Sustaining Fiscal Policy through Immigration

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Using a calibrated general equilibrium overlapping generations model, which explicitly accounts for differences between immigrants and natives, this paper investigates whether a reform of immigration policies alone could resolve the fiscal problems associated with the aging of the baby boom generation. Such policies are found to exist and are characterized by an increased inflow of working-age high- and medium-skilled immigrants. One particular feasible policy involves admitting 1.6 million 40–44-year-old high-skilled immigrants annually. These findings are illustrated by computing the discounted government gain of admitting additional immigrants, conditional on their age and skills.

I. Introduction

The fiscal implications of immigration to the United States are, potentially, very large, not only because the inflow of immigrants is strong—about 1.1 million per year—but also because immigrants are younger than Americans and have a wider distribution of skills. If skilled workers immigrate and immediately start paying taxes, the net fiscal effects are likely to be large and positive, even when the gains are traded off with the subsequent costs of retirement. Moreover, young immigrants would alleviate the current demographic imbalance, but without a 20-year period of childhood. Thus selective immigration should be able to mitigate some of the fiscal burden

associated with the aging of the baby boom generation and might, to some extent, serve as an alternative to tax hikes or spending cuts for financing future fiscal deficits.[1]

   This paper explores whether a selective immigration policy alone could be used as an instrument to balance the budget and avoid fiscal reform altogether. The findings are illustrated by computing the net government gain, in present value terms, of admitting one additional immigrant, conditional on skills and age at the time of immigration.

   The framework is a dynamic equilibrium model of population transition, closely related to the model of Auerbach and Kotlikoff (1987). Immigration is given by a selective immigration policy determining the age and skill structure and the annual inflow of new immigrants. Natives and immigrants in the model economy differ in age, skills, and fertility. In addition, immigrants are differentiated by age at the time of immigration and by their legal status. The overlapping generations framework captures the first-order effects of immigration: an inflow of working-age immigrants increases tax revenues per capita and reduces government debt and government expenditures per capita. When immigrants retire, these effects are reversed. A general equilibrium analysis is required since the government budget is also affected through increases in interest rates and decreases in wages due to a rise in the labor/capital ratio (when it is assumed that capital does not flow into the country in response to immigration). Higher interest rates increase the cost of servicing the public debt, and lower wages reduce tax revenues.

   I find that selective immigration policies, involving an increased inflow of working-age high- and medium-skilled immigrants, can remove the need for future fiscal reform. In contrast, an increased inflow of immigrants with the age and skills composition of average *current* immigrants cannot, in itself, induce long-run budget balance. I compute, as a benchmark, the smallest increase in annual immigration required to balance the budget, given that the government is free to choose the distribution of age and skills of new immigrants, while restricted to keeping the current tax and spending policies unchanged. This minimum change involves increasing annual immigration from 0.44 percent to 0.62 percent of the population, or about 1.6 million, provided that all new immigrants are high-skilled and 40–44 years old. Admitting adult immigrants but excluding their children may not be politically feasible, however. If immigrants

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[1] For instance, using data from the Health and Retirement Survey, Gustman and Steinmeier (1998) show that immigrants, on average, have provided a positive net contribution to Social Security.

were instead admitted in family units, the minimum number of immigrants required would increase to 1.08 percent of the population annually, with the head of the family assumed to be high-skilled and 45–49 years old. While admitting 1.6 million immigrants annually might seem like a considerable policy change, it is illuminating to contrast this to an alternative fiscal reform: income taxes would have to increase by 4.4 percentage points if one opted for changing taxes instead of immigration policy or government expenditures. Thus it seems sensible to consider at least marginal reforms of immigration policy as part of a larger fiscal reform package.

These findings are driven by the following results: Under the current fiscal policy and the immigration policy outlined above, the discounted value of future tax receipts less government expenditures associated with an additional immigrant varies considerably with age and skills and reaches a maximum of $177,000, or seven times gross national product per capita, for high-skilled immigrants arriving when they are 40–44 years old. This includes the cost of future descendants. The average net present value (NPV) of representative high-, medium-, and low-skilled legal immigrants is found to be $96,000, −$2,000, and −$36,000, respectively. In comparison, the NPV of a newborn native is −$88,000.

All age profiles of NPV for new immigrants are hump-shaped and peak between the ages of 35 and 44. The timing of the peak is robust to several changes in the model setup because of a basic trade-off between a longer remaining working life on the one hand and a smaller number of new children on the other. Abstracting from the cost of future children would increase the average discounted gain by $20,000 and make the age profiles peak earlier. If, alternatively, family migration is considered (immigrants bringing existing children when immigrating), the maximum NPV falls to $140,000 per 40–44-year-old high-skilled head of household.

To the extent that one is willing to consider using the immigration policy for enriching public coffers, the paper offers several immediate policy implications. The analysis suggests which groups of immigrants to target, if the aim is to maximize the public coffer contribution per immigrant. For instance, the Canadian "point system" for allocating visas to prospective immigrants favors skilled immigrants in the age group 20–40. My calculations suggest, however, that focusing on high-skilled immigrants in the age group 20–49 would make more sense if the objective is to maximize the public gain since the NPV of high-skilled immigrants between 40 and 49 far exceeds that of 20–24-year-old high-skilled immigrants.

Moreover, the results indicate that the discounted government cost of new illegal immigrants can be as large as $54,000 per immi-

grant, compared with $36,000 for legal low-skilled immigrants. If curbing illegal immigration is infeasible, these results suggest that converting young illegal immigrants to legal ones, along the lines of the Immigration Reform and Control Act of 1986, is beneficial, provided that the flow of illegal immigrants is not affected by this amnesty policy.

Finally, I find that return migration decreases the discounted contribution of high-skilled immigrants under 50. Thus policies that lower the probability of return migration for this group might improve public finances. Straightforward examples of such reforms would be to make less strict the rules for allocating visas and green cards to immigrants already working in the United States and to automatically grant green cards to foreign students on graduation.

Despite the strong implications of immigration for public finance, surprisingly few studies address the cost-benefit aspect of immigration.[2] Huddle (1993), Borjas (1994), and Passel (1994) compute the net government surplus in a particular year, stemming from the cross section of immigrants currently residing in the United States. The key shortcomings of this approach are that the instantaneous fiscal impact of immigrants changes with their age structure and that costs and expenditures occurring later in the life of an immigrant (e.g., pensions) should be discounted. Simon (1984) and Akbari (1989) compute the tax revenues and government expenditures directly associated with different immigration cohorts. They are used as a stand-in for a time profile of net contributions, which in turn are discounted to get a crude measure of the ''net public gain.'' These studies ignore the descendants of immigrants, the changes in the age and skill profiles of immigrants, and the general equilibrium interaction between immigrants and an aging population. Canova and Ravn (1998) study the macroeconomic effects of low-skilled immigration in an infinitely lived–agent model, ignoring life cycle aspects altogether. The papers by Bonin, Raffelhüschen, and Walliser (1997) and Auerbach and Oreopoulos (1999) include dynamic effects of immigration by performing partial equilibrium generational accounting exercises for Germany and the United States, respectively. Auerbach and Oreopoulos find relatively small fiscal effects of current immigration, which is consistent with my findings.[3]

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[2] Although the economic effects of immigration have received substantial attention, the literature has focused mainly on the impact on employment and wages for natives (see, e.g., Friedberg and Hunt [1995] for a survey).

[3] After the acceptance of this article, I became aware of the paper by Lee and Miller (1997), on which chap. 7 in Smith and Edmonton (1997) is based. In a partial equilibrium setting, Lee and Miller compute the fiscal impact, in present value terms, of admitting new immigrants.

The paper then proceeds as follows. The model economy and the competitive equilibrium are defined in Section II. The parameterization of the economy is described in Section III, and the results are reported in Section IV. Section V presents conclusions.

II.   The Model

A.   *Population Process and Heterogeneity*

The economy is populated by agents who live a maximum of I periods. Agents differ in age, skills, legal status (native, legal immigrant, or illegal immigrant), and, if an immigrant, the age at the time of immigration. The "type" of an agent is denoted by (i, s), where i is age, $s(1)$ is the age at the time of immigration (natives have $s(1) = 1$), $s(2)$ is skill, and $s(3)$ is legal status. The key difference between natives and legal immigrants in the model occurs in terms of labor productivity and fertility. Distinguishing immigrants by legal status is important because illegal immigrants might be very different from legal ones, with respect to their impact on public coffers. Moreover, illegal immigration constitutes a substantial share of the migration to the United States (Chiswick 1988).

The immigrants' skills (or education) take on three values: low-skilled, medium-skilled, and high-skilled. Skills are exogenous and do not change during an agent's lifetime. For simplicity, the skills of natives are assumed to be homogeneous (conditional on age).

Children of immigrants, born after their parents immigrated, are considered as natives. Thus the skills of second-generation immigrants are assumed to be independent of the skills of their parents. As in Lee (1974) and Ríos-Rull (1992), the number of newborn natives in period t is given by

$$\#\text{newborn}_t = \sum_{i,s} \phi_{i,s}\, \mu_{i,s,t} + y_t, \tag{1}$$

where $\mu_{i,s,t}$ is the number of type (i, s) agents in period t, $\phi_{i,s}$ are type-specific fertility rates averaged over time, and y_t is a deterministic process. Agents do face longevity uncertainty, however, and the probability of surviving to age $i + 1$, conditional on being alive at age i, is given by π_i.

A selective immigration policy is chosen by the government and determines annual immigration and the distribution of age and skills of new *legal* immigrants, as a function ψ of the state of the economy. I assume that the government cannot alter the flow of illegal immigrants. There are numerous ways of specifying the possible immigration policies. I focus on a very simple type of policies in

which the inflow of each age and skill group is some fixed fraction of the size of the population.

Empirical studies have documented that as many as 18–20 percent of new immigrants return to their respective home countries within 10 years after their first arrival to the United States (Warren and Peck 1980; Jasso and Rosenzweig 1982; Borjas and Bratsberg 1996). The probability of return migration, η_j, is assumed to simply depend on the length of the spell in the host country (where j stands for years since immigration). Moreover, to ensure that immigrants do not take the event of return migration into consideration when making decisions, I assume that the agents who return-migrate will face the same prices, transfers, and taxes in their home country that they would have faced in the United States.

B. Preferences, Technology, and Government

Agents derive utility from leisure $1 - n$ and a standard consumption good c. Those below age ζ are defined as children. They consume the transfers they get from the government and do not work. Furthermore, agents do not care about their children and have no bequest motives, although they may end up leaving accidental bequests. At age ν, all agents retire. A type s agent maximizes her expected lifetime utility, given by

$$\max_{\{c_i, n_i\}} E \sum_{i=\max\{s(1),\zeta\}}^{I} \beta^i \mu(c_i, n_i) =$$

$$\max_{\{c_i, n_i\}} \sum_{i=\max\{s(1),\zeta\}}^{I} \beta^i \frac{[c_i^\alpha (1 - n_i)^{1-\alpha}]^{1-\gamma}}{1 - \gamma} \prod_{j=s(1)}^{i-1} \pi_j, \quad (2)$$

subject to the intertemporal budget constraint and the pension system.

Output in period t is given by a standard constant return to scale production function $z_t f(K_t, N_t)$ with aggregate labor N_t and capital K_t as inputs. The exogenous productivity level, z_t, is growing at a deterministic rate. Output is used for consumption and investment in new capital. Labor productivity of an agent is measured in equally productive efficiency units, which implies that native and immigrant labor are perfect substitutes and that N_t is given by the sum of efficiency units supplied by agents. Firms rent labor and capital on spot markets at a given wage rate W_t and a net rental rate R_t and solve a standard profit maximization problem $\max_{K,N}\{z_t f(K, N) - (R_t + \delta) K - W_t N\}$, where δ is the depreciation rate for capital.

Fiscal policy is given exogenously and consists of a tax rule, a pub-

lic spending rule, and a transfer rule. The tax rule specifies a constant payroll tax rate τ_p and a constant tax rate τ on capital and labor income. Natives and legal immigrants are taxed at the same rates. Illegal immigrants differ from their legal counterparts in that they pay no taxes and receive no government transfers. They are assumed, however, to incur public consumption at the same rate as their legal counterparts.

Public consumption is given by a rule determining government purchases of goods and services as a function of population and time:

$$G_t \equiv (1 + \Gamma)^t \sum_{i,s} g_i \mu_{i,s,t}, \tag{3}$$

where g_i is government consumption per agent of age i in period 0 and Γ is the rate of growth in GNP per capita in steady state. Conditioning the incidence of public consumption on age is important since large components of government purchases of goods and services are age dependent (e.g., the schooling system).

The Social Security system is modeled explicitly. Old-age insurance (OAI) benefits are paid to retired agents and are a function $h(\cdot)$ of the individual's average indexed monthly earnings (AIME) during her time in the work force. The remaining components of Social Security, plus all other government transfer programs, are modeled as age-specific lump-sum transfers ξ_i.[4] All benefits are assumed to be tax-exempt. The results are very robust to this assumption (Storesletten 1999).

Residence in the United States when retired is not a requirement for collecting benefits. Let $\hat{\mu}_{i,s,t}$ denote the number of living return-migrated legal immigrants of type s who qualify for full Social Security benefits, let $\hat{\xi}_i$ be their lump-sum transfers, and assume that only a fraction κ of these immigrants actually collect their benefits. The aggregate government transfers in period t can then be computed as

[4] This specification abstracts from possible differences between immigrants and natives in the utilization of government transfer programs. Borjas and Hilton (1996) document that immigrants have a higher participation rate in welfare programs than natives. Fix, Passel, and Zimmermann (1996) argue that these differences are explained by the higher participation rate in welfare programs among refugees and retired immigrants (who, presumably, do not qualify for Social Security benefits). I focus, however, on labor migrants, i.e., working-age legal immigrants who will most likely qualify for Social Security when old. Moreover, my measure of ξ_i encompasses *all* government transfers (net of OAI), including programs in which natives may well have a higher participation rate, such as unemployment insurance or survivors insurance. In the case of Canada, where labor immigrants are explicitly targeted, the welfare participation rate among immigrants is lower than among natives (Baker and Benjamin 1995).

$$T_t \equiv \sum_{s \in \mathcal{L}} \left(\sum_{i=s(1)}^{v} \mu_{i,s,t}(1 + \Gamma)^t \xi_i \right.$$

$$+ \sum_{i=v+1}^{I} \{\mu_{i,s,t}[(1 + \Gamma)^t \xi_i + h(d_{i,s,t})] \tag{4}$$

$$\left. + \kappa \hat{\mu}_{i,s,t}[(1 + \Gamma)^t \hat{\xi}_i + h(d_{i,s,t})]\} \right),$$

where $d_{i,s,t}$ is the AIME of an agent (i, s) in period t, and the condition $s \in \mathcal{L}$ ensures that illegal immigrants are excluded from T_t. The total tax revenues are given by

$$\text{revenues}_t \equiv \left[1 - \left(1 - \frac{\tau_p}{2} \right) \left(1 - \tau - \frac{\tau_p}{2} \right) \right] W_t \hat{N}_t + \tau R_t \hat{A}_t, \tag{5}$$

where $\hat{N}_t$ and $\hat{A}_t$ are aggregate labor input and the private financial wealth of natives and legal immigrants. Note that the employer part of Social Security contributions is tax deductible. Budget deficits are financed by increases in government debt, held as bonds B_t by private agents.

The only individual portfolio constraint is that agents of age I, who will die for sure, cannot leave negative bequests. There are no annuity markets in the economy, so the agents face the risk of dying with positive wealth. Each period, accidental bequests are donated to newborn natives in a lump sum x_t. Immigrants are assumed to bring no wealth when they arrive, whereas return migrants bring their savings out of the country when they leave. The term RM_t denotes the aggregate amount of capital brought out of the economy in period t.

This model specification abstracts from nonrival public goods and congestion effects (scarce public capital diluted by new immigrants). I shall, however, consider the sensitivity of the results to the inclusion of a nonrival public good. One feature of the model that does capture a public-good element of immigration is that the per capita government debt falls as immigration increases. As the model abstracts from government-owned physical capital, parts of government consumption, g_i, can be interpreted as a stand-in for replenishing government capital per agent of age i. Thus a potentially increased pressure for public investments due to immigration is captured in the model since government consumption is increasing in the number of new immigrants.

C. Equilibrium

Given initial conditions for government debt B_0, the error term of the fertility process y_0, and the distributions of assets a_0, past average earnings d_0, and population μ_0 and $\hat{\mu}_0$, an equilibrium is defined as a sequence

$$\{W_t, R_t, N_t, K_t, B_t, RM_t, x_t, \{n_{i,s,t}, c_{i,s,t}, a_{i,s,t}, d_{i,s,t}, \mu_{i,s,t}, \hat{\mu}_{i,s,t}\}_{s,i=s(1)}^I \}_{t=0}^{\infty},$$

a tax rate τ, and an immigration policy rule ψ such that the following conditions hold. (*a*) The wage rate and rate of return on savings, W_t and R_t, equal net marginal productivities of labor and capital. (*b*) The aggregate resource constraint holds every period. (*c*) Each sequence $\{c_{i,s,t+i}, n_{i,s,t+i}\}_{i=s(1)}^I$ solves the utility maximization problem (2) of agents of type *s* who were born in period $t - s(1)$, subject to their budget constraints, the pension system, and the price sequence $\{R_t, W_t\}_{t=1}^{\infty}$. Moreover, the sequences of individual wealth and average indexed earnings, $\{a_{i,s,t+i}, d_{i,s,t+i}\}_{i=s(1)}^I$, are consistent with the agents' consumption and leisure choices. (*d*) Aggregate accidental bequests per newborn native in period *t*, x_t, are consistent with the distribution of assets and population. (*e*) The government policy (ψ, τ) is feasible in the sense that current government debt equals the net present value of future budget deficits and surpluses. (*f*) The sequence of government debt evolves according to $B_{t+1} = (1 + R_t) B_t + T_t + G_t -$ revenues$_t$, and the aggregate figures N_t and RM_t are computed by aggregating individual labor effort and return migrants' wealth holdings. (*g*) Aggregate capital K_t equals aggregate private wealth minus government debt B_t in period *t*. (*h*) The population sequences $\{\{\mu_{i,s,t}, \hat{\mu}_{i,s,t}\}_{i=s(1)}^I\}_{t=1}^{\infty}$ are generated by μ_0, $\hat{\mu}_0$, y_0, ψ, and the mortality, fertility, and return migration processes.

III. Parameterization of the Model Economy

A. Population Parameters

The length of a period in the model is taken to be five years. Each agent retires after period 13 and might live until period 18 (i.e., agents retire at 65 and die before 90). The mortality rates of natives and immigrants are assumed to be identical, fixed at the 1988 U.S. levels. Since many immigrants originate from countries in which tropical diseases are common, a case could be made that immigrants have higher mortality than natives. Shorter longevity would increase net government benefit from immigration, so the equal mortality assumption is a conservative benchmark.

The age-specific average fertility rates in equation (1) for natives

are estimated by averaging over the 1960–89 time period.[5] Storeslet-
ten (1995) estimates immigrant women's fertility by constructing
synthetic cohorts from the 1990 and 1980 censuses and computing
changes between 1980 and 1990 in the average number of children
for various groups. This approach implies that the average total fer-
tility rate (TFR) of high-skilled immigrants is 16 percent lower than
that of natives, whereas the TFR for medium- and low-skilled immi-
grants, respectively, is 7 percent and 50 percent higher than that of
natives. The $\phi_{i,s}$ parameters are set accordingly. The error term y_t in
(1) follows a deterministic AR(2) process with coefficients $\rho_1 = 1.28$
and $\rho_2 = -0.65$, estimated using U.S. data from 1960 to 1990. The
1990 values of the estimated process are used as the starting point
y_0.

   Return migration appears to be quite high in the first years after
immigration but declines sharply over time. To approximate the re-
turn migration process, I assume that the return migration rate, η_j,
is constant after the first period. Warren and Peck (1980) find that
by April 1970, 18 percent of the 1960–70 cohort of new immigrants
and 5.2 percent of the immigrants present in 1960 had emigrated
from the United States. Using these measurements, I set $\eta_1 = 17.06$
percent and $\eta_j = 2.63$ percent for all $j \geq 2$.

   All alternative immigration policies considered in this paper con-
stitute an increased inflow, relative to the status quo immigration
policy, of one or several groups of legal immigrants. I measure the
status quo immigration policy, unconditional on legal status, as the
distribution of age and skills of immigrants enumerated in the 1990
census, who immigrated during the period 1988–90. The status quo
annual inflow of immigrants is 0.44 percent of the population. The
annual inflow of illegal immigrants currently constitutes about
300,000, or 0.12 percent of the population (Fix and Passel 1994),
and I assume this fraction to be constant over time. All illegal immi-
grants are assumed to be low-skilled.

   Note that the status quo population process implies a lower future
dependency ratio (retirees per worker), after 2010, than the stan-
dard alternative projections. For instance, the status quo case pro-
jects a maximum dependency ratio of 0.315 in 2035 (and 0.276 even-
tually), compared to 0.369 in 2035 (and 0.421 eventually) for
projections by the Social Security Administration (SSA) (Bell 1997).
This discrepancy is due to higher mortality rates, more immigration,
and higher fertility rates (after the year 2000) in the status quo popu-
lation process than are assumed in the SSA projections. Higher fertil-

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[5] This implies a final total fertility rate of 2.23, compared with 2.25 in the middle
projections of the U.S. Bureau of the Census (1992).

ity rates will worsen the future fiscal burden, whereas higher mortal-
ity rates will alleviate the problems. In Section IV*G*, I explore the
sensitivity of the results to increased life expectancy.

B.   *Efficiency Unit Profiles, Preferences, and Technology*

Estimates of the efficiency unit profiles for each type *s* are taken
from Storesletten (1995).[6] This implies that immigrants who came
when they were, say, 27 years old, earn, on average, 2 percent less
than natives over their remaining lifetime, and those who immi-
grated when 37 years old earn 13 percent less than natives. These
estimates are somewhat below those of Chiswick (1978). Since the
public finance implications of immigration are sensitive to the labor
income of natives, I also try an alternative earnings profile in which
immigrants earn 10 percent less than my estimates. The skills of im-
migrants are measured as completed education and are divided into
three groups: (1) ''low-skilled,'' high school or less; (2) ''medium-
skilled,'' more than high school but less than a bachelor's degree;
and (3) ''high-skilled,'' a bachelor's degree or more. This distributes
the recent immigrants in the 1990 census into three roughly equally
sized skill groups.

   The functional form of the utility function (2) implies a unit elas-
ticity of substitution between consumption and leisure, which is mo-
tivated by fairly constant annual hours worked per household in the
postwar period. The parameter α is set to 0.33 (see Ríos-Rull 1996),
and the inverse of the intertemporal elasticity of substitution, γ, is
set to four since a period in the model is fairly long. The time prefer-
ence parameter β is set to 1.011 (annualized), on the basis of esti-
mates from Hurd (1989).

   The technology is standard. I assume a standard Cobb-Douglas
production function taking labor and capital as inputs, $Y_t = z_t K_t^{\theta} N_t^{1-\theta}$. Following Cooley and Prescott (1995), I set the capital's
share of income, θ, and the (annualized) depreciation rate, δ, to 0.4

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[6] The estimation technique involves accounting for changes in national origin,
gender, and the age of new immigrants over the 1950–90 period. This requires
aggregation over sex, national origin, etc. The approach is to divide the 5 percent
1990 census sample into $15 \times 3 \times 12 \times 6 \times 2$ boxes (age, education, age at the
time of immigration, region of origin, and sex) and to compute the average wage
for each box. The efficiency unit profiles for new immigrants are then computed
as weighted averages over these boxes, where the relative weight of each box is based
on the 1988–90 cohorts of immigrants. ''Cohort effects'' should not be a problem
since observables are controlled for (LaLonde and Topel 1992). Since legal status
is not identified in the 1990 census, I assume that no differences in wages between
legal and illegal immigrants are left after controlling for education, region of origin,
age, age at the time of immigration, and sex.

and 4.8 percent, respectively. The steady-state growth rate in consumption per capita, Γ, is 1.5 percent (annualized), which equals the average annual U.S. growth rate in GNP per capita over the last two decades.

C.   Government

The income tax rate of the "status quo" fiscal policy is calibrated to $\tau = 28.2$ percent, which would make total tax revenues amount to 32.5 percent of output in the first period of the "fiscal reform" economy, the same as total federal, state, and local tax revenues in 1993.[7] The payroll tax, τ_p, is set to 15.3 percent of labor income.

The age-specific government consumption levels, g_i in (3), are taken from Auerbach et al. (1989) and are scaled so that overall government consumption is 16.1 percent of GNP in the first period of the fiscal reform economy, the same as in 1993.

I assume all workers, except illegal immigrants, to be enrolled in Social Security. The OAI formula is a function $h(\cdot)$ of average indexed earnings, indexed at rate Γ.[8] The age-specific lump-sum transfers from the remaining components of Social Security, including Medicare, are estimated from unpublished data from the SSA. All agents who have contributed to the Social Security system for more than 10 years qualify for benefits according to U.S. law. Using historical immigration figures and the calibrated return migration process, I find that 930,000 return migrants did qualify for Social Security benefits in 1970. Warren and Peck (1980) report that only 230,000 return migrants actually did collect benefits in 1970 (many countries have bilateral treaties with the United States, limiting the scope of collecting benefits from more than one country). Hence, I assume that $\kappa = 25$ percent of the return migrants claim the benefits to which they are entitled. Moreover, age-specific lump-sum transfers to return-migrated agents, $\hat{\xi}_i$, contain only survivors insurance and disability insurance.

All other transfers on the federal, state, and local levels, which added up to 7 percent of GNP in 1993, are distributed evenly to all natives and legal immigrants as part of ξ_i. Aggregate government

[7] For calibrating several model parameters, I use as a benchmark a "fiscal reform" economy in which the current immigration policy is pursued and the budget is balanced through increasing taxes. Note that the equilibrium tax rate in the fiscal reform economy exceeds the status quo tax rate.

[8] The formula is standard: h is piecewise linear with two "bend points," which are set to 20 percent and 122 percent of GNP per capita. The replacement rates (i.e., slopes of h) within brackets 1, 2, and 3 are 90 percent, 32 percent, and 15 percent, respectively.

transfers in the first period, T_1, are then 14.4 percent of GNP in the fiscal reform economy, the same as the total federal, state, and local transfers and subsidies in 1993.

D.   Initial Conditions for the State Variables

I use the 1992 distribution of natives as the initial condition for the population distribution. The initial distribution of immigrants across age and skills is taken from the 1990 census. Out of the initial 8 million low-skilled immigrants, 3.2 million are assumed to be illegal residents (Fix and Passel 1994).

The initial government debt, which consists of financial assets of the federal, state, and local governments, is set to 50 percent of GNP (in the fiscal reform economy). The initial distribution of assets equals the steady-state distribution of assets scaled so that the initial capital to output ratio is 3.3. The steady-state capital to output ratio in this economy is 2.4, and agents must hold 126 percent more wealth than in the steady state to reach 3.3.[9] In Storesletten (1999), I document that the results are quite robust to the choice of initial capital stock.

IV.   Findings

The model is solved by using a method related to the Auerbach and Kotlikoff (1987) approach; see Storesletten (1999) for details.[10]

A.   Fiscal Reform

Before turning to the immigration policy reform experiments, I shall briefly describe the fiscal reform economy, where the current immi-

[9] Note that there is, at most, one stable steady state for a given pair of immigration policy and fiscal policy. As attention has been restricted to policies that are constant over time, the immigration policy and initial conditions for the state variables will determine the lowest constant income tax rate, τ, satisfying equilibrium condition e. Equally, the equilibrium condition e, the income tax rate τ, the initial conditions for the state variables, and a particular distribution of new immigrants pin down the required number of new immigrants and the future path of government debt. If the tax rates or the immigration policy were allowed to vary over time, however, the need for higher taxes or increased immigration during the demographic transition could be alleviated by aiming at a higher long-run debt to output ratio, e.g.

[10] In a nutshell, the idea is to iterate on the tax rate or immigration policy and, for every iteration, solve for a finite equilibrium price sequence, given initial conditions and the assumption that the economy is in the steady state after 50 periods. The approximations are quite accurate since the economies converge well before they are supposed to be in the steady state. For instance, after 30 periods—or 150 years—the annualized rate of return on capital has typically been less than 10 basis points away from its steady-state value in the economies I have considered.

gration policy is pursued and the budget is balanced through a once-and-for-all tax increase in the first period.

The equilibrium income tax rate τ in this economy is 32.6 percent, 4.4 percentage points higher than the "status quo" tax rate of 28.2 percent. Thus a once-and-for-all immediate tax hike of 4.4 percentage points would preempt the need for any future fiscal reform associated with the demographic transition.

The aggregate capital stock falls sharply during the first periods as a result of a relatively high initial wealth to output ratio (3.8 in the first period, compared to 2.0 in the steady state). Consequently, the rate of return on capital (before tax) rises from 6.8 percent in the first period to 10.0 percent in the steady state, and the initial growth rates in GNP per capita are lower than Γ. All the immigration reform economies studied below exhibit a similar pattern. Note that the steady-state age profiles of consumption and work effort in the theoretical economies fit reasonably well with the data (Ríos-Rull 1996; Storesletten 1999).

B. Immigration Policy Reform

This paper investigates whether immigration policy reform alone can be used as an instrument for satisfying the government's long-run budget constraint, given that current tax and spending policies remain unchanged, that is, when τ equals its status quo level of 28.2 percent. To this end, I explore a particular type of selective policies: let future immigration of each age and skill group of legal immigrants be some fixed fraction of the population. For each single age-skill group of new legal immigrants, I compute the smallest annual inflow of such immigrants, over and above the status quo flows of immigrants, that would balance the budget in the long run.

The first four rows in table 1 summarize the key results for the benchmark calibration. Within this class of policies, I find that the budget can be balanced with a sufficient inflow of any age group of high-skilled immigrants between 20 and 54. If attention is restricted to immigrants below 20 or above 54, however, the budget cannot be balanced without increasing taxes or reducing government spending. For medium-skilled immigrants, the feasible age range is 25–49, whereas no positive inflow of legal low-skilled immigrants can balance the government budget.

The group with the lowest fraction of new immigrants required to balance the budget is the 40–44-year-old high-skilled immigrants: 0.617 percent annually, or about 1.6 million, compared to 0.44 percent today. This policy will be referred to as the "immigration re-

TABLE 1

ANNUAL IMMIGRATION (Percentage of Population) REQUIRED TO BALANCE THE
GOVERNMENT BUDGET IF THE FISCAL POLICY IS KEPT UNCHANGED

	AGE OF NEW IMMIGRANTS						
EXPERIMENT	20–24	25–29	30–34	35–39	40–44	45–49	50–54
1. Baseline (high-skilled)	1.89	.84	.66	.62	.62	.77	2.01
2. Medium-skilled	· · ·*	3.13	2.01	1.79	2.13	3.86	· · ·
3. Low-skilled	· · ·	· · ·	· · ·	· · ·	· · ·	· · ·	· · ·
4. Averaged over skills	· · ·	2.23	1.50	1.40	1.67	3.61	· · ·
5. Family unit	4.20	2.06	2.02	1.57	1.10	1.08	2.06
6. Low earnings	· · ·	1.20	.90	.80	.80	1.10	3.52
7. No return migration	1.17	.65	.54	.50	.53	.74	2.43

* No positive number of immigrants was large enough to balance the budget in the long run.

form'' policy, and if it is pursued, the steady-state population growth would be 0.9 percent annually.

Thus, to the extent that an immigration reform that involves the admission of 1.6 million 40–44-year-old high-skilled immigrants annually is feasible, the government can choose between this reform and an income tax hike of 4.4 percentage points. While admitting 1–2 million high-skilled immigrants might be feasible from a domestic political point of view, attracting such a large number of high-skilled, middle-aged immigrants might, in practice, be a bigger obstacle to feasibility. In comparison, the number of high-skilled 25–49-year-old immigrants required to balance the budget is 1.8 million, or 0.70 percent of the population annually (simple average across age groups 25–49 in table 1). Currently, only 15.0 percent of new immigrants, about 160,000 annually, are 25–49 years old and are high-skilled (according to the 1990 census 5 percent sample). But even though the prospects of achieving, say, an 11-fold increase of this figure might be slim, tripling or quadrupling the size of this group would still go a long way toward alleviating the need for fiscal reform.

The strong fiscal impact of immigration can be further demonstrated by considering the evolution of the debt to output ratio in the immigration reform economy, which declines from 50 percent of GNP in 1995 to −21 percent of GNP in the year 2040. The government budget, excluding interest payments, is running a surplus from 1995 to 2035. If interest payments are included, the government runs a deficit until 2000, five years more than in the fiscal reform economy.

These calculations incorporate the general equilibrium effects of immigration, which can be expected to suppress the net benefits of immigrants. If immigration is not associated with a capital inflow (as

I have assumed here), an increase in immigration increases interest rates and reduces wages. Consequently, the cost of servicing the public debt increases, and the tax revenues fall, since most tax revenues are collected from labor under the U.S. tax system. These effects are quantitatively large. Consider, for example, the impact of abstracting from general equilibrium effects when recalculating on the number of 40–44-year-old immigrants required to balance the budget. If the prices are held fixed and equal to those of the fiscal reform economy—where the status quo immigration policy is being pursued—the required number of immigrants decreases by one-fifth, to 0.48 percent of the population per year.

C. Net Present Value Calculations

To understand these findings, it is illuminating to consider the net discounted gain to government of admitting one extra immigrant. Since the aim is to compute the fiscal impact under the status quo fiscal policy, the immigration reform economy is used as a starting point for the NPV calculations. These exercises are partial equilibrium exercises in that potential changes in prices and bequests due to increased immigration are ignored.

Let $J(i, s, t)$ denote tax revenues minus government consumption and transfers directly incurred by an agent (i, s) in period t. Simply computing the NPV of $\{J(i, s, \cdot)\}_{i=s(1)}^{I}$ is not sufficient for determining the net contribution of an immigrant, however. One must also include the cost or gain associated with potential future children, grandchildren, and so forth. The net discounted gain, $\text{NPV}(s, t)$, including the cost of future children, of receiving one new immigrant (or native newborn) of type s in period t must then satisfy

$$
\text{NPV}(s, t) = \sum_{i=s(1)}^{I} \frac{1 + R_t}{\displaystyle\prod_{j=0}^{i-s(1)} (1 + R_{t+j})}
$$
$$
\times \left[J(i, s, t + i - s(1)) + \frac{\phi_{i,s}}{1 + R_{t+i-s(1)+1}} \text{NPV}(0, t + i - s(1) + 1) \right],
$$

(6)

where $\text{NPV}(0, t)$ denotes the NPV of a native newborn in period t. This figure is computed by applying (6) recursively and is found to be $-\$88{,}000$. Note that a negative NPV of newborn natives can be
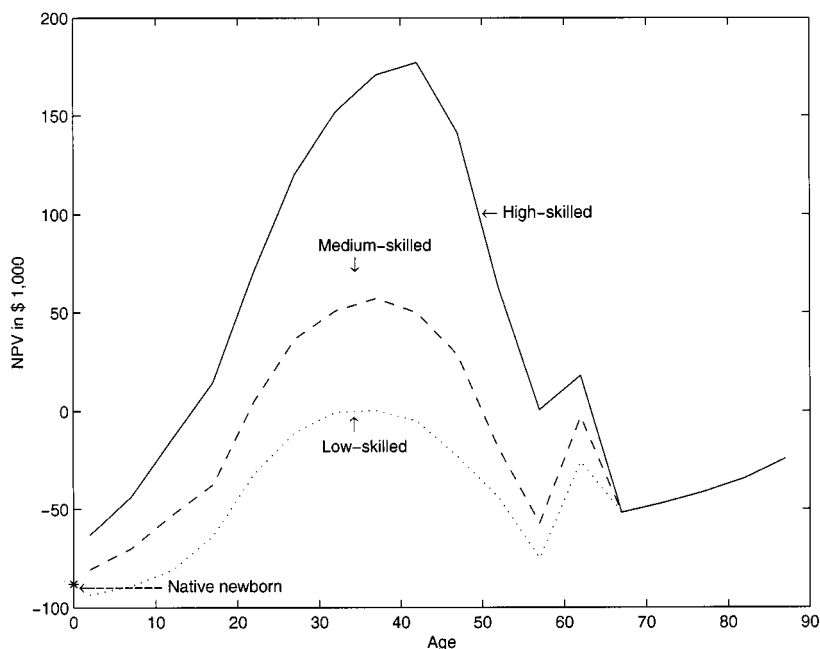
Fig. 1.—Discounted net public gain of admitting additional immigrants, conditional on age and skills.

consistent with a long-run government budget balance because there is a sufficient number of working-age agents alive, whose NPV of remaining tax revenues minus expenditures is large and positive.

Figure 1 displays NPV profiles across age and skills for new immigrants. All NPV figures are reported in 1993 dollars and use the prices and fiscal policy of the immigration reform economy. The "skill" of an adolescent immigrant is defined as the education she will acquire in the future. Thus the NPV of, say, a low-skilled adolescent immigrant is the NPV conditional on her being low-skilled her entire life.

The results reveal dramatic differences in fiscal impact across these groups: the net government gain of new immigrants ranges from −$94,000 for an infant immigrant, conditional on being low-skilled during her entire life, to $177,000, or 7.0 times annual GNP per capita, for a 40–44-year-old high-skilled immigrant. Thus denying a prospective 40–44-year-old high-skilled immigrant a visa is expected to cost the government $177,000.

Conditional on age, the NPV of high-skilled immigrants exceeds the NPV of medium-skilled immigrants, which in turn dominates the NPV of low-skilled immigrants, except for immigrants past the

retirement age. In fact, the NPV of low-skilled immigrants is negative for all age groups, which explains why no positive inflow of low-skilled immigrants would suffice to balance the budget. In contrast, all high-skilled working-age immigrants yield a positive NPV.

All age profiles exhibit a strong hump shape, which peaks between 35 and 44, reflecting a trade-off between a longer remaining working life on the one hand and a smaller number of new children on the other. The local maximum for 60–64-year-old immigrants is due to the minimum requirement of 10 years of Social Security contributions for receiving full benefits. Thus 55–59-year-old immigrants are the oldest group that can enjoy full Social Security benefits during retirement. After 65, all groups coincide (since skills by assumption distinguish immigrants on productivity and fertility only). The NPV of retired immigrants increases monotonically with age as the remaining lifetime becomes shorter.

The global maximum occurs later for high-skilled immigrants (40–44) than for medium- and low-skilled immigrants (35–39). Social Security benefits relative to tax contributions are lower for the high-skilled than for the other skill groups, so getting to the peak earnings years (40–60) more quickly becomes relatively more important than avoiding the costs associated with retirement. If the cost of children is excluded (which is equivalent to a zero fertility assumption), the peak NPV comes five to 10 years earlier for the low- and medium-skilled. Including the cost of children is of most importance for immigrants who arrive before 35. If the cost of children was excluded, the NPV of this group would be $29,000 higher. The timing of the peak is also influenced by the discount rate. If the sequence of individual net contributions, $\{J(i, \ s, \ \cdot)\}_{i=s(1)}^{I}$, is discounted at, say, 4 percent (annualized) instead of the equilibrium return on capital, the NPV profiles would peak at 30–34 for all skill groups. With a lower discount rate, the peaks shift to the left since the costly retirement years are discounted to a smaller extent.

Given the empirical age structure of new immigrants currently admitted to the United States, I can compute the government gain, in NPV terms, of admitting one additional "representative" legal immigrant by weighting the age structure of current new immigrants with the NPV profiles in figure 1. This yields a net discounted gain of a mere $7,400. Auerbach and Oreopoulos (1999) also find the net gain on current immigration to be small but positive: closing down immigration after the year 2000 would, in their model, increase the fiscal burden on each member of future generations by $3,000–$4,000. When conditioning on skills, I find the NPV of representative high-, medium-, and low-skilled immigrants to be $96,000, −$2,000, and −$36,000, respectively. In contrast, the NPV of a repre-
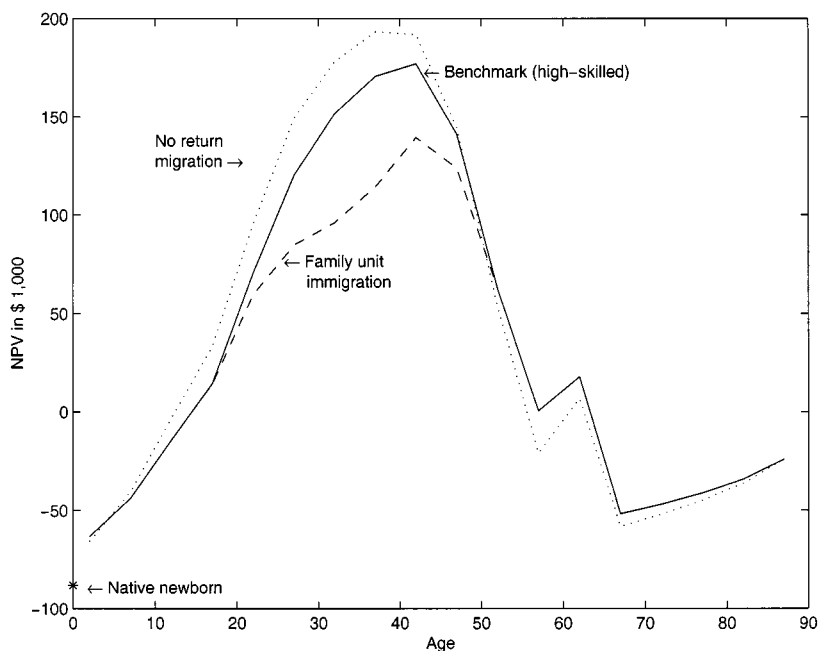
FIG. 2.—Discounted net public gain of admitting additional immigrants: return migration and family units.

sentative *illegal* immigrant is −$54,000, given the rather extreme assumptions that they incur the same government consumption as natives, pay no taxes, receive no transfers, and have the same return migration process as legal immigrants.

D.   The Role of Return Migration

Return migration is an important part of the demographic process, and to the extent that public policy can influence return migration, one would like to understand its impact on public coffers. To this end, I contrast the benchmark return migration process to a polar case of no return migration. The NPV profiles for high-skilled immigrants, displayed in figure 2, reveal that reducing return migration to zero would increase the NPV of 5–49-year-old immigrants and reduce the NPV for others. The calibrated return migration process implies substantial emigration after the first (five-year) period, so groups facing a long sequence of positive (negative) contributions to government in the near future will see their NPV increase (decrease) if return migration is decreased.

   This picture is mirrored by the calculations regarding the flows

of immigrants required to balance the budget (see row 7 of table 1). A smaller number of new immigrants are required for all age groups between 20 and 49, whereas a larger number are needed for the 50–54-year-old high-skilled immigrants.

E.   The Role of Family Migration

Admitting adult immigrants but excluding their (already existing) children may not be politically feasible. To understand the impact of family migration, I contrast the benchmark single-immigrants case with a case in which immigrants bring children who are 15 years old or younger and leave their older children behind. The children are assumed to be medium-skilled, and the distribution of an immigrant's children is computed, conditional on her age, by assuming premigration fertility rates to be a fixed fraction of native fertility (this fraction is set so that the inflow of immigrants under 15 matches the data).

The dashed line in figure 2 illustrates the effect of family unit migration on the NPV profile of high-skilled immigrants. The numbers denote NPV per head of household, including her children brought from the emigration country. The effects are considerable: the NPV of 20–50-year-old immigrants decreases by $37,000 relative to the single-immigrant case. The impact is largest for 30–39-year-old immigrants, whose NPV is reduced by $56,000, on average. The reason is that these families have the largest number of children under 15, on average 1.53 per adult family member, according to my calculations.

This picture is largely confirmed when one considers the number of immigrants (including children) required for balancing the budget; the minimum annual number increases to 1.08 percent of the population. The head of the household is then assumed to be high-skilled and 45–49 years old (see row 5 of table 1), five years older than those for whom the NPV profile peaks. The discrepancy arises from the fact that, even though 40–44-year-old immigrants have a higher NPV, including children, their households are larger than those headed by 45–49-year-old agents.

F.   Static Accounting Exercises

Huddle (1993), Borjas (1994), and Passel (1994) quantify the gain on immigration in a static accounting framework by computing the government surplus or cash flow in one particular year of all immigrants currently residing in the United States and find this figure to be −$40 billion, −$16 billion, and $27 billion, respectively (1993

figures). To contrast my findings to those of these previous studies, I perform a similar exercise with my model. I consider the current fiscal policy and the current immigration policy, disregarding that this combination is infeasible and using the prices of the immigration policy reform experiment. I then compute the net government surplus in the first period, resembling the 1993–97 period, to be about 0.32 percent of GNP, or $21 billion in 1993, which is within the range of the previous studies. Note that the current age distribution of immigrants is favorable since the surge in immigration is a recent phenomenon. If a similar static accounting exercise is performed for future periods, it will produce negative numbers after six periods (30 years), provided that the status quo immigration policy is continued.

G.   Sensitivity Analysis

To check the sensitivity of the assumption of the absence of public goods, I assume, alternatively, that part of government consumption provides a nonrival public good and that future public-goods expenditures, in levels, are a fixed fraction of government consumption in the fiscal reform economy. Thus additional immigrants do not increase the public-goods provision, and the immigrants' net contributions, $J(i, s, t)$, are increased accordingly. I set the fraction of public goods in government consumption to 31 percent, which equals the 1990–94 share of national defense, foreign affairs, and general science, space, and technology in government purchases of goods and services. Moreover, agents' preferences are assumed to be additively separable over the public good on the one hand and the standard private consumption–leisure composite on the other, so that the provision of public goods does not affect the agents' decisions. In this case, the NPV of new immigrants increases by a substantial $19,000 on average; the younger the immigrants, the larger the increase ($21,000 for a 0–4-year-old).

  The benchmark calibration implies a life expectancy of 77 years. The SSA population projections, for instance, assume life expectancy to increase gradually and reach 82 years by 2075. To explore how sensitive the results are to the mortality assumptions, I study an extreme case in which life expectancy is 82 years from period 1. Under this demographic scenario, the implied dependency ratios exceed the SSA projections until 2050 and reach a maximum of 0.399 in 2035, if the current immigration policy is pursued. The income tax hike and inflow of high-skilled immigrants aged 40–44 required to balance the budget are, in this case, 5.6 percent and 0.80 percent,

respectively, compared to 4.4 percent and 0.62 percent under the benchmark mortality assumptions.

All results are sensitive to the wage income of immigrants. To illustrate this, I explore the case in which immigrants earn 10 percent less than in the benchmark case, which reduces the net benefits of immigration significantly. For example, the NPV of 40–44-year-old high-skilled immigrants falls by about one-sixth, or $31,000, and the NPV of a representative immigrant falls to −$6,000. The minimum number of new high-skilled immigrants required to balance the budget increases to 0.80 percent of the population (see row 6 in table 1).

V. Conclusion

This paper demonstrates that immigration can have strong quantitative implications for U.S. fiscal policy. In particular, the paper investigates whether a reform of immigration policies alone could resolve the future fiscal problems associated with the aging of the baby boom generation.

Using a calibrated general equilibrium overlapping generations model, which explicitly accounts for key differences between immigrants and natives, Social Security, and the demographic transition, I find that immigration policies sustaining the current fiscal policy do exist and are characterized by an increased inflow of middle-aged, high- and medium-skilled immigrants. Admittedly, the American public seems opposed to such large increases in immigration. However, when one is faced with the trade-off between higher taxes on the one hand and a larger number of high-skilled immigrants on the other, it seems reasonable that a majority would, on the margin, opt for increasing the number of immigrants.

These findings are illustrated by computing the net government gain, in present value terms, of admitting one additional immigrant to the United States, conditional on age and skills at the time of immigration. This discounted gain varies considerably across the age and skills of new immigrants, with large and positive figures for high- and medium-skilled working-age immigrants.

Thus the perspective should be one of considering high- and medium-skilled working-age migrants as an attractive resource, for which various countries compete, rather than viewing immigration as a problem. Moreover, to the extent that one is willing to use immigration for generating revenues, the immigration policy should involve attempts to actively attract such immigrants. This analysis has described how some of the migration rents go to natives via the government. A larger share of these rents could be seized, however, by deviating from the principle of taxing natives and legal immigrants

at the same rates, although such reforms would have to be traded off against the reduced attractiveness of the United States as a host country.

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