Intergenerational Mobility and the Political Economy of Immigration*

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Abstract

Flows of US immigrants are concentrated at the extremes of the skill distribution. We develop a dynamic political economy model consistent with these observations. Individuals care about wages and the welfare of their children. Skill types are complementary in production. Voter support for immigration requires that the children of median-voter natives and of immigrants have sufficiently dissimilar skills. We estimate intergenerational transition matrices for skills, as measured by education, and find support for immigration at high and low skills, but not in the middle. In a version with guest worker programs, voters prefer high-skilled immigrants but unskilled guest workers.

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1 Introduction

A stylized fact of US immigration policy is that the inflows tend to be concentrated at the extremes of the skill distribution. Since 1970 about 60% of immigrants are either "high skilled" (BA degree or more) or "unskilled" (less than High School degree), while the rest is "medium-skilled" (High School degree or some college). Because the share of medium-skilled individuals in the US population is more than 50%, the amount of skilled and unskilled individuals as percentage of their native counterparts is larger than for the middle group. For example, for the decade of the 90's, we estimate that there were 5.65 unskilled (net) immigrants per 1000 unskilled natives in the US, about 2.02 medium-skilled per 1000 native medium skilled, and 4.15 skilled immigrants per 1000 skilled US natives.[1] In a 30 year period these numbers would account for immigration quotas of roughly 18%, 6% and 13%, when compared to the composition of the native population.

These flows could be consistent with the medium-skilled majority deciding over immigration policy in a static framework since marginally allowing immigrants of the other two skill types may produce an increase in the wages of the medium-skilled under certain conditions of the production function and constant returns to scale. However, at a generational frequency, large immigration inflows have also the potential to affect the composition of the future labor force and thus affecting the opportunities of the voter's children. Hence, when voters care about their children, they would consider the dynamic implications of the immigration flows.

The dynamic dimension of the problem complicates the analysis significantly. For example, if the children of skilled immigrants are "too successful" compared to their native peers, it could be the case that the medium skilled would like to restrict high skilled immigration because of future competition with their children if there was a high probability of the medium skilled children to move up in the skill ladder. Similarly, if the children of unskilled immigrants were very likely to stay unskilled, it could be that the worry of the medium-skilled was about whether the unskilled could represent a net burden on them and their children if the wage effects are not enough to cover redistribution transfers that those individuals on average could represent. Hence in order to study the different trade-offs that the medium-skilled majority faces when voting over immigration policy we use a dynamic politico-economic model of immigration calibrated to the US economy. The model can be used to study how intergenerational mobility of immigrants and natives shape the equilibrium immigration policy.

In the model there exist three types of labor inputs: skilled, medium-skilled and unskilled. Each worker supplies one unit of their work-type to the production process, earns a wage, pays proportional taxes that are then redistributed via lump-sum, has children according to a fertility profile that depends on skill and place of birth, and votes over immigration policy before the skill type of

[1] See appendix for details on these numbers.

their children is revealed. The calibrated demographic process for the US is such that with or without immigration, the medium-skilled type would be the absolute majority in each generation. Immigrants don't have the right to vote, but the children of immigrants are citizens identical in everything to natives, which in turn have the right to vote. We use Markov Perfect as the equilibrium concept, as it is now common in the literature of dynamic political economy.

Two important objects in the model are the matrices of intergenerational mobility for natives and for immigrants, which we estimate from the General Social Survey. This survey collects information on education data on the respondents and their parents, and it also identifies whether the parents are foreign born, among other variables. The data required for our purposes is available since 1977. We find that on average the children of unskilled and medium-skilled parents do better than their native counterparts, while there is no statistical difference for children of skilled parents. Consistent with this, Card, DiNardo and Estes (2000) find with regression analysis that children of immigrants (second generation immigrants) have on average higher schooling and wages than children of native parents with comparable education level.

We make several contributions to the literature. First, we derive the Markov perfect equilibrium of the model. Second. We show that the intergenerational mobility of children of unskilled workers can be a major determinant for the political support of unskilled immigration by the majority (medium-skilled). The model shows that the higher the probability that children of unskilled immigrants become high skilled (not medium-skilled, but high skilled), the higher the unskilled immigration quota that is politically chosen. In this case 2^{nd} generation immigrants from unskilled parents mostly "complement" the children of medium-skilled natives. Also the higher the probability that children of unskilled immigrants become medium-skilled, the lower the unskilled immigration quota that is politically chosen because 2^{nd} generation immigrants from unskilled parents are mostly "substitutes" of the children of medium-skilled natives.

Since we estimate that on average children of unskilled immigrants have a higher probability of upward mobility, with lower probability of becoming medium-skilled or staying unskilled than natives, these effects help explain why the US allows significant quantities of unskilled immigrants. Another way to put this is the following. If children of unskilled immigrants had on average the same probability of becoming skilled as the unskilled natives, the number of unskilled immigrants allowed in equilibrium would decrease considerably from current flows.

Third, the model suggests that intergenerational mobility of 2nd generation immigrants from skilled parents is not very important for the admission of skilled individuals. The high skilled individuals are so productive and the intergenerational mobility matrices such that the medium-skilled majority wouldn't want to restrict their immigration from current flows, even though it could mean more competition for the children of medium skilled that were in the "skilled" state. Their desirability would decrease (their quota) only if they had an unrealistically high probability of having unskilled children.

Fourth, when the policy space is enlarged to allow for both immigration and guest worker programs, we find that the medium-skilled majority chooses to offer guest worker immigration to unskilled individuals, while offering full immigration (with it's dynamic consequences) to skilled individuals. Since there is no official guest worker program in the US currently, the model suggests that a guest worker program for unskilled individuals will be integral part of any immigration reform in the US, as well as continuation of relatively easy immigration by very high skilled individuals and/or a push for allowing more skilled immigration.[2]

We perform sensitivity analysis and find that the results are robust. Qualitative effects are identical across specifications, while there is some variation in magnitudes of the effects induced by the considered experiments.

Related literature on equilibrium political-economic models of immigration includes the seminal work of Benhabib (1996) on immigration policy under heterogeneous agents. Ortega's (2005) finds the Markov Perfect Equilibrium of a model with an skilled and unskilled labor force with skill upgrading. Dolmas and Huffman (2004) study the interaction of immigration and redistribution. Sand and Razin (2007) study the joint determination of immigration and social security with a Markov equilibrium concept. Cohen, Razin and Sadka (2009), study the theory and empirical relation between the size of the welfare state and the composition of the immigration flows in a static model. Lopez-Velasco and Bohn (2008) study immigration games when immigrants have a larger fertility rate than natives. On the dynamic fiscal effects of immigration there are papers by Storesletten (2000) and Lee and Miller (2000). Ben Gad (2004) studies dynamic aspects of immigration related to capital accumulation. The paper is also related to the macroeconomic literature where current voters foresee the consequences of their choices on the future behavior of voters. Some examples include Krusell and Rios-Rull (1999) and Hassler et.al (2003). Empirical studies on the intergenerational mobility of immigrants include Borjas (1992) and Card, DiNardo and Estes (2000).

The paper is organized as follows. In section 2 we present the model and the equilibrium concept. Section 3 discusses the data, the choice of functional forms and the estimation/calibration of parameters of the model with particular emphasis on the estimation of intergenerational transition matrices for US natives and immigrants from the General Social Survey. In section 4 we do some experiments with the model and the main results are presented. Section 5 does sensitivity analysis. Section 6 concludes.

[2] It can be argued that illegal immigration may somewhat resemble a guest worker program. Some of the undocumented workers return to their homes after a few years in the US. Hence another interpretation for the model is that in absence of a reform, there might be support for the status-quo.

2 The Model

2.1 Demographics

Consider a model with 3 types of agents: unskilled (labeled type 1), medium-skilled (type 2) and high skilled (type 3) which we just call "skilled" from here on. Individuals work full-time when adult, vote over immigration policy and also have children whose skill type is unknown at the time of the vote but whose probability distribution over skill types is stationary. Children are assumed not to take any economic decisions.

Natives have η_i children, while immigrants have η_i' for skill levels i=1, 2, 3, and these fertility profiles are later estimated by skill levels and nativity.

There is intergenerational mobility across skill types, where each type will earn the current wage that their labor skill level commands. Define q_{ij} as the probability that the children of a parent of skill type $[i]$ will be of skill type $[j]$ (i=1, 2, 3 and j=1, 2, 3). For example, q_{13} denotes the probability that the children of an unskilled parent will be skilled. With this notation we define the intergenerational ("transition") matrix for the children of native parents as Q_n given by

$$Q_n = \begin{bmatrix} q_{11} & q_{12} & q_{13} \\ q_{21} & q_{22} & q_{23} \\ q_{31} & q_{32} & q_{33} \end{bmatrix} = \begin{bmatrix} -Q_{n[1]}- \\ -Q_{n[2]}- \\ -Q_{n[3]}- \end{bmatrix} . \tag{1}$$

The rows of the transition matrix add up to 1 as they are probability distributions. We denote these [1x3] row vectors (and probability distributions) from the transition matrix as $Q_{n[i]}$ for i=1, 2, 3. Similarly, the children of first generation immigrants have a transition matrix Q_m which is allowed to be different of Q_n

$$Q_m = \begin{bmatrix} q_{11}' & q_{12}' & q_{13}' \\ q_{21}' & q_{22}' & q_{23}' \\ q_{31}' & q_{32}' & q_{33}' \end{bmatrix} = \begin{bmatrix} -Q_{m[1]}- \\ -Q_{m[2]}- \\ -Q_{m[3]}- \end{bmatrix} . \tag{2}$$

Define the [3x1] vectors of skill-types native population and the vector of immigrants at time [t] as $N_t = [N_{1,t} \;\; N_{2,t} \;\; N_{3,t}]'$ and $M_t = [M_{1,t} \;\; M_{2,t} \;\; M_{3,t}]'$ respectively. Also define immigration quotas of each type (chosen by the median voter) as $\theta_{i,t} = \frac{M_{i,t}}{N_{i,t}}$.

Given the assumptions on intergenerational mobility and fertility, the evolution of the native population is given by

$$\begin{aligned} N_{i,t+1} &= (\eta_1 q_{1i} + \eta_1' q_{1i}' \theta_{1,t}) N_{1,t} + \\ & \quad (\eta_2 q_{2i} + \eta_2' q_{2i}' \theta_{2,t}) N_{2,t} + && (3) \\ & \quad (\eta_3 q_{3i} + \eta_3' q_{3i}' \theta_{3,t}) N_{3,t} && (4) \\ \text{for } i &= 1, 2, 3 && (5) \end{aligned}$$

which in matrix notation can be written as

$$N_{t+1} = \left(Q_n^T \eta + Q_m^T \eta_m \theta_t\right) N_t \ , \tag{6}$$

where the fertility profiles and immigration quotas are written for conformity as [3x3] diagonal matrices given by $\eta = diag\left\{\eta_1, \eta_2, \eta_3\right\}$ and $\eta_m = diag\left\{\eta_1', \eta_2', \eta_3'\right\}$, and $\theta_t = diag\left\{\theta_1, \theta_2, \theta_3\right\}$. This implies that $M_t = \theta_t N_t$.

The evolution of the demographic process is assumed to be such that the native medium skilled is always the majority, at any point in time, irrespective of the immigration policy. This assumption will be justified in the calibration of the model. Immigrants don't have the right to vote, but the children of immigrants are citizens identical in every respect to natives, and as such they have the right to vote.

2.2 Production

There exist three inputs of production that correspond to the skill types of agents: unskilled, medium-skilled and skilled labor. Each worker supplies one unit of their labor-type inelastically and all labor inputs are used to produce a final good via a production function $F(\bullet)$

$$Y_t = F\left(L_{1t}, L_{2t}, L_{3t}\right) \quad , \tag{7}$$

where $F(\bullet)$ is constant returns to scale, $L_{i,t}$ is the total amount of input of type $[i]$ at time $[t]$. Thus $L_{1,t}$ is the quantity of unskilled workers, $L_{2,t}$ the quantity of medium-skilled workers and $L_{3,t}$ the number of skilled workers.

Wages are paid their marginal products

$$w_{i,t} = \frac{dF}{dL_{i,t}} \quad \text{, for i=1, 2, 3.} \tag{8}$$

Immigrants and natives are assumed to be perfect substitutes in each skill category[3], which defines $L_{i,t}$ as

$$L_{i,t} = N_{i,t} + M_{i,t} = N_{i,t}\left(1 + \theta_{i,t}\right) \quad \text{for i=1, 2, 3.} \tag{9}$$

In matrix notation, the [3x1] vector of the labor force L_t can be written as

$$L_t = \left(I + \theta_t\right) N_t \ , \tag{10}$$

where I is the [3x3] identity matrix. Since wages depend on the relative quantity of labor-types, wages can be written as functions of the vector L_t,

$$w_{i,t} = w_i\left(L_t\right), \ \text{ for i=1, 2, 3.} \tag{11}$$

The [3x1] vector of wages is written as W_t.

[3] There is evidence by Ottaviano and Peri (2006) that immigrants and natives for a same level of schooling/experience are not perfect substitutes. Borjas (2009) argues that for all practical purpose they can be considered perfect substitutes. For the present purpose out of simplicity we assume that they are perfect substitutes.

2.3 Government

There is a government that taxes in a proportional way the income of all agents in the economy and the revenue is returned via lump-sum to all workers. Because of the higher wages of skilled workers, they are net contributors to the system, while unskilled workers would receive a net benefit. Depending on wages, medium-skilled workers can be net contributors or net beneficiaries.

Defining τ as the tax rate, then the transfer that each worker in the economy receives is given by

$$B_t \left(W_t \left(\theta_t \right), \theta_t \right) = \tau \left(\frac{N_t' \left(I + \theta_t \right) W_t}{N_t' \left(I + \theta_t \right) 1} \right) , \tag{12}$$

where 1 is a [3x1] vector of ones.

2.4 Utility

Individuals care about their own consumption $c_{i,t}$ (i=1, 2, 3) and also about the future welfare of their children. Consumption is given by wages net of taxes, plus transfers

$$c_{i,t} = (1 - \tau) w_{i,t} + B_t, \quad \text{i=1, 2, 3,} \tag{13}$$

and the current-period utility that they derive from consumption is given by a utility function $u(c_{i,t})$ that ranks flows of consumption.

When agents vote over immigration policy the skill type of their children has not yet been revealed. Hence we assume that they value the welfare of their offspring in an expected-utility form. The lifetime utilities of each agent-type in this model are given by

$$v_{i,t} \left(c_{i,t}, E \left[v_{t+1} | i \right] \right) = u \left(c_{i,t} \right) + \beta E \left[v_{t+1} \left(\bullet \right) | i \right] \quad \text{for i=1,2,3.} \tag{14}$$

Where β is a scalar that governs the strength of the altruism motive, the function $v_{i,t} \left(c_{i,t}, E \left[v_{t+1} | i \right] \right)$ is the lifetime utility of an agent of skill $[i]$ at time $[t]$ and the expectation is conditional on the skill type of the parent. Given the transition matrix, the lifetime utilities can be written as

$$v_{i,t} = u \left(c_{i,t} \right) + \beta \left[q_{i1} v_{1,t+1} + q_{i2} v_{2,t+1} + q_{i3} v_{3,t+1} \right] \quad \text{for i=1,2,3,} \tag{15}$$

where for simplicity we omitted the arguments in $v_{i,t}$ but discuss this more thoroughly in the next section. In matrix notation we can write

$$V_t = U \left(C_t \right) + \beta Q_n V_{t+1} \tag{16}$$

where the vectors V_t and $U \left(C_t \right)$ are defined as $V_t = \left[v_{1,t} \quad v_{2,t} \quad v_{3,t} \right]'$ and $U \left(C_t \right) = \left[u \left(c_{1,t} \right) \quad u \left(c_{2,t} \right) \quad u \left(c_{3,t} \right) \right]'$.

Since wages depend on the relative supply of each type of input, immigration affects utility of natives directly by its current effect on wages, but also affects the wages in the future by affecting the composition of the future native labor force, which in turn affects the wages and welfare of the next generation. In addition, an immigration policy changes B_t.

2.5 Equilibrium

The transition matrices that we consider and fertility rates are such that the medium-skilled holds the majority, irrespective of the immigration quotas (see the next section for the empirical justification). Hence the medium-skilled is also the majority voter and so they choose policy every period.

Since at every point in time the problem is repeated for each generation, where the majority is the medium-skilled and the state of the economy is given by the composition of the N_t vector, we use Markov perfect equilibrium (MPE) as the equilibrium concept. In the MPE the equilibrium strategies are a function of the state but not of the history of the game. This concept is typically used in dynamic political macroeconomic games.

Under this equilibrium concept, agents fully incorporate the expected induced effects on future policy due to changes in the current policy. In other words, when making a voting decision agents consider how future generations will respond to changes in current policy. For the medium skilled workers, who are the majority, a strategy maps the state N_t into an immigration quota for each type of worker.

Since the production function is constant returns to scale, the ratios $\left(\frac{N_{3t}}{N_{2t}}\right)$ and $\left(\frac{N_{1t}}{N_{2t}}\right)$ are sufficient to characterize the state, with either a constant, growing or declining population.

Because consumption depends on wages and transfers, and these in turn depend on the state (N_t) and immigration quotas (θ_t), consumption can be written as a function with the following arguments

$$c_{i,t} = \widetilde{C}_i\left(\theta_t, N_t\right) \qquad \text{for i=1,2,3.} \tag{17}$$

Define $v^*_{i,t+1}$ as the value function of an agent of skill type $[i]$ at time $[t+1]$, and V^*_{t+1} as the vector of value functions in period $[t+1]$, where $\left[V^*_{t+1}\right] = \left[v^*_{1,t+1} \quad v^*_{2,t+1} \quad v^*_{3,t+1}\right]'$, given that the next generation plays their best response in Markov strategies, defined by $\theta^*_{t+1} = G(N_{t+1})$.

In the case of the medium-skilled worker, since they choose the immigration policy their optimal strategy is to vote according to

$$\begin{aligned} G\left(N_t\right) &= \underset{\theta_t \in H(N_t)}{\arg\max} \left\{u\left(\widetilde{C}_2\left(\theta_t, N_t\right)\right) + \beta Q_{n[2]} V^*_{t+1}\left(G\left(N_{t+1}\right), N_{t+1}\right)\right\} \\ s.t. \quad N_{t+1} &= \left(Q_n^T \eta + Q_m^T \eta_m \theta_t\right) N_t \end{aligned} \tag{18}$$

where the current voter is choosing over the space of policies that map the state N_t into an immigration policy $\theta_t \in H\left(N_t\right)$, given that future generations play their best response $\theta^* = G\left(N\right)$. The value function of the medium-skilled is in turn given by the maximized utility function and therefore satisfies the functional equation

$$\begin{aligned} v^*_{2,t}\left(G\left(N_t\right),N_t\right) &= u\left(\widetilde{C}_2\left(G\left(N_t\right),N_t\right)\right)+\beta Q_{n[2]}V^*_{t+1}\left(G\left(N_{t+1}\right),N_{t+1}\right) \\ with \quad N_{t+1} &= \left(Q_n^T\eta+Q_m^T\eta_m G\left(N_t\right)\right)N_t \end{aligned} \tag{19}$$

where we define V^*_{t+1} as the vector of value functions in period [t+1]. The value functions of the unskilled and skilled types are given by the lifetime utility that results from the current median voter (medium-skilled worker) choosing the Markov strategy immigration policy $G(N_t)$ and every future median voter (medium-skilled) generation optimally choosing $G\left(N_{t+j}\right)$ for all $j>0$. The value function for those players is given by

$$\begin{aligned} v^*_{i,t}\left(G\left(N_t\right),N_t\right) &= u\left(\widetilde{C}_i\left(G\left(N_t\right),N_t\right)\right)+\beta Q_{n[i]}V^*_{t+1}\left(G\left(N_{t+1}\right),N_{t+1}\right) \quad \text{for i=1,3} \\ with \quad N_{t+1} &= \left(Q_n^T\eta+Q_m^T\eta_m G\left(N_t\right)\right)N_t \end{aligned} \tag{20}$$

In matrix notation and ignoring the time subscripts we have that the 3 value functions and the optimal policy $G\left(N\right)$ satisfy the following 3 functional equations

$$V^*\left(G\left(N\right),N\right)=\left\{\begin{array}{c} U\left(\widetilde{C}\left(G\left(N\right),N\right)\right)+ \\ \beta Q_n V^*\left(G\left(\left(Q_n^T\eta+Q_m^T\eta_m G\left(N\right)\right)N\right),\left(Q_n^T\eta+Q_m^T\eta_m G\left(N\right)\right)N\right) \end{array}\right\}. \tag{21}$$

3 Data and Calibration

3.1 Intergenerational Mobility Matrices

Many studies of intergenerational mobility use transition matrices to analyze the relative position of people in the income distribution compared to that of their parents. Such studies typically suffer from possible life-cycle effects and a small number of observations (PSID, NLS for example). Since we are interested in the intergenerational mobility of individuals based on skills, we focus on the education levels of individuals and their parents in studying intergenerational mobility.

We use the General Social Survey for this matter, which is an annual survey since 1972. Starting in 1977, this survey captures, in addition to the schooling level of the respondent, information on the schooling level of the respondent's parents. The survey also identifies whether the respondents and their parents were born in the US. Hence, we can estimate transition matrices and perform some statistical tests for natives and children of first generation immigrants.

We consider individuals who were born on or after 1945 and whose age at the time of the interview was between 25 and 55 years old. Some individuals were born before, but since the earliest GSS wave that has the information used in this paper is in 1977, that implies using individuals that might be too old. We cap it at 55 because of a possible relationship between mortality and education level. The education variable used to classify individuals is based on whether the individuals (either respondent or his/her parents) obtained any of the following degrees: less than high school, high school (HS), junior college, college and grad school. We classify individuals as 2nd generation immigrants, whose transition matrix we are interested in, if the respondent was born in the US but any of the parents were born outside the US.[4] Natives in turn are individuals whose parents were born in the US.

For the transition matrices we define "unskilled" as an individual with less than a high school degree, "medium-skilled" as either having a high-school or a junior college degree, and a "skilled" individual if he has either a college or graduate degree. For individuals with information on both parents, we use the maximum degree obtained by any of them. More details on the construction of these matrices, including the criteria for data selection, matrices estimated under alternative assumptions as well as statistical tests on them are found in the appendix.

The transition matrices Q_n and Q_m are estimated from the GSS as follows. For each element q_{ij} in (1) and q'_{ij} in (2), the estimate is the number of children with corresponding education level i and parents with education level j divided by the total number of parents with educational level j. The empirical frequencies differ somewhat across subsamples in the GSS (e.g. for men and women; see appendix); but since they do not differ greatly, our main calibration uses results for both all men and women, which are

$$\widehat{Q}_n = \begin{bmatrix} .253 & .665 & .082 \\ .061 & .706 & .232 \\ .009 & .405 & .586 \end{bmatrix} \quad , \quad \widehat{Q}_m = \begin{bmatrix} .216 & .581 & .203 \\ .066 & .631 & .303 \\ .022 & .330 & .649 \end{bmatrix}.$$

3.2 Fertility Rates

In order to calibrate the number of children that agents have, we construct total fertility rates by education level (TFR) for 3 different years: 1990, 2000 and 2005. The concept of total fertility rate measures the expected number of children that a woman would have in her lifetime if she was subject to the current (cross-section) age-specific fertility profiles. [5]

[4] We could classify second generation immigrants as those respondents born in the US whose both parents (rather than only one) were born outside the US. We don't do this because 1) the number of observations greatly decreases for second generation immigrants (from 1259 to 434) and 2) because the numbers don't appear to be significantly different according to the unskilled, medium-skilled, skilled classification used in this paper. See the appendix.

[5] Total Fertility rates are constructed as follows. First divide the total number of births whose mothers are in a specific age-education group (i.e. 20-24 year old mothers with 11 or less years of education) by the number of women in that age-education group. Since the age groups are for 5 year increments, the resulting number is multiplied by 5. Finally, those

Total fertility rates can be accurately calculated with birth data from the National Center for Health Statistics (downloaded from their VitalStats system), and age-education groups from Census data (1990, 2000) and the Current Population Survey (2005). However, the available data on births doesn't detail whether the mothers are US-born, or foreign-born. Hence, information from the American Community Survey (ACS) for several years is also used for the estimation of total fertility rates. Details are in the appendix.

Table 2. Total Fertility rates. Years 1990, 2000 and 2005

	US-Born			Foreign-Born		
Year	Unskilled	Medium	Skilled	Unskilled	Medium	Skilled
2005	1.98	1.94	1.82	2.78	2.44	1.99
2000	2.24	2.00	1.59	3.04	2.50	1.76
1990	2.41	1.89	1.82	3.21	2.39	1.99
Average	2.21	1.94	1.75	3.01	2.44	1.91

The estimated fertility rates show the well-known negative relationship between education and fertility, and also display that foreign-born women have higher fertility rates than US-born women of the *same skill level*. Given these estimated TFR's, the implied model parameters are $\eta_1 = 1.1$, $\eta_2 = 0.97$, $\eta_3 = 0.87$ and $\eta_1' = 1.5$, $\eta_2' = 1.22$, $\eta_3' = 0.96$.

3.3 Production

We assume the production technology is of the constant elasticity of substitution (CES) type

$$Y_t = \left[\phi_1 (L_{1,t})^\rho + \phi_2 (L_{2,t})^\rho + \phi_3 (L_{3,t})^\rho\right]^{\frac{1}{\rho}}, \tag{22}$$

where for simplicity the share parameters are normalized so that

$$1 = \phi_1 + \phi_2 + \phi_3. \tag{23}$$

The elasticity of substitution between labor types is defined as $\sigma = \frac{1}{1-\rho}$. This production function encompasses among other cases, Cobb-Douglas ($\sigma = 1$ if $\rho = 0$), Leontief ($\sigma = 0$ if $\rho = -\infty$) and perfect substitutes ($\sigma = \infty$ if $\rho = 1$) production functions. The domain of the parameter ρ is $(-\infty, 1]$.

Production parameters are ϕ_1, ϕ_2, ϕ_3 and ρ. In the labor literature, the elasticity of substitution $\left(\frac{1}{1-\rho}\right)$ is reported to be between 1.4 and 2.5 in several studies.[6] We use $\rho = \frac{1}{2}$, which implies $\sigma = 2$, but later do sensitivity analysis.

Given ρ, we can calibrate the stylized production function to match average skill premia using data on the relative quantities of labor types. The equations relating wage premia to the production parameters are

quantities are added for a given education level. The result is a cross-section measure of expected number of children a woman would have in her lifetime.

[6] See for example Ottaviano and Peri (2006).

$$\left(\frac{\phi_i}{\phi_j}\right) = \frac{w_{i,t}}{w_{j,t}} \left(\frac{L_{j,t}}{L_{i,t}}\right)^{\rho-1} \qquad \text{for i} \neq \text{j=1,2,3,} \tag{24}$$

and the normalized shares equation given by (23).

We use census data of the mean earnings of full time workers that are 25 years and older by educational attainment, for the years 1991 to 2007. We obtain $\left\{\overline{\left(\frac{L_2}{L_1}\right)}, \overline{\left(\frac{L_3}{L_2}\right)}\right\} = \{6.396, .540\}$ and $\left\{\overline{\left(\frac{w_2}{w_1}\right)}, \overline{\left(\frac{w_3}{w_2}\right)}\right\} = \{1.448, 1.787\}$, and given $\rho = \frac{1}{2}$, we obtain $\left\{\widehat{\phi_1}, \widehat{\phi_2}, \widehat{\phi_3}\right\} = \{.1056, .3868, .5076\}$.

3.4 Preferences

We assume that the period utility function $u(x)$ is given by logarithmic preferences

$$u(x) = \ln x, \tag{25}$$

For the discount factor β, we follow Ortega (2005) in setting an annual value of $\widetilde{\beta} = .985$, which for 30 year periods yield a model parameter of $\beta = .985^{30} = .63546$. We perform sensitivity analysis on this parameter later.

3.5 Baseline Calibration

We interpret a model period as 30 years, which is roughly the average age of mothers. Given the 5.15 immigrants per 1000 natives annual estimate for unskilled workers, and 4.15 skilled immigrants per 1000 skilled natives, the quotas for a 30 year equivalent are roughly $\theta_1 = 18\%$ and $\theta_3 = 13\%$.

On the supply side, we assume a huge pool of unskilled immigrants willing to come to the US, which we can argue is consistent with reality without further elaboration. In the case of medium-skilled immigration, the optimal policy of equilibrium under any realistic calibration will always dictate $\theta_2^* = 0\%$ and hence the supply side turns out to be irrelevant ($\theta_2^{\max}$ is irrelevant as $\theta_2^* = 0\%$). The case of skilled immigration is more complicated. We observe $\theta_3^* = 13\%$, which could be either the unconstrained optimal choice of the medium-skilled voter from a bigger pool of skilled immigrants, or it could be a corner solution $\theta_3^* = \theta_3^{\max}$ as the supply of high-skilled workers is not without bound; that is, the supply side could be constraining skilled immigration.[7]

[7] Some possible limits to skilled immigration are discussed. First, if there is massive skilled immigration, the wages of those individuals would decrease, and that makes immigration to other countries (with whom the US would be competing) more attractive. Second, depending on the calibration, there can be a demand side limit of immigration when $w_2 = w_3$, as any skilled immigration above that level would actually decrease w_2 since high-skilled people would be able to work in medium skilled jobs. Finally, not all skilled individuals in other countries have human capital that would be considered high-skilled in the US because of knowledge that would only be useful in the country (lawyers), or accreditation problems (doctors for example).

For any "realistic" upper bound on skilled immigration (say 40% for 30 year periods, which is much more than what has been observed), the model typically generates $\theta_3^* = \theta_3^{\max}$. This suggests that skilled immigration would be constrained by it's supply side rather than by the voting choice of the medium-skilled majority. Hence we set $\theta_3^{\max} = 13\%$. We discuss alternative interpretations in the sensitivity section.

We use value function iteration in order to solve for the MPE of the model, with discretized state and policy spaces and bilinear interpolation in the evaluation of the value function[8]. The state variables are the ratios $\left(\frac{N_1}{N_2}\right)$ and $\left(\frac{N_3}{N_2}\right)$. Given the demographic profile of natives (Q_n, η), we first compute the steady state distribution of skill types of the native population in absence of immigration which we denote as $\left\{\left(\frac{N_1}{N_2}\right)^{SS}, \left(\frac{N_3}{N_2}\right)^{SS}\right\}$. Then given the demographic profile of immigrants (Q_m, η_m) we consider a grid in the state space that contains both the initial steady state and the future steady state induced by the optimal immigration policy chosen by the medium-skilled majority. The policy space is given by elements in $[0, \theta_1^{\max}] \times [0, \theta_2^{\max}] \times [0, \theta_3^{\max}]$. The scalar $\theta_1^{\max}$ is big enough to allow for an interior solution as we assume that there is a huge pool of unskilled immigrants. More details are in the appendix.

Given the estimated and calibrated parameters, for the objective $\theta_1 = 18\%$ and $\theta_3 = 13\%$ we calibrate a tax rate of $\tau = 36.1\%$ and $\theta_3^{\max} = 13\%$. To summarize, the parameter values are

Baseline Calibration

Demographic Profiles	Production and Preferences	Immigration Pool and Taxes
$Q_n = \begin{bmatrix} .253 & .665 & .082 \\ .061 & .706 & .232 \\ .009 & .405 & .586 \end{bmatrix}$	$\rho = 0.5$	$\theta_1^{\max} = 1.0$ $\theta_2^{\max} = N/A$ $\theta_3^{\max} = .13$
$Q_m = \begin{bmatrix} .216 & .581 & .203 \\ .066 & .631 & .303 \\ .022 & .330 & .649 \end{bmatrix}$	$\begin{bmatrix} \phi_1 \\ \phi_2 \\ \phi_3 \end{bmatrix} = \begin{bmatrix} .1056 \\ .3868 \\ .5076 \end{bmatrix}$	
$\begin{matrix} \eta \\ \eta_m \end{matrix} = \begin{matrix} \text{diag}\{1.1, 0.97, 0.87\} \\ \text{diag}\{1.5, 1.22, 0.96\} \end{matrix}$	$\beta = .985^{30}$	$\tau = .361$

In the baseline calibration the equilibrium immigration policy implies allowing all skilled immigrants in the skilled pool at any point on the state grid.

Regarding unskilled immigration, the optimal policy has a quota of unskilled workers that is decreasing in $\frac{N_1}{N_2}$ and increasing in $\frac{N_3}{N_2}$. In words, the higher the number of unskilled natives relative to medium-skilled, the lower demand

[8] Spline interpolation was also used. The results are identical to bilinear interpolation, but the computational cost is much higher.

there is for unskilled immigration as ceteris-paribus there is less "room" for new unskilled workers whose positive effects on medium-skilled wages would be smaller but their net benefit from transfers possibly larger. Similarly, the higher the number of skilled individuals relative to medium-skilled, the higher the equilibrium quota of unskilled workers since the higher the number of skilled workers, the larger the wages of both unskilled and medium-skilled workers.

Medium skilled workers are not accepted in equilibrium as the "cost" of allowing some of them (lower current medium-skilled wages) is higher than future benefits. Even though in reality we do see some medium-skilled immigration, in general it is small compared to the other categories and we hypothesize from this analysis that medium skilled immigration is not justified by the economic trade-offs identified in this paper. Alternatively, this model is a stylized description of reality (immigration of the extremes).

The optimal voting policy induces a unique steady state irrespective of initial conditions (for the grid considered). In general, the equilibrium strategy implies a faster convergence toward the new steady state starting from any point in the state grid than convergence to the steady state in absence of immigration. Also, the optimal policy can be considered state-contingent immigration. That is, if the country is in a state with very little unskilled population, there would be (higher) demand for unskilled immigration. The "bracero" program that the US signed with Mexico in 1942 could be an example of this. Similarly, illegal immigration (typically confined to unskilled jobs) could also be interpreted as a demand side factor (at least partially) as the native unskilled population in the US as percentage of the labor force has been shrinking over time.

4 Using the Model

4.1 How does the Intergenerational Mobility of Immigrants affect Immigration Policy?

In this section we study changes to entries in the transition matrix of immigrants Q_m, holding other parameters constant. Since we cannot ceteris-paribus change individual entries in Q_m without affecting other entries in that row (since for example $\Delta q'_{11} + \Delta q'_{12} + \Delta q'_{13} = 0$), then in this section whenever we change an entry, the ratio of the other two probabilities in that row are left unchanged. We use a 10 percentage points increase in each entry of the baseline Q_m matrix and document the results.

The most significant changes in equilibrium unskilled immigration come from changes in the probability distribution of unskilled agents. In particular, an increase of 10 percentage points in q'_{13} increases θ_1 to 56% in the initial steady state (from a baseline of 18%), with a long run quota (at the new induced steady state) of 44%. In turn, modifying q'_{11} changes the equilibrium unskilled quota marginally, while an increase in q'_{12} would result in no support for unskilled immigration ($\theta_1 = 0$ in both short and long run). We explain these results. A higher q'_{12} leads to lower immigration of unskilled immigrants because their children would compete in the most likely scenario with the children of the native medium-skilled (there is a 70% probability that children of medium skilled continue being medium skilled). In turn, a higher q'_{13} leads to higher immigration as the possible complementarity of the children of immigrants with natives who are in states "unskilled" or "medium-skilled" outweighs the cost of the competition if the children of natives were in the "skilled" state.

Changing the probability distribution of skilled workers almost doesn't affect the immigration quotas at the steady state without immigration. However, the steady state induced by the preferred immigration policy has a significantly lower unskilled quota when q'_{31} is increased ($\theta_1 = 8.2\%$). This is because in this case skilled individuals have more unskilled children, which yields a lower demand for unskilled immigration.

The changes to any of the probabilities for medium skilled parents don't affect the unskilled or skilled quotas because the equilibrium quotas for medium-skilled are zero and the "small" changes in probabilities considered here are not enough to produce positive medium-skilled quotas.

It is possible to generate cases in which $\theta_3 < \theta_3^{\max}$. However, given the calibrated model they would require very unrealistic probability distributions for the children of skilled immigrants. For example, if from the baseline case we add 60 percentage points to q'_{31}, which we substract from q'_{33}, then the immigration of high skilled workers does depend on the state space, and the future induced steady state has $\theta_3 = 12.3 < 13\%$. This experiment illustrates how difficult it is to obtain an interior solution for θ_3, again motivating our interpretation of observed high-skilled immigration as a corner solution.[9]

4.2 What if Immigrants had identical demographic profiles to natives?

Our baseline results are driven in part by differences between the transition matrices Q_m and Q_n. There are two ways to think about a world without such differences. One experiment is to maintain the baseline calibration as correct and consider a impact of a change in Q_m. If we set $Q_m = Q_n$, equilibrium unskilled immigration is adversely affected because immigrants seem to have better upward mobility odds (though this might not be true for every immigration group, it is true in average). Hence with lower mobility more children of unskilled immigrants would be in states that turn out to be undesirable for the medium-skilled majority. In terms of magnitudes, the unskilled quota would decrease from 18% to 0% at the initial steady state, with an induced steady state quota of 0%.

A second experiment is to recalibrate the model under the assumption of

[9] If instead of increasing q'_{31} we increase q'_{32} by 60 percentage points (so that the children of high skilled immigrants compete in the more likely state for the children of the medium skilled natives -medium-skilled), this doesn't generate an interior solution to θ_3. Alternatively if we distribute those 60 percentage points between q'_{31} and q'_{32} we don't obtain an interior solution to θ_3. Only when the full weight is given to q'_{31} we obtain an interior solution. We discuss other possibilities in the sensitivity analysis of $\theta_3^{\max}$.

identical profiles ($Q_m = Q_n$ and $\eta_m = \eta$). This would implicitly assume that voters disregard the estimated differences. In this case, one obtains positive unskilled immigration, as in the baseline, but for a different tax rate. Specifically, a tax rate of 31.75% generates $\theta_1 = 18\%$ and $\theta_3 = 13\%$.[10] If one introduced differences in mobility starting from this alternative calibration, moving to the estimated intergenerational mobility of immigrants would significantly increase support for unskilled immigration to almost $\theta_1 = 52\%$. Thus in both experiments, a high upward mobility of unskilled immigrants implies more unskilled immigration.

In order to understand these results we also examine the effects of modifying Q_m one row at a time, starting with the estimated matrix. If only the unskilled immigrants have a skill distribution of children identical to that of natives $\left(Q_{m[1]} = Q_{n[1]},\text{ while } Q_{m[j]} = Q_{n[j]} \text{ for j=2,3}\right)$, the unskilled immigration quota would be 0% in both the short and long run. This result is robust to either using identical fertility for natives and immigrants, or using the estimates for differential fertility. What helps explaining this is that natives have a higher proportion of unskilled children than immigrants. Hence, when we set $Q_{m[1]} = Q_{n[1]}$, the medium-skilled demands less unskilled immigration as that would imply more competition in the case that their children turn out to be unskilled, and at the same time less complementarity of the children as upward mobility of immigrants would be lower. Alternatively, the amount of unskilled immigration that can be supported decreases as in this case unskilled immigrants have more unskilled children and there is therefore less room for unskilled immigration.

Changing the medium skilled distribution doesn't change the unskilled immigration quota because in equilibrium there is no medium-skilled immigration in our calibrated models. And finally, if children of skilled immigrants have the same transition probabilities as natives, the medium-skilled would demand more unskilled immigration. This is so because the Q_m matrix estimated has a slightly bigger probability (but still small) that their children will become unskilled. Hence using the same probabilities as natives implies lower number of unskilled natives over time (as well as less skilled natives) and the medium-skilled demands slightly more unskilled immigration. From this exercise we conclude that more successful children of unskilled immigrants gives political support for a bigger unskilled quota, and the opposite is also true.

4.3 Immigration Policy if Guest Worker Programs are Available

In this section we enlarge the policy space to allow for the possibility of guest worker quotas, in addition to immigration quotas. In the model, the only difference between guest workers (or braceros) and immigrants is that immigrants affect the future composition of the native population because they have chil-

[10] If we assume both identical intergenerational mobility ($Q_m = Q_n$) and differential fertility ($\eta_m \neq \eta$), then the tax rate that yields $\theta_1 = 18\%$ is $\tau = 28\%$.

dren, while guest workers have a zero fertility rate (they return to their home country).

We assume that there is a large pool of unskilled immigrants willing to come as braceros (guest workers), which the model determines endogenously. In the case of skilled workers we assume that the hard maximum of immigrants+guest workers of the skilled type is given by $\theta_3^{\max}$. We assume that a maximum quantity of braceros $\theta_{3B}^{\max}$ is part of the immigration pool, while the quota of skilled guest workers is given by θ_{3B}. Thus we assume that $\theta_{3B} + \theta_3 \leq \theta_3^{\max}$ and $\theta_{3B} \leq \theta_{3B}^{\max} \leq \theta_3^{\max}$.

The case of medium-skilled workers is irrelevant since allowing braceros of that type doesn't change the incentives of the native median voter since there would be only "costs" of allowing braceros of medium-skill level (lower wages), while there are no benefits (no change in the future composition of native workers) for the medium skilled native.

Under the baseline parameterization but allowing for 3 more choice variables given by the guest worker quotas (θ_{1B}, θ_{2B}, θ_{3B}) we find that the median voter would choose full immigration for skilled immigrants (no guest worker for them), no immigration/guest worker for medium skilled, while in the case of unskilled individuals only guest workers would be chosen. We discuss the reasons below.

The median voter would offer full immigration to skilled individuals rather than a guest worker program because in equilibrium the median voter would like more skilled workers than the current available supply of skilled immigrants. By granting them full immigration, the native medium-skilled can affect the composition of the population in a more advantageous way to their children, who have a large probability of being medium skilled.

When comparing across regimes, the quota of unskilled guest workers is higher than the unskilled immigration quota when the guest worker program is not available ($\theta_{1B} = 61\% > 18\% = \theta_1$ in absence of guest worker in the baseline case). There are two reasons for this. First, unskilled immigrants have a much higher fertility rate than natives. Hence, allowing unskilled immigrants can affect more easily the size of the future native population (and the composition) than allowing the same number of individuals of a different type; and second, unskilled immigrants have a majority of children that become medium-skilled, which in turn would most likely compete with native children of medium-skilled. When the dynamic effects are removed (via allowing braceros), the only effects that are considered by the natives are the contemporaneous wage effects: the medium-skilled voter allows unskilled guest workers until the marginal benefit (higher wages for medium-skilled) equals the marginal cost (redistribution) to these workers, everything else constant. Another way to see this is the following: if a guest worker program is not feasible, then the immigration quota for unskilled workers would be lower than the quota of guest workers due to the future competition that these children represent for the medium-skilled.

If we modify Q_m it is possible to generate a case where the median voter allows both unskilled immigration and unskilled guest workers. For example, from the baseline matrix Q_m (which already has higher upward mobility than natives), decreasing q'_{21} by 12 percentage points (from 58.1% to 46.1%) and adding those points to q'_{31} (from 20.3% to 32.3%) would produce some unskilled immigration in the short run ($\theta_1 = 10\%$, $\theta_{1B} = 52\%$) but in the long run there would only be a bracero program with a quota of 55%.

For the interpretation, note that admitting unskilled guest workers is economically equivalent to a policy of tacitly tolerating unskilled illegal/undocumented workers. One way to implement such a policy is by neglecting border controls combined with measures that exclude these individuals from medium-and high-skilled jobs, e.g., background checks of licensing requirements. Thus the voting equilibrium in this section resembles US immigration policy, which permits high-skilled immigration and seems to tolerate illegals doing unskilled work.

Also note that admitting a succession of unskilled guest workers (withouth children) would be equivalent to admitting unskilled immigrants if all their descendents remained unskilled; for example , if their children were given low quality education. It may be an interesting issue for future research to examine if the changing educational opportunities of immigrant children (e.g., the end of billingual education in California) have influenced voter support for immigration. Our analysis implies, for example, that voters will be less tolerant of immigration if a greater proportion of immigrant children is medium-skilled rather than low-skilled.

4.4 On the Supply Side of Skilled Immigration

In this section we consider some alternative interpretations/justifications of the model regarding the supply side of skilled immigration.

Our main calibration assume that the supply side is binding. Some support for this view comes from the observation that immigration laws in the US typically allow high skilled individuals easier access to coming/staying in the country (specially those with advanced degrees).

One alternative is that the observed immigration policy is suboptimal for the medium-skilled majority, and hence future reform could focus on, among other things, increasing skilled immigration that would benefit the medium skilled majority. In this case the model would be interpreted as dictating the most preferred unskilled and medium skilled immigration policies in the presence of an exogenous limit on skilled immigration, as the medium-skilled would prefer more than the current level.

Another alternative is that the model gives the right qualitative predictions, but not necessarilly the right quantitative ones. Qualitatively, the calibration suggests immigration of unskilled workers, as well as for skilled workers, while constraining medium-skill immigration. This is what we observe in the US.

Finally, the sensitivity section provides hints about conditions under which the medium-skilled majority would choose to limit skilled immigration as their optimal policy. In general, one obtains limits on skilled immigration if skilled immigrants have children with a high probability of becoming unskilled. Hence one may suspect that if one extended the model by assuming uncertainty about the intergenerational mobility matrix of immigrants, one could generate an optimal policy that involves an interior solution on skilled immigration.[11]

5 Sensitivity Analysis

5.1 Different degree of substitution in the Production Function ($\frac{1}{1-\rho}$)

We perform sensitivity in the value of the elasticity of substitution between labor inputs, given by $\sigma = \frac{1}{1-\rho}$. We do it for two alternative values of ρ given by $\left\{\frac{2}{5}, \frac{3}{5}\right\}$. Setting $\rho = \frac{2}{5}$ we obtain share parameters $(\phi_1,\ \phi_2,\ \phi_3)$, given by $(.0922, .4063, .5014)$, while for $\rho = \frac{3}{5}$ we obtain $(.1207, .3670, .5123)$. The calibrated tax rates $\tau(\rho)$ in turn are given by $\tau\left(\rho = \frac{3}{5}\right) = 28.2\%$ and $\tau\left(\rho = \frac{2}{5}\right) = 43.5\%$.

The findings remain the same under these alternative parameterizations. We find the same qualitative effects of the comparative statics, but with some differences in magnitudes. For example when setting $Q_m = Q_n = \widehat{Q}_n$ we find no immigration of unskilled individuals for the case of $\rho = \frac{3}{5}$ irrespective of which fertility profile is used (identical to natives or differentiated fertility), while we find some unskilled immigration ($\theta_1 = 6.25\%$ in short run and $\theta_1 = 8.85\%$ in the long run) in the case with $\rho = \frac{2}{5}$ and identical fertility for the natives and the foreign-born. We also find the result of a guest worker program for unskilled immigrants, and full immigration to skilled ones. In summary, the model is robust to this parameter.

5.2 Other values of β

We used $\beta = 0.985^{30}$ in the exercises, which is the same annual value used in Ortega's model (2005), though he sets one model-period to be 40 years rather than 30. In general, holding everything else constant a higher β produces lower unskilled immigration (without effects on skilled immigration).

For example, using $\beta = .5$ ($\beta = .75$) given the rest of the parameters of the baseline calibration and tax rate of 36.1%, increases unskilled immigration to $\theta_1 = 28.7\%$ ($\theta_1 = 9.6\%$) in the initial steady state, and there is full immigration of high skilled individuals. The induced steady state yields $\theta_1 = 23.33\%$ $(\theta_1 = 10.26\%)$.

For $\beta = .5$, the calibrated tax rate is $\tau(\beta = 0.4) = 38.25\%$, while for $\beta = .75$ we would obtain $\tau(\beta = 0.6) = 33.75\%$. The qualitative behavior of the model is the same as in the baseline case.

[11] We do not pursue extensions to uncertainty due to a curse of dimensionality. Because the value function iteration required to obtain the MPE requires optimization over a grid of states indexed by the entire distribution of types, computational effort is growing exponentially with the number of possible types.

5.3 Pool of Skilled Immigrants ($\theta_3^{\max}$)

In the baseline calibration we assumed that the supply of skilled immigrants ($\theta_3^{\max}$) could be inferred by the observed flow of skilled immigration to the US, which would imply a quota of 13%. Here we modify $\theta_3^{\max}$ and study the results.

Using the same tax rate calibrated as in the baseline model (36.1%), when the pool of skilled immigrants is set at 30% rather than at 13% we find that the qualitative results remain unchanged: the quota of skilled immigrants is still constrained by the supply side ($\theta_3^* = \theta_3^{\max} = 30\%$), and there is slightly higher unskilled immigration that the additional skilled workers in equilibrium make possible ($\theta_1^* = 19\%$). Comparative statics work as in the baseline.

If we allow guest worker quotas in addition to immigration, the results are still full immigration for the skilled pool of immigrants $\theta_3^* = 30\%$, with guest worker for the unskilled workers given by $\theta_{1B}^* = 72\%$ at the steady state without immigration, higher than if only immigration is available ($\theta_1^* = 19\%$). Again, similar to what was found before.

In order to understand the extent to which the pool of skilled immigrants ($\theta_3^{\max}$) affects the results, we also analyze a case where we completely shut down skilled immigration ($\theta_3^{\max} = 0$). In this case the unskilled quota would be slightly lower in the short run ($\theta_1^* = 17\%$ as opposed to 18% in the baseline), and because in the long run there wouldn't be as many skilled individuals as when there can be skilled immigration, the long run quota of unskilled individuals is even lower $\left(\theta_1^{LR} = 12\%\right)$.

An interior solution for θ_3^* can be found more easily under the assumption that $\theta_3^{\max} = 30\%$. In this case, adding 32 percentage points (as opposed to 60) to q'_{31} is enough to generate an immigration policy that restricts skilled immigration to $\theta_3 = 28\%$ in the short run, and in the long run to $\theta_3^{LR} = 22.8\%$.[12] This suggests that, although the baseline calibration doesn't generate an interior solution for skilled immigration, we speculate that lack of information on intergenerational mobility of immigrants could generate an interior solution. That is, if the medium skilled worker has beliefs that skilled individuals might have low mobility (or if there is uncertainty in the immigrants matrix Q_m) then their demand for skilled immigration could produce an interior solution. We leave that issue for future research.

The main result in this section is that if the supply side is not constraining skilled immigration, then the middle skilled worker would like more of that type of immigration. This could be consistent with the often made argument that

[12] Intuitively, increasing q_{23} (probability that the children of medium skilled natives become high skilled) while decreasing q_{22} suggests finding an interior solution to θ_3 as high skilled immigration would represent more competition to the children of the medium skilled in the state "high-skilled" (though it would represent less competition in the state "medium-skilled"). However, for small decreases to q_{22} (which we add to q_{33}) the model cannot generate an interior solution. But if we assume a high probability q'_{31} that yields an interior solution on θ_3, decreasing q_{22} and increasing q_{23} by the amount that q_{22} decreases would yield a lower quota of skilled immigration. For example, adding 30 percentage points to q'_{31} and reducing q_{22} to 60.7% (from 70.6%), while increasing q_{23} to 33.3% (from 23.3%) would decrease equilibrium θ_3 from 28% in the short run (22.8% in the long run) to 20.7% (16.7%).

the US requires more skilled immigration.

5.4 An Alternative Definition of the Medium-Skilled Group

In this section we consider a different definition of medium-skilled labor. We put high school graduates, those with Junior College and Bachelor degrees in the middle category, with extremes being only those individuals who have less than a high school degree and those with a master/above degree.

The intergenerational mobility matrices in this case for men and women are given by

$$\widehat{Q}_n = \begin{bmatrix} .253 & .719 & .028 \\ .052 & .877 & .071 \\ .006 & .728 & .266 \end{bmatrix} \qquad \& \qquad \widehat{Q}_m = \begin{bmatrix} .216 & .710 & .074 \\ .060 & .826 & .114 \\ .008 & .661 & .331 \end{bmatrix} ,$$

where we use exactly the same filters (and observations) as those used to estimate the matrices under the baseline definitions.

Given $\rho = 1/2$, the production share parameters (ϕ_1, ϕ_2, ϕ_3) are estimated to be (.1097, .5153, .3750), where in this case we use wages information of individuals 18 years and older since the data for 25 years and older doesn't disaggregate enough for this exercise. However, when we compare the wage premia of the two series (defining the same type of groups) there is a very high correlation between the two. The fertility profiles can only be estimated at the level of dissagregation desired from the ACS for the years 2001-2008. The fertility profiles are estimated for unskilled women, medium skilled and high-skilled to be $\{2.41, 2.04, 1.97\}$ for native women and $\{3.23, 2.44, 2.08\}$ for foreign-born women. This implies model parameters of $\eta = diag\{1.21, 1.02, .99\}$ and $\eta_m = diag\{3.23, 2.44, 2.08\}$. The parameter β is set as in the baseline.

Given the new definitions we compute that during the 90's there were 2.43 medium-skilled immigrants per 1000 medium-skilled natives, 4.3 skilled per 1000 skilled natives, and the unskilled remains the same. This numbers yield $\theta_3 =$ 13.75% for a model-period of 30 years, with $\theta_1 = 18\%$ as the definition of unskilled remains constant. Under this specification the calibrated tax rate is given by $\tau = 46.5\%$.

The comparative statics work in the same direction as in the baseline case. For example, increasing q'_{31} from 7.4% to 17.4% while leaving the ratio of the other probabilities constant would increase the quota at the initial steady state from 25% to 79% (55% in the induced steady state). Increasing q'_{11} results in a similar unskilled quota in the short run of 17.6%, but only 11.8% in the long run as unskilled immigrants would have more unskilled children. This results are similar to the baseline case.

When we allow for the possibility of guest worker programs, we obtain similar results as previously. Full immigration for high skilled individuals and bracero program (with a higher quota than if no guest worker program was available) for unskilled workers.

6 Conclusions

We study a dynamic macroeconomic model of intergenerational mobility and immigration with three types of labor. In it, the demographic process is such that the medium-skilled is always the majority. We calibrate the model for the US and among other things find that children of unskilled immigrants and medium skilled immigrants seem to be more "successful" than the children of natives, using data from the General Social Survey (the higher the probability of children being skilled). We find the Markov Perfect equilibrium of the model and the optimal policy shows that if the children of unskilled immigrants are more successful than those of unskilled natives, there is more political support for unskilled immigration by the majority (the medium-skilled). The optimal policy is increasing in the share of skilled individuals in the economy and decreasing in the share of unskilled workers.

In general, the current effect on wages and transfers from the high-skilled individuals are very important for the welfare of the medium-skilled and thus their intergenerational mobility is relatively unimportant for the political support of skilled immigration.

If quotas of guest worker are available policy choices in addition to immigration, the medium-skilled would choose a guest worker program for unskilled immigrants, and full immigration for high skilled individuals.

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Appendix

A Open Economy Interpretation of the Production Function

Assume that the production function of the host country is given by

$$Y = AK^{\alpha}L^{1-\alpha}$$

where A is technology level, K is aggregate capital and L is a composite labor input. Assuming perfect capital mobility with an exogenous world interest rate (r) then capital adjusts so that the return on domestic investment is the same as the world return. Equalizing the marginal product of capital to the world interest rate and substituting into the production function yields

$$\begin{aligned} Y &= A'L \\ \textit{with} \qquad A' &= \left(\frac{\alpha A}{r}\right)^{\frac{\alpha}{1-\alpha}} \end{aligned}$$

where r is the return on capital. Since A' is just a multiplicative constant, without loss of generality we just assume that $A' = 1$. The resulting production function is a constant returns to scale in the composite labor input, which means that immigration doesn't change the average wage, only affects relative wages in this model.

B Foreign Born Population

The next table shows numbers of gross immigration to the US by education levels.

Foreign born population by date of entry

	2000-04	**1990-99**	**1980-89**	**1970-79**
Number (1000's)	3434	8679	6969	4494
Percentages of Corresponding Group by Completed Schooling Levels				
Less than High School	30.7	34.9	34.9	30.5
High School+Some College	35.0	37.5	40.7	40.6
Bachelor Degree & Beyond	34.3	27.6	24.4	28.9

Source: U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplement, 2004 Immigration Statistics Staff, Population Division. Table 2.5 Educational Attainment of the Foreign-Born Population 25 Years and Over by Sex and Year of Entry: 2004

In order to compute net immigration by skill level, we use the estimates in Ben-Gad (2004) of 3.2 immigrants per 1000 natives for the 1990-99 decade. Estimates of population by education level for individuals 25 years and older are 19.1% for LTHS, 58% for HS+SC and 22.8% for BA and beyond. With these numbers and some algebraic manipulation we can obtain estimates of 5.65 unskilled immigrants per 1000 unskilled natives, 2.025 medium skilled immigrants per 1000 natives and 4.14 skilled immigrants per 1000 skilled natives.

C Average Schooling Years by Cohort in the GSS

The average number of schooling years for individuals born in the US and aged between 25 and 55 years old at the time of the interview ranges from 11.03 for those born in the period 1915-1924 to 13.86 for the cohort 1975-1984. We use individuals born on or after 1945 because the average schooling years by cohort are roughly constant since then, while the average schooling years trend upward for previous cohorts.

Average number of schooling years by cohort in the GSS*

Cohort	**Mean**	**Std. Dev.**	**N**
1915 – 24	11.03	3.33	115
1925 – 34	12.01	3.20	1,193
1935 – 44	12.93	2.95	3,342
1945 – 54	13.65	2.74	7,157
1955 – 64	13.64	2.52	7,277
1965 – 74	13.87	2.55	3,561
1975 – 84	13.86	2.55	996
All	13.49	2.74	23,641

*Individuals born in the US, age 25-55 at the time of the interview. Men and Women

D Intergenerational Mobility Matrices

The GSS identifies whether the respondents and their parents were born in the US. Hence, we can estimate transition matrices and perform some statistical tests for natives and children of first generation immigrants.

We consider individuals who were born on or after 1945 and whose age at the time of the interview was between 25 and 55 years old. Some individuals were born before, but since the earliest GSS wave that has the information used in this paper is in 1977, that implies using individuals that might be too old. We cap it at 55 because of a possible relationship between mortality and education level. The education variable used to classify individuals is based on whether the individuals (either respondent or his/her parents) obtained any of the following degrees: less than high school, high school (HS), junior college, college and grad school. We classify individuals as 2nd generation immigrants, whose transition matrix we are interested in, if the respondent was born in the US but any of the parents were born outside the US. We could classify second generation immigrants as those respondents born in the US but whose both parents were born outside the US. We don't do this because 1) the number of observations greatly decreases for second generation immigrants (from 1259 to 434) and 2) because the numbers don't appear to be significantly different according to the unskilled, medium-skilled, skilled classification used in this paper. Natives in turn are individuals whose parents were born in the US.

We define "unskilled" as an individual with less than a high school degree, "medium-skilled" as either having a high-school or a junior college degree, and a "skilled" individual if he/she has either a college or graduate degree. For individuals with information on both parents, we use the maximum degree obtained by any of them.

D.1 Estimation of transition matrices and some tests

Define n_{ij} (i=1, 2, 3; j = 1, 2, 3) as the number of cases of a parent with education degree $[i]$ with sons/daughters of degree $[j]$. Also define N_i (i=1, 2, 3) as the total number of observations whose parents have degree $[i]$. Then $N_i = \sum_{j=1}^{3} n_{ij}$. The maximum likelihood estimates (MLE) of the probabilities describing a first order Markov process are given by $\widehat{q}_{ij} = \frac{n_{ij}}{N_i}$ (Anderson and Goodman (1957)).

Using data for men in the GSS, aged 25-55 at the time of the interview for individuals belonging to the cohorts of 1945-1984, for interviews taken during the period 1977-2008, we obtain 7645 observations for natives and 554 observations for sons of first generation immigrants. The estimated matrices are given by

$$\widehat{Q}_n = \begin{bmatrix} .28 & .63 & .09 \\ .07 & .69 & .24 \\ .01 & .41 & .58 \end{bmatrix} \quad , \quad \widehat{Q}_m = \begin{bmatrix} .25 & .52 & .23 \\ .06 & .64 & .30 \\ .025 & .35 & .625 \end{bmatrix}.$$

The first two rows of the transition matrices show that the children of unskilled and medium skilled immigrants to the US appear to be more "successful" than natives. In the case of unskilled parents, children of immigrants have a lower probability of staying unskilled, and a higher probability of upward mobility. Indeed, children of unskilled natives have a 9% probability of becoming skilled, while the children of unskilled immigrants have a probability of 23%. Given medium-skilled parents, the differences are not as marked as in the unskilled case but their odds seem to be better.

We can formally test whether the probability distributions for natives and children of immigrants are statistically the same, conditional on the skill of the parents. In other words, we test whether the row [i] of matrix $\widehat{Q}_n$ is statistically different from the same row in the matrix $\widehat{Q}_n$. The null hypothesis is given by $H_0 : q^1_{ij} = q^2_{ij}$ for all j=1,2,3, given row $[i]$.

If the parameters q_{ij} of the population are unknown, then they are estimated via maximum likelihood (ML), which just considers one big sample of all immigrants and natives cases. Denote the ML estimator under the null hypothesis as $\widetilde{q}_{ij}$. Then H_0 is rejected if the statistic $\sum_{m=1,2} S_i^m > \chi^2_{(k-1)}$, where $S_i^m = n_i^m \sum_{j=1}^{k} \frac{(q_{ij}-\widetilde{q}_{ij})^2}{\widetilde{q}_{ij}}$, and n_i^m is the total counts of row i (in transition matrix) of sample m. This test can be generalized for more than two populations, in which case H_0 is rejected if $\sum_{b=1}^{m} S_i^b > \chi^2_{(m-1)(k-1)}$ where m is the number of samples that we are comparing under a null of identical population.

With this $\chi^2_{(k-1)}$ test we obtain for each row the following statistics; $\sum_{m=1,2} S_1^m = 28.27$, $\sum_{m=1,2} S_2^m = 4.12$ and $\sum_{m=1,2} S_3^m = 5.80$. Each one is to be compared with a $\chi^2_{(3-1)}$ with 3-1=2 degrees of freedom. The $\chi^2_{(2)}$ at the 5% and 1% significance levels are respectively 5.99 and 9.21. Hence with these tests we can only reject the null hypothesis for unskilled parents.

We can also test for the equality of both matrices. The test (see Amemiya Pp. 417 and Mood-Graybill-Boes Pp. 449) is given by summing over rows, with the null hypothesis that $q_{ij}^1 = q_{ij}^2$ for all i=1,2,3 and j=1,2,3. Then the null is rejected if $\sum_{i=1}^{k} \sum_{m=1,2} S_i^m > \chi^2_{(k(k-1))}$ where the degrees of freedom are in this case $(k-1)\,k = 3\,(2) = 6$. The test produces a statistic of 38.19, which is to be compared with a χ^2 critical value at 1% significance with 6 degrees of freedom, which is 16.81. Hence, the test rejects that children of natives and those of first generation immigrants have the same transition matrix.

In the case of women under the same filters we have the following estimated transition matrices

$$\widehat{Q}_n^{women} = \begin{bmatrix} .237 & .688 & .075 \\ .056 & .720 & .224 \\ .011 & .401 & .588 \end{bmatrix} \quad , \quad \widehat{Q}_m^{women} = \begin{bmatrix} .195 & .623 & .181 \\ .069 & .623 & .308 \\ .019 & .314 & .667 \end{bmatrix},$$

where the total number of observations for the estimation of natives is 9427, and 705 for daughters of immigrants. In general we observe the same pattern as with men: the probabilities of upward mobility (according to schooling level) are higher for children of immigrants. The row test confirms that they are statistically different since the statistics are 28.33 for children of unskilled parents, and 14.81 for medium-skilled parents, which is higher than the 9.21 value of a χ^2 with 2 degrees of freedom at the 1% level of significance. There is not statistical difference in the probability distribution of daughters of skilled parents, as the test statistic = 5.03 is lower than the critical value of the test of 5.99 (At the

5% level). The test for the whole matrix testing whether q_{ij}^{women} for all i,j are identical for both populations is rejected. The test statistic is 48.17 > 16.81.

D.2 Further partitions of the data

Men Vs Women. Comparing the transition matrices for native men and women, the first two rows suggests that men have slightly more extreme outcomes than women. The row tests show that the probability distributions for sons of unskilled and medium-skilled parents are different to those of daughters, with statistics of 12.81 (unskilled parents) and 12.00 (medium-skilled), while we cannot reject that the probability distribution of sons and daughters of skilled parents are the same (statistic=1.95). The matrix test rejects that men and women have the same transition matrices, with an statistic of 26.76>16.81.

In the case of immigrants, the matrix test produces an statistic of 4.65, which cannot reject that the matrices are equal. The differences are of the order of magnitude of those of natives, but in this case the lower number of observations is the main cause that we cannot reject the null hypothesis of equality.

If we compare white men to white women (natives), the results remain essentially unchanged as the matrices almost don't change, nor the results of the tests.

Using only white natives for comparison with children of immigrants. If for native immigrants we use only data of white men, the results are practically identical to our previous results. The row tests again show probability distributions significantly different for unskilled (statistic = 24.23) and statistically the same for children of medium skilled parents (statistic =2.42), as well as those of skilled parents (5.21). The test for the whole matrix again rejects that they are identical (statistic=32.16).

When using native women vs daughters of first generation immigrants, again the natives matrix for all races and for whites are almost identical. The row tests again rejects that the probabilities distributions are the same for unskilled and medium-skilled parents, while for skilled parents we can't reject that they are the same.

D.3 Estimated Intergenerational Transition Matrices

Transition Matrices for Natives

#	*Transition* *Matrix* (Q_n)				*Men/* *Women*	Race	Age
	.277	.63	.093	$N_1 = 1411$			
1	.068	.690	.242	$N_2 = 4502$	Men	All	25-55
	.007	.409	.584	$N_3 = 1732$			
	.278	.625	.097	$N_1 = 1033$			
2	.064	.684	.252	$N_2 = 3948$	Men	White	25-55
	.007	.392	.601	$N_3 = 1616$			
	.237	.688	.075	$N_1 = 2108$			
3	.056	.720	.224	$N_2 = 5440$	Women	All	25-55
	.011	.401	.588	$N_3 = 1879$			
	.230	.693	.077	$N_1 = 1387$			
4	.046	.715	.239	$N_2 = 4545$	Women	White	25-55
	.009	.387	.604	$N_3 = 1698$			
	.253	.665	.082	$N_1 = 3519$			
5	.061	.706	.232	$N_2 = 9942$	Both	All	25-55
	.009	.405	.586	$N_3 = 3611$			
	.250	.664	.086	$N_1 = 2240$			
6	.055	.701	.245	$N_2 = 8493$	Both	White	25-55
	.008	.390	.602	$N_3 = 3314$			

Transition Matrix for Children of Immigrants

	Transition *Matrix* (Q_m)				*Men/* *Women*	Race	Age
	.247	.520	.233	$N_1 = 150$			
1	.063	.641	.296	$N_2 = 284$	Men	All	25-55
	.025	.350	.625	$N_3 = 120$			
	.195	.623	.181	$N_1 = 215$			
2	.069	.623	.308	$N_2 = 334$	Women	All	25-55
	.019	.314	.667	$N_3 = 156$			
	.216	.581	.203	$N_1 = 365$			
3	.066	.631	.303	$N_2 = 618$	Both	All	25-55
	.022	.330	.649	$N_3 = 276$			

Tests with 5% critical values (χ^2)

H_0 Null Hypothesis	Matrix Test CV=12.59	Row1 Test CV=5.99	Row2 Test CV=5.99	Row3 Test CV=5.99
$Q_n[\#1] = Q_m[\#1]$	38.19	28.27	4.12	5.80
$Q_n[\#2] = Q_m[\#1]$	32.16	24.23	2.72	5.21
$Q_n[\#3] = Q_m[\#2]$	48.17	28.33	14.81	5.03
$Q_n[\#4] = Q_m[\#2]$	41.96	24.51	13.19	4.26
$Q_n[\#2] = Q_n[\#4]$	33.36	10.84	19.10	3.42
$Q_m[\#1] = Q_m[\#2]$	4.65	3.87	0.23	0.55
$Q_n[\#1] = Q_n[\#3]$	26.76	12.81	12.00	1.95
$Q_n[\#5] = Q_m[\#3]$	82.8	56.4	17.06	9.34

Notes: The 1% critical value of the test for equality of matrices is 16.81, from a chi-squared distribution with 6 degrees of freedom. The 1% critical value for the tests of equality of rows is 9.21.

D.4 On the definition of Second Generation Immigrants

The following transition matrices are constructed when the definition of second generation immigrant is given to individuals whom both parents were born outside the US. The sample size across all skills categories is only 434.

Transition Matrices of children of immigrants: both parents born outside US

	Transition Matrix (Q_m)				*Men/ Women*	Race	Age
1'	.294	.412	.294	$N_1 = 68$	Men	All	25-55
	.091	.584	.325	$N_2 = 77$			
	.053	.421	.526	$N_3 = 38$			
2'	.165	.612	.223	$N_1 = 103$	Women	All	25-55
	.058	.544	.398	$N_2 = 103$			
	.022	.311	.667	$N_3 = 45$			
3'	.216	.532	.251	$N_1 = 171$	Both	All	25-55
	.072	.561	.367	$N_2 = 180$			
	.036	.361	.602	$N_3 = 83$			

E Estimation of Fertility Rates of US and Foreign Born Women

Here we detail how we estimate fertility rates by education level and nativity, starting from the fertility rates by education level that can be computed from birth and census data. Since birth data available at the VitalStats website didn't distinguish whether the mother was US-born or foreign-born, we construct estimates with the help of the American Community Survey (ACS), which identifies the place where the mother was born and can be used to estimate total fertility rates. The estimators are derived for a specific level of education, and so this can be generalized to any level of education. Define

X_i^N =number of children born to US-Born women age group i during the year

X_i^F =number of children born to foreign-Born women age group i during the year

Z_i^N =number of US-Born mothers in age group i during the year

Z_i^F =number of Foreign-Born mothers in age group i during the year

Y_i^N =number of US-Born women in age group i

Y_i^F =number of Foreign-Born women in age group i

i =number of age groups of 5 years

F^N =total fertility rate of US-born women

F^F =total fertility rate of foreign-born women

F =Total fertility rate of all women living in the US

Then the formula for TFR is

$$F = 5\sum_{i=1}^{n}\left[\frac{X_i^N}{Y_i^N}w_i^N + \frac{X_i^F}{Y_i^F}\left(1-w_i^N\right)\right]$$

with weights w_i^N given by

$$w_i^N = \frac{Y_i^N}{Y_i^N+Y_i^F},$$

that are just US-born women of age-group i as a share of all women of age group i, for a given level of education.

It can be shown that we can rewrite the total fertility rates of foreign women F^F and US-born women F^N as

$$F^F = F + 5\sum_{i=1}^{n} m_i w_i^N,$$

$$F^N = F - 5\sum_{i=1}^{n} m_i\left(1-w_i^N\right).$$

where

$$m_i = \left(\frac{X_i^F}{Y_i^F} - \frac{X_i^N}{Y_i^N}\right)$$

is the difference in births per foreign–born women and births per US-born women in age group i (for a given level of education). This shows that we can estimate F^F and F^N from the total fertility rate F as long as we have data on both $m_i's$ and $w_i's$. We can back up exact data on weights w_i from the census of 1990, 2000 and the 2005 CPS. However, data is not available for the differences m_i for these years. Hence, we estimate the average difference m_i for each age-education group for years 2001-2008 for which ACS data is available and use fertility rates F to estimate fertility rates by nativity. Fertility rates, weights (w_i) and differences (m_i) are shown below.

Fertility rates. Years 1990, 2000 and 2005

Year	less than HS	HS+Some College	BA+
2005	2.73	1.95	1.85
2000	2.26	2.00	1.84
1990	2.43	2.04	1.61
Average	2.47	2.00	1.77

Figure 1: Weights wi, Census 1990, Census 2000 and CPS-2005

Age Group	1990 Unskilled	1990 Medium	1990 Skilled	2000 Unskilled	2000 Medium	2000 Skilled	2005 Unskilled	2005 Medium	2005 Skilled
15-19	0.082	0.068	0.250	0.092	0.083	0.256	0.078	0.089	0.209
20-24	0.209	0.079	0.091	0.296	0.113	0.135	0.263	0.109	0.107
25-29	0.229	0.077	0.106	0.394	0.127	0.160	0.383	0.133	0.157
30-34	0.248	0.075	0.111	0.400	0.122	0.161	0.476	0.148	0.189
35-39	0.257	0.070	0.096	0.360	0.107	0.155	0.452	0.142	0.177
40-44	0.241	0.075	0.099	0.339	0.097	0.135	0.386	0.117	0.159
45-49	0.208	0.074	0.101	0.345	0.087	0.115	0.348	0.099	0.141
50-54	0.185	0.077	0.106	0.303	0.088	0.106	0.345	0.090	0.116

Estimates of m_i , averages for 2001-2008 ACS

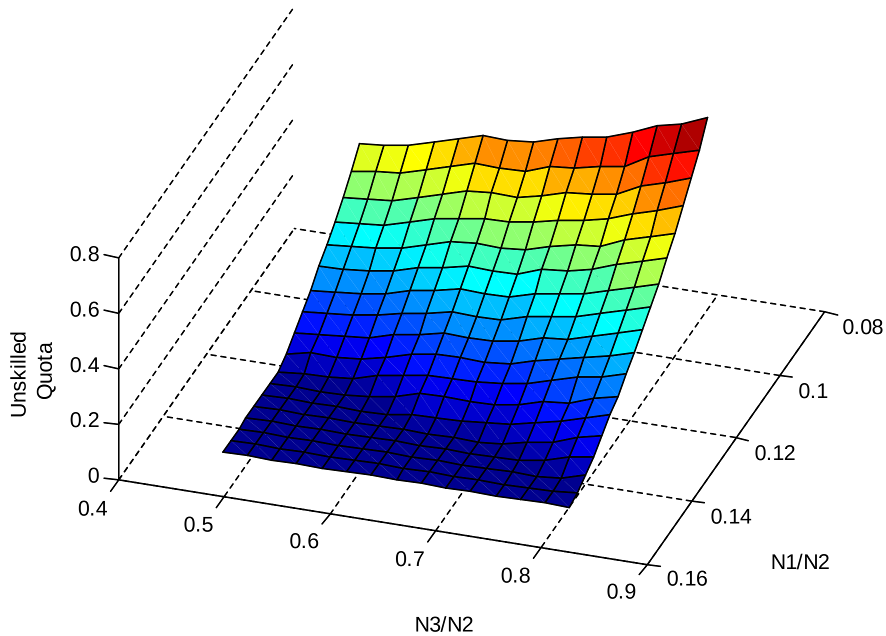
Age Group	Unskilled	Med-Skilled	Skilled
15-19	.014	.002	-.003
20-24	.002	.000	.010
25-29	.042	.0016	.005
30-34	.051	.037	-.004
35-39	.036	.030	.012
40-44	.015	.012	.009
45-49	.000	.003	.003
50-54	.000	.000	.001

F Optimal Policy Function, Baseline case

Consider the optimal policy function that results from the baseline parameterization in a state grid given by 15 points in $\left[-0.13\left(\frac{N_1}{N_2}\right)_{SS1}, 0.5\left(\frac{N_1}{N_2}\right)_{SS1}\right]$ and 15 points in $\left[-0.1\left(\frac{N_3}{N_2}\right)_{SS1}, 0.5\left(\frac{N_3}{N_2}\right)_{SS1}\right]$ for a total of 225 pairs in $\left(\frac{N_1}{N_2}, \frac{N_3}{N_2}\right)$. These points that are used for interpolation are chosen as the roots of Chebyshev polynomials in the considered state spaces.

The policy space considers 125 points for θ_1 in the space $[0,1]$, 11 points for θ_2 in $[0,.5]$ and 21 points for θ_3 in $[0,.13]$. Since for this example we find no immigration of medium-skilled individuals, the space for θ_2 is unimportant. For θ_3 in turn we find that for all points in the state space the immigration quota hits the maximum ($\theta_3 = \theta_3^{\max}$) and therefore we don't present a graph.

The steady state ratios in absence of immigration are $\left\{\left(\frac{N_1}{N_2}\right)_{SS1}, \left(\frac{N_3}{N_2}\right)_{SS1}\right\} = \{0.0952,\ 0.5396\}$. Solving the model with a tolerance of .0000001 of the sup norm between the value functions of the current and the previous iteration, we obtain the following optimal policy function for the preferred quota of unskilled workers for the median voter shown below.



After simulating the model from any starting position in the state grid, the unique steady state induced by the immigration policy chosen by the median voter is given by $\left\{\left(\frac{N_1}{N_2}\right)_{SSN}, \left(\frac{N_3}{N_2}\right)_{SSN}\right\} = \{0.0978,\ 0.5848\}$.