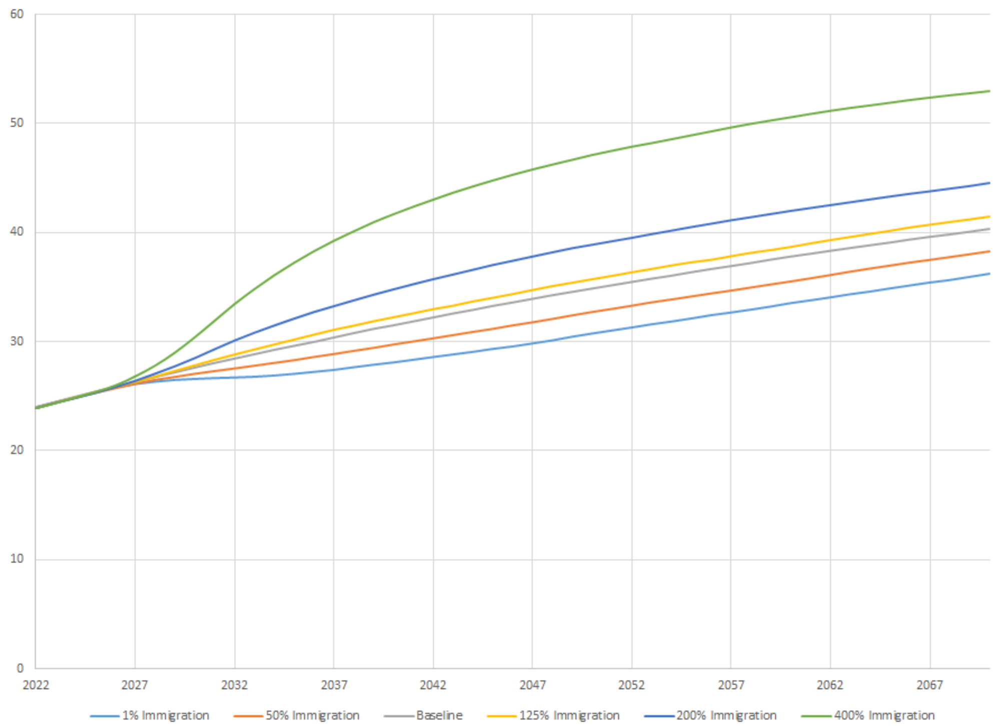
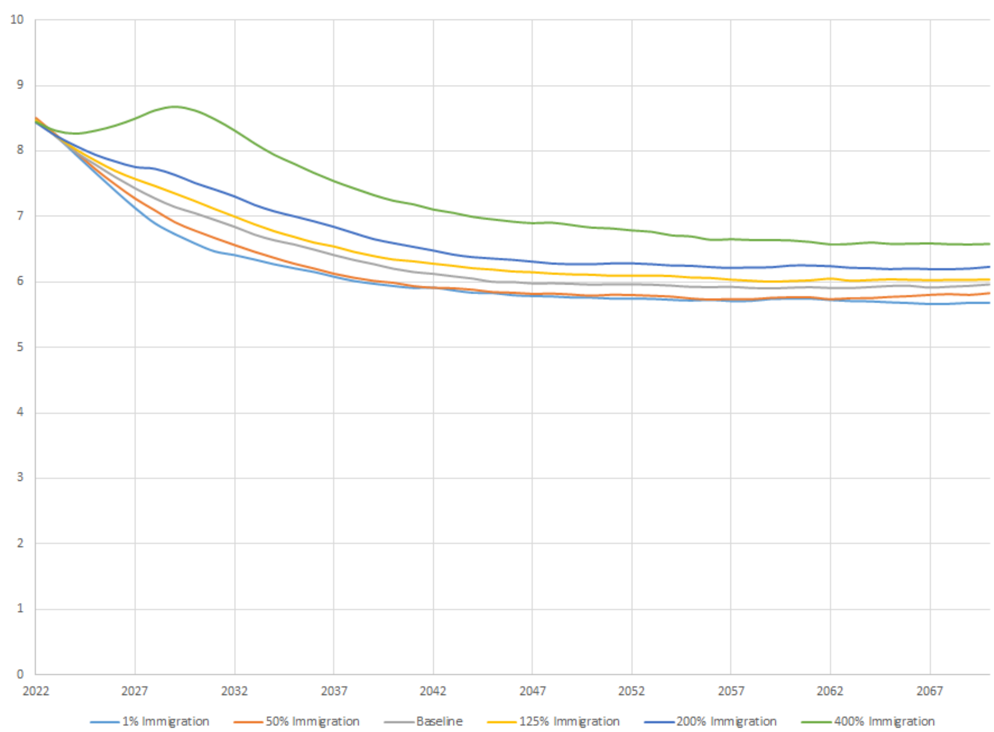


Figure 8: Unauthorized Population by Year (in millions)



Changing the size of immigration flows may change their composition. For our modeling, we assume the composition of new flows remains the same during projection years[8]. However, the relatively higher proportion of higher-ability immigrants in the current population may be the result of self-selection. That is, with a higher potential cost to immigration, only those individuals who believe they will recover that cost from future income would choose to immigrate. Similarly, lowering the cost to migrate could reverse that behavior.

Another trend observed in the data is an aging of the arriving immigrant population throughout much of the mid 2000s, before leveling off in the 2010s[9]. Assuming future immigration inflows will have the same age composition as those in 2017 implies that the trend does not resume in the future. If incoming immigrants in future years continued to be older than previous immigrant cohorts, the benefits of having a younger population would be dampened relative to our assumptions.

The microsimulation model simulates wages for individuals from different demographics and backgrounds based on CPS-ASEC data. We use legal status group averages as an input to the overlapping generations model to generate age- and year-specific productivity differentials across such groups, while assuming the same stochastic process for labor shock. On average, legal immigrants' labor productivity is 74.67% relative to citizens', and unauthorized immigrants' is 69.29%[10].

3 Macroeconomic model

The macroeconomic model used in our analysis is a standard Bewley-type overlapping generations, general equilibrium, incomplete markets model with heterogeneous households who are taken to be adults differing in age, wealth, and average lifetime earnings. Households are subject to a joint idiosyncratic shock which determines labor productivity and

[8] Currently, projection begins in 2017, using data through 2019, following the methodology discussed above.

[9] In 2005, the average incoming immigrant was 26.6 years old. By 2010, the average arriving immigrant was 30.1 years old, and average age fluctuated between 29 and 31 throughout the decade, settling at 30.92 in 2019.

[10] Recent data show that a growing share of unauthorized immigrants are visa overstayers. Thus, unauthorized immigrant demographics are slowly converging to those of legal immigrants– including similar ages and educational backgrounds. As a consequence, their available productivities are also approaching those of legal immigrants. The remaining gap is explained by the non-overstay portion of the unauthorized immigrant population and by the missed work opportunities that an unauthorized legal status imposes.

legal status, that is citizenship/immigration status. The production sector of the economy consists of competitive firms which transform labor and capital into the numeraire output good. Corporate tax treatment applies to a subset of the firms, with the rest treated as pass-through entities.

Government collects taxes and provides old age pension benefits based on working history in a manner similar to the OASI program. The government also provides transfer programs such as SNAP, Medicaid, Medicare, and others. The government's debt grows as the budget is not balanced on the transition path. Steady state assumes a fixed debt-to-output ratio, which is maintained in terminal steady state via a consumption tax.

3.1 Exogenous shocks

In many heterogeneous agent models with idiosyncratic shocks, labor income to a particular household is given by

$$y_L = wnz \tag{1}$$

where, for a particular time period, w is the market wage rate, n is the labor supply choice of the household, and z is the exogenous idiosyncratic labor productivity shock of that household. One can generalize the meaning of a household's exogenous shock so that a single shock process can be used to inform multiple dimensions of a household state. In this approach, the shock is a vector random variable with a distribution which captures joint transitions–that is,

$$z_t = \left(z_t^1, z_t^2, ..., z_t^k\right) \tag{2}$$

with $Pr(z_{t+1}|z_t, \mathbf{s_t})$ where the distribution depends on the current shock state z_t and household state $\mathbf{s_t}$.

For the purposes of the immigration model in this work, allow z^1, with support $[0, \infty)$, to be a continuous labor productivity shock, and z^2, with support $\{citizen, authorized, unauthorized\}$, to be a discrete variable on legal status. Transitions of labor earnings and legal status are thus jointly determined.

For numerical computation, continuous exogenous shocks are discretized into a finite state space. This discretization implies a finite set of time-varying transition probability matrices $\{\Omega(\mathbf{s}, t)\}$ where $\mathbf{s} \in \mathcal{S}$ is a particular state in the discretized state space $\mathcal{S}$ and t is the time period.

Multi-dimensional exogenous shocks are a convenience to consolidate various exogenous states into a single state space. One advantage to using a single multi-dimensional state space is that it naturally provides a joint distribution which may be more cumbersome to implement otherwise. A second advantage is that, in certain circumstances, a full Cartesian product of all exogenous states may not be desirable. Using our approach, one can control the size of the state space by selecting relevant joint states. For instance, the modeler could define 20 labor shock states for citizens and authorized immigrants but only 10 for unauthorized immigrants. This type of state assignment may be useful in maximizing details of population demographics while minimizing the computational load needed to solve the model.

While the current work uses multi-dimensional exogenous state to model transitions of legal status jointly with labor productivity, this framework may be applicable to other characteristics, such as marital state, number of children, health state, and so on, so long as the modeler considers these transitions to be reasonably described by exogenous distributions rather than endogenous choices by model agents.

3.2 Households

A household in the model is an adult person. Household state is given by $\mathbf{s} = (j, a, b, z)$, where j denotes age, a denotes assets, b denotes average lifetime labor earnings used for calculation of Social Security pension benefits, and z denotes the exogenous shock realization vector. Labor supply, n, and savings, a', are continuous choice variables. Consumption is taken to be the residual of after-tax income and savings. The household's period utility function is given by

$$u(c, n) = \frac{\left[c^{\gamma}(1-n)^{1-\gamma}\right]^{1-\sigma}}{1-\sigma}, \tag{3}$$

so that households derive utility from consumption, c, and leisure, $1 - n$.

In every period, a working-age adult is endowed with one unit of time that can be allocated to work and leisure. At age $J_r(i)$ workers of cohort i are forced to retire and start receiving Social Security benefits, $oasi(b)$, which depend on average lifetime labor earnings, b. The mandatory retirement age is specific to birth-cohort i and there is no endogenous retirement choice.

At each period agents aged j survive to the next period with probability s_{j+1} unless $j = J_d$, in which case they die with probability 1. In the event of death, accidental bequests are collected by the government and distributed among the living population by means of lump-sum transfers. Inheritances follow a state-specific distribution pattern where relative sizes of inheritances are calibrated from the Survey of Consumer Finances. Note that it is possible to condition survival probability on the agent's full state, which includes legal status (from z), though we do not condition on state other than age in this work.

Households can accumulate positive quantities of assets. A unit of asset a is ownership of a unit of a portfolio of physical capital and government debt. Households do not choose their portfolio allocation, rather households are forced to acquire government debt to clear the market and any residual savings are allocated to physical capital. Returns to savings are taken as given by households who choose next period assets a' subject to a no borrowing constraint.

Tax treatments in the model at the household level include:

1. Ordinary rates treatment which operates on wage income, ordinary business income from pass-through business, some corporate distributions, and Social Security income.

2. Preferred rates treatment which operates on some corporate distributions.

3. Payroll tax which operates on wage income and self-employed income.

Each tax function is a cumulative tax liability from a marginal tax rate function. It is defined from a set of rates and bracket thresholds between which the rates are applied. The estimation of the tax functions is derived from PWBM's tax model calibrated from the Internal Revenue Service public use files. As a convenience, we write $\tau_h(\mathbf{s}, \mathbf{S})$ to describe the cumulative tax liability of a household characterized by state $\mathbf{s}$ given an aggregate state $\mathbf{S}$. The tax function depends on the exogenous state z, so that, for instance, citizens face a different tax function than unauthorized immigrants.

Social Security's Old-Age and Survivor's Insurance (OASI) retirement pension benefits, $oasi(b)$, are determined by calculating an estimate of the average indexed monthly earnings (AIME) for the retired individual. The AIME becomes an input into the statutory income replacement formula for pension benefits. Lawful residents–citizens and authorized immigrants–receive benefits while unauthorized immigrants generally do not (Favreault and Nichols (2011))[11].

Working age $j < J_r$ households have no pension income, $oasi(b) = 0$. For these households, the state parameter b evolves according to:

$$b' = \frac{1}{j}\left((j-1)b + \max\left(y_L, y_L^{taxmax}\right)\right), \tag{4}$$

where labor income is capped for the purposes of determining Social Security wages as it is under current policy–the taxable maximum abbreviated as 'taxmax'. For retired households, $b' = b$. The benefit calculation follows the statutory formula and includes indexing benefits to average wage growth in the economy until retirement age and indexing benefits by price inflation thereafter.

A household's total income is

$$y = wz^1 n + r_p a + oasi(b) + trans + inherit \tag{5}$$

where $wz^1 n$ represents the household's labor income as described by (1), $oasi(b)$ is pension income from Old Age and Survivors Insurance (OASI), and r_p is the rate of return on portfolio assets a. Government transfers to the household, $trans$, depend on time-varying government policy and the state of the household. Inheritance, $inherit$, depends on the total amount of bequests in the economy and the household-state specific relative allocation. Labor sourced income maps to wages, benefits, and some income from pass-through business

[11] Also see Goss et al. (2013), which estimates a \$12 billion net transfer to Social Security from unauthorized immigrants in 2007.

activity.

Let $V(\mathbf{s}, \mathbf{S}; \mathbf{\Psi})$ denote the current period value function for households with state $\mathbf{s}$ and aggregate state $\mathbf{S}$ for a given government policy schedule, $\mathbf{\Psi}$. The household Bellman equation is given by:

$$V(\mathbf{s}, \mathbf{S}; \mathbf{\Psi}) = \max_{c,a',n} \left\{ u(c,n) + s_{j+1}\beta E\left[V(\mathbf{s}', \mathbf{S}'; \mathbf{\Psi}')\right]\right\} \tag{6}$$

s.t.

$$c = y + a - a' - \tau_h(\mathbf{s}, \mathbf{S}; \mathbf{\Psi}) \tag{7}$$

$$c, a', n \geq 0, \tag{8}$$

where s_{j+1} is the survival probability to next period, (7) is the budget constraint, y is total income as defined in (5), a is current period assets in dollars, a' is choice of next period assets (purchased this period), and $\tau_h(\cdot)$ is the total tax liability. Equation (8) represents the standard non-negativity constraints.

3.3 Assets and government debt

Government issues debt to finance budget deficits. The interest rate paid on government debt, denoted by r_d, is the effective rate derived from an exogenous yield curve and the maturity distribution (which depends endogenously on the growth of debt). In general, $r_d \neq r_k$, where r_k is the return on capital. Since both government debt and capital returns are riskless, allowing choice in portfolio allocation would lead to corner solutions. Instead, we take the approach that households are forced to clear the market for government debt. This approach may be odd from the standpoint of a purely theoretical model, but it allows a way to allocate portfolios between two assets when the capital asset is actually risky in the real world but riskless in the model. Having a government debt asset in the model allows a closer simulation of the real economy where household saving into government debt funds current government spending.

The asset portfolio consists of physical capital, a_k, and government debt, a_d, such that

$a = a_k + a_d$. Thus, portfolio return is given by the weighted average

$$r_p = r_d \frac{A_d}{A_d + A_k} + r_k \frac{A_k}{A_d + A_k} \tag{9}$$

where A_d is aggregate household saving into government debt and A_k is aggregate household saving into real capital. Savings into government debt, A_d, is pinned down by a forced market clearing where household savings must first absorb government debt before any allocations toward real capital. Household level tax treatments take account of the different sources of portfolio income as interest income is usually taxed at higher rates than capital income.

Since the government's budget path is not balanced under current policy, an equilibrium which does not violate the transversality condition does not exist. We, therefore, implement a consumption tax which begins in the year 2060 and calculate a time-varying consumption tax rate such that the debt-to-output ratio is fixed from 2060 onward.

3.4 Foreign investors

We model the U.S. as a partially open economy. Take-up rates by foreign investors of U.S. government debt issuance and capital investment are estimated from historical data. Foreign investors in the model purchase a fraction of newly issued government debt, with the remainder purchased by U.S. households as explained above. Foreign investors also purchase (or sell) physical capital. The amount of foreign capital investment is calculated as in Berkovich and He (2019), where the total amount of capital inflow needed under a small open economy assumption is scaled by the estimated 'openness' of the U.S. economy.

3.5 Production

The production sector of the economy consists of identical, competitive firms such that total output of the economy is given by

$$Y = K^{\alpha} L^{1-\alpha} \tag{10}$$

where aggregate capital services, K, consist of the physical capital assets. Aggregate labor services, L, consist of total efficiency-adjusted labor hours demanded by the firm. As is usual for a setup with a zero-profit firm in competitive markets, labor demand is set equal to labor supply as equilibrium implies wages are the marginal product of labor.

The return to capital, r_k, is the post entity tax return to owners of capital. In the case of pass-through firms, tax treatment is applied at the shareholder level, but operating costs and depreciation still reduce capital returns. The return r_k is the dividend rate along with any capital gains from changes in the price of capital.

The firm earns revenues from sales of a homogeneous, numeraire good. The stream of dividends, $\{d_t\}$, represents earnings net of firm operating expenses and other costs, taxes, and investment. Negative d_t implies that the firm takes in equity financing in excess of its earnings during period t.

Dividends in the model represent free cash flow to the business entity and do not necessarily correlate with discretionary dividend payments which real-world entities pay to shareholders. Dividends are defined by

$$
\begin{aligned}
d_t = y_t & & \text{(Output)} \\
& - w_t l_t & \text{(Labor costs)} \\
& - (k_{t+1} - (1-\delta)k_t) & \text{(Investment)} \\
& - C_k(k_t, k_{t+1}) & \text{(Capital adjustment cost)} \\
& - \zeta_t^{other} y_t & \text{(Other expenses)} \\
& + b_{t+1} & \text{(Business debt proceeds)} \\
& - (1+\rho_t) b_t & \text{(Business debt repayment)} \\
& - T_t & \text{(Corporate taxation)}
\end{aligned}
\tag{11}
$$

Gross revenue is y_t from the production function defined above. Labor costs (wages plus benefits) are $w_t l_t$. Depreciation of fixed capital is δk_t, where capital deteriorates with economic depreciation rate of δ. Capital adjustment costs are given by

$$C_k(k_t, k_{t+1}) = \frac{\eta}{2}\left(\frac{k_{t+1} - (1-\delta)k_t}{k_t}\right)^2 k_t \tag{12}$$

where the capital adjustment cost function, $C_k(\cdot)$, is quadratic with scaling parameter η. Other current expenses, $\zeta_t^{other} y_t$, are measured as a fraction of output and calibrated from data. Business debt, b_t, is calculated from a tax-shield optimization problem, and the interest rate the firm pays on debt is ρ_t. Corporate taxation, T_t, includes credits and deductions for investment and interest expenses.

The total amount of corporate income tax liability is given by

$$T_t = \tau_t \Pi_t^{taxable} - \zeta_t^{cred} y_t \tag{13}$$

where τ_t is the U.S. statutory corporate income tax rate and $\zeta_t^{cred} y_t$ are corporate tax credits, taken as a fraction of output. Taxable income is

$$\begin{aligned}
\Pi_t^{taxable} = y_t & \qquad \text{(Sales)} \\
- w_t l_t & \qquad \text{(Labor deduction)} \\
- \phi_t^{int} \rho_t b_t & \qquad \text{(Interest deduction)} \\
- \phi_t^{exp} \left(k_{t+1} - (1-\delta)k_t\right) & \qquad \text{(Investment expensing)} \\
- C_k(k_t, k_{t+1}) & \qquad \text{(Capital installation deduction)} \\
- \zeta_t^{ded} y_t & \qquad \text{(Residual deduction)}
\end{aligned}$$

where parameter ϕ_t^{int} is the average deductible share of net interest expense and $\rho_t b_t$ is total interest expense including leverage cost. The investment expensing term, ϕ_t^{exp}, is the present value of depreciation deductions for the average dollar of current investment. It is calculated as:

$$\phi_t^{exp} = \sum_{s=0}^{40} \frac{1}{(1+R)^s} \psi_{t+s} \tag{14}$$

where ψ_{t+s} is the depreciation rate s years from the time of purchase, t, and the longest length of an asset's lifetime for tax purposes is 40.[12] The residual, $\zeta_t^{ded} y_t$, accounts for other deductions, under-reporting and conceptual differences, taken as a fraction of output and calibrated from data. Labor costs, $w_t l_t$, are fully deducted, as are capital adjustment costs, $C_k(k_t, k_{t+1})$. We assume capital adjustment costs consist primarily of fully deductible expenses such as labor costs and payments to outside contractors.

3.6 Recursive competitive equilibrium

Equilibrium prices are wage, w_t, and the return to physical capital (net of entity level taxes), $r_{k,t}$, in competitive equilibrium such that households solve their problem and firms solve their problem with the labor market clearing and asset market clearing. Aggregate capital is

$$K = \int_{\mathbf{s}} a_k d\Gamma(\mathbf{s}) \tag{15}$$

with household state equilibrium distribution $\Gamma(\mathbf{s})$. Aggregate labor services consist of the total effective labor supplied by households,

$$L = \int_{\mathbf{s}} z^1 n d\Gamma(\mathbf{s}) \tag{16}$$

with the same equilibrium distribution across household states.

4 Legal Immigration Results

We examine policies which change the flow of legal immigrants for the years 2022 to 2027. For these experiments, we assume that the supply of willing immigrants exceeds the threshold set by policy so that increasing the threshold results in increased immigration.

[12] Using current law depreciation rates, we find $\phi_{2020}^{exp} = 0.97, 0.91, 0.87, 0.83$ for R equals 1%, 3%, 5%, and 7%, respectively.

4.1 Demographics

We assume transitions across legal status remain fixed at the latest data available, as well as emigration, survival, and fertility rates. This assumption shapes the law of motion of total population (and those of individual group populations). Despite constant transition rates, each change in immigration flows generates a different population for each experiment, as shown in figure 9. For instance, although a policy does not change the inflow of unauthorized immigrants, that group population can still change due to more (or fewer) previously authorized immigrants overstaying their visas.

In the 6 years the immigration policy is active, the population spikes up (down) and then follows expected patterns such as an increase (decrease) when the children of immigrants are expected to join the labor market. In terms of the age distribution, figure 10 shows that increased immigration inflows decrease the average age of total population in the years of the policy. As inflows revert to baseline levels, the age distribution begins to converge toward that of the baseline, only to deviate again when immigrants' children reach the labor market, moving back toward the baseline in a cyclical fashion.

This wave shape is most evident in figure 11, which depicts the deviation from baseline of the available labor productivity per capita—a measure of the average potential labor productivity per hour for the average individual in the economy should they choose to work. As before, the valleys (below the zero horizontal line) represent periods of larger inflow of young working-age people in the economy when compared to the baseline, whereas the peaks represent periods of larger than baseline older working-age population. Young people, particularly young immigrants, are less productive than the rest of the population because they are at an early stage of their income life-cycle, when they are still relatively inexperienced. As they mature and gain experience, their labor productivity increases, peaking around the late 50s. By then, not only their productivity starts to decline, reducing the overall average, but also their children enter the labor force, reinforcing the downward trend in per capita productivity. With time, the fraction of retirees, for whom productivity is zero, in the economy tends to increase. An inflow of working-age immigrants (and their native children) contributes to a positive labor productivity, while a growing fraction of the citizen population is in retirement.

Figure 9: Total Population (percent deviation from baseline)

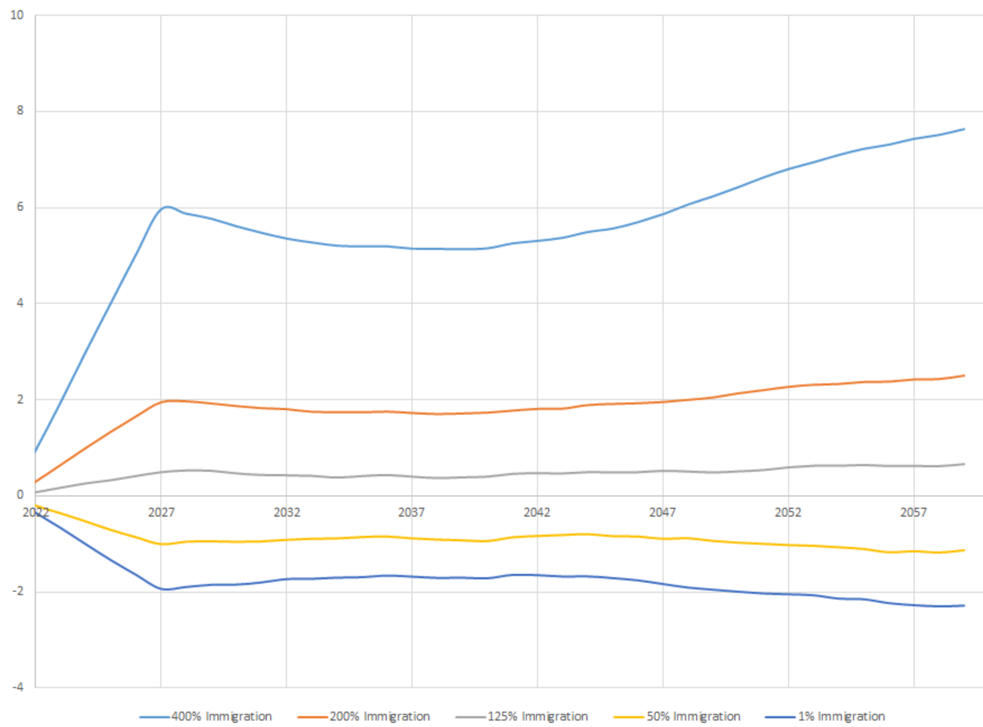


Figure 10: Average Age (deviation from baseline)

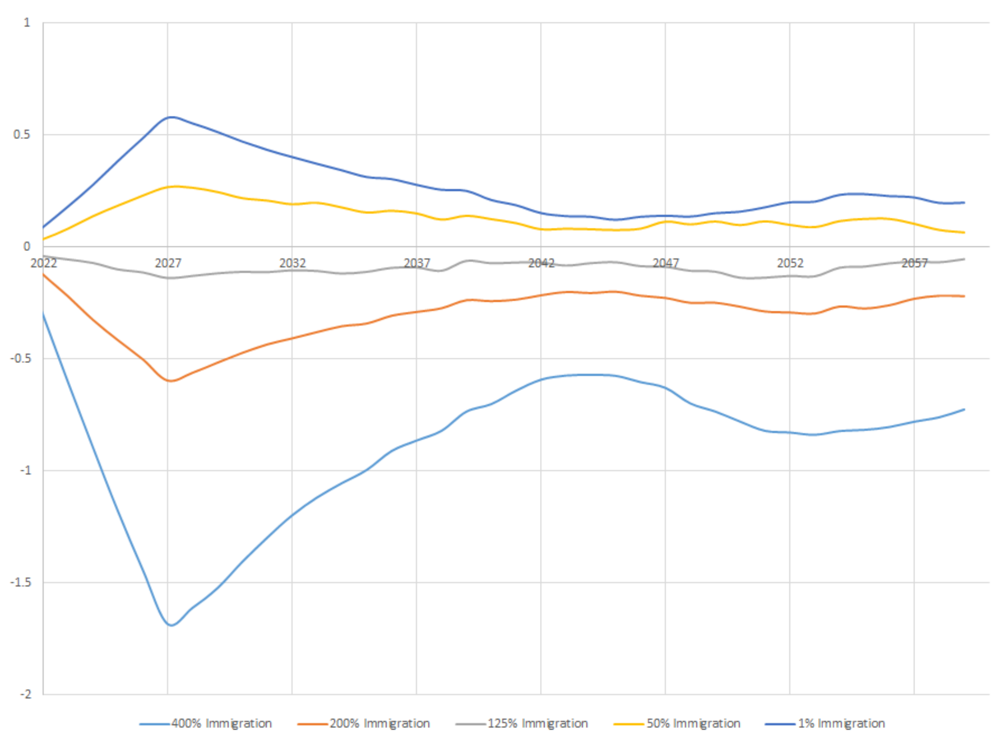
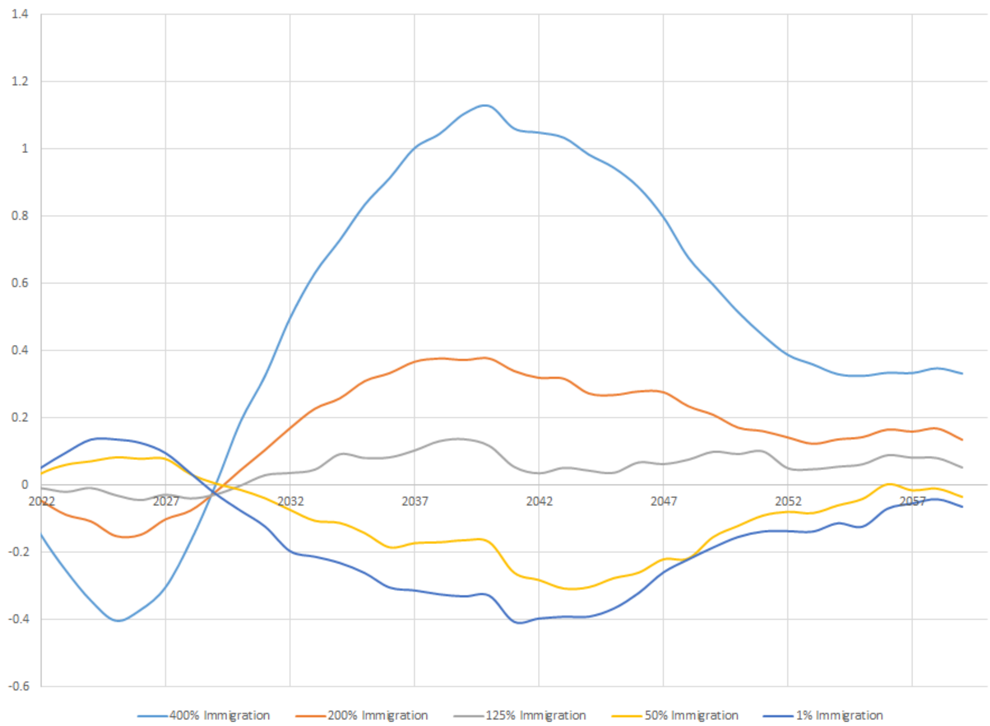


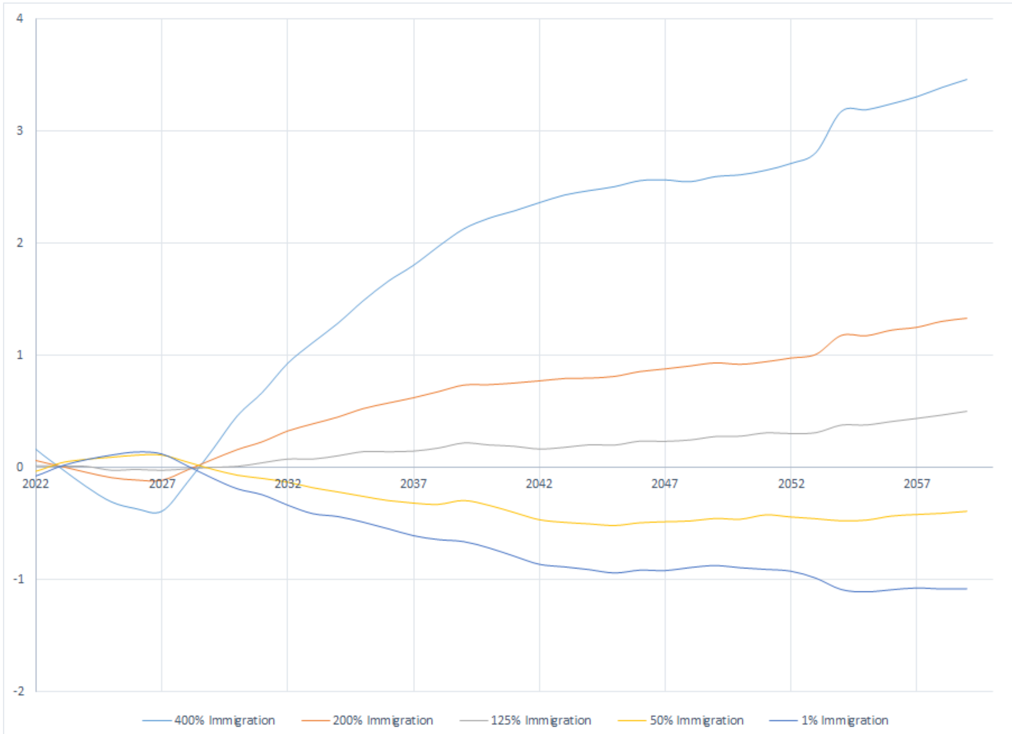
Figure 11: Available Labor Productivity per Capita (deviation from baseline)



4.2 Macroeconomics

At the begining of these policies, output per capita tracks available labor productivity per capita. Until approximately 2028, output per capita decreases for immigration increasing policies, and increases for immigration decreasing policies relative to baseline. In the first case, the economy absorbs an inflow of less productive workers. In the second case, the economy gets rid of less productive workers. These short-term costs or benefits of immigration policies are quickly and permanently reversed. This reversal arises from the increase in immigrants' per capita productivity over time. More (fewer) immigrants delay (speed up) the aging of the overall population. In the long-term, capital adjusts to the new level of labor in the economy and consolidates the permanently larger (lower) output level as the new equilibrium.

Figure 12: Output per capita (deviation from baseline)



The labor supply per capita measure couples the productivity measure with the supply of hours. When there is an inflow of lower productivity workers into the economy, the per capita labor supply may rise, provided that workers contribute enough work hours. That effect is shown in figure 13 for the increasing immigration experiments. Labor supply per capita follows a hump-shape with the peak coinciding with the peak productivity years for the additional immigrants and natives. Labor supply per capita starts decreasing with the aging of the population as in a life-cycle profile and as the available labor productivity per capita declines (figure 11), but remains above baseline. Capital per capita takes longer to adjust, getting back to baseline levels by the early 2030s. After that point, capital continues increasing to adjust to higher total labor.

For the decreasing inflows policies, labor supply per capita decreases initially. As immigration inflows revert to pre-policy levels, labor supply per capita still remains below the baseline level, slowly converging back to the pre-policy level once the demographic effects of the policy subside. Capital per capita increases at first, but then adjusts to the new lower levels of labor supply.

Figure 13: Labor Supply per capita (deviation from baseline)

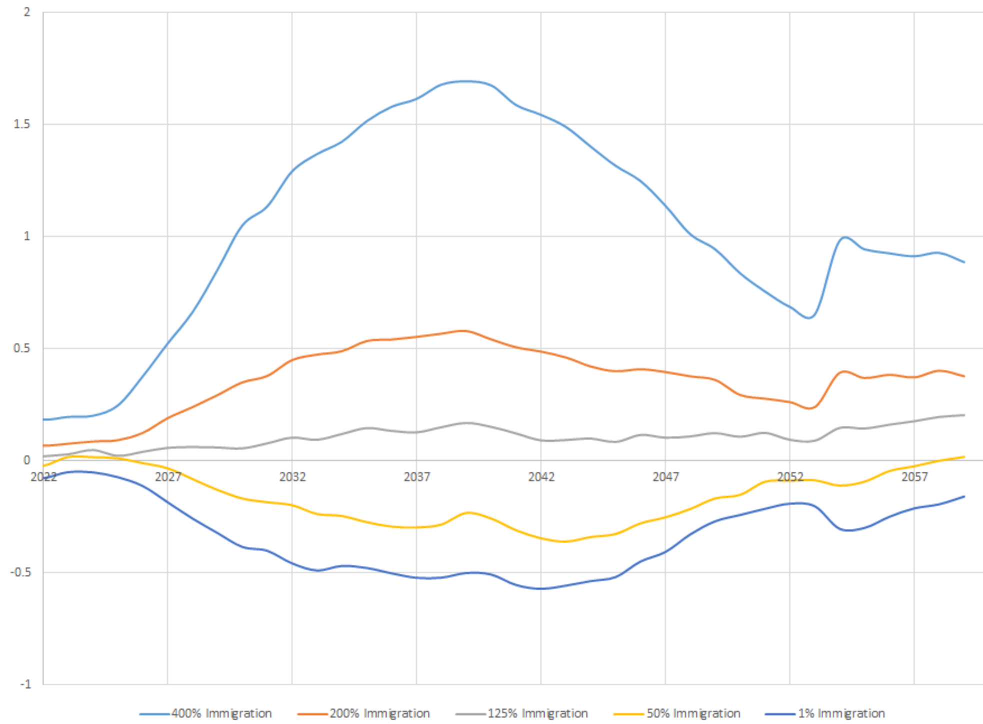
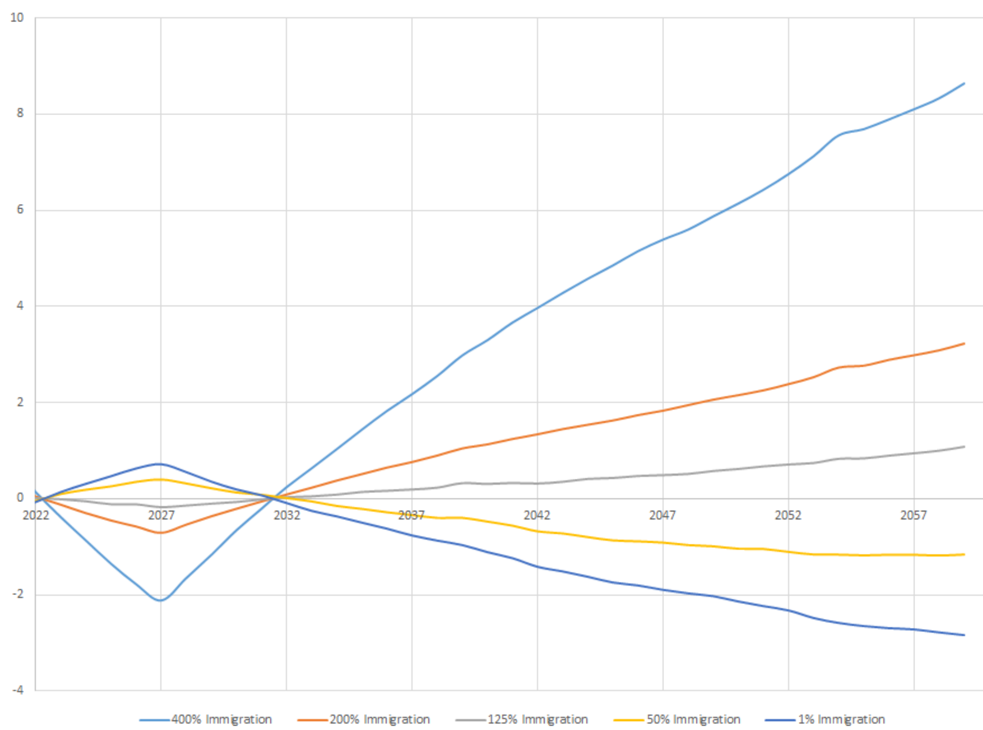


Figure 14: Capital per capita (deviation from baseline)



Production input prices are plotted below. Wages and capital rates cross the baseline values (that is, the dashed zero horizontal line) a little while after per capita capital recovers to baseline.

Figure 15: Hourly wages (deviation from baseline)

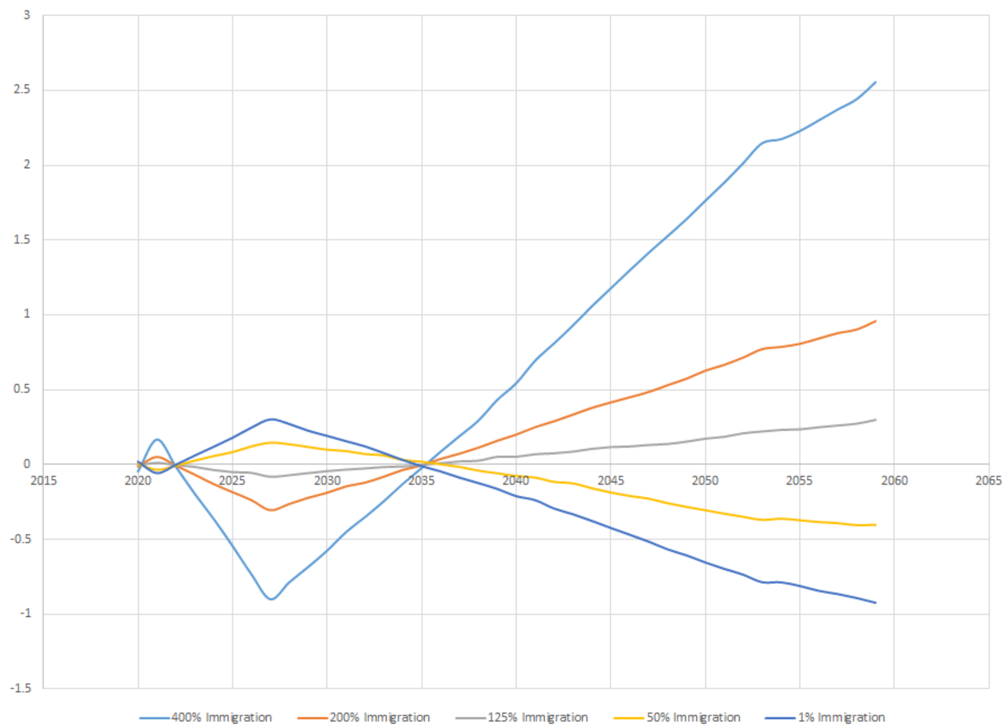
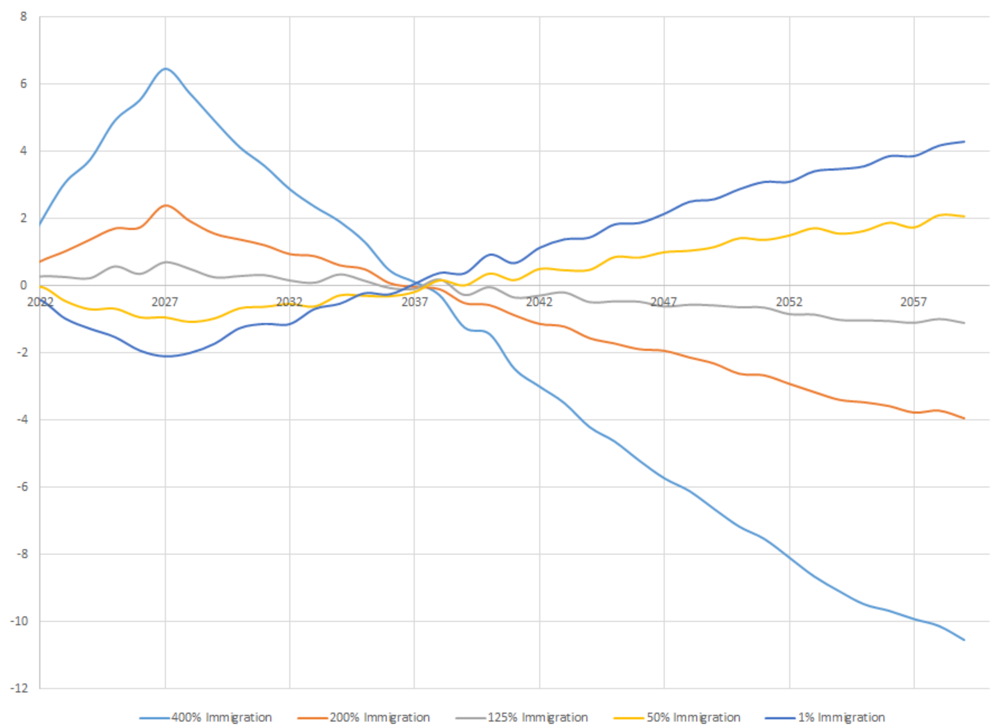


Figure 16: Capital return rates (deviation from baseline)



4.3 Government

Government debt is mostly driven by two factors: (1) Capital crowding-in (-out) generated by increasing (decreasing) immigration policies, and (2) the new levels of revenue and spending that result from demographic changes. The crowding-in (out) effect results from the higher (lower) levels of capital per capita required to reestablish the equilibrium in input factor markets (see figure 14). The larger (lower) the capital stock, the lower (larger) the proportion of debt in the assets portfolio.

Table 1: Government Debt per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	-0.64	-0.24	-0.06	0.08	0.19	0.00	-0.02
2032	-9.46	-3.28	-0.84	1.59	3.35	-0.30	-0.22
2042	-15.28	-5.33	-1.40	2.61	5.25	-0.10	-0.18
2052	-20.13	-7.08	-1.93	3.52	6.94	0.59	0.03

Tables 2 and 3 depict the second set of factors determining government debt: revenues and spending. The expansion of immigration policy generates, at first, a decrease in the government revenue per capita. This effect occurs because (a) younger and less productive workers (such as the average newly-arrived immigrant) earn lower labor income and, as a consequence, contribute less in taxes, and (b) wages decline in these initial years because of the relative abundance of labor with respect to capital, until the latter adjusts. Lower wages translate into lower tax base and lower revenue. Similarly to revenue, spending per capita decreases for the immigration expansion policies. The former measure illustrates that the extra spending induced by the newly arrived immigrants does not rise enough to compensate for the broader population base. In other words, per capita spending for immigrants is lower than that for the general population.

Table 2: Revenue Model per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	-0.93	-0.40	-0.25	0.01	0.21	-0.12	-0.19
2032	-0.25	0.04	0.09	-0.05	0.33	0.19	0.22
2042	1.13	0.40	0.17	-0.44	-0.41	-0.25	0.03
2052	1.22	0.42	0.03	-0.15	-0.51	-0.19	-0.06

Table 3: Government Spending per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	-0.63	-0.26	-0.11	0.03	0.15	0.02	-0.08
2032	-3.76	-1.29	-0.33	0.62	1.32	0.76	0.25
2042	-2.96	-1.03	-0.29	0.59	1.00	0.97	0.45
2052	-2.73	-0.99	-0.39	0.29	0.81	0.96	0.35

Tables 4 and 5 show that personal income taxes and payroll taxes follow the trend in wages depicted in figure 15. When wages are below the observed level in the baseline, labor income falls below its baseline level as well, implying a smaller tax base. These figures also show that most of the revenue changes can be explained by these two components.

Table 4: Personal Income Taxes per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	-0.33	-0.13	-0.06	-0.01	0.04	-0.08	-0.08
2032	0.20	0.09	0.04	-0.01	-0.04	-0.07	0.01
2042	1.85	0.62	0.12	-0.41	-0.70	-0.31	-0.05
2052	2.09	0.77	0.24	-0.35	-0.76	-0.35	-0.08

On the spending side, the main effect comes from the interaction of eligibility criteria

Table 5: Payroll Taxes per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	0.06	-0.01	0.13	0.02	-0.05	0.04	0.01
2032	0.21	-0.07	0.60	0.04	-0.23	1.02	0.56
2042	0.69	-0.42	2.14	0.14	-0.82	0.23	0.19
2052	0.91	-0.39	2.56	0.29	-0.88	-0.18	0.01

for the biggest spending programs and changed demographics. The most sizeable programs are related to the aging of the population–Social Security benefits and Medicare, depicted in tables 6 and 7, respectively. As discussed above, an increase (decrease) of immigration inflows decreases (increases) the average age of the population, which delays (expedites) the costly consequences of an aging population. In other words, with a larger (smaller) working-age population the per capita costs of sustaining safety net programs that benefit retirees and the elderly go down (up).

Table 6: Social Security Benefits per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	-0.42	0.04	-1.00	-0.18	0.25	-0.01	-0.14
2032	-1.83	0.86	-5.35	-0.48	1.89	-0.11	-0.25
2042	-1.66	0.96	-4.86	-0.45	1.64	0.21	0.07
2052	-1.70	0.79	-4.84	-0.56	1.51	0.44	0.06

Table 7: Medicare Spending per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	-0.35	0.06	-0.85	-0.14	0.20	0.01	-0.09
2032	-1.41	0.67	-4.13	-0.36	1.43	1.16	0.43
2042	-0.99	0.52	-2.89	-0.30	0.89	1.59	0.77
2052	-1.03	0.38	-2.86	-0.43	0.77	1.57	0.64

Income-based programs display different patterns. Even though the initial decrease in wages reduces average labor income, making more people fall below program eligibility thresholds, the age component again plays an important role. In the case of Medicaid, table 8 shows that more (fewer) immigrants reduce (raise) the per capita cost of the program because newly arriving immigrants are slightly younger, which brings down their health costs compared to the overall population, due to age-specific Medicaid costs. For the SNAP program, table 9 illustrates that there is an initial increase (decrease) of such benefits per capita when wages are below (above) baseline levels and then, towards the end of the period, when the average age of the working population drops with the arrival of the immigrants' children (increases with the aging of the population). In the long run, immigration expanding policies increase the share of citizens who receive SNAP benefits (figure **??**). Younger workers, regardless of legal status, are less productive, hence, poorer. As native-born immigrant children enter the workforce, these younger workers are more likely to receive SNAP benefits. For the legal immigrant group, we observe that the share of recipients increases at first, when wages drop and they are younger relatively to the rest of the population, but soon drops below the share of baseline for the immigration increasing policies.

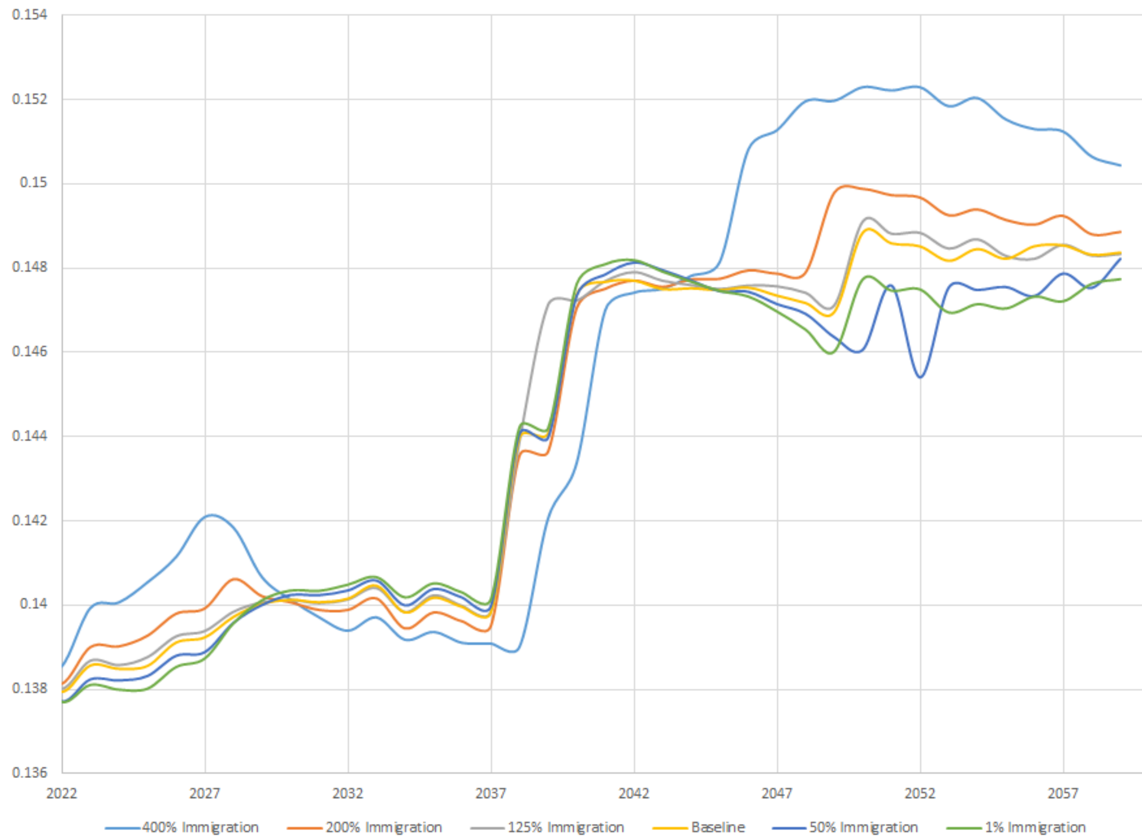
Table 8: Medicaid Spending per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	0.09	0.04	0.08	0.03	-0.01	0.06	0.05
2032	-0.27	0.17	-0.77	-0.07	0.28	1.94	0.95
2042	-0.23	0.05	-0.31	-0.13	0.17	1.38	0.67
2052	-0.29	0.05	-0.61	-0.23	0.16	0.82	0.37

Table 9: SNAP Benefits Spending per capita (Deviation from baseline)

Year	400% Imm	200% Imm	125% Imm	50% Imm	1% Imm	FullLegalize	HalfLegalize
2022	0.15	-0.17	0.45	0.05	-0.18	0.08	0.00
2032	-0.19	0.14	-0.54	-0.02	0.24	1.00	0.53
2042	-0.03	0.30	-0.26	0.11	0.34	0.88	0.29
2052	0.78	-1.93	2.59	0.23	-0.67	0.67	0.19

Figure 17: Share of total population receiving SNAP



5 Legalization Results

We model policies which provide legal status to unauthorized immigrants. The unauthorized immigrant population consists of both illegal entrants and visa overstays. As described above, we estimate that even a "full-legalization" policy would not cause all unauthorized immigrants to become legalized.

5.1 Demographics

When a legalization policy is implemented, demographic changes are more subtle than those affecting flows of immigrants. First of all, previously unauthorized immigrants, now legal, were already in the economy, being accounted for in population, average age and productivity measures, and so on. The immediate changes are, therefore, smaller. For example, in our model, emigration rates for legal immigrants are lower than for unauthorized immigrants, so legalization entails more people remaining in the U.S. instead of going back to their country of origin. A consequence of the reduced emigration rate is the slow and continuous increase of total population with respect to baseline after a legalization policy. As figure 18 shows, population continuously increases until around 2045.

Another difference with respect to changes in immigration flow is the average age of the population through time, depicted in figure 19. Although immigrants are younger on average than citizens, legalized older immigrants are more likely to remain. The more newly legalized immigrants remain in the country, the larger the effect. Average age increases earlier for the full legalization policy than for the half legalization one.

Legalization also differs from the immigration flow policies in its effect on the population of immigrants' native children. Existing immigrants are older than newly arriving immigrants (38.6 years old versus 30.9 years old for new unauthorized immigrants), so existing immigrants are less likely to bear children. Importantly, as unauthorized immigrants were already present in the country and on average middle-aged, many of their children have already been born (as natives or otherwise, but already accounted for in the baseline economy).

Figure 20 shows that labor productivity increases slightly right after the legalization policy takes place because of our assumption that legal immigrants have access to formal labor markets and better work opportunities than unauthorized immigrants. That assumption translates into a higher labor income prospect, which in our model enters as a higher labor productivity.

Figure 20 shows that, after the discrete increase in productivity, there is a decreasing trend with respect to baseline. Newly legalized immigrants are more likely to remain and, because they have a lower education achievement on average, the long-run available labor productivity per capita declines.

Figure 18: Total Population (percent deviation from baseline)

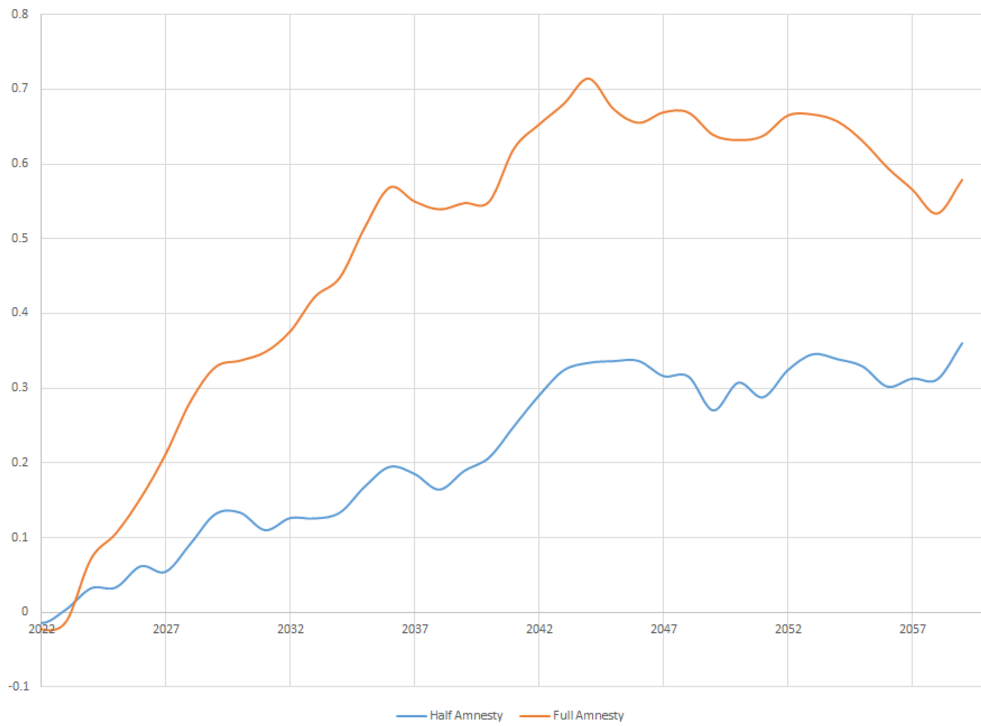


Figure 19: Average Age (deviation from baseline)

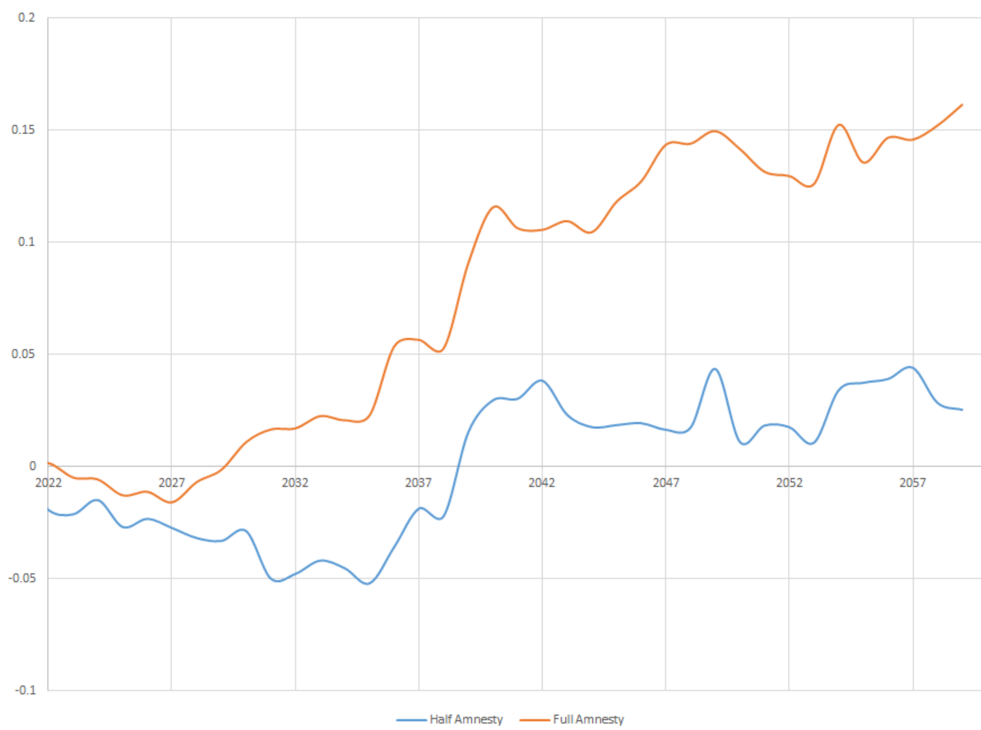
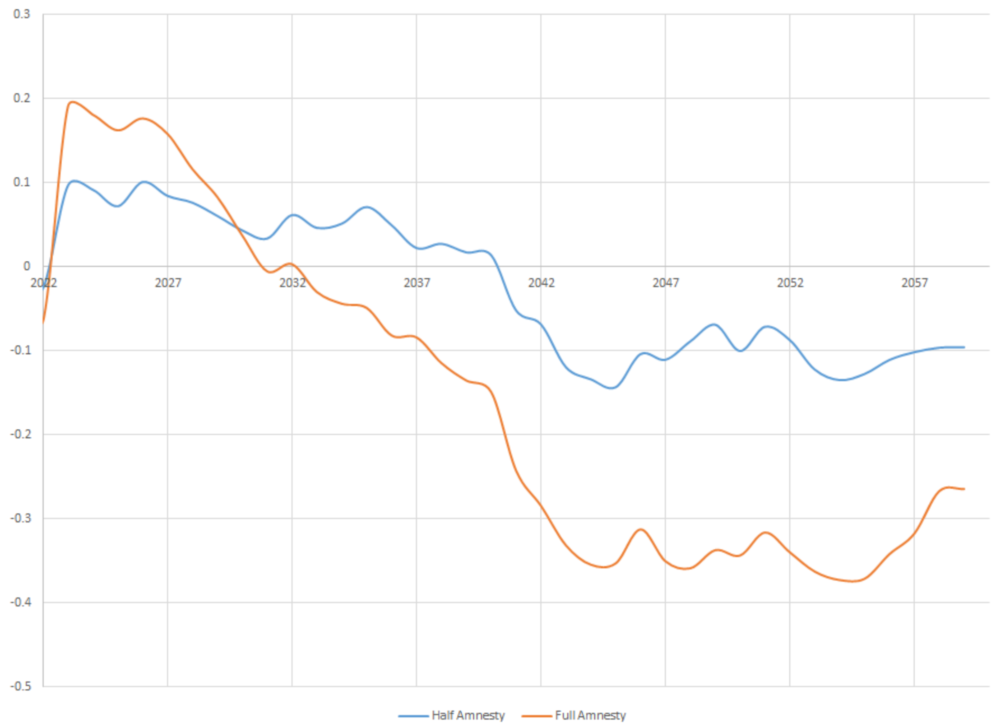


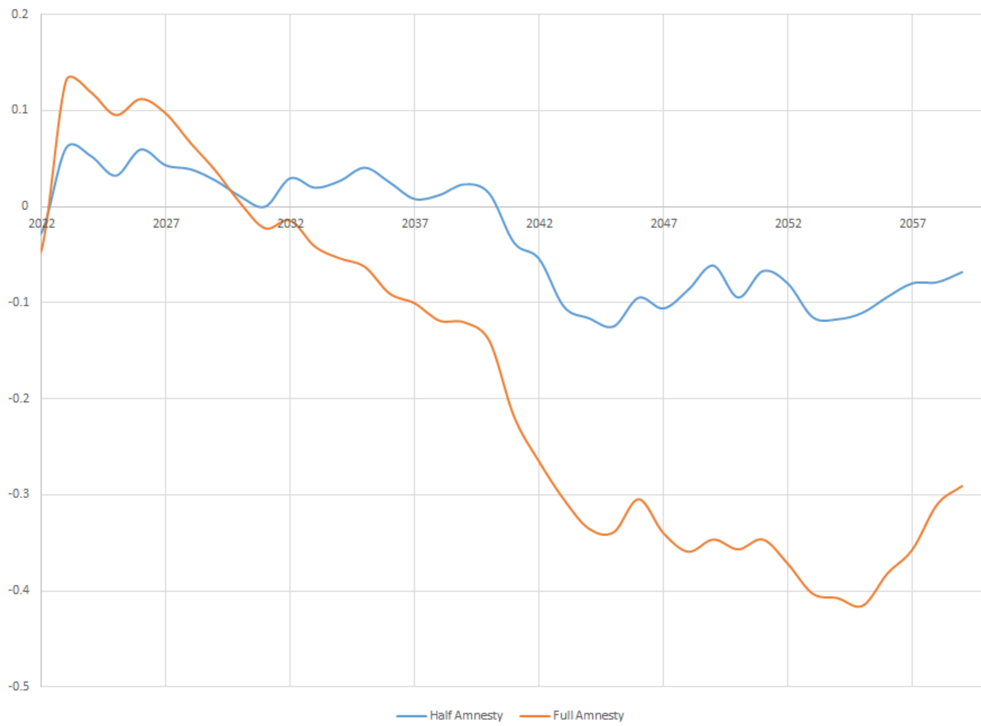
Figure 20: Available Labor Productivity per Capita (deviation from baseline)



5.2 Macroeconomics

Figure 21 shows that output per capita for the legalization policies closely follows the pattern observed for available labor productivity. When unauthorized immigrants gain legal status and their productivity rises due to the status change, output per capita goes up. Since legalized immigrants are less productive than the population average and are more likely to stay in the country, output per capita drops in the long-run.

Figure 21: Output per capita (deviation from baseline)



Labor supply per capita follows a similar path as labor productivity, while capital per capita adjusts to the new labor supply levels.

Figure 22: Labor Supply per capita (deviation from baseline)

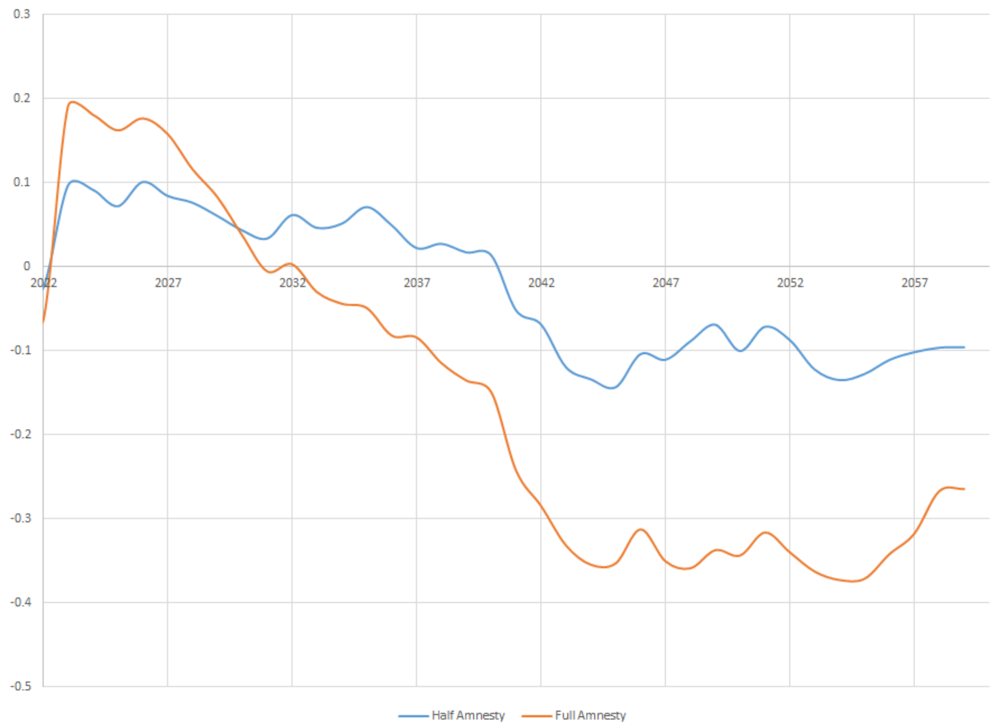
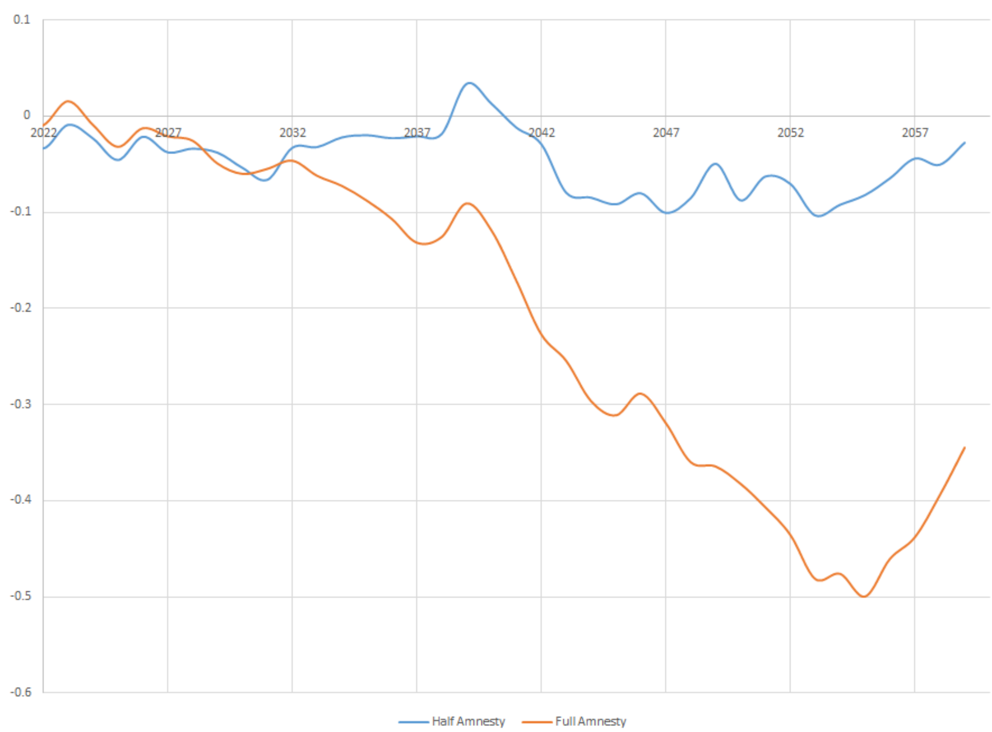


Figure 23: Capital per capita (deviation from baseline)



Unauthorized workers earn less than natives (mostly due to demographic characteristics, especially education). Legalization increases their propensity to remain in the country, thus decreasing per capita wage. However, legalization increases that population's average wage while having minimal effect on the wages of the rest of the population. This effect is a version of Simpson's Paradox–average wage is decreasing even though every individual's wage has gone up simply because more low-productivity people live in the country. Nonetheless, wage fluctuations are very small in magnitude as those workers were already present in the economy and represent a much smaller share of the population than in the legal immigration experiments. Return on capital rates track the path of capital changes.

Figure 24: Hourly wages (deviation from baseline)

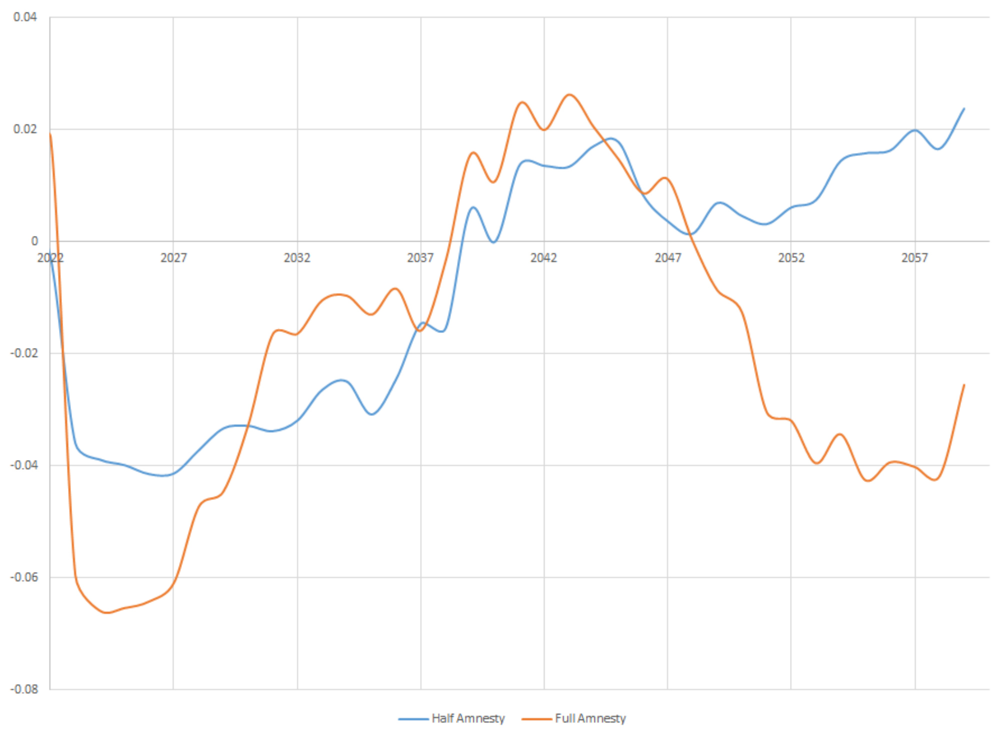
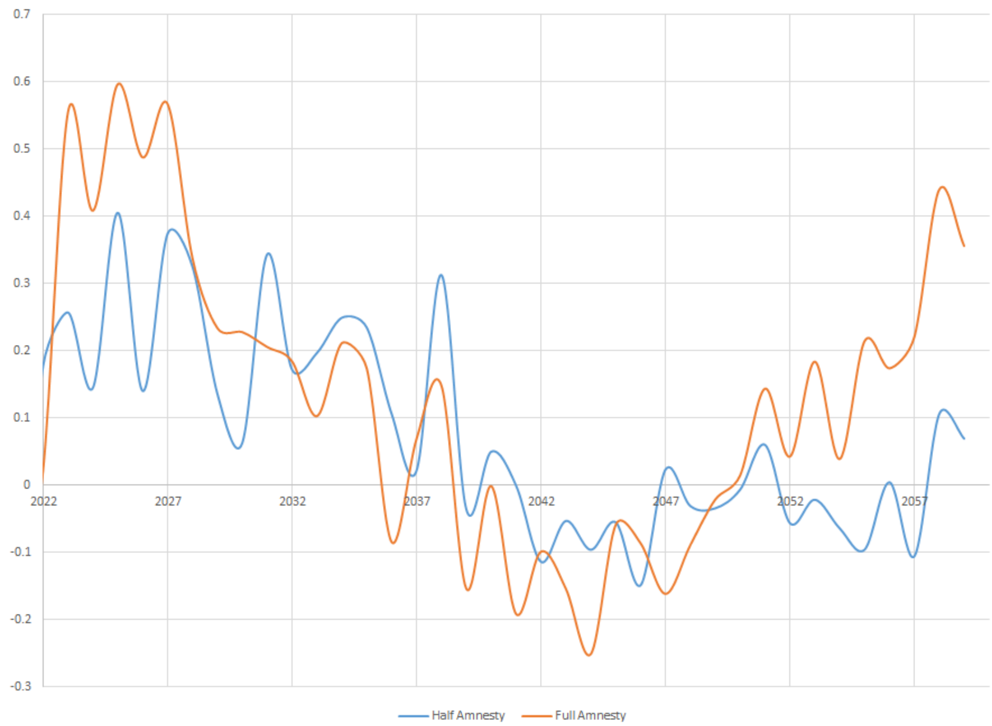


Figure 25: Equity dividend rates (deviation from baseline)



5.3 Government

Government debt behavior is mostly driven by the levels of revenue and spending that track the demographic changes. Debt per capita decreases initially as most newly legal immigrants are of working-age and remain more often in the country, contributing to taxes.

Figure 26: Government debt per capita (deviation from baseline)

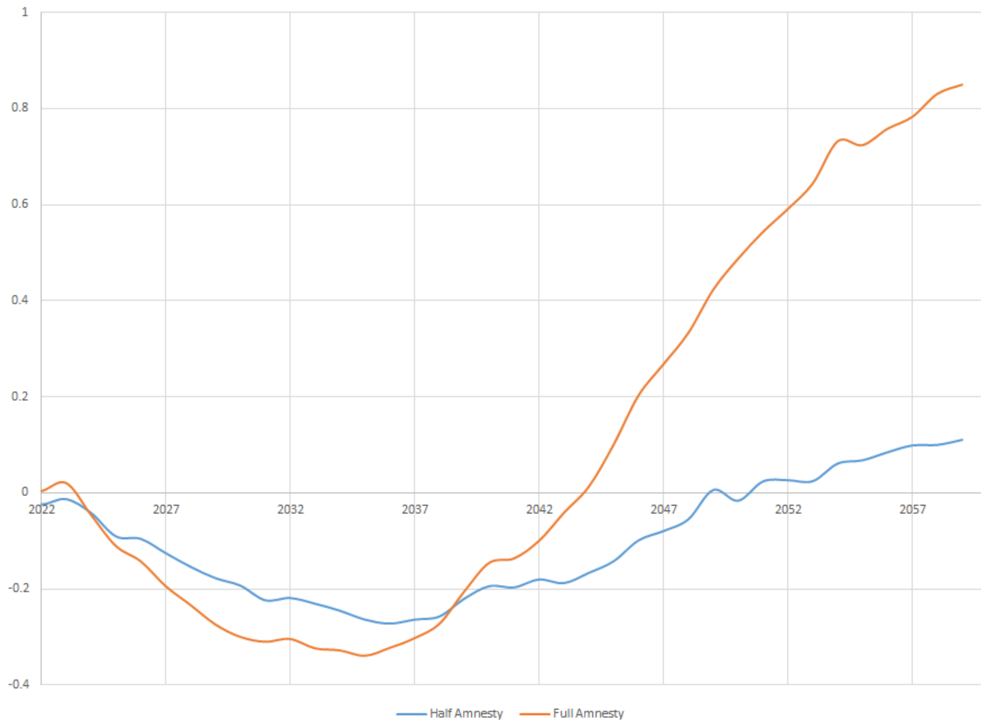


Figure 27: Government Revenue per capita (deviation from baseline)

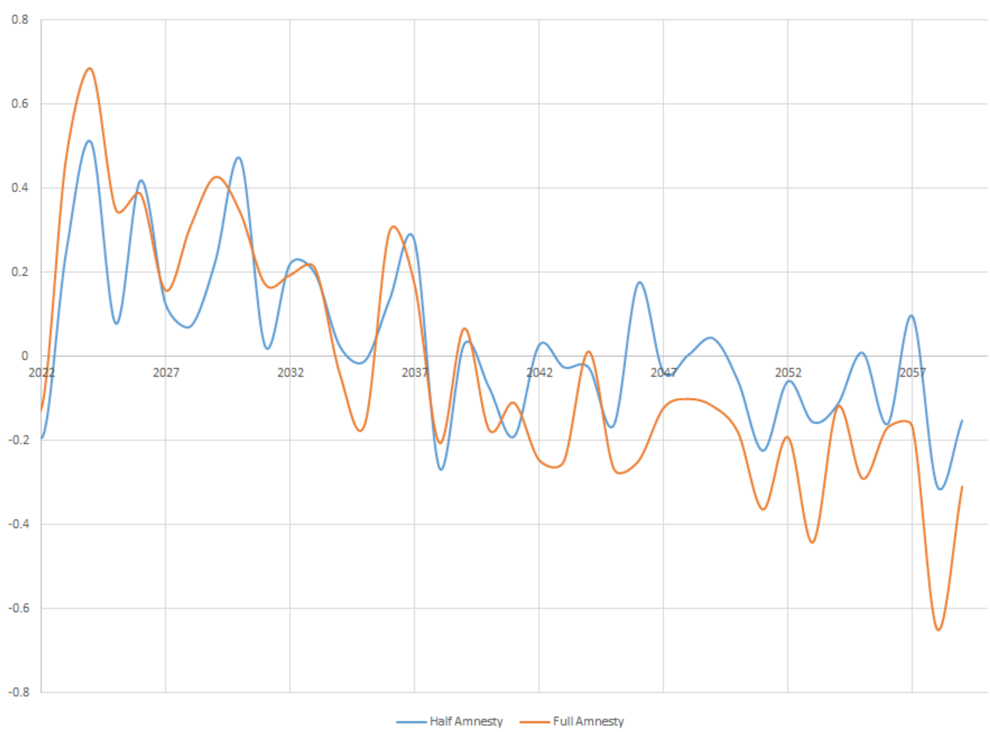
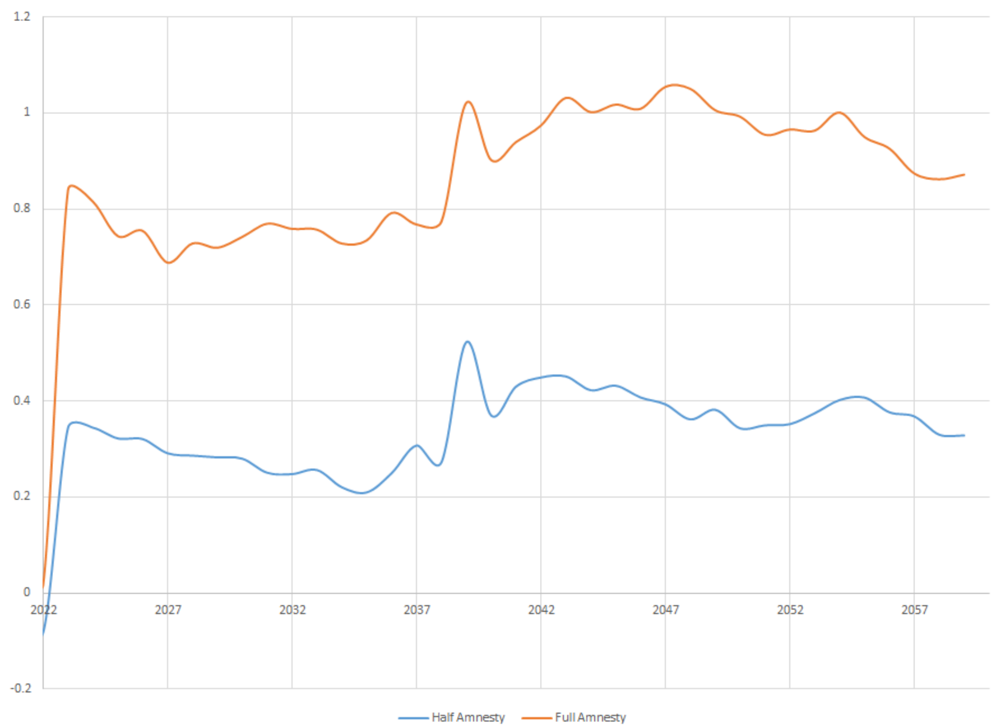


Figure 28: Government Spending per capita (deviation from baseline)



Figures 26 and 27 show that the initial decrease in government debt per capita results from a larger revenue per capita. We assume only a fraction of the unauthorized immigrants pay income taxes as a proxy to their disproportionately larger involvement in informal labor markets. According to Actuarial Note No. 151 by the Social Security Administration (April 2013), 28.7% of unauthorized immigrants pay payroll taxes[13]. We use this number for both payroll and personal income tax compliance by unauthorized workers. Since legalized immigrants pay more taxes on average, the legalization policy entails an immediate increase in government revenues. However, as labor income decreases, revenue per capita decreases and, eventually, goes below the baseline level, culminating in a debt per capita increase. Spending per capita rises immediately after the policy is implemented and permanently stays at a higher level. The increase is due to legal immigrants being eligible for certain transfer programs[14] which are not available to unauthorized immigrants.

[13]Suro and Findling (2021) also points out that frequent policy changes in the ITIN number system unauthorized immigrants use to pay taxes complicates compliance, so Legalization is likely to increase ease of compliance even for non-informal unauthorized workers.

[14]In general, the eligibility rules for most safety net programs require legal permanent residency for the previous five years. In the current model, we do not to track length of legal permanent residency explicitly.

Figures 29 and 30 show revenue per capita separated by personal income taxes and payroll taxes. With the increase in labor productivity of the immigrants who gained legal status comes an initial increase in labor income, which increases the tax base for those two taxes. Moreover, newly legalized immigrants are assumed to pay taxes, so total revenue per capita increases due to higher compliance with personal income taxes and payroll taxes. The magnitude of the increase in payroll taxes is larger because that tax is a flat rate on labor income rather than the low rates on personal income tax that lower income individuals pay in the progressive personal income tax. As time progresses, the decline in both available labor productivity and labor supply leads to the decrease in labor income which shrinks the tax base. Revenue, thus, falls below the baseline level, with the decline happening earlier for personal income taxes.

Figure 29: Personal income taxes per capita (deviation from baseline)

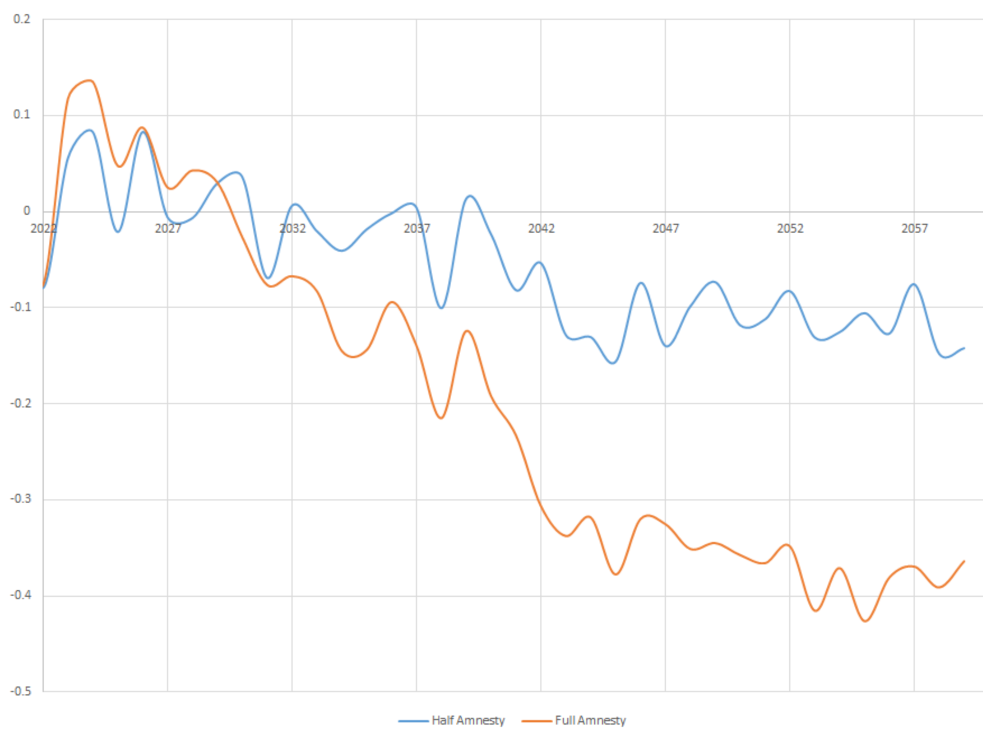
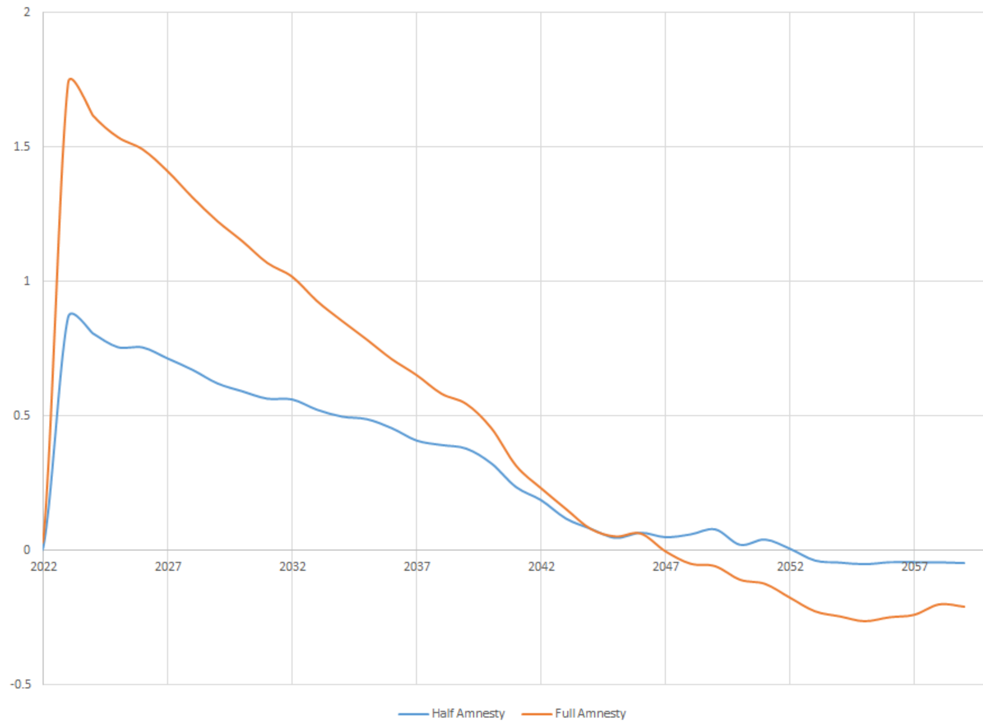


Figure 30: Payroll taxes per capita (deviation from baseline)



Looking at government spending, figure 31 shows that per capita spending on Social Security benefits decreases relative to the baseline due to the lower emigration rates of newly legalized immigrants of working-age who previously would have left the country. As these workers retire and become eligible for retirement benefits, Social Security spending increases beyond the baseline level.

Figure 31: SS benefits per capita (deviation from baseline)

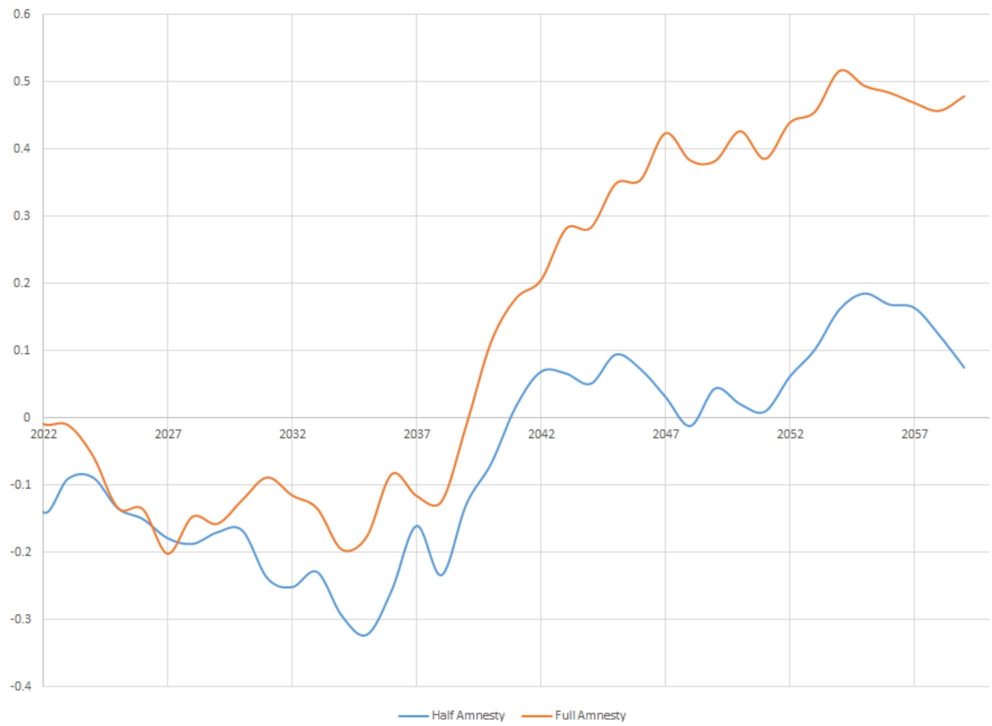
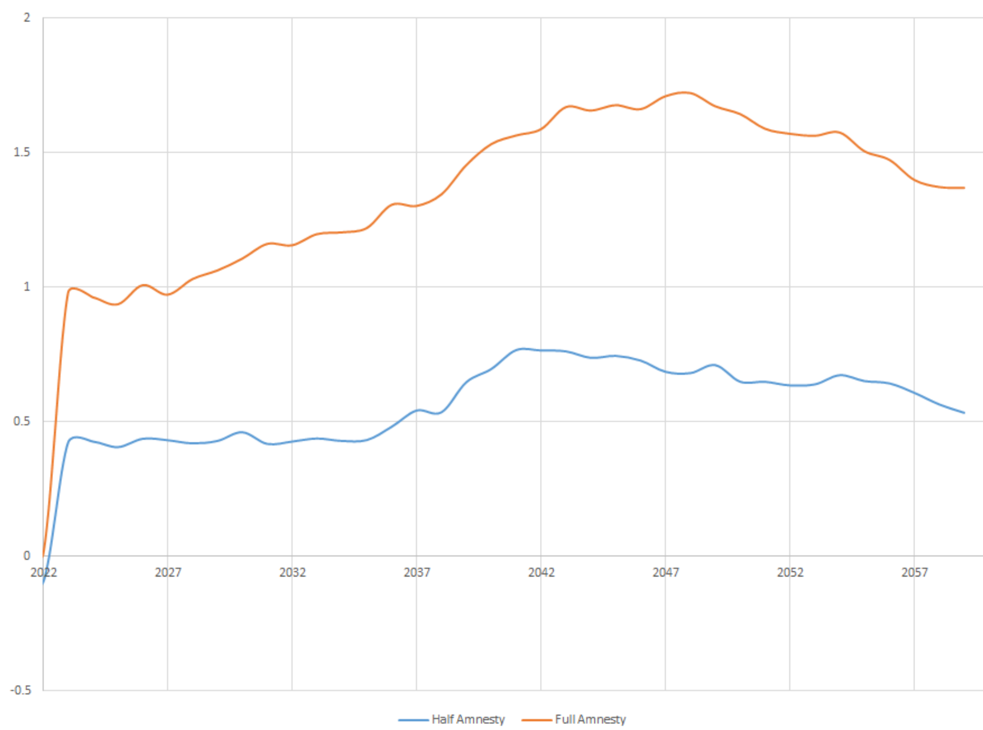


Figure 32: Medicare spending per capita (deviation from baseline)



Figures 33 and 34 display the per capita spending on SNAP and Medicaid programs. The initial drop in wages coupled with the increase in the population that can qualify to receive federal benefits raise Medicaid and SNAP benefits per capita up relative to the baseline. With time, both programs cost levels drop slightly though remain above the baseline.

Figure 33: Medicaid spending per capita (deviation from baseline)

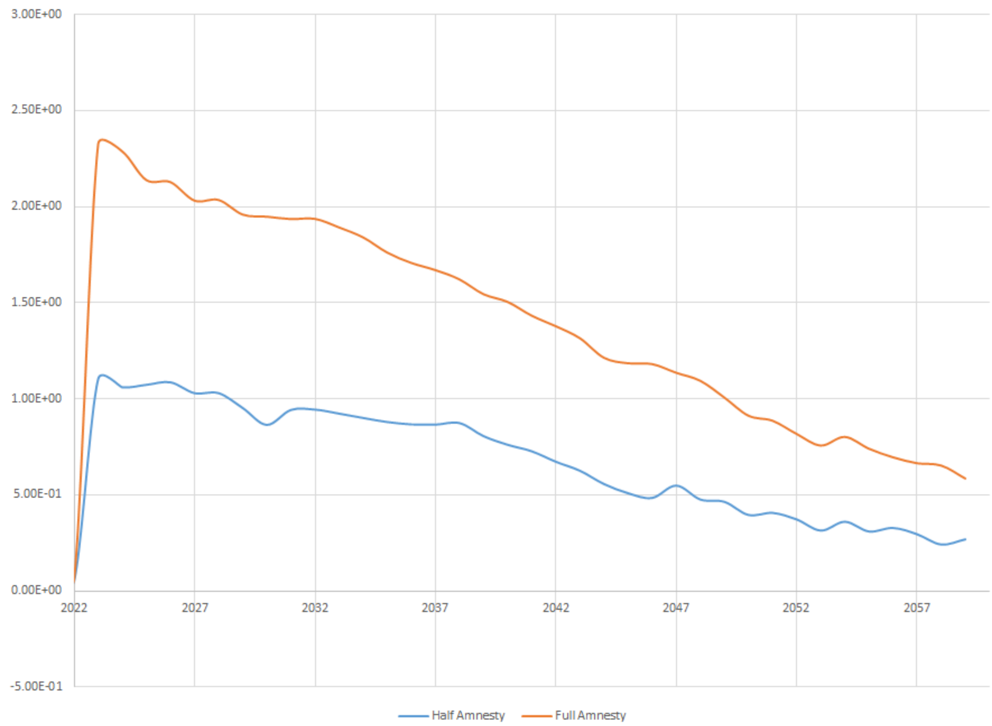


Figure 34: SNAP benefits spending per capita (deviation from baseline)

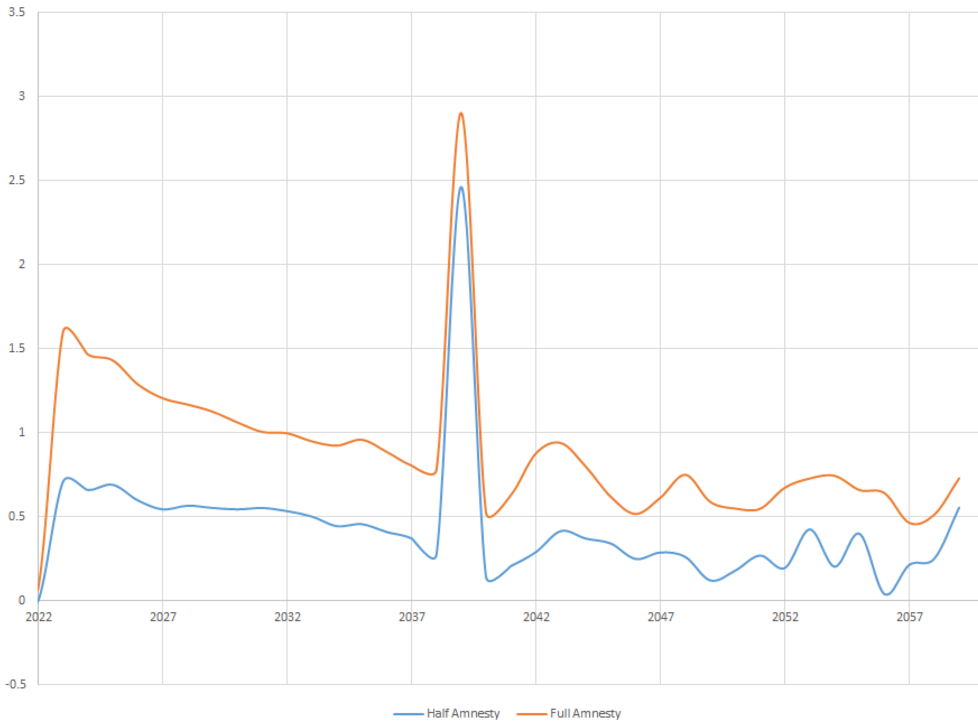
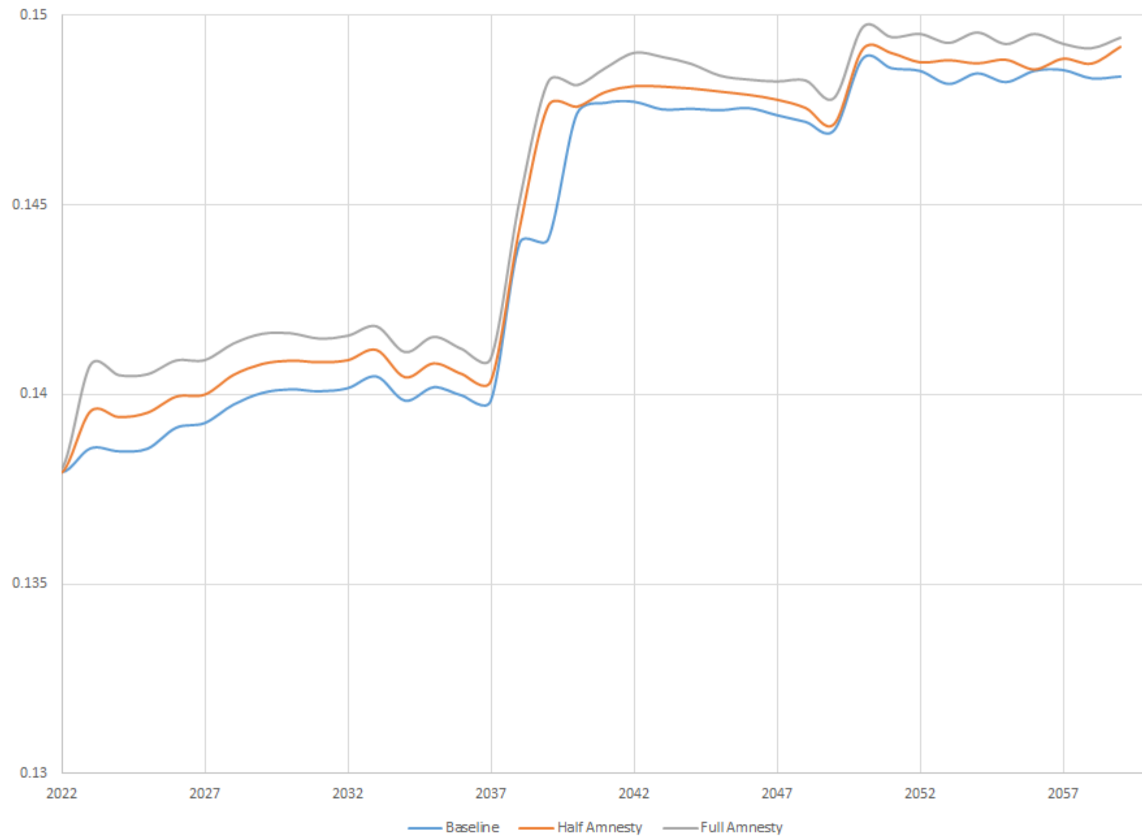


Figure 35: Share of total population receiving SNAP



6 Conclusion

Using a heterogeneous agent, overlapping generations, incomplete markets, general equilibrium model with an exogenous shock process which jointly defines labor productivity and immigration legal status transitions, we analyze the macroeconomic effects of immigration policies which alter the inflow of legal immigrants and policies which provide legalization of unauthorized immigrants. We find that, after an initial period, increasing legal immigration improves both the government's fiscal balance and the economy on a per capita basis. Legalization policies, on the other hand, worsen the government's fiscal balance due to increased spending, while having modest effects on the economy broadly.

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