In this paper, we adopt a political economy approach to looking at the issue of immigration. In particular, we examine the economic determinants of natives' preferences over the level of immigration and—assuming a majority-voting framework—the translation of those preferences into policies. Our model is a dynamic one—households in the economy make consumption-savings decisions which, in conjunction with levels of immigration, determine the path of the economy's capital-labor ratio.

A key feature of the environment is that potential immigrants are heterogeneous in terms of their initial wealth, or capital. This heterogeneity turns out to have important consequences for the economy's policy decision. The preferences of natives in our economy are, in a sense, 'polarized'—depending on the extent to which a native is more or less reliant on either capital or labor income he or she will prefer admission policies which either minimize or maximize the economy's capital-labor ratio. When immigrants are homogeneous, this implies an 'all-or-none' policy choice—the economy will either admit everyone or no one, depending on whether the 'capital-rich' or 'capital-poor' are in the majority.[1] When immigrants are heterogeneous, the polarization of natives' preferences can still translate into an 'interior' policy—something between keeping everyone out and letting everyone in.

The paper is organized as follows. The following section lays out the basic features of the economy in a two-period example. We show that heterogeneity of immigrants in terms of their initial capital (together with a simple rule for determining the characteristics of a given quantity of immigrants to be admitted) can lead to an 'interior' equilibrium under majority voting. This result obtains under certain conditions on the distributions of immigrant and native wealth—loosely, under certain sets of demographics—and we try to provide some rough quantitative feel for the likelihood of the result obtaining in practice, for a country such as the US *vis-à-vis* the less-developed world. We also offer a comparison between our model and that of Benhabib [1], which is closely related to our work. As we argue, our work is both a simplification (along one dimension) and a generalization (along others) of Benhabib's; we also try to make a case that real-world demographics favor the direction in which we've simplified.

In the next section, we then extend our two-period intuition to an overlapping generations model with two-period-lived agents. In the context of this many-period model, we characterize the dynamics of immigration and capital accumulation, and illustrate that multiple steady state equilibria are possible. Also, the paths of immigration and capital accumulation depend on the growth rate of exogenous technological progress—with faster growth rates leading to larger immigrant inflows. This suggests the possibility that some of the variation in observed immigration to countries such as the US may be due, at least in part, simply to changes in the technology growth rate.

2 A two-period model

2.1 The basic set-up

In this section, we develop the intuition for the behavior of our model economy in the context of a simple two-period model in which natives decide how many immigrants to admit, then divide their first-period wealth between consumption and savings; immigrants, if admitted, arrive in the second period, at which time production takes place using labor and capital (savings of natives plus endowments of immigrants) as inputs. The key to our voting results is that when immigrants differ in their holdings

[1] And, depending on what ratio of capital to labor a typical immigrants brings.

of capital, and an economy follows a rule of accepting immigrants in descending order of wealth, there will (under some restrictions on the model's parameters) be a level of immigration which maximizes the second-period capital-labor ratio. This level of immigration turns out to be a local maximum or a local minimum of every native's lifetime utility. When the distribution of initial wealth among natives is such that the wealth of the median native lies below a particular critical value, then the level of immigration which maximizes the second-period capital-labor ratio is the unique preferred policy for at least half of the native population. We also provide some rough quantitative evidence suggesting that, at least for a country like the US, it's reasonable to expect the sufficient condition just described to hold, though—as will become clear—the condition is not simply about native demographics, but also about the demographics of the pool of prospective immigrants.

We will first lay out the basic features of the two-period model, then describe natives' preferences over alternative second-period capital-labor ratios. We then analyze the relationship between capital-labor ratios and immigration policies—in particular, describing conditions under which a capital-labor-ratio-maximizing policy exists—and then show how natives' preferences over capital-labor ratios translate into preferences over immigration policies.

We now proceed to describe the model. The economy in this section lasts for two periods. The population in the first period consists of a measure one of natives. Each native is endowed with some amount of initial capital, which may be consumed or saved for period two. Capital which a native saves for the second-period is rented to the economy's production sector at a competitively determined real rental rate r. Each native also has a unit of labor to supply in the second period, and that unit earns a competitively determined real wage of w. The production sector is characterized by a Cobb-Douglas production function $F(K, L) = AK^{\alpha}L^{1-\alpha}$. The second-period labor input, L, consists of the unit labor supplies of natives and immigrants, and the second-period capital stock consists of native savings plus capital brought by immigrants. Natives may differ in their initial capital-holdings, the total mass of natives is one, and $\bar{k}$ denotes average initial native capital.

We assume that all natives have the same time-additive, logarithmic preferences over consumption in the two periods. The problem faced by a native with initial capital k is

$$\max_{s} \log(k - s) + \beta \log(rs + w),$$

where $\beta \in (0, 1)$ is the native's utility discount factor. The solution to the native's problem is characterized by the following savings decision-rule:

$$s(k; w/r) = \frac{\beta}{1+\beta}k - \frac{1}{1+\beta}\frac{w}{r}. \tag{1}$$

Aggregating savings over natives (at a given wage-rental ratio w/r) gives the total amount of capital supplied by natives, at the given prices, for production in the second period.

Immigrants, if admitted, arrive in the second period. Let M denote the number of immigrants admitted. Immigrants arrive with a unit of labor to supply plus some amount of capital. Let $\kappa(M)$ denote the total amount of capital among M immigrants, so aggregate native saving plus $\kappa(M)$ equals the total input of capital, K, in period two.

Implicitly, positing $\kappa(M)$ means assuming the economy has some rule for deciding on the order in which heterogeneous immigrants are to be admitted. We will assume that the economy follows a 'wealthiest-immigrants-first' rule, so that $\kappa'(M)$—the increment to total immigrant capital from a marginal immigrant—is decreasing in M.[2]

For a given value of M, describing the economy's equilibrium is straightforward. Let ξ denote the second-period capital-labor ratio. Given a period-two wage-rental ratio, the savings behavior of natives plus capital brought by immigrants implies a period-two capital-labor ratio

$$\xi = \frac{s\left(\bar{k}; w/r\right) + \kappa\left(M\right)}{1+M}.$$

Here, we have used the facts that, with a unit mass of natives, aggregate saving is identical to average saving, and, with a linear saving rule, average saving is the saving of the native with the average initial endowment of capital. On the other hand, from the Cobb-Douglas production technology, a capital-labor ratio of ξ implies a second-period wage-rental ratio of

$$\frac{w}{r} = \frac{1-\alpha}{\alpha}\xi. \tag{2}$$

Equilibrium, then, is characterized by a value of ξ such that

$$\xi = \frac{s\left(\bar{k}; \frac{1-\alpha}{\alpha}\xi\right) + \kappa\left(M\right)}{1+M}. \tag{3}$$

All other quantities, as wells as prices, then follow directly from the equilibrium ξ.

In this economy, the only effect of immigration on natives' welfare comes through the effect of immigration on the equilibrium capital-labor ratio, and the consequent effect this has on factor prices. Hence, before thinking about the majority-rule equilibrium level of immigration, it is useful to think about natives preferences in terms of the economy's second period capital-labor ratio.

The Cobb-Douglas technology implies that the equilibrium rental rate on capital will be

$$r = \alpha A \xi^{\alpha-1}.$$

Substituting this expression, the expression for the wage-rental ratio (2), and the savings decision rule (1) into a typical native's utility function gives the following indirect utility function defined over $\xi \in (0, +\infty)$ for a native with initial capital k:

$$v_k\left(\xi\right) = \left(1+\beta\right)\log\left(\alpha k + \left(1-\alpha\right)\xi\right) - \beta\left(1-\alpha\right)\log\left(\xi\right).$$

It's straightforward to show that $v_k\left(\xi\right)$ is '$\cup$-shaped', with

$$\lim_{\xi\to 0} v_k\left(\xi\right) = \lim_{\xi\to+\infty} v_k\left(\xi\right) = +\infty,$$

and attaining a global minimum at

$$\xi_k = \frac{\alpha\beta}{1+\alpha\beta}k.$$

[2] Benhabib [1] examines the case where there is a distribution of immigrant capital-holdings, say $F\left(k\right)$, with associated density $f\left(k\right)$. A policy in Benhabib's model is a choice of 'cut-off' values, l and $u \geq l$, such that the economy admits all immigrants with capital-holdings in the interval $[l, u]$. Our $\kappa\left(M\right)$ corresponds to a restriction $u = +\infty$. Below, we will argue that our 'wealthiest first' assumption is not particularly restrictive: in a more general setting, such as Benhabib's, the native population would be polarized between a 'poorest first' and 'wealthiest first' policy, with the relatively poorer part of the native population (and presumably a majority) preferring the 'wealthiest first' alternative.

Now, suppose that feasible immigration policies correspond to an interval $[\xi_*, \xi^*]$ of second-period capital-labor ratios. Hold off momentarily on the possibility that two policies lead to the same value of ξ—or, equivalently, imagine that ξ is the issue to be decided. It follows from the $\cup$-shape of natives' utilities over ξ that if a native has initial capital k such that his minimum point, ξ_k, lies below the lower bound ξ_*, then that native prefers the upper bound ξ^* to any other $\xi \in [\xi_*, \xi^*]$. Conversely, if k is such the native's minimum point lies above the upper bound ξ^*, then the native prefers the lower bound ξ_*. If k is such that ξ_k is in between the upper and lower bounds, *i.e.*, $\xi_* \leq \xi_k \leq \xi^*$, then the native's most preferred point could be either ξ_* or ξ^*. One can show that there is a critical value of k—call it k^c—such that natives with $k < k^c$ prefer the higher ξ^* while natives with $k > k^c$ prefer the lower ξ_*.[3] Consequently, if the *median* level of initial native capital is less than the critical value k^c, a majority of natives prefer the higher capital-labor ratio ξ^*.[4] Thus, if there is a unique level of immigration which produces the maximal capital-labor ratio ξ^*, that policy will be a majority-rule equilibrium.

What is going on here is that a native who is relatively poor (*i.e.*, one whose k is low) would prefer a high value of ξ, because this would imply a higher wage. Conversely, a native who is relatively rich (*i.e.*, one whose k is high) would prefer a low value of ξ, because this would imply a higher return to capital. If there are enough natives who are relatively poor, a majority of natives will favor a higher value of ξ.

2.2 The K/L-maximizing level of immigration

In this section, we turn to consider conditions on $\kappa(M)$ which imply that ξ^* or ξ_* are attained by unique policies. We assume that feasible values of M lie in an interval $[0, M_{\max}]$. Using the form of the savings rule (1), the expression (3) for the equilibrium value of ξ becomes

$$\xi = \frac{1}{1+M}\left\{\frac{\beta}{1+\beta}\bar{k} - \frac{1}{1+\beta}\frac{1-\alpha}{\alpha}\xi + \kappa(M)\right\}.$$

Solving for ξ gives:

$$\xi = \frac{\alpha\beta\bar{k} + \alpha(1+\beta)\kappa(M)}{1+\alpha\beta+\alpha(1+\beta)M} \equiv \xi(M). \tag{4}$$

In the appendix, we prove the following:

Proposition 1 *Suppose that $\kappa(M)$ is C^2, strictly increasing and strictly concave on the set $(0, M_{\max})$, with $\kappa(0) = 0$. If $\kappa(M)$ is such that $\kappa'(0) > [\alpha\beta/(1+\alpha\beta)]\bar{k} > \kappa'(M_{\max})$, then there exists a unique $M^* \in (0, M_{\max})$ which attains ξ^*. Also, if $\kappa(M_{\max})/M_{\max} \leq [\alpha\beta/(1+\alpha\beta)]\bar{k}$, then $M = M_{\max}$ attains ξ_*; otherwise, $M = 0$ attains ξ_*.*

The first part states that concavity of $\kappa(M)$, together with conditions on its slope at $M = 0$ and $M = M_{\max}$, guarantee existence of a unique maximizer M^*. The middle term in the inequality $\kappa'(0) > [\alpha\beta/(1+\alpha\beta)]\bar{k} > \kappa'(M_{\max})$ is simply the capital-labor ratio which would obtain absent immigration. Thus, the inequality will hold if the marginal capital brought by the wealthiest immigrant exceeds the

[3] See the appendix for details.

[4] As we will see below, assuming the median native prefers ξ^* to ξ_* amounts to a joint assumption on all the parameters of the model. We think that it is a reasonable assumption, however, at least for the case of a developed economy like the US vis-a-vis a large pool of potential immigrants who are, *on average*, relatively quite poor.

average amount per native person at $M = 0$, and if this average, in turn, exceeds the marginal capital which would be brought by the poorest immigrant, were he or she to be admitted. The second part of the proposition is simply about locating the minimizer of $\xi(M)$; since $\xi(M)$ turns out to be hump-shaped, this minimizer is at either $M = 0$ or $M = M_{\max}$, depending on the average amount of capital of the entire potential immigrant pool. In either case, let M_* denote the value of M, either 0 or $M_{\max}$, which attains ξ_*.

2.3 Natives' preferences over immigration

Now, we turn to consider natives' preferences over M. As noted above, in terms of the economy's next-period capital-labor ratio, the preferred point of any particular native will be either ξ^* or ξ_*, depending on whether that native's initial wealth lies below or above the critical value k^c. As we show in the appendix, the critical value of initial native wealth is given by

$$k^c = \left(\frac{1-\alpha}{\alpha}\right) \frac{\xi^* (\xi_*)^\eta - \xi_* (\xi^*)^\eta}{(\xi^*)^\eta - (\xi_*)^\eta}, \tag{5}$$

where $\eta = \beta(1-\alpha)/(1+\beta)$. Every native with $k < k^c$ prefers ξ^* to ξ_*—and so prefers ξ^* to *any* alternative capital-labor ratio ξ. Hence, every native with $k < k^c$ prefers immigration M^* to any other $M \in [0, M_{\max}]$. Correspondingly, every native with $k > k^c$ prefers immigration M_* to any other $M \in [0, M_{\max}]$, where M_* is whichever of the two values, either 0 or $M_{\max}$, attains ξ_*.

The majority rule outcome will depend on whether the *median* native capital-holding, k^m, falls below k^c or above k^c. In the former case, M^* will be a majority rule outcome, while in the latter case it will be M_*. By a 'majority rule outcome' we mean the Nash equilibrium of the standard two-candidate competition for votes with simultaneous announcement of platforms over the issue M. Natives' preferences violate single-peakedness, so that the median voter theorem doesn't apply here. However, the fact that natives can be separated into two groups, with natives in each group sharing a *common* most preferred point, implies that, for either candidate, announcing the policy preferred by the larger group is a best response to any platform announced by one's opponent, so that both candidates announcing the policy preferred by the majority forms a Nash equilibrium in dominant strategies. Excluding the knife-edge case where $k^m = k^c$, and assuming a continuous distribution of native capital, the equilibrium policy is also clearly unique.

We record the following proposition:

Proposition 2 *Let k^c be defined as in (5), and assume $\kappa(M)$ satisfies the same set of assumptions as in Proposition 1. Then, if $k^m < k^c$, M^* is a majority-rule equilibrium policy.*

Since k^c is such that

$$\xi^* \geq \frac{\alpha\beta}{1+\alpha\beta} k^c \geq \xi_*,$$

we can put a rough lower bound on the critical capital-holding k^c. In the appendix, we show:

Corollary 1 *Suppose that $k^m < \bar{k}$, and $\kappa(M)$ satisfies the same set of assumptions as in Proposition 1. If either (a) $\kappa(M_{\max})/M_{\max} > [\alpha\beta/(1+\alpha\beta)]\,\bar{k}$ or (b)*

$$\left(\frac{1+\alpha\beta}{\alpha\beta}\right)\left(\frac{\alpha\beta\bar{k} + \alpha(1+\beta)\kappa(M_{\max})}{1+\alpha\beta+\alpha(1+\beta)M_{\max}}\right) \geq k^m,$$

then M^* is a majority-rule equilibrium policy.

It's possible to get a feel for whether or not k^m would fall below the critical bound k^c in a reasonably parametrized model. To that end, let λ denote the ratio of average potential immigrant capital to native capital—*i.e.*, $\kappa(M_{\max})/M_{\max} = \lambda\bar{k}$. Then, case (a) from the corollary—in which simply having $k^m \leq \bar{k}$ is sufficient to give M^* as the majority's preferred policy—obtains if

$$\lambda > \frac{\alpha\beta}{1+\alpha\beta}.$$

A standard value for α, capital's share in the production function is 0.30. The choice of β depends implicitly on the length of period we are assuming. For example, a period length of ten years would correspond (roughly) to a β of 0.7. For those parameter values, we are in case (a) if the ratio of average potential immigrant capital to average native capital exceeds $0.21/1.21 \cong 0.174$.

If $\lambda < \alpha\beta/(1+\alpha\beta)$, we could turn to evaluate the approximate bound in part (b) of the corollary. However, this bound—as we will see—turns out to be quite crude. Using λ to again denote the ratio of average potential immigrant capital to average native capital, the inequality in part (b) of the corollary may be written as

$$\left(\frac{1+\alpha\beta}{\alpha\beta}\right)\left(\frac{\alpha\beta+\alpha(1+\beta)\lambda M_{\max}}{1+\alpha\beta+\alpha(1+\beta)M_{\max}}\right) > k^m/\bar{k}.$$

In the US, the ratio of median wealth to average wealth is on the order of 0.3, while the ratio of median income to average income is on the order of 0.6.[5] Does the expression on the left side of the last inequality exceed 0.30 or 0.60 for reasonable parameters? While α and β are fairly straightforward to calibrate, the choices of $M_{\max}$ and λ—the characteristics of the pool of potential immigrants—are more difficult. For example, the population of the rest of the world is roughly 22 times the population of the US. World GDP per person is about one-fifth US GDP per person, so we might take $0.2^{\frac{1}{0.3}}$ as a rough estimate of λ.[6] For those numbers, the expression on the left-hand side of the last inequality is 0.1217, which is below the ball-park range $[0.30, 0.60]$ for $k^m/\bar{k}$.

But is $M_{\max} = 22$ a reasonable size for the US's pool of potential immigrants? The model is missing a number of features—notably land and possible congestion effects—which would surely come into play at levels of immigration that high. If we cut $M_{\max}$ in half, to $M_{\max} = 11$, keeping $\lambda = 0.2^{\frac{1}{0.3}}$, the bound increases only slightly to 0.1996—again less than 0.30.

The following table, however, records the *exact* critical values k^c at values of $M_{\max}$ ranging from 5 to 20, and values of λ ranging from 0.002 to 0.20. All fall above the 0.30 threshold (which is approximately the ratio of US median wealth to US mean wealth) and many fall above even the 0.60 threshold (which is approximately the ratio of US median income to US mean income).

[5] See Díaz-Giménez, *et al.* [2].

[6] This assumes identical production technologies for the US and the rest of the world, so that the ratio of per-person GDPs must equal the ratio of per-person capital stocks raised to the power $\alpha = 0.3$. Flipping this around, the ratio of per-person capital stocks must equal the ratio of per capita GDPs raised to the $\alpha^{-1} = 0.3^{-1}$.