REFERENDUM-LED IMMIGRATION POLICY IN THE WELFARE STATE

Yuji Tamura

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Yuji Tamura*

Department of Economics, University of Warwick, UK

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Abstract

Majority voting outcomes over different immigration levels of low-skilled workers are examined in a two-period overlapping-generation model in which the labour market and intra- and intergenerational transfer schemes translate the impact of immigration into preferences of heterogeneous citizens. In most of the cases being examined, the model predicts a unique policy choice. However, a voting cycle can also arise in certain circumstances, subjecting the referendum outcome to manipulation.

Key words: international migration, majority voting, intragenerational transfer, intergenerational transfer

JEL classification: D70, F22, I38

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1 Introduction

One aspect of immigration policy is concerned with legal immigrant workers who are low-skilled. In a developed country, the supply of such labour immigrants is potentially very high, considering the high standard of living that people in the host country enjoy. The level of demand, on the other hand, is not immediately obvious, for a ceratin level of immigration of low-skilled labour is likely to have different impacts on different individuals of the host country. Some would demand more than the others. Since each of these different individual demands refers to the aggregate quantity at the national level, they cannot be added up or averaged to determine the host country's demand for low-skilled immigrant workers. Abstaining from non-economic factors, we examine whether a referendum could determine it and, if it could, what level of demand would emerge.

Two of the economic arguments with respect to the immigration of low-skilled labour are well known. One is related to the labour market effect, and the other to the welfare outlay effect.[1] The labour market effect can be either a fall in the wage rate or an increase in unemployment, or some combination of both. The wage rate for low-skilled labour is expected to fall if immigrants increase the supply of substitutable labour. Unemployment may rise if some natives choose not to work at the reduced wage rate which is still sufficiently attractive to immigrants. In this view, it is the fear of losing earnings or/and jobs among natives whose labour types are similar to immigrants' that recommends restrictive policy.

The welfare outlay effect can be either positive or negative. The negative impact is expected because low-skilled immigrants are likely to use the host country's budget for welfare programmes which are targeted to low-income households. However, these workers also share the burden of meeting welfare expenditures through taxation. This positive effect may be of particular interest for a country with the ageing population if its intergenerationally

[1] For instance, Borjas (1999) and Boeri, Hanson & McCormick (2002) discuss empirical evidence regarding these effects in the United States and European countries.

redistributive system is under pressure. It is therefore not clear *a priori* whether low-skilled immigrant workers are consequently net beneficiaries or contributors in the welfare state. An evaluation of the net welfare outlay effect is however irrelevant to the analysis of individual preferences, for a negative net effect may still benefit some group of the electorate. We are interested in how immigration affects economic prospects of individual natives via different welfare programmes rather than its net welfare outlay effect at the macroeconomic level.

We integrate into one framework the existing theoretical studies on the political economy of immigration policymaking in the welfare state, which is roughly split into two.[2] In the literature, one group studies the subject in the static context of intragenerational transfers, and the other in the dynamic context of intergenerational transfers.[3] However, intra- and intergenerational transfers often coexist in the welfare state. Concentrating on one of these transfers reveals only a partial effect of immigration on economic prospects of the citizens and is hence likely to mislead us in studying individual preferences. We therefore use an analytical framework which contains both types of transfers as well as the supposed labour market effects in order to examine individual preferences of the electorate in the host country in detail. The country's demand for low-skilled immigrant workers is then derived by majority voting, determining the degree of the labour market's

[2]In this paper, we abstract from immigration policymaking in the presence of competition between welfare states, e.g., Haupt & Peters (2001) and Breyer & Kolmar (2002). We concentrate on one welfare state for which there is no lack of the supply of low-skilled immigrants.

[3]For the static analyses of immigration and intragenerational transfer, see for example Razin & Sadka (1995). Kemnitz (2002) examines policymaking of low-skilled immigration when an unemployment insurance scheme operates. See also Epstein & Hillman (2003) on immigration and unemployment in a static welfare state setting. For the dynamic analyses of immigration and intergenerational transfer, see Scholten & Thum (1996) and Haupt & Peters (1998) who focus on immigration policymaking under a balanced pay-as-you-go pension system.

openness towards low-skilled immigrant workers.[4]

We show four main findings. First, our framework generates the preferences of workers which are close to what an European survey suggests. Second, the existence of intragenerational redistribution among workers has a role in letting an intermediate level of immigration emerge as a possible majority voting outcome. Without such redistribution, a referendum decides on policy to permit either zero or the maximum feasible quantity, which appears too extreme.[5] Third, the decided policy is to be applied in every period, the majority's preference over the policy alternatives can become intransitive in some circumstances, although we find a unique policy choice by majority voting in the other. To our best knowledge, the emergence of a voting cycle in a referendum over immigration policy has not been predicted in the literature and implies the existence of room for outcome manipulation. Fourth, our results are robust in the sense that they persist, whether the skill type of each agent is exogenously given or endogenously determined by human capital investment.

The paper proceeds as follows. Section 2 describes the benchmark model. Section 3 examines individual preferences over different levels of immigration of low-skilled labour and, by using these, derive referendum outcomes. Section 4 extends the benchmark model by endogenising individual decisions of skill acquisition and shows that the results obtained in section 3 are robust. Section 5 discusses our results in the European context.

[4]Our model is related to Casarico & Devillanova's (2003) which is an extension of Razin & Sadka's (2000). These two studies do not include intragenerational redistribution explicitly but only implicitly, and not among young agents as we do subsequently, because their pay-as-you-go pension schemes are made of a single tax rate on different wage earnings and a flat lump sum per capita benefit. Neither of these studies explicitly examined individual preferences and referendum outcomes. They dealt with immigration which exogenously takes place only in one period. We consider immigration that occurs in not only one but every period, and majority voting decides on the level of it.

[5]Only such corner solutions can be derived under both Razin & Sadka's (2000) and Casarico & Devillanova's (2003) models where the impact of immigration manifests only via the labour market and intergenerational redistribution.

2 The model

Consider a country which is inhabited by overlapping generations of agents who live for two periods. In the first period, each agent supplies labour to earn wage income, saves a fraction of her/his disposable income for the second period and consumes the rest. In the second period, the agent does not work, receives a pension benefit and withdraws the savings which have earned interest over one period. She/he consumes all the income in the second period, i.e., no bequest.

The government operates two welfare programmes. One is a pension scheme which is balanced pay-as-you-go. That is, the sum of pension benefits received by current pensioners equals the sum of contributions paid by current workers. In addition to the unfunded pension scheme which is intergenerationally redistributive, an income support programme provides each low-wage earner with a flat lump sum benefit. The programme is financed by a linear tax on the gross wages of all workers, and hence intragenerational redistribution takes place from the rich to the poor at the same time as young agents support the elderly.

2.1 Population

Agents are categorised into two groups — natives and immigrants. The total number of working natives in period t is denoted by N_t. The growth rate of the native population is assumed to be a positive constant, i.e., $\delta > 0$. There are two types of labour skills — low and high. The skill type of an agent is exogenously given and is fixed for the lifetime.

We define *immigration* to be the entry of low-skilled immigrant workers into the host country in the first period of their lifetime without dependants. We denote the number of immigrants by M_t in period t. They are fully employed and stay in the host country for two periods of their lifetime. Their reproductive behaviour during their working period is the same as natives'.

Their children and natives' are not distinguishable.[6] We denote the ratio between immigrant and native workers in period t by

$$m_t := \frac{M_t}{N_t} \in [0, \overline{m}] \tag{1}$$

where $\overline{m}$ is the exogenously given maximum feasible immigration ratio. In what follows, we assume that $\overline{m}$ is sufficiently high.

Each working agent provides one unit of labour. Since immigrant workers are low-skilled, the total supply of high-skilled workers in period t is

$$H_t := hN_t \tag{2}$$

where $h \in (0, 1)$ denotes the proportion of high-skilled agents in the native workforce. The total supply of low-skilled labour in period t is then

$$L_t := (1 - h) N_t + M_t. \tag{3}$$

We assume that high- and low-skilled labour are imperfect substitutes of each other.

2.2 Production

The production in the host country, Y, is characterised by the following Cobb-Douglas function:

$$Y_t (K_t, H_t, L_t) := K_t^{\gamma} H_t^{\varphi} L_t^{\varrho}$$

where the output share parameters, γ, φ and ϱ, are all on the interval $(0, 1)$ and $\gamma + \varphi + \varrho = 1$. We assume international perfect mobility of capital, K, and the host country is small relative to the rest of the world. The interest

[6] The last two sentences ensure that immigrants do not influence the growth rate of the native population, δ. Alternatively, we could think of constant δ as the declining growth rate of the native population being offset by the high fertility rate of immigrant workers.

rate is hence exogenously given.[7] Accordingly, our production function reduces to

$$Y_t\left(H_t, L_t\right) = H_t^{\alpha} L_t^{1-\alpha}. \tag{4}$$

Under perfect competition, firms make zero profit. Wages perfectly adjust for full employment. By differentiating the production function (4) with respect to H and L respectively, we obtain the marginal product of labour of each skill type, i.e.,

$$w_t^H := \frac{\partial Y_t}{\partial H_t} = \alpha \left(\frac{H_t}{L_t}\right)^{-(1-\alpha)} \tag{5}$$

and

$$w_t^L := \frac{\partial Y_t}{\partial L_t} = (1-\alpha)\left(\frac{H_t}{L_t}\right)^{\alpha}. \tag{6}$$

These are the wage rates for one unit of high- and low-skilled labour respectively. Note that it is the ratio between the stocks of high- and low-skilled labour that influences these wage rates. We assume $w_t^L < w_t^H$ always holding. This enables us to identify low-skilled workers with low-wage earners and high-skilled workers with high-wage earners.

2.3 Government

The country operates an income support programme for low-wage earners. We simply assume that all low-skilled workers receive such support which is flat lump sum, θ. It can be thought of as guaranteeing a minimum level

[7] The interest rate is the marginal product of capital, $r_t := \frac{\partial Y_t}{\partial K_t} = \gamma K_t^{\gamma-1} H_t^{\varphi} L_t^{\varrho}$. For a fixed interest rate, $K_t = \left(\frac{\gamma}{r}\right)^{\frac{1}{1-\gamma}} H_t^{\frac{\varphi}{1-\gamma}} L_t^{\frac{\varrho}{1-\gamma}}$. By substituting this expression back into the production function, we get $Y_t\left(H_t, L_t\right) = AH_t^{\alpha} L_t^{1-\alpha}$ where $A := \left(\frac{\gamma}{r}\right)^{\frac{1}{1-\gamma}}$ and $\alpha := \frac{\varphi}{\varphi+\varrho} \in (0,1)$. Thus, capital exists but does not explicitly enter the production function. The amount of capital perfectly adjusts to the interest rate which is exogenous. For ease of exposition, we normalise $A = 1$.

of income for all low-wage earners. The programme is financed through a programme-specific tax rate, μ. The budget constraint in period t is then

$$\theta_t L_t = \mu_t \left(w_t^H H_t + w_t^L L_t \right). \tag{7}$$

The tax is thus imposed on all workers, and the revenue is shared by only low-skilled workers. Hence pensioners are not affected by the programme, while high-skilled workers redistribute to low-skilled workers.

The country also runs a pension scheme which is balanced pay-as-you-go. We assume that the per capita pension benefit, b, is a flat lump sum payment for all pensioners. It represents only the basic component of old-age pension which gives the same amount to all, as we can regard individual savings as the funded part of pension in our model.[8] Accordingly, the following budget constraint must hold in period t:

$$b_t \frac{N_t}{1+\delta} = \tau_t \left(w_t^H H_t + w_t^L L_t \right) \tag{8}$$

where τ is the payroll tax rate common to all workers. The left hand side of the equation represents the total amount of pension benefits to be paid to the pensioners in period t, and the right hand side the total amount of contributions to be collected from the workers in that period.

We could consolidate these two budget constraints into $\frac{\theta_t}{\mu_t} L_t = \frac{b_t}{\tau_t} \frac{N_t}{1+\delta}$. However, we keep them separate so as to distinguish between the impacts of immigration through these intra- and intergenerational transfer schemes. In what follows, we will assume that the per capita income support, θ, and the payroll tax rate, τ, are exogenously given.[9] Accordingly, immigration

[8] We thus follow Razin & Sadka's (2000, fn. 7, p. 467) approach. Individual savings are implicit in expression (10) below. Note that our flat lump sum pension scheme implies redistribution among pensioners. That is, all agents receive the same amount of pension in the post-retirement period, whereas high-skilled ones contribute more to the pension system than the low-skilled during the working period. Hence our pay-as-you-go pension scheme is both inter- and intragenerationally redistributive.

[9] The reason why we fix θ and τ rather than otherwise is because the referendum outcomes are more interesting than the other cases. However, in appendix 8, we will discuss the remaining cases where μ and/or b are/is fixed instead.

determines the tax rate in (7) and the per capita benefit in (8) residually, making the policy choice unidimensional.

2.4 Households

The lifetime utility of a worker over consumption, c, is Cobb-Douglas, i.e.,

$$u_t\left(c_t, c_{t+1}\right) := c_t^{\beta} c_{t+1}^{1-\beta} \tag{9}$$

where $\beta \in (0,1)$. Her/his lifetime budget constraint is

$$c_t + c_{t+1}\left(1+r\right)^{-1} = z_t$$

where r is the interest rate and z_t the lifetime income which depends on the skill type, i.e.,

$$\begin{array}{ll} \text{either} & z_t^H\left(w_t^H, \mu_t, b_{t+1}\right) := \left(1-\tau-\mu_t\right) w_t^H + b_{t+1}\left(1+r\right)^{-1} \\ \text{or} & z_t^L\left(w_t^L, \mu_t, b_{t+1}\right) := \left(1-\tau-\mu_t\right) w_t^L + \theta + b_{t+1}\left(1+r\right)^{-1}. \end{array} \tag{10}$$

Using (9) and (10), we obtain the following indirect utility function:

$$v_t\left(z_t\right) := \Lambda z_t \tag{11}$$

where $\Lambda = \beta^{\beta}\left(1-\beta\right)^{1-\beta}\left(1+r\right)^{1-\beta}$ is a constant. Since the relationship between v_t and z_t is positive linear in expression (11), we focus on z_t to examine the preferences of native workers in the subsequent analyses.

2.5 Preliminary results

The equilibrium conditions for this economy are the flexible wage rates (5) and (6) which are determined by the ratio between the stocks of high- and low-skilled workers (2) and (3).

The following lemma gives the properties of the endogenous variables which influence the individual preferences of natives. These are important ingredients for the subsequent analyses.

Lemma 1. *In the immigration ratio,* $m_t \in [0, \overline{m}]$*,*

(a) *the high-skilled wage rate,* w_t^H*, is strictly increasing,*

(b) *the low-skilled wage rate,* w_t^L*, is strictly decreasing,*

(c) *the income support tax rate,* μ_t*, is strictly increasing and*

(d) *the per capita pay-as-you-go pension,* b_t*, is strictly increasing.*

Proof. Using the definitions (1), (2) and (3), we can rewrite as follows the expressions (5) $w_t^H = \alpha \kappa_t^{-(1-\alpha)}$, (6) $w_t^L = (1-\alpha)\kappa_t^{\alpha}$, (7) $\mu_t = \theta \kappa_t^{-\alpha}$ and (8) $b_t = \tau(1+\delta) h \kappa_t^{-(1-\alpha)}$ where $\kappa_t := \frac{h}{1-h+m_t}$ and $\frac{d\kappa_t}{dm_t} < 0$. Since $\alpha \in (0,1)$, we have $\frac{dw_t^H}{dm_t} > 0$, $\frac{dw_t^L}{dm_t} < 0$, $\frac{d\mu_t}{dm_t} > 0$ and $\frac{db_t}{dm_t} > 0$. ■

Lemma 1 indicates that assuming $w_t^L < w_t^H$ for $m_t = 0$ can assure $w_t^L < w_t^H$ $\forall m_t \in [0, \overline{m}]$. In what follows, we equivalently assume $h < \alpha$.

3 Main results

Suppose for simplicity that there has been no immigration in the past, i.e., prior to some period t. We consider a referendum that takes place only once in the very beginning of period t, and all natives rationally vote to decide on the level of immigration, perfectly anticipating its impact in the host country. Our focus is on the determination of the variable, m. An infinite number of potential policy alternatives over the interval $[0, \overline{m}]$ are compared.

We examine cases of both *temporary* and *permanent* immigration. By temporary immigration, we mean that immigration takes place in period t only.[10] It is studied by both Razin & Sadka (2000) and Casarico & Devillanova (2003) for the case of $\theta = 0$. However, neither of these examined individual preferences and majority voting outcomes explicitly.

In the case of permanent immigration, we assume that, once a decision is taken, the chosen policy becomes effective from the beginning of period

[10] It should be noted that temporary immigration in this paper is different from immigrants who enter as guest workers because temporary immigrants do not depart in the second period of their life in our model.

t onwards without fear of policy change in the future. Hence the same immigration ratio occurs in every period. The optimal choice of immigration is then the steady state solution, i.e., $m = m_{t+j} \forall j \geq 0$. That is, since the key variable, z_t, depends on both m_t and m_{t+1} as implied by (10), we set $m_t = m_{t+1}$ for ease of exposition. Hereafter, we drop all the time subscripts because they are unnecessary in both temporary and permanent scenarios.

3.1 Individual preferences

We begin with the simplest preferences, i.e., those of pensioners. Immigration in period t cannot affect their first-period incomes earned in period $t-1$ in our model.[11] In addition, everyone receives the same amount of pension in their post retirement period t. Accordingly, the preferences of all pensioners over $[0, \overline{m}]$ are identical regardless of their skill types and depend only on the effect of m on b. We hence denote the utility of a retired pensioner by

$$V_R(m) \equiv b(m). \quad (12)$$

Since the life of a pensioner in period t ends in that period, she/he is concerned only with the impact of immigration in period t. Lemma 1(d) then implies the following statement.

Lemma 2. *The utility of a retired pensioner, $V_R(m)$, is strictly increasing in immigration, whether it is temporary or permanent.*

Proof. Lemma 1(d) implies $\frac{db}{dm} > 0$, and (12) suggests $\frac{dV_R}{dm} > 0$. ■

While the preferences of pensioners are homogeneous over $[0, \overline{m}]$, those of working natives are heterogeneous and depend on their skill types as well as

[11] If we relax our assumption of the fixed interest rate, immigration is likely to change the marginal product of capital and thus affect pensioners through savings as well as the pension benefit. However, since an increase in labour due to immigration would raise the interest rate, the preference of a pensioner is unlikely to be modified even if we introduce flexibility for the interest rate.

whether immigration is temporary or permanent. As argued above,[12] the preferences of young natives over $[0, \overline{m}]$ depend only on how m affects their lifetime incomes. Hence we write the utility of a young native as a function of m as follows:

$$\begin{array}{ll} \text{either} & V_H(m) \equiv z^H\left(w^H(m), \mu(m), b(m)\right) \\ \text{or} & V_L(m) \equiv z^L\left(w^L(m), \mu(m), b(m)\right). \end{array} \tag{13}$$

The following two lemmata state the properties of these utilitites of workers.

Lemma 3. *If the size of per capita income support, θ, is sufficiently small, the utility of a high-skilled worker, V_H, is concave in temporary immigration with a unique maximum at*

$$\tilde{m} := \left\{1 + \left[\frac{1-\alpha}{\theta}(1-\tau)\right]^{\frac{1}{\alpha}}\right\} h - 1 \in (0, \overline{m}). \tag{14}$$

That of a low-skilled worker, V_L, is strictly decreasing in it.

Proof. For temporary immigration, (10) implies , after rearrangement, $V_H = \alpha\kappa^{-1}\left[(1-\tau)\kappa^\alpha - \theta\right] + \frac{b(0)}{1+r}$ and $V_L = (1-\tau)(1-\alpha)\kappa^\alpha + \alpha\theta + \frac{b(0)}{1+r}$ where $\kappa := \frac{h}{1-h+m}$ and $b(0) = \tau(1+\delta)h^\alpha(1-h)^{1-\alpha}$. We then obtain $\frac{dV_H}{dm} = \frac{\alpha}{h}\left[(1-\tau)(1-\alpha)\kappa^\alpha - \theta\right]$. Define the sufficiently small size of θ as satisfying $\theta < (1-\tau)(1-\alpha)\left(\frac{h}{1-h}\right)^\alpha$, which implies $\frac{dV_H}{dm} > 0$ at $m = 0$. Since $\frac{d\kappa}{dm} < 0$, we have $\frac{dV_L}{dm} < 0$, and V_H is concave in m with a unique maximum at $\tilde{m} \in (0, \overline{m})$ by assuming sufficiently high $\overline{m}$. ■

Lemma 3 implies that high-skilled young natives have more liberal attitudes towards immigration than low-skilled ones. This fits the empirical finding by Scheve & Slaughter (2001) that less skilled individuals tend to prefer more restrictive immigration policy.[13]

[12] See equation (11).

[13] However, the type of immigrants was not specified in the survey questionnaire, and hence it is unclear whether the respondents' preferences referred specifically to low-skilled immigration in the study.

Lemma 4. *If the size of per capita income support, θ, is sufficiently small, the utility of a high-skilled worker, V_H, is concave in permanent immigration with a unique maximum at*

$$\hat{m} := \left\{1 + \left[\frac{1-\alpha}{\theta}\left(1 - \tau + \tau\frac{1+\delta}{1+r}\frac{h}{\alpha}\right)\right]^{\frac{1}{\alpha}}\right\} h - 1 \in (0, \overline{m}) . \tag{15}$$

That of a low-skilled worker, V_L, is quasiconvex in it, if the pension payroll tax rate, τ, is sufficiently low, with a unique minimum at

$$\check{m} := \alpha\frac{1-\tau}{\tau}\frac{1+r}{1+\delta} + h - 1 \in (0, \overline{m}) . \tag{16}$$

Proof. For permanent immigration, (10) implies, after rearrangement, $V_H = \alpha\kappa^{-1}\left[\left(1-\tau+\tau\frac{1+\delta}{1+r}\frac{h}{\alpha}\right)\kappa^{\alpha}-\theta\right]$ and $V_L = (1-\tau)(1-\alpha)\kappa^{\alpha}+\alpha\theta+\tau\frac{1+\delta}{1+r}h\kappa^{-(1-\alpha)}$. We obtain $\frac{dV_H}{dm} = \frac{\alpha}{h}\left[\left(1-\tau+\tau\frac{1+\delta}{1+r}\frac{h}{\alpha}\right)(1-\alpha)\kappa^{\alpha}-\theta\right]$. Define sufficiently small θ as satisfying $\theta < \left(1-\tau+\tau\frac{1+\delta}{1+r}\frac{h}{\alpha}\right)(1-\alpha)\left(\frac{h}{1-h}\right)^{\alpha}$, which implies $\frac{dV_H}{dm} > 0$ at $m = 0$. Since $\frac{d\kappa}{dm} < 0$, V_H is concave in m with a unique maximum at $\hat{m} \in (0, \overline{m})$ by assuming sufficiently high $\overline{m}$. For the low-skilled, $\frac{dV_L}{dm} = (1-\alpha)\kappa^{\alpha}\left[\tau\frac{1+\delta}{1+r} - \frac{(1-\tau)\alpha}{1-h+m}\right]$. Define sufficiently low τ as meeting $\tau < \frac{\alpha}{\alpha+\frac{1+\delta}{1+r}(1-h)}$, which implies $\frac{dV_L}{dm} < 0$ at $m = 0$. Since $\frac{d^2V_L}{dm^2} = \frac{\alpha(1-\alpha)}{1-h+m}\kappa^{\alpha}\left[\frac{(1-\tau)(1+\alpha)}{1-h+m} - \tau\frac{1+\delta}{1+r}\right]$, V_L is quasiconvex in m with a unique mimimum at $\check{m} \in (0, \overline{m})$. ■

Lemmata 3 and 4 highlight the difference between the impacts of temporary and permanent immigration on the preferences of workers. In both cases, the utility of a high-skilled worker is concave in immigration. It has a unique interior maximum if income support per capita is sufficiently small and if the maximum feasible immigration ratio is sufficiently high. This is because the positive wage effect is more than offset by the negative intragenerational transfer effect when the level of immigration is very high.

Notice that the achievement of the maximum utility of a high-skilled worker requires a higher level of immigration when it is permanent than temporary, i.e., $\tilde{m} < \hat{m}$ as observable in (14) and (15). This is the difference depending on whether the positive impact of immigration on the per capita pension benefit in period $t+1$ exists or not. Both $\tilde{m}$ and $\hat{m}$ are more liberal with smaller θ, smaller α and higher h. In other words, generous income support per capita, a high production share parameter for high-skilled labour and a low proportion of high-skilled workers can all contribute to make $\tilde{m}$ and $\hat{m}$ less liberal. In addition, a higher pension payroll tax rate, τ, makes $\tilde{m}$ more restrictive, while a higher population growth rate, δ, and a lower interest rate, r, makes $\hat{m}$ more liberal.

The impact of immigration via b_{t+1} also affects the utility of a low-skilled worker positively. Her/his utility is strictly decreasing in temporary immigration because of its adverse effect through the labour market.[14] However, such a negative impact can be eased by increasing the expected positive pension effect in the next period if a sufficiently high level of permanent immigration is permitted. Hence the utility of a low-skilled worker could have an upward sloping portion.

In what follows, we assume sufficiently small θ and sufficiently low τ so that both Lemmata 3 and 4 hold.

3.2 Referendum outcomes

With $\delta > 0$, the group of pensioners can never form the majority on their own, i.e., $\frac{1}{2+\delta} < \frac{1}{2}$. Equivalently, the sum of both high- and low-skilled workers will form the majority, i.e., $\frac{1}{2} < \frac{1+\delta}{2+\delta}$. Let us first observe the referendum outcome when explicit intragenerational redistribution does not exist among workers. This situation was studied by Razin & Sadka (2000) and Casarico & Devillanova (2003), but both of them neither examined individual preferences nor derived the majority voting outcome.

Proposition 1. *Suppose the income support programme is abscent.*
(I) *If immigration is either temporary or permanent and $V_L(\overline{m}) < V_L(0)$, a referendum decides on either* (i) *free entry policy, $\overline{m}$, if $\frac{1+\delta}{2+\delta}(1-h) < \frac{1}{2}$ or*

[14]Note that V_L is not adversely affected by immigration via μ because every low-skilled worker receives θ, out of which $(1-\alpha)\theta$ is paid back to the programme via μ, making the net income support per capita $\alpha\theta$. That is, $\mu w^L = (1-\alpha)\theta$. See the proof of Lemma 3.

(ii) *the status quo,* 0*, otherwise.*

(II) *If it is permanent and* $V_L(0) < V_L(\overline{m})$*, natives decide on free entry policy unanimously.*

Proof. When $\theta = 0$, (10) implies $V_H = (1-\tau) w^H + \frac{b(0)}{1+r}$ and $V_L = (1-\tau) w^L + \frac{b(0)}{1+r}$ if immigration is temporary and $V_H = (1-\tau) w^H + \frac{b}{1+r}$ and $V_L = (1-\tau) w^L + \frac{b}{1+r}$ if it is permanent. Lemma 1 suggests $\frac{dV_H}{dm} > 0$ for both temporary and permanent immigration. Lemma 2 then implies that high-skilled workers and pensioners most prefer $\overline{m}$. When m is temporary, low-skilled workers most prefer the status quo because Lemma 1 implies $\frac{dV_L}{dm} < 0$. When m is permanent, $\frac{dV_L}{dm}$ is the same as shown in the proof of Lemma 4, which implies that low-skilled workers most prefer either 0 or $\overline{m}$, depending on whether $V_L(0) > V_L(\overline{m})$ or not. ■

Proposition 1 reveals that, in the abscence of intragenerational redistribution among workers, the majority voting policy choice is either of the two extreme, namely free entry or complete closure. Now let us introduce the income support programme which redistributes from high- to low-wage earners during their working period. The referendum-led policy can then no longer be necessarily extreme. Let us first observe the chosen policy when immigration is temporary.

Proposition 2. *Suppose the income support programme exists. When immigration is temporary, a referendum over the policy alternatives* $[0, \overline{m}]$ *decides on either* (i) $\tilde{m}$ *if* $\frac{1+\delta}{2+\delta}(1-h) < \frac{1}{2}$ *or* (ii) *the status quo otherwise.*

Proof. Lemmata 2 and 3 imply that every individual preference is single peaked over the policy interval, and $\tilde{m}$ defined by (14) is the median voter's choice if low-skilled workers cannot form the majority on their own. ■

Thus, free entry policy is no longer a possibility. It is ruled out because pensioners never form the majority on their own due to $\delta > 0$. Instead, high-skilled workers' most preferred policy, $\tilde{m}$, emerges. It is interior because raising the immigration ratio beyond it causes a marginal reduction in V_H. That is, too high m redistributes from high- to low-skilled workers more than it increases the wage rate for high-skilled labour. The existence of intra-generational redistribution among young agents thus makes $\overline{m}$ unattractive to high-skilled workers. The intermediate policy, $\tilde{m}$, is agreeable if low-skilled workers cannot form the majority on their own, for the utilities of the other two groups oppose to each other — V_L strictly decreases but V_R strictly increases in temporary immigration.

Predicting the referendum outcome becomes more complex when immigration is permanent as the following proposition indicates because V_L is not single peaked. By comparing $\hat{m}$ with $\check{m}$ in (15) and (16) respectively, we notice $\hat{m} \lesseqgtr \check{m}$, depending on the values of the exogenous parameters, α, h, δ, r, θ and τ. Without further restrictions on these parameters, we have four circumstances with respect to the projections of V_H and V_L over $[0, \overline{m}]$. The possible outcomes include not only unique ones but also indeterminacy.

Proposition 3. *Suppose the income support programme exists. Consider a referendum over the policy alternatives* $[0, \overline{m}]$ *of permanent immigration.*
(I) *If* $V_L(\overline{m}) < V_L(\hat{m}) < V_L(0)$, *the chosen policy is*
either (i) $\hat{m}$ if $\frac{1+\delta}{2+\delta}(1-h) < \frac{1}{2}$
or (ii) the status quo otherwise.
(II) *If* $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ *and* $V_H(0) < V_H(\overline{m}) < V_H(\hat{m})$, *it is*
either (i) $\overline{m}$ if $\frac{1+\delta}{2+\delta}(1-h), \frac{1+\delta}{2+\delta}h < \frac{1}{2} < \frac{1+(1+\delta)(1-h)}{2+\delta}, \frac{1+(1+\delta)h}{2+\delta}$,
(ii) $\hat{m}$ if $\frac{1+\delta}{2+\delta}h > \frac{1}{2}$
or (iii) the status quo if $\frac{1+\delta}{2+\delta}(1-h) > \frac{1}{2}$.
(III) *If* $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ *and* $V_H(\overline{m}) < V_H(0) < V_H(\hat{m})$, *it is*
either (i) manipulable if $\frac{1+\delta}{2+\delta}(1-h), \frac{1+\delta}{2+\delta}h < \frac{1}{2} < \frac{1+(1+\delta)(1-h)}{2+\delta}, \frac{1+(1+\delta)h}{2+\delta}$,
(ii) $\hat{m}$ if $\frac{1+\delta}{2+\delta}h > \frac{1}{2}$
or (iii) the status quo if $\frac{1+\delta}{2+\delta}(1-h) > \frac{1}{2}$.
(IV) *If* $V_L(0) < V_L(\overline{m})$, *it is*
either (i) $\overline{m}$ if $\frac{1+\delta}{2+\delta}h < \frac{1}{2}$
or (ii) $\hat{m}$ otherwise.

Proof. (I.i) Lemmata 2 and 4 imply $\hat{m}\mathsf{P}m \in (\hat{m}, \overline{m}]$ by all workers and $\hat{m}\mathsf{P}m \in [0, \hat{m})$ by high-skilled workers and pensioners. (II.i) $\overline{m}\mathsf{P}0$ and $\hat{m}\mathsf{P}m \in [0, \hat{m})$ by high-skilled workers and pensioners and $\overline{m}\mathsf{P}m \in [\hat{m}, \overline{m})$ by low-skilled workers and pensioners. (III.i) $\hat{m}\mathsf{P}m \in [0, \hat{m})$ by high-skilled workers and pensioners, $\overline{m}\mathsf{P}m \in [\hat{m}, \overline{m})$ by low-skilled workers and pensioners and $0\mathsf{P}\overline{m}$ by all workers. The majority's preference is then intransitive over $[0, \overline{m}]$. Suppose an agenda setter wishes to maintain the status quo, i.e., zero immigration policy. This can be achieved by imposing the following procedure in the referendum: Compare policy alternatives over $(0, \hat{m}]$, then pit the winner against the rest of non-zero alternatives $(\hat{m}, \overline{m}]$, finally pit the winner against the status quo. (IV.i) $\overline{m}\mathsf{P}m \in [0, \overline{m})$ by low-skilled workers and pensioners. ■

The first case (I) is similar to Proposition 2, but the difference is that the policy now allows a higher level of immigration, i.e., $\hat{m} > \tilde{m}$, if low-skilled workers cannot form the majority on their own. This is due to the positive pension effect which makes immigration more preferable for all workers than in the case of temporary policy.

The second case (II) is where the the intragenerational transfer effect is realtively weak, i.e., small θ, and the pension effect is modest. The possible outcome (II.i) is interesting because, if neither high- nor low-skilled workers can form the majority on their own, the policy choice settles at $\overline{m}$, i.e., free entry policy which is most preferred by pensioners.

The most interesting is the third case (III) where the pension effect is modest but the intragenerational transfer effect is realtively strong. The possible outcome (III.i) is the consequence of the majority's preference being intransitive. The referendum outcome is then indeterminate, and there is room for outcome manipulation, as the proof shows. Any outcome could be arranged under this circumstance.

The fourth case (IV) illustrates the situation where the positive pension effect is so influential that $V_L(\overline{m})$ can exceed $V_L(0)$. Accordingly, low-skilled workers and pensioners share the same interest.

Table 1 summarises all the possible outcomes which we obtained in Propositions 1 to 3. It shows that the model predicts that a referendum would decide only on an unrealistically extreme outcome in the abscense of intragenerational redistribution among young agents. It also reveals that there might be room for outcome manipulation if a referendum decide on permanent policy when the pension effect is modest and the income support effect is strong. We now show that the results in these propositions are robust. More specifically, our findings are hardly affected by endogenising the skill composition of the working native population under reasonable assumptions.

TABLE 1. REFERENDUM-LED IMMIGRATION POLICY, FIXED h

Utility		Possible outcomes	
Low-skilled	High-skilled	Temporary	Permanent
(a) $\theta = 0$			
$V_L(\overline{m}) < V_L(0)$	$V_H(0) < V_H(\overline{m})$	$\{0, \overline{m}\}$	$\{0, \overline{m}\}$
$V_L(\overline{m}) > V_L(0)$	$V_H(0) < V_H(\overline{m})$	n.a.	$\overline{m}$
(b) $\theta > 0$			
$V_L(\overline{m}) < V_L(\hat{m}) < V_L(\tilde{m}) < V_L(0)$	$V_H(0) \lesseqgtr V_H(\overline{m})$	$\{0, \tilde{m}\}$	$\{0, \hat{m}\}$
$V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$	$V_H(0) < V_H(\overline{m})$	n.a.	$\{0, \hat{m}, \overline{m}\}$
$V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$	$V_H(0) > V_H(\overline{m})$	n.a.	$\{0, \hat{m}, \text{cycle}\}$
$V_L(\overline{m}) > V_L(0)$	$V_H(0) \lesseqgtr V_H(\overline{m})$	n.a.	$\{\hat{m}, \overline{m}\}$

NB: If m is temporary, $\frac{dV_L}{dm} < 0$, hence n.a. = not applicable. $0 < \tilde{m} < \hat{m} < \overline{m}$

4 Endogenous skill acquisition

We have so far assumed that the skill type of each agent is exogenously given and remains as it is for her/his lifetime. However, the skill acquisition decision of an agent in the host country may be influenced by the level of immigration if it affects the economic prospects among different skill types. There are some evidence that the decision to invest in human capital does respond to a change in returns to the investment, e.g., Topel (1997).

Casarico & Devillanova (2003) introduce in their model endogenous skill acquisition decisions which depend on the wage gap between high- and low-skilled labour.[15] They argue that such endogeneity subdivides young agents into smaller interest groups than the exogenously given two, i.e., the high- and low-skilled groups, and hence the distribution of heterogeneous costs of skill acquisition across individuals is crucial in identifying interest groups. We show that, while such a division would introduce non-smooth preferences among those whose human capital investment decisions are influenced by immigration, it hardly changes the possible policy choices by majority voting. In our model, the skill acquisition decision is affected by not only the wage gap between high- and low-skilled labour but also intragenerational redistribution managed by the welfare state. In spite of the added complexity, we find under reasonable assumptions that amost all the results in Table 1 are maintained.

4.1 Skill acquisition decision

We now assume that native agent i is born low-skilled with parameter e^i which indicates an idiosyncratic pecuniary cost to become high-skilled. The smaller the value of $e^i \in [0, \overline{e}]$ is, the less costly it is for young native i to become high-skilled, where $\overline{e}$ is the highest cost of skill acquisition being distributed among the young natives. The existence of the idiosyncratic cost of skill acquisition implies that, while some young natives can afford to become high-skilled, skill acquisition is too costly for the others. We continue to assume that immigrants are always low-skilled.

The lifetime utility of young native i over consumption is $u_t^i\left(c_t^i, c_{t+1}^i\right) := \left(c_t^i\right)^{\beta}\left(c_{t+1}^i\right)^{1-\beta}$. The agent's lifetime budget constraint is $c_t^i + c_{t+1}^i\left(1+r\right)^{-1} = z_t^i$ where

$$z_t^i\left(w_t^H, w_t^L, \mu_t, b_{t+1}\right) := \begin{cases} \left(1-\tau-\mu_t\right) w_t^H - e^i + b_{t+1}\left(1+r\right)^{-1} & \text{if } e^i \leq \widetilde{e}_t \\ \left(1-\tau-\mu_t\right) w_t^L + \theta + b_{t+1}\left(1+r\right)^{-1} & \text{otherwise.} \end{cases} \tag{10'}$$

[15] See also Chiswick (1989) for such a model. Fuest & Thum (2001) consider the relationship between immigration policy and skill acquisition of natives.

Note that z^i is a function of both w^H and w^L because these are compared when the skill acquisition decision is made. We denote by $\widetilde{e}_t$ the threshold level of the skill acquisition cost in period t and assume that young native i with $e^i > \widetilde{e}_t$ remains low-skilled. As before, we obtain the corresponding indirect utility function, $v_t^i\left(z_t^i\right) := \Lambda z_t^i$ where the relationship between v_t^i and z_t^i is positive linear.

We assume that young native i becomes high-skilled if the high-skilled lifetime income is at least as high as the low-skilled, i.e.,

$$e^i \leq \widetilde{e}_t\left(w_t^H, w_t^L, \mu_t\right) := (1 - \tau - \mu_t)\left(w_t^H - w_t^L\right) - \theta. \tag{17}$$

Notice that we need to compare only the respective first-period incomes because both high- and low-skilled workers receive the same amount of pension in the post-retirement period.

Let us assume for ease of exposition that the cost parameter is uniformly distributed among young native workers.[16] We can then express the proportion of high-skilled workers in the native workforce by using its cumulative distribution function as $h_t := \frac{\widetilde{e}_t}{\overline{e}} \in [0, 1]$.

The set of the equilibrium conditions for the economy now requires the threshold cost (17) and the income support programme budget constraint (7) in addition to (2), (3), (5) and (6). This is because the stocks of labour resources, which affects the two wage rates, are influenced by $\widetilde{e}_t$, i.e.,

$$H_t = \frac{\widetilde{e}_t}{\overline{e}} N_t \tag{2'}$$

and

$$L_t = \left(1 - \frac{\widetilde{e}_t}{\overline{e}}\right) N_t + M_t, \tag{3'}$$

but the threshold cost and hence h_t depend on the two wage rates, as we can see in (17).[17] Furthermore, h_t depends on the endogenous tax rate, μ_t,

[16] It is possible to assume other, perhaps more realistic, distributions for e^i, though it is then likely that we need to resort to numerical simulation.

[17] This is one potential reason why empirical evidence for the impact of immigrant

via (17), while this tax rate is affected by the two wage rates and the ratio between the labour stocks via (7).

As we continue to use the same concept of permanent immigration below, we hereafter drop all the time subscripts.

4.2 Skill composition

Let us examine the impact of immigration on the skill composition of the labour force in the host country. The proof of Lemma 1 above showed that we can rewrite expressions (5) to (7) as functions of m by using definitions (1) to (3). We substitute these into the expression for $\widetilde{e}$ in (17) to obtain the following implicit function which defines h as $h(m)$:

$$h = \frac{1}{\overline{e}} \left[(1-\tau) \left(\frac{h}{1-h+m} \right)^{\alpha} \left(\alpha \frac{1+m}{h} - 1 \right) - \alpha \frac{1+m}{h} \theta \right]. \tag{18}$$

The equilibrium conditions of the model are thus reduced to this single equation. The following lemma gives the properties of $h(m)$.

Lemma 5. *The proportion of high-skilled workers in the native workforce, h, is quasiconcave in the immigration ratio, m, with a unique interior maximum over the feasible policy interval $[0, \overline{m}]$ if*

(i) *the size of per capita income support, θ, is sufficiently small,*

(ii) *the maximum cost of skill acquisition, $\overline{e}$, is sufficiently high and*

(iii) *the maximum feasible immigration rato, $\overline{m}$, is sufficiently high.*

Furthermore, $\frac{dh}{dm} \in (-1, 1)$.

Proof. See appendix 1.[18] ■

workers on the host country's labour market is mixed. Endogenous skill acquisition decisions of native workers may lessen the labour market impact of immigration. LaLonde & Topel (1997), for instance, found that immigration would have only a small impact on the labour market at destination.

[18] The precise conditions for this lemma are shown in the appendix.

The conditions (i) and (iii) were also assumed when we examined individual preferences of high-skilled workers in the case of fixed h in Lemmata 3 and 4. In Lemma 5, these conditions assure that $h(m)$ initially increases but subsequently decreases over the feasible interval. We additionally assume that the condition (ii) holds. This is equivalent to assuming the responsiveness of h with respect to m being less than unity regardless of its sign. This condition is also necessary for $h(m)$ to have a single peak over $[0, \overline{m}]$, as the proof shows.

We now observe the impact of immigration on the labour market and the welfare programmes.

Corollary 1. *If the conditions* (i)*,* (ii) *and* (iii) *of* Lemma 5 *hold,* Lemmata 1 *and* 2 *continue to hold.*

Proof. See appendix 2. ■

Corollary 1 indicates that, if (i), (ii) and (iii) of Lemma 5 hold, we continue to have $\frac{dw^H}{dm} > 0$, $\frac{dw^L}{dm} < 0$, $\frac{d\mu}{dm} > 0$ and $\frac{db}{dm} > 0$. It also implies that we have $w^L < w^H$ $\forall m \in [0, \overline{m}]$ if we assume $h(0) < \alpha$.[19]

If (a), (b) and (c) of Lemma 1 hold, the behaviour of h stated in Lemma 5 can be explained as follows. As m increases, the impact of immigration in terms of the widening wage gap is initially stronger than that on the increasing tax rate specific to the income support programme in the expression for $\widetilde{e}$ in (17). However, as m continues to increase, the adverse impact through μ becomes more influential than the wage gap. This implies that receiving too many immigrants requires excessive redistribution through the income support programme. Therefore, over the feasible interval, there is a unique immigration ratio which maximises the proportion of high-skilled workers in the native workforce.

In addition, the endogenous skill acquisition decision does not change the

[19] Note that $h(m) < \alpha$ may not necessarily hold for all $m \in [0, \overline{m}]$. Still $w^L < w^H$ does so because $\frac{dh}{dm} \in (-1, 1)$ if Lemma 5 applies. That is, an increase in h would be less than an increase in m.

preference of a retired pensioner, as (12) and Lemma 1(d) imply. Lemma 2 is therefore still applicable, i.e., $\frac{dV_R}{dm} > 0$.

In what follows, we assume that the three conditions (i), (ii) and (iii) hold, and hence Lemmata 1, 2 and 5 apply. We also assume $h(0) < \alpha$.

4.3 Individual preferences of workers

While the preferences of pensioners continue to be homogeneous over $[0, \overline{m}]$, those of working natives are heterogeneous and now depend on the size of the idiosyncratic cost for skill acquisition. We also need to take into account the endogeneity of h as stated in Lemma 5. Let us write the utility of young native i born with the skill acquisition cost, e^i, as a function of m as follows:

$$V^i(m) \equiv z^i\left(w^H(m, h(m)), w^L(m, h(m)), \mu(m, h(m)), b(m, h(m))\right). \tag{13'}$$

Note that it now depends on both w^H and w^L because the skill acquisition decision is endogenous. Notice also that the utility level of a worker who remains low-skilled is not influenced by the idiosyncratic parameter, as (10') indicates. This implies that the utilities of workers who do not become high-skilled are identical.

Let V_H and V_L denote the utilities of young natives who are always high- and low-skilled respectively regardless of $m \in [0, \overline{m}]$. The following lemma states the properties of these two utilitites over temporary immigration.

Lemma 6. *The utility, V_H, is quasiconcave in temporary immigration with a unique maximum at*

$$\tilde{m} := \left\{1 + \left[\frac{1-\alpha}{\theta}(1-\tau)\right]^{\frac{1}{\alpha}}\right\} h(\tilde{m}) - 1 \in (0, \overline{m}). \tag{14'}$$

The utility, V_L, is strictly decreasing in it.

Proof. See appendix 3. ■

This corresponds to Lemma 3 of the exogenous-h version. In fact, the expression for $\tilde{m}$ in (14') is exactly the same as in (14) except for h which is now endogenously determined. The policy, $\tilde{m}$, is more liberal with smaller θ, smaller τ and smaller α.

The utilities of young natives who become high-skilled at any $m \in [0, \overline{m}]$ are parallel to each other with the differences among them being the differences in the size of the idiosyncratic cost of skill acquisition in (10'). Therefore, they all maximise their utilities at $\tilde{m}$ defined in (14').

The skill acquisition decisions of some young natives are influenced by immigration. Their utilities are expressed by some combinations of V_H^i and V_L^i without discontinuity over the interval $[0, \overline{m}]$. Table 2 summarises different utilities of young natives and shows that there are two situations. Note that V_H has superscript i while V_L does not because the former depends on e^i while the latter does not, as we can observe in expression (10'), i.e., $V_L^i = V_L$ for all workers.

TABLE 2. UTILITIES OF YOUNG NATIVES WITH VARIOUS COSTS, e^i

e^i	case 1	case 2
low	$V^i = V_H^i \ \forall m \in [0, \overline{m}]$	$V^i = V_H^i \ \forall m \in [0, \overline{m}]$
$\uparrow$	$V^i = \begin{cases} V_H^i & \text{if } m \in [0, m_{c1}^i) \\ V_L & \text{otherwise} \end{cases}$	$V^i = \begin{cases} V_L & \text{if } m \in [0, m_{a2}^i) \\ V_H^i & \text{otherwise} \end{cases}$
$\downarrow$	$V^i = \begin{cases} V_H^i & \text{if } m \in [m_{a1}^i, m_{b1}^i] \\ V_L & \text{otherwise} \end{cases}$	$V^i = \begin{cases} V_H^i & \text{if } m \in [m_{b2}^i, m_{c2}^i] \\ V_L & \text{otherwise} \end{cases}$
high	$V^i = V_L \ \forall m \in [0, \overline{m}]$	$V^i = V_L \ \forall m \in [0, \overline{m}]$

NB: $m_a < m_b < m_c$

The difference between cases 1 and 2 is whether $V_H^i < V_L$ or not at high m for those who belong to $h(0)$. In case 1, this holds and implies that some or all of those who become high-skilled without immigration would remain low-skilled if many immigrants enter the country. The utility of young native i in this group then exhibits a kink at m_{c1}^i. In addition, we can divide those who remain low-skilled without immigration into two: those who continue to remain low-skilled regardless of immigration and the others who become high-skilled over some interior subset of $[0, \overline{m}]$. The utility of young native i in the latter group exhibits two kinks at m_{a1}^i and m_{b1}^i.

In case 2, $V_L < V_H^i \ \forall m \in [0, \overline{m}]$ for all of those who belong to $h(0)$. The utilities of those who remain low-skilled without immigration but would become high-skilled with some immigration can be divided into two types: those which have one kink at m_{a2}^i and the others which have two kinks at m_{b2}^i and m_{c2}^i.

Similar to the comparison between Lemmata 3 and 4 shown in the fixed-h model, permanent immigration is likely to make all young natives be in more favour of receiving immigrants than temporary immigration because it increases the lifetime income by increasing the size of the per capita pension benefit in the next period. The next lemma corresponds to Lemma 4 of the exogenous-h model.

Lemma 7. *The utility, V_H, is quasiconcave in permanent immigration with a unique maximum at*

$$\hat{m} := \left\{1 + \left[\frac{1-\alpha}{\theta}\left(1 - \tau + \tau\frac{1+\delta}{1+r}\frac{h(\hat{m})}{\alpha}\pi\right)\right]^{\frac{1}{\alpha}}\right\} h(\hat{m}) - 1 \in (0, \overline{m}) \quad (15')$$

$$\textit{where} \quad \pi := \frac{[1-\alpha(1-\psi(\hat{m}, h(\hat{m})))](1+\hat{m}) - h(\hat{m})\,\psi(\hat{m}, h(\hat{m}))}{(1-\alpha)(1+\hat{m})(1-\psi(\hat{m}, h(\hat{m})))} > 0.$$

The utility, V_L, is quasiconvex in permanent immigration with a unique interior minimum over $[0, \overline{m}]$ if (iv) *the pay-as-you-go pension payroll tax rate, τ, is sufficiently low.*

Proof. See appendix 4. ■

By comparing $\hat{m}$ defined in (15') with $\tilde{m}$ in (14'), we notice $\tilde{m} < \hat{m}$. With the appearance of π, the expression for $\hat{m}$ in (15') is more complex than that in (15) of Lemma (4) due to the endogeneity of h. In addition, V_L is no longer strictly decreasing in immigration. It initially decreases because the labour market effect dominates, but the pension effect becomes influential as immigration continues to increase. As a result, V_L rises after a certain immigration ratio and beyond. For this shape to be observed, we assume the condition (iv) holding.[20]

As in the previous case of temporary immigration, there are those whose skill acquisition decisions are influenced by immigration. Table 2 above still applies.

4.4 Temporary immigration policy

In this and the next sections, we derive the majority voting outcomes when skill acquisition decisions are endogenous and compare the results with those already obtained from the fixed-h model. We do not discuss the results for the cases of no income support, i.e., $\theta = 0$, but they are essentially the same as what Proposition 1 states.[21]

Under the fixed-h framework, we saw in Proposition 2 that all individual preferences are single peaked over the temporary policy alternatives $[0, \overline{m}]$. However, Table 2 implies that the preferences of some young natives are not single-peaked over $[0, \overline{m}]$ because their skill acquisition decisions depend on the immigration ratio. We cannot then simply rely on the median voter theorem. Nevertheless, we find a unique referendum outcome when immigration is temporary.

To derive the majority voting outcome, we divide the native population into five groups. Let H denote the number of those young natives who would become high-skilled in the status quo, and R that of retired pensioners. The rest are divided into three groups: L_0 denotes the number of those who would remain low-skilled over $[0, \overline{m}]$; L_1 that of those who would undertake skill

[20] If this condition does not hold, V_L is strictly increasing in permanent immigration. In this case, those native workers who remain low-skilled over $[0, \overline{m}]$ would share the same preference as pensioners.

[21] Appendix 5 shows the results that correspond to what Proposition 1 states for the case of exogenous skill acquisition with $\theta = 0$.

acquisition over some subset of $[0, \overline{m}]$ and have $V^i(\overline{m}) < V_H^i(\tilde{m}) < V_L(0)$; and L_2 the rest who would also undertake skill acquisition over some subset of $[0, \overline{m}]$ and have either $V^i(\overline{m}) < V_L(0) \leq V_H^i(\tilde{m})$ or $V_L(0) \leq V_H^i(\overline{m}) < V_H^i(\tilde{m})$. Figure 1 illustrates the utilities of young natives in these different groups as functions of immigration.

[FIGURE 1 HERE]

On the one hand, an L_1-type young native most prefers the status quo because skill acquisition does not allow her/him to have a higher level of utility than $V^i(0) \equiv V_L(0)$. However, she/he would become high-skilled over some subset of $[0, \overline{m}]$ because $V_H^i(m)$ is greater than $V_L(m)$ over that subset. We say that this worker would be pushed out of the low-skilled workforce due to immigration. On the other, an L_2-type young native most prefers $\tilde{m}$ because the maximum utility that is obtainable after skill acquisition is at $\tilde{m}$ and is greater than $V^i(0) \equiv V_L(0)$. We say that this worker would be pulled into the high-skilled workforce due to immigration.

Proposition 4. *Consider temporary immigration. A referendum over the policy alternatives* $[0, \overline{m}]$ *then decides on either* (i) $\tilde{m}$ *if* $L_0 + L_1 < L_2 + H + R$ *or* (ii) *the status quo otherwise.*

Proof. Since $\delta > 0$, always $R < L_0 + L_1 + L_2 + H$. Hence $\tilde{m}\mathsf{P}m \in (\tilde{m}, \overline{m}]$ by the majority. Lemmata 2 and 6 imply the following additional information about the majority's preference: (a) $\tilde{m}\mathsf{P}m \in [0, \tilde{m})$ if $L_0 + L_1 < L_2 + H + R$ and (b) $0\mathsf{P}m \in (0, \overline{m}]$ if $L_0 + L_1 > L_2 + H + R$. ■

This proposition corresponds to Proposition 2 of the exogenous-h model. The difference is that the condition for reaching $\tilde{m}$ is less strict than with the exogenous skill composition. That is, in Proposition 2, $\tilde{m}$ is the outcome if $\frac{1+\delta}{2+\delta}(1-h) < \frac{1}{2}$ or equivalently $L_0 + L_1 + L_2 < H + R$ in the current context. Proposition 4 takes into account those workers who would be pulled into the high-skilled workforce due to immigration, i.e., L_2. It implies that $\tilde{m}$ is the more likely choice than the status quo if h sufficiently responds to an increase in immigration.[22]

4.5 Permanent immigration policy

When immigration is permanent under the exogenous skill composition, we showed that a voting cycle could arise in Proposition 3(III.i). We find that this possibility is even more likely when h is endogenous. More specifically, we show that the case corresponding to Proposition 3(II) could give rise to a voting cycle. However, we also find that all the other cases which correspond to (I), (III) and (IV) of Proposition 3 yield exactly the same possible outcomes as with exogenously given h. Hence we relegate some of the results to the appendix.

First, we examine the case of $V_L(\overline{m}) < V_L(\hat{m}) < V_L(0)$, which corresponds to Proposition 3(I). We continue to denote by R, H and L_0 the number of retired pensioners, those young natives who would become high-skilled in the status quo and those young natives who would remain low-skilled over $[0, \overline{m}]$ respectively. The rest of the young natives would undertake skill acquisition over some subset of $[0, \overline{m}]$ which depends on e^i. They are divided into two groups: L_1 denotes the number of those who would have $V_H^i(\hat{m}) < V_L(0)$; and L_2 that of those who would have $V_L(0) \leq V_H^i(\hat{m})$. We say that L_1-type workers would be pushed out of the low-skilled workforce due to immigration with $V_L(0)$ being the highest, while L_2-type ones would be pulled into the high-skilled workforce with $V_H^i(\hat{m})$ being the highest. Figure 2 illustrates the utilities of young natives in these different groups as functions of immigration.

[FIGURE 2 HERE]

[22] Even if the skill acquisition decision is not very responsive with respect to immigration, $\hat{m}$ might still be a strong candidate in an economy where those with low e^i are more willing to participate into the referendum than those with high e^i. Such a tendency is for example empirically observed in Switzerland, according to de Melo, Miguet & Müller (2002).

Proposition 5. *Consider permanent immigration. Suppose* $V_L(\overline{m}) < V_L(\hat{m}) < V_L(0)$. *A referendum over the policy alternatives* $[0,\overline{m}]$ *then decides on either* (i) $\hat{m}$ *if* $L_0 + L_1 < L_2 + H + R$ *or* (ii) *the status quo otherwise.*

Proof. Since $\delta > 0$, always $R < L_0+L_1+L_2+H$. Hence Lemmata 3 and 7 imply $\hat{m}\mathsf{P}m \in (\hat{m},\overline{m}]$ by the majority. We have the following additional information about the majority's preference: (a) $\hat{m}\mathsf{P}m \in [0,\hat{m})$ if $L_0 + L_1 < L_2 + H + R$ and (b) $0\mathsf{P}m \in (0,\overline{m}]$ if $L_0 + L_1 > L_2 + H + R$. ■

The policy $\hat{m}$ is similar to Proposition 4(i) for temporary immigration except that a higher rate of immigration is chosen when $L_0+L_1 < L_2+H+R$, i.e., $\tilde{m} < \hat{m}$. This observation is intuitive because, if $V_L(\overline{m}) < V_L(\hat{m}) < V_L(0)$, the increasing part of V_L does not matter to the majority voting outcome, as $\overline{m}$ would not yield as high utility as $\hat{m}$ or 0 would for any group of young natives. This observation is the same as what the comparison between Propositions 2(i) and 3(I.i) indicates for the exogenous-h model.

Second, consider the case of $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$. Now it matters to the referendum outcome whether $V_H(\overline{m}) < V_H(0)$ or not, as we saw in the cases (II) and (III) of Proposition 3.[23] The case where both $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ and $V_H(\overline{m}) < V_H(0)$ holding is explored in appendix 6, which shows that the possible outcomes are the same as the corresponding case of Proposition 3(III). Here, let us suppose $V_H(0) < V_H(\overline{m})$. That is, the negative impact of immigration on V_H via the income support programme is not strong enough to make $V_H(\overline{m})$ lower than $V_H(0)$. This case corresponds to Proposition 3(II) of the fixed-h model.

Groups R, H and L_0 are the same as before. The rest are now divided into four groups, and they all would undertake skill acquisition over some subset of $[0,\overline{m}]$. Denote by L_1 the number of those having $V^i(\hat{m}) < V^i(\overline{m}) < V_L(0)$; L_2 those having $V^i(\overline{m}) \leq V_H^i(\hat{m}) < V_L(0)$; L_3 those having $V^i(\overline{m}) < V_L(0) \leq V_H^i(\hat{m})$; and L_4 the rest having $V_L(0) \leq V_H^i(\overline{m}) < V_H^i(\hat{m})$. Agents

[23]Remember that the utility, V_H, is of those young natives who become high-skilled regardless of immigration.

in groups L_1 and L_2 would be pushed out of the low-skilled workforce, while ones in groups L_3 and L_4 would be pulled into the high-skilled workforce. Figure 3 illustrates the utilities of young natives in these different groups as functions of immigration.

[FIGURE 3 HERE]

Proposition 6. *Consider permanent immigration. If* $V_H(0) < V_H(\overline{m})$ *and* $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$*, a referendum over the policy alternatives* $[0, \overline{m}]$ *decides on*

either	(i)	manipulable	if	$L_0 + L_1 + L_2 < L_3 + L_4 + H + R$, $L_0 + L_1 + R > L_2 + L_3 + L_4 + H$ and $L_0 + L_1 + L_2 + L_3 > L_4 + H + R$,
	(ii)	$\overline{m}$	if	$L_0 + L_1 + L_2 + L_3 < L_4 + H + R$ and $L_0 + L_1 + R > L_2 + L_3 + L_4 + H$,
	(iii)	$\hat{m}$	if	$L_0 + L_1 + L_2 < L_3 + L_4 + H + R$ and $L_0 + L_1 + R < L_2 + L_3 + L_4 + H$,
or	(iv)	the status quo	if	$L_0 + L_1 + L_2 > L_3 + L_4 + H + R$.

Proof. Lemmata 2 and 7 imply the following information about the majority's preference:

(a)	$\hat{m}\mathsf{P}m \in [0, \hat{m})$	if $L_0 + L_1 + L_2 < L_3 + L_4 + H + R$;
(b)	$0\mathsf{P}m \in (0, \overline{m}]$	if $L_0 + L_1 + L_2 > L_3 + L_4 + H + R$;
(c)	$\hat{m}\mathsf{P}m \in (\hat{m}, \overline{m}]$	if $L_0 + L_1 + R < L_2 + L_3 + L_4 + H$;
(d)	$\overline{m}\mathsf{P}m \in [\hat{m}, \overline{m})$	if $L_0 + L_1 + R > L_2 + L_3 + L_4 + H$; and
(e)	$0\mathsf{P}\overline{m}$	if $L_0 + L_1 + L_2 + L_3 > L_4 + H + R$.

(i): Suppose the conditions in (a), (d) and (e) hold. Then, $\hat{m}$ is not the Condorcet winner because it is beaten by $\overline{m}$, according to (d). If $\overline{m}$ is the Condorcet winner, it must beat not only $m \in [\hat{m}, \overline{m})$ but also $m \in [0, \hat{m})$. This is not true because $0\mathsf{P}\overline{m}$ by the majority due to (e).[24] Hence $\overline{m}$ is not the Condorcet winner. However, the status quo is beaten by $\hat{m}$, according to (a). The majority's

[24] To be precise, there exists $[0, m''] \subset [0, \hat{m})$ where $V^i(\overline{m}) \leq V^i(m'')$ for all L_0, L_1, L_2 and L_3. This subset $[0, m'']$ is preferred to $\overline{m}$ by the majority when the condition in (e) is met.

preference is thus intransitive over $[0, \overline{m}]$, and no policy can beat every other alternatives, leading to the emergence of a voting cycle. The referendum-led policy is then subject to manipulation. For example, the status quo can be maintained by setting the following agenda: Compare policy alternatives over $(0, \hat{m}]$, then pit the winner against the rest of non-zero alternatives $(\hat{m}, \overline{m}]$, finally pit the winner against the status quo.

(ii): Suppose the condition in (e) does not hold. Then, the condition in (a) is met. Suppose the condition in (d) holds. Although there is a subset $[m', \hat{m})$ whose elements are preferred to $\overline{m}$ by L_2, L_3, L_4 and H, holding the condition in (d) implies that $\overline{m}$ cannot be beaten by any $m \in [m', \hat{m})$.

(iii): Suppose the conditions in (a) and (c) hold. Then, $\hat{m}$ beats all other policy alternatives and hence is the Condorcet winner.

(iv): Suppose the condition in (b) holds. Then, regardless of whether the condition in (c) or that in (d) holds, 0 beats all other policy alternatives and hence is the Condorcet winner. ■

Proposition 6 thus shows that this case additionally includes a voting cycle as a possible outcome with endogenous skill acquisition decision making, which was not found in Proposition 3(II).

Finally we left the the case corresponding to Proposition 3(IV). It yields the same possible outcomes as under the exogenous skill composition, and hence we relegate the result to appendix 7.

Table 3 summarises all the results from the endogenous-h framework, including the ones in the appendix. Compared to Table 1, it shows the same possible outcomes except the permanent case with $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ and $V_H(0) < V_H(\overline{m})$ when intragenerational redistribution takes place among workers. We have thus shown the robustness of our results obtained by using the simpler fixed-h framework. What the comparison between Tables 1 and 3 does not reveal is however that, when skill acquisition decision making is endogenous, there is a tendency to reduce the number of those who would oppose to the entry of low-skilled workers because immigration changes the profitability of skill acquisition.

Table 3. Referendum-led Immigration Policy, Endogenous $h(m)$

Utility		Possible outcomes	
Low-skilled	High-skilled	Temporary	Permanent
(a) $\theta = 0$			
$V_L(\overline{m}) < V_L(0)$	$V_H(0) < V_H(\overline{m})$	$\{0, \overline{m}\}$	$\{0, \overline{m}\}$
$V_L(\overline{m}) > V_L(0)$	$V_H(0) < V_H(\overline{m})$	n.a.	$\overline{m}$
(b) $\theta > 0$			
$V_L(\overline{m}) < V_L(\hat{m}) < V_L(\tilde{m}) < V_L(0)$	$V_H(0) \lesseqgtr V_H(\overline{m})$	$\{0, \tilde{m}\}$	$\{0, \hat{m}\}$
$V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$	$V_H(0) < V_H(\overline{m})$	n.a.	$\{0, \hat{m}, \overline{m}, \text{cycle}\}$
$V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$	$V_H(0) > V_H(\overline{m})$	n.a.	$\{0, \hat{m}, \text{cycle}\}$
$V_L(\overline{m}) > V_L(0)$	$V_H(0) \lesseqgtr V_H(\overline{m})$	n.a.	$\{\hat{m}, \overline{m}\}$

NB: If m is temporary, $\frac{dV_L}{dm} < 0$, hence n.a. = not applicable. $0 < \tilde{m} < \hat{m} < \overline{m}$

5 Discussion

Our investigation into the referendum-led policy formation concerning the immigration of low-skilled labour considered three channels through which citizens of the host country are economically affected, namely the labour market, the income support programme and the pay-as-you-go pension scheme. The first part of the paper assumed that the skill type of a native agent is exogenously given, while the second part endogenised individual skill acquisition decisions. In both parts, we examined temporary and permanent immigration.

Towards the temporary immigration of low-skilled labour, we found that high-skilled native workers have more liberal attitudes than the low-skilled, i.e., Lemmata 3 and 6. Figure 7 shows summary statistics from European Social Survey 2002/03 regarding individual attitudes towards immigrants from poorer-than-host countries. It shows that high-educated people are more willing to receive such immigrants than the low-educated, although we cannot confirm that survey respondents identified immigrants from poor countries with low-skilled workers. The pie charts show a portion of low-educated workers also prefer some positive level of immigration. This may reflect their anticipation of a gain from skill acquisition in the post-immigration period.

Figure 7 may also suggest that, if the European picture describes the case of permanent immigration, the positive pension effect is not very strong, i.e., $V_L(\overline{m}) < V_L(0)$ in Lemmata 4 and 7. Our lemmata then seem to describe the preferences of workers in the real world fairly well even though we concentrate on economic factors. However, the survey statistics are subject to the influence of non-economic factors. Older people are probably more conservative than younger generations, which may make them have even less liberal attitudes than low-educated workers, as the figure shows. This is not counted in our Lemma 2 which implies that pensioners are the most liberal.

[FIGURE 7 HERE]

Does our prediction of referendum outcomes fit any actual immigration policy? For example, in Switzerland, there have been seven occasions where citizens voted for or against a proposed immigration ratio which is more restrictive than the status quo, e.g., the sixth proposal to limit m from 19.3 to 18 percent in 2000.[25] In all the referenda, the proposal to reduce the level of immigration were rejected by majority voting. Let us assume voters consider permanent immigration.[26] Individual skill acquisition decisions may also respond to changes in economic prospects due to immigration. Suppose the status quo is the policy which is most preferred by high-skilled workers, i.e., $\hat{m}$, and the proposal, $m^P \in (0, \hat{m})$, is lower than that. Also assume, as Figure 7 implies, $V_L(\overline{m}) < V_L(0)$. Then, the outcome of $\hat{m}$ winning can be seen in the context of Proposition 5(i), 6(iii) or A6.1(ii). If either of

[25] Migration Dialogue's *Migration News* **7**(10), http://migration.ucdavis.edu/mn, Accessed: 29 May 2004

[26] It is unreasonable to assume that the electorate can expect the permanence of a referendum policy decision in Switzerland where seven referenda took place in the past 40 years. However, temporary policy is even more unrealistic because it guarantees zero immigration from the next period onwards.

these were the case, currently high-skilled workers and those young natives who would be pulled into the high-skilled workforce by immigration must have been many in the total number of actual voters. This may be the case because, according to de Melo, Miguet & Müller (2002), high-educated people were more likely to exercise their voting rights than low-educated ones in Swiss majority voting.

Suppose now that the condition of Proposition 6(i) or A6.1(i) applies instead. It is still possible for the status quo, $\hat{m}$, to win the majority if an alternative proposal is chosen only from the inteval $[0, \hat{m})$. Equivalently, an anti-immigration agenda setter could have pitted the status quo, $\hat{m}$, against a very liberal policy, $\overline{m}$, initially and then the winner, $\overline{m}$, against the most restrictive policy of zero immigration which will be chosen by majority voting. We have thus shown some manipulability in a referendum over the level of immigration of low-skilled labour, which signals the persistence of restrictive policy against immigration even though an increasing number of experts have argued to wide audiences for more liberal immigration policy as a solution for their ageing populations.[27]

We assumed in this paper that today's majority voting decision can fix the policy into the future when immigration is permanent. However, it is more reasonable to assume that there are more than one policy decision point during one's lifetime. If a referendum takes place in every period, young agents in a period, when voting in that period, would be concerned with the referendum outcome in the next period when they are retirees. This future referendum outcome would be influenced by not only themselves but also young agents in that period, and also retired immigrants and their children if they are given voting rights. Thus, a referendum in every period should induce strategic behaviour among young agents.

[27]For instance, see *The Economist* (15 Feb 1992, Strangers inside the gates; and more recently 31 Oct 2002, A modest contribution) and *Financial Times* (M. Wolf, 28 Nov 2001, Fighting for economic equality).

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Appendix

1. Proof of Lemma 5

Rearrange expression (18) as follows:

$$0=\frac{1}{\overline{e}}\left[(1-\tau)\left(\frac{h}{1-h+m}\right)^{\alpha}\left(\alpha\frac{1+m}{h}-1\right)-\alpha\frac{1+m}{h}\theta\right]-h\equiv F_0\left(m,h\right).$$

By partially differentiating F_0 with respect to m, we obtain

$$\frac{\partial F_0}{\partial m}=\frac{\alpha}{\overline{e}h}\left[(1-\tau)\left(1-\alpha\right)\eta-\theta\right]$$

and

$$\frac{\partial F_0}{\partial h}=\frac{\alpha\left(1+m\right)}{\overline{e}h^2}\left[\theta-(1-\tau)\left(1-\alpha\right)\eta\right]-1$$

where $\eta:=\frac{1+m}{1-h+m}\left(\frac{h}{1-h+m}\right)^{\alpha}$. The implicit function theorem implies

$$\frac{dh}{dm}=\frac{h}{1+m}\psi \tag{A1.1}$$

where

$$\psi:=\frac{(1-\tau)\left(1-\alpha\right)\eta-\theta}{\frac{\overline{e}h^2}{\alpha(1+m)}+(1-\tau)\left(1-\alpha\right)\eta-\theta}. \tag{A1.2}$$

First, if

$$\theta<(1-\tau)\left(1-\alpha\right)\frac{1}{1-h\left(0\right)}\left(\frac{h\left(0\right)}{1-h\left(0\right)}\right)^{\alpha}, \tag{A1.3}$$

we have $\psi>0$ and hence $\frac{dh}{dm}>0$ with no immigration. This inequality defines sufficiently small θ, i.e., the condition (i).

Second, we assume $\overline{e}$ is sufficiently high such that $\psi\in(-1,1)$. Let $\psi:=\frac{\lambda}{x+\lambda}$ where $x:=\frac{\overline{e}h^2}{\alpha(1+m)}$ and $\lambda:=(1-\tau)\left(1-\alpha\right)\eta-\theta$. The sufficient size of $\overline{e}$ is defined by the restriction such that $\psi\in(-1,1)\Rightarrow\lambda'<-2$ and $\lambda'>0$ where λ' denotes $\frac{x}{\lambda}$ for $\lambda\neq0$. If $\lambda'<-2\Leftrightarrow x>2\left|\lambda\right|$ where $\lambda<0$

since $x > 0$. If $\lambda' > 0 \Leftrightarrow x > 0$ where $\lambda > 0$, which is unconditionally true. Hence we assume $x > 2|\lambda|$ or equivalently $\overline{e} > \frac{2\alpha(1+m)}{h^2}|\lambda|$ over $[0, \overline{m}]$. This inequality defines the condition (ii). Accordingly, since $h \in (0,1)$, we have $\frac{dh}{dm} \in (-1,1)$. By restricting the interval of ψ in this way, we have $\frac{d\eta}{dm} = -(1-\psi)\frac{\alpha(1+m)+h}{(1-h+m)^2}\left(\frac{h}{1-h+m}\right)^{\alpha} < 0$.

Finally, we assume sufficiently high $\overline{m}$, i.e., the condition (iii), so that the sign of λ changes from positive to negative over $[0, \overline{m}]$ as the immigration ratio increases.

We thus conclude that, if the conditions (i), (ii) and (iii) hold, h is initially increasing but subsequently decreasing in m and $\frac{dh}{dm} \in (-1,1)$.

2. Proof of Corollary 1

Suppose the conditions (i), (ii) and (iii) of Lemma 5 holding. We use equations (5) to (8) being reexpressed as functions of m in the proof of Lemma 1. The total differentiation of the high-skilled wage rate with respect to immigration gives

$$\frac{dw^H}{dm} = \alpha(1-\alpha)\frac{1-\psi}{h}\kappa^{\alpha} > 0 \tag{A2.1}$$

where ψ is defined by (A1.2) in appendix 1 and $\kappa := \frac{h}{1-h+m}$ as defined in the proof of Lemma 1. Note h is now a function of m. Still, the sign of $\frac{d\kappa}{dm}$ is the same as in the fixed-h model, i.e.,

$$\frac{d\kappa}{dm} = \frac{-\alpha(1-\psi)}{1-h+m}\kappa^{\alpha} < 0. \tag{A2.2}$$

For low-skilled worker, we have

$$\frac{dw^L}{dm} = -\alpha(1-\alpha)\frac{1-\psi}{1-h+m}\kappa^{\alpha} < 0. \tag{A2.3}$$

The total differentiation of the tax rate for intragenerational transfer with respect to immigration gives

$$\frac{d\mu}{dm} = \alpha\theta\frac{1-\psi}{1-h+m}\kappa^{-\alpha} > 0, \tag{A2.4}$$

and that of the per capita pension benefit yields

$$\frac{db}{dm} = \tau(1+\delta)\left[(1-\alpha)\left(1-\frac{h\psi}{1+m}\right)+\alpha\frac{1-h+m}{1+m}\right]\kappa^{\alpha} > 0, \qquad \text{(A2.5)}$$

as $\frac{dh}{dm} = \frac{h\psi}{1+m} \in (-1,1)$ by restricting $\psi \in (-1,1)$. Since Lemma 1(d) holds, $\frac{dV_R}{dm} > 0$. Lemma 2 then also holds.

3. Proof of Lemma 6

When immigration policy is temporary, its impact only on the first period income matters. Expression (10') then indicates, for the high-skilled,

$$V_H \equiv z^i_{e^i \leq \hat{e} \forall m \in [0,\overline{m}]} := (1-\tau-\mu)\,w^H - e^i + \frac{b(0)}{1+r}. \qquad \text{(A3.1)}$$

By substitution, we obtain

$$V_H = (1-\tau)\,\alpha\kappa^{-(1-\alpha)} - \alpha\theta\kappa^{-1} - e^i + \frac{b(0)}{1+r}. \qquad \text{(A3.1')}$$

The total differentiation of V_H with respect to m gives, by using (A1.1),

$$\frac{dV_H}{dm} = \frac{\alpha}{h}(1-\psi)\left[(1-\tau)(1-\alpha)\kappa^{\alpha} - \theta\right] \qquad \text{(A3.2)}$$

where we assume $\psi \in (-1,1)$ as shown in appendix 1.

First, we assume

$$\theta < (1-\tau)(1-\alpha)\left(\frac{h(0)}{1-h(0)}\right)^{\alpha} \qquad \text{(A3.3)}$$

so that $\frac{dV_H}{dm} > 0$ at $m = 0$. Since (A3.3) is more restrictive than (A1.3), we replace the latter with the former for the condition (i) of Lemma 5.

Second, expression (A2.2) implies that the sign of $\frac{dV_H}{dm}$ changes from positive to negative with sufficiently high $\overline{m}$, i.e., the condition (iii) of Lemma 5. By solving $\frac{dV_H}{dm} = 0$ for m in (A.3.2), we obtain $\tilde{m}$ defined in (14'). Let us rearrange (14') as

$$F_1 \equiv 1 + \tilde{m} = \Phi h(\tilde{m}) \equiv F_2$$

where $\Phi := 1 + \left[\frac{1-\alpha}{\theta}(1-\tau)\right]^{\frac{1}{\alpha}}$ which is a constant. The uniqueness of $\tilde{m}$ requires us to assume $\Phi h(0) > 1$. Since h is quasiconcave in m with a unique interior maximum over $[0, \overline{m}]$ as stated in lemma 5, F_1 and F_2 crosses only once at m if the intercept of F_2 at $m = 0$ is higher than that of F_1, i.e., unity. We assume $\Phi h(0) > 1$ so that $h(\tilde{m})$ is unique.

Note also that the comparison between (A1.1) and (A3.2) imply that h continues to increase in m even when the peak of V_H is reached.

For the low-skilled, expression (10') indicates

$$V_L \equiv z^i_{e^i > \widetilde{e} \forall m \in [0,\overline{m}]} := (1-\tau-\mu)\, w^L + \theta + \frac{b(0)}{1+r}. \tag{A3.4}$$

By substitution, we obtain

$$V_L = (1-\tau)(1-\alpha)\,\kappa^{\alpha} + \alpha\theta + \frac{b(0)}{1+r}. \tag{A3.4'}$$

The total differentiation of V_L with respect to m gives

$$\frac{dV_L}{dm} = -(1-\tau)\,\alpha(1-\alpha)\,\frac{1-\psi}{1-h+m}\kappa^{\alpha} < 0. \tag{A3.5}$$

Notice that $\frac{dV_L}{dm} = (1-\tau)\frac{dw^L}{dm}$ where $\frac{dw^L}{dm}$ is shown in (A2.3). This implies that immigration does not affect V_L via the income support programme. This is also obvious in (A3.4') as it can be rewritten as $V_L = (1-\tau)\,w^L + \alpha\theta + \frac{b(0)}{1+r}$.

4. Proof of Lemma 7

By substitution into expression (10') for $e^i \leq \widetilde{e}$, we obtain

$$V_H = \left[(1-\tau)\,\alpha + \tau\frac{1+\delta}{1+r}h\right]\kappa^{-(1-\alpha)} - \alpha\theta\kappa^{-1} - e^i. \tag{A4.1}$$

By partially differentiating it, we have

$$\frac{\partial V_H}{\partial m} = \frac{\alpha(1-\alpha)(1-\tau)\,\kappa^{\alpha}}{h} + (1-\alpha)\,\tau\frac{1+\delta}{1+r}\kappa^{\alpha} - \frac{\alpha\theta}{h}$$

and

$$\frac{\partial V_H}{\partial h} = \left[-\frac{\alpha(1-\alpha)(1-\tau)\,\kappa^{\alpha}}{h} + \left(\alpha - \frac{h}{1+m}\right)\tau\frac{1+\delta}{1+r}\kappa^{\alpha} + \frac{\alpha\theta}{h}\right]\frac{1+m}{h}.$$

The total differentiation of V_H with respect to m then gives, by using (A1.1),

$$\begin{aligned}\frac{dV_H}{dm} &= \frac{\alpha}{h}(1-\psi) \\ &\times\left\{\left[(1-\tau)(1-\alpha)+\tau\frac{1+\delta}{1+r}\frac{h}{\alpha(1-\psi)}\left(1-\alpha+\left(\alpha-\frac{h}{1+m}\right)\psi\right)\right]\kappa^{\alpha}-\theta\right\}.\end{aligned} \tag{A4.2}$$

Compared with (A3.2) for the temporary case, we have an additional term, $\tau\frac{1+\delta}{1+r}\left(1-\frac{h\psi}{1+m}-\alpha(1-\psi)\right)\kappa^{\alpha}>0$, due to the positive impact of m via b. Let us assume sufficiently small θ such that $\frac{dV_H}{dm}>0$ at $m=0$, i.e.,

$$\begin{aligned}\theta\kappa(0,h(0))^{-\alpha} &< (1-\tau)(1-\alpha) \\ &+\tau\frac{1+\delta}{1+r}\frac{h(0)\left[1-\alpha+(\alpha-h(0))\psi(0,h(0))\right]}{\alpha(1-\psi(0,h(0)))}.\end{aligned} \tag{A4.3}$$

The condition (A4.3) holds if (A3.3) holds, for the latter is more restrictive than the former. We continue to use (A3.3) for sufficiently small θ. The reason is that holding (A3.3) is sufficient to meet conditions (A4.3) as well as (A1.3), while holding (A4.3) does not guarantee (A1.3) holding without restrictions on the parameters, τ, δ, r, α, $h(0)$ and $\psi(0,h(0))$, i.e.,

$$\frac{\tau}{1-\tau}\frac{1+\delta}{1+r}\frac{(1-h(0))\left[1-\alpha+(\alpha-h(0))\psi(0,h(0))\right]}{\alpha(1-\alpha)(1-\psi(0,h(0)))}\lesseqgtr 1.$$

This ambiguity arises because the lifetime income gap between the high- and low-skilled may start narrowing, while the high-skilled lifetime income is still rising. This implies that the low-skilled lifetime income would begin rising after falling before V_H reaches its peak as m increases.

To obtain $\hat{m}$ defined in (15'), set the expression inside the braces in (A4.2) equal to zero and rearrange as

$$F_3\equiv\kappa^{-\alpha}=\frac{(1-\alpha)(1-\tau)}{\theta}+\frac{\tau}{\theta}\frac{1+\delta}{1+r}\frac{h}{\alpha(1-\psi)}\left[1-\alpha+\left(\alpha+\frac{h}{1+m}\right)\psi\right]\equiv F_4.$$

According to (A2.2), the F_3 function is strictly increasing in m with an intercept at $\left(\frac{1-h(0)}{h(0)}\right)^{\alpha}>0$. As for the F_4 function, we substitute (A1.2) for

ψ and rearrange to get

$$F_4 \equiv \frac{(1-\alpha)(1-\tau)}{\theta} + \frac{\tau}{\theta}\frac{1+\delta}{1+r}\frac{1-h+m}{\overline{e}h} \times \left[\frac{1-\alpha}{\alpha}\overline{e}h^2 + (1-\tau)(1-\alpha)\frac{1+m}{1-h+m}\left(\frac{h}{1-h+m}\right)^{\alpha} - \theta\right].$$

By totally differentiating it with respect to m, we obtain

$$\frac{dF_4}{dm} = \frac{\tau}{\theta}\frac{1+\delta}{1+r}\frac{1-h+m}{\overline{e}h}(1-\psi) \times \left[\frac{1-\alpha}{\alpha}\frac{\overline{e}h^2}{1-\psi}\left(1-\frac{h\psi}{1+m}\right) + (1-\tau)(1-\alpha)\frac{1-h+m-\alpha(1+m)}{1-h+m}\kappa^{\alpha} - \theta\right],$$

whose sign is always positive by assuming sufficiently high $\overline{e}$. Hence the F_4 function is also strictly increasing in m with an intercept at $\frac{(1-\alpha)(1-\tau)}{\theta} + \left[\frac{1-\alpha+(\alpha-h(0))\psi(0,h(0))}{1-\psi(0,h(0))}\right]\frac{\tau}{\theta}\frac{1+\delta}{1+r}\frac{h(0)}{\alpha} > 0$. Suppose $\frac{dF_3}{dm} > \frac{dF_4}{dm}$. Then, there is a unique crossing point which gives $\hat{m} \in (0, \overline{m})$ with sufficiently high $\overline{m}$ if the intercept of F_3 is smaller than that of F_4. With sufficiently high $\overline{e}$, this situation holds.

The discussion about (A4.3) above has already implied that V_L may be initially decreasing but subsequently increasing in m. By substitution into expression (10') for $e^i > \widetilde{e}$, we obtain

$$V_L = \left[(1-\tau)(1-\alpha) + \tau\frac{1+\delta}{1+r}(1-h+m)\right]\kappa + \alpha\theta. \tag{A4.4}$$

By partially differentiating it, we obtain

$$\frac{\partial V_L}{\partial m} = \left[(1-\alpha)\tau\frac{1+\delta}{1+r} - \frac{\alpha(1-\alpha)(1-\tau)}{1-h+m}\right]\kappa$$

and

$$\frac{\partial V_L}{\partial h} = \frac{1+m}{h}\left[-\left(\frac{h}{1+m}-\alpha\right)\tau\frac{1+\delta}{1+r} + \frac{\alpha(1-\alpha)(1-\tau)}{1-h+m}\right]\kappa.$$

By using (A1.1), the total differentiation of V_L for the low-skilled with respect to m then yields

$$\frac{dV_L}{dm} = \left\{\tau\frac{1+\delta}{1+r}\left[1-\frac{h\psi}{1+m}+\alpha(1-\psi)\right] - \frac{\alpha(1-\alpha)(1-\tau)(1-\psi)}{1-h+m}\right\}\kappa. \tag{A4.5}$$

We assume

$$\tau < \left\{1 + \frac{1+\delta}{1+r}\frac{(1-h(0))\left[1-h(0)\psi(0,h(0)) + \alpha(1-\psi(0,h(0)))\right]}{\alpha(1-\alpha)(1-\psi(0,h(0)))}\right\}^{-1} \tag{A4.6}$$

so that $\frac{dV_L}{dm} < 0$ at $m = 0$. This is what we mean by sufficiently small τ, i.e., (iv) of the lemma holding. The sign of $\frac{dV_L}{dm}$ changes from negative to positive over $[0, \overline{m}]$ with sufficiently high $\overline{m}$ if

$$\tau < \left\{1 + \frac{1+\delta}{1+r}\frac{1-h+m}{1-\alpha}\left[1 + \frac{1-h\psi+m}{\alpha(1-\psi)(1+m)}\right]\right\}^{-1}$$

is violated as m increases. This is the case, as we assume $\psi \in (-1,1)$ and hence $\frac{dh}{dm} \in (-1,1)$.

5. Majority voting over $[0, \overline{m}]$ if $\theta = 0$ with $h(m)$

If $\theta = 0$, the tax rate μ no longer appears in the expression for $\widetilde{e}$ in (17). This changes the impact of immigration on the skill acquisition decisions of young natives as well as the skill composition of the workforce.

Lemma A5.1. *If $\theta = 0$, h is strictly increasing in immigration, whether temporary or permanent, and also* (a), (b) *and* (d) *of* Lemma 1 *hold.*

Proof. If $\theta = 0$, (17) implies $\widetilde{e} = (1-\tau)\left(w^H - w^L\right)$. Accordingly, (18) reduces to $\frac{1-\tau}{\overline{e}}\left(\frac{\alpha(1+m)}{h} - 1\right)\kappa^\alpha - h = 0$, whether immigration is temporary or permanent. Using the implicit function theorem, we get $\frac{dh}{dm} = (1-\alpha)h(1+m)\left[(1-\alpha)(1+m)^2 + \frac{\overline{e}h^2(1-h+m)}{\alpha(1-\tau)\kappa^\alpha}\right]^{-1} \in (0,1)$ because the first term in the square brackets is strictly greater than the numerator. By using this total derivative in (5), (6) and (8) with $\xi^{-1} := \overline{e}h^2(1-h+m) + \alpha(1-\alpha)(1-\tau)(1+m)^2\kappa^\alpha$, we obtain $\frac{dw^H}{dm} = \alpha(1-\alpha)\overline{e}h^2\kappa^{-(1-\alpha)}\xi > 0$, $\frac{db}{dm} = \alpha^2(1-\alpha)\tau(1-\tau)(1+\delta)(1+m)(1-h+m)\kappa^{2\alpha}\xi > 0$ and $\frac{dw^L}{dm} = -\alpha(1-\alpha)\overline{e}h^2\kappa^\alpha\xi < 0$. ■

When the income support programme is abscent, high-skilled workers do not redistribute to low-skilled ones during their working period. Accordingly, the threshold cost of skill acquisition is affected by immigration only via the widening wage gap, and the proportion of high-skilled workers is strictly increasing in immigration, as Lemma 1(a,b) implies. The behaviour of h with respect to m is thus different from what Lemma 5 states for the case of $\theta > 0$. Lemma A5.1 suggests that a young agent would either become high-skilled regardless of immigration, become high-skilled at a certain immigration ratio and beyond or remain low-skilled regardless of immigration. Let us now examine the utilities of those who is always high- or low-skilled over $[0, \overline{m}]$., i.e., V_H and V_L respectively.

Lemma A5.2. *Consider temporary immigration. If $\theta = 0$,* (i) *V_H is strictly increasing,* (ii) *V_L is strictly decreasing and* (iii) *V_R is strictly increasing in m.*

Proof. (A3.1) reduces to $V_H = (1-\tau) w^H - e^i + \frac{b(0)}{1+r}$ and (A3.4) to $V_L = (1-\tau) w^L + \frac{b(0)}{1+r}$, while (12) remains as it is, i.e., $V_R = b$. Lemma A5.1 then implies $\frac{dV_H}{dm} > 0$, $\frac{dV_L}{dm} < 0$ and $\frac{dV_R}{dm} > 0$. ■

Lemma A5.3. *Consider permanent immigration. If $\theta = 0$,* (i) *V_H is strictly increasing,* (ii) *V_L is convex with a unique interior minimum over $[0, \overline{m}]$ if the pension payroll tax rate τ is sufficiently small and* (iii) *V_R is strictly increasing in m.*

Proof. (10') and (13') imply $V_H = (1-\tau) w^H - e^i + b(1+r)^{-1}$ and $V_L = (1-\tau) w^L + b(1+r)^{-1}$ if $\theta = 0$, while (12) remains as it is, i.e., $V_R = b$. Lemma A5.1 then directly implies $\frac{dV_H}{dm} > 0$ and $\frac{dV_R}{dm} > 0$. For the low-skilled, $\frac{dV_L}{dm} = (1-\tau)\frac{dw^L}{dm} + \frac{db}{dm}(1+r)^{-1}$, and as the proof of Lemma A5.1 implies, $\frac{dV_L}{dm} = \alpha(1-\alpha)(1-\tau) h\xi\kappa^{\alpha}\left[\alpha\tau\frac{1+\delta}{1+r}(1+m)\kappa^{-(1-\alpha)} - \overline{e}h\right]$. By assuming sufficiently small τ, i.e., $\tau < \overline{e}\left(\alpha\frac{1+\delta}{1+r}\right)^{-1}\varsigma$ where $\varsigma := \frac{h}{1+m}\kappa^{1-\alpha}$, we have $\frac{dV_L}{dm} < 0$ at $m = 0$. Since $\frac{d\varsigma}{dm} = -\xi h^{2-\alpha}(1-h+m)^{-(2-\alpha)}(1+m)^{-2}\Upsilon$ where $\Upsilon := \alpha(1-\alpha)(1-\tau)(1+m)^2\kappa^{\alpha}\left[(2-(1-\alpha)h)m - (2h + \alpha(1-h) + (1-\alpha)h^2)\right] + \overline{e}h^2(1-h+m)(2(1+m)-h)$ is strictly decreasing in m, even though the sign of the first term of Υ is ambiguous, by assuming sufficiently high $\overline{e}$, the sign of $\frac{dV_L}{dm}$ subsequently becomes positive. ■

Using these two lemmata, we can identify V^i in either case of temporary or permanent immigration. To derive the majority voting outcome over temporary immigration, we divide the native population into five groups. Let H denote the number of those young natives who would become high-skilled in the status quo, and R that of retired pensioners. The other young natives are divided into three groups: L_0 denotes the number of those who would remain low-skilled over $[0, \overline{m}]$; L_1 the number of those who would undertake skill acquisition over some subset of $[0, \overline{m}]$ and have $V_H^i(\overline{m}) < V_L(0)$; and L_2 the rest who would also undertake skill acquisition over some subset of $[0, \overline{m}]$ and have $V_L(0) \leq V_H^i(\overline{m})$. As for permanent immigration, Lemma A5.3(ii) suggests that the utility, V_L, could exhibit either $V_L(\overline{m}) < V_L(0)$ or $V_L(0) < V_L(\overline{m})$. In the former case, we divide the native population into five groups in the same way as for temporary immigration. In the latter case, there is no need for such a division of the population, as the next proposition shows.

Proposition A5.1. *Suppose the income support programme is abscent.*
(I) *If immigration is either temporary or permanent and* $V_L(\overline{m}) < V_L(0)$*, a referendum decides on either* (i) *free entry policy if* $L_0 + L_1 < L_2 + H + R$ *or* (ii) *the status quo otherwise.*
(II) *If it is permanent and* $V_L(0) < V_L(\overline{m})$*, natives decide on free entry policy unanimously.*

Proof. (I) Lemmata A5.2 and A5.3 implies the following preference by the majority: (i) $\overline{m}\mathsf{P}m \in [0, \overline{m})$ if $L_0 + L_1 < L_2 + H + R$ and (ii) $0\mathsf{P}m \in (0, \overline{m}]$ if $L_0 + L_1 > L_2 + H + R$. (II) If $V_L(0) < V_L(\overline{m})$, Lemma A5.3 implies that $\overline{m}$ gives the highest utility for every agent. ■

This proposition corresponds to Proposition 1 of the fixed-h model, and a referendum outcome takes an extreme policy alternative in the abscence of intragenerational redistribution among young natives.

6. Majority voting over permanent policy when $V_H(\overline{m}) < V_H(0)$ and $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$

This case corresponds to Proposition 3(III) of the fixed-h model. The situation, $V_H(\overline{m}) < V_H(0)$, implies that the negative impact of immigration on V_H via the income support programme is so strong that $V_H(\overline{m})$ cannot be higher than $V_H(0)$. Groups H, R and L_0 are the same as before. All the rest would undertake skill acquisition over some subset of $[0, \overline{m}]$ and are divided into three. Group L_1 consists of those with $V_H^i(\hat{m}) < V_L(\overline{m}) < V_L(0)$. Group L_2 consists of those with $V^i(\overline{m}) \leq V_H^i(\hat{m}) < V_L(0)$. Group L_3 consists of the rest with $V^i(\overline{m}) < V_L(0) \leq V_H^i(\hat{m})$. Those in groups L_1 and L_2 would be pushed out of the low-skilled workforce. Those in group L_3 would be pulled into the high-skilled workforce. Figure 4 illustrates the utilities of young natives in these different groups as functions of $m \in [0, \overline{m}]$.

Proposition A6.1. *Consider permanent immigration. Suppose* $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ *and* $V_H(\overline{m}) < V_H(0)$. *A referendum over the policy alternatives* $[0, \overline{m}]$ *then decides on either*

either	(i)	manipulable	if	$L_0 + L_1 + L_2 < L_3 + H + R$ and
				$L_0 + L_1 + R > L_2 + L_3 + H$,
	(ii)	$\hat{m}$	if	$L_0 + L_1 + L_2 < L_3 + H + R$ and
				$L_0 + L_1 + R < L_2 + L_3 + H$
or	(iii)	the status quo	if	$L_0 + L_1 + L_2 > L_3 + H + R$.

Proof. With $\delta > 0$, Lemmata 2 and 7 imply $0\mathsf{P}\overline{m}$ by the majority because $V^i(\overline{m}) < V^i(0)$ for all native workers. We have the following additional information about the majority's preference:

(a) $\hat{m}\mathsf{P}m \in [0, \hat{m})$ if $L_0 + L_1 + L_2 < L_3 + H + R$;

(b) $0\mathsf{P}m \in (0, \overline{m}]$ if $L_0 + L_1 + L_2 > L_3 + H + R$;

(c) $\hat{m}\mathsf{P}m \in (\hat{m}, \overline{m}]$ if $L_0 + L_1 + R < L_2 + L_3 + H$; and

(d) $\overline{m}\mathsf{P}m \in [\hat{m}, \overline{m})$ if $L_0 + L_1 + R > L_2 + L_3 + H$.

The proofs for outcomes (ii) and (iii) are the same as for (iii) and (iv) of Proposition 6 respectively. As for outcome (i), the conditions in (a) and (d) hold. Then, $\hat{m}$ is not the Condorcet winner because it is beaten by $\overline{m}$, according to (d). If $\overline{m}$ is the Condorcet winner, it must beat not only

$m \in [\hat{m}, \overline{m})$ but also $m \in [0, \hat{m})$. However, $0\mathsf{P}\overline{m}$ by the majority.[28] Hence $\overline{m}$ is not the Condorcet winner. However, 0 is not the Condorcet winner, as it is beaten by $\hat{m}$, according to (a). The majority's preference is thus intransitive over $[0, \overline{m}]$, and no policy can beat every other alternatives, leading to the emergence of a voting cycle. The referendum-led policy is then subject to manipulation. ■

7. Majority voting over permanent policy when $V_L(0) < V_L(\overline{m})$

This case corresponds to Proposition 3(IV) where the positive pension effect is very strong. Groups R, H and L_0 are the same as before. Group L_1 now consists of those who would undertake skill acquisition over some subset of $[0, \overline{m}]$ and have $V_H^i(\hat{m}) < V_L(\overline{m})$. Group L_2 consists of the rest who would also undertake skill acquisition over some subset of $[0, \overline{m}]$ and have $V^i(\overline{m}) \leq V_H^i(\hat{m})$. Both figures 5 and 6 illustrate this case.

An L_1-type young native now most prefers $\overline{m}$ because skill acquisition does not allow her/him to have a higher level of utility than $V^i(\overline{m}) \equiv V_L(\overline{m})$. However, she/he would become high-skilled over some subset of $[0, \overline{m}]$ because $V_H^i(m)$ is greater than $V_L(m)$ over that subset. She/he is the worker who would be pushed out of the low-skilled workforce due to immigration. An L_2-type young native most prefers $\hat{m}$ because the maximum utility that is obtainable after skill acquisition is at $\hat{m}$ and is greater than $V^i(\overline{m}) \equiv V_L(\overline{m})$. This worker would be pulled into the high-skilled workforce due to immigration.

Proposition A7.1. *Consider permanent immigration. Suppose* $V_L(0) < V_L(\overline{m})$*. A referendum over the policy alternatives* $[0, \overline{m}]$ *then decides on either* (i) $\overline{m}$ *if* $L_0 + L_1 + R > L_2 + H$ *or* (ii) $\hat{m}$ *otherwise.*

Proof. (Case I, e.g., Figure 5) Suppose $V_L(0) < V_L(\hat{m}) < V_L(\overline{m})$. Then, $V^i(0) \equiv V_L(0) < V^i(\hat{m}) \equiv V_H^i(\hat{m}) < V^i(\overline{m}) \equiv V_L(\overline{m})$ for L_1. Lemmata

[28] To be precise, there exists $[0, m''] \subset [0, \hat{m})$ where $V_L(m'') = V_L(\overline{m})$. This subset $[0, m'']$ is preferred to $\overline{m}$ by the majority when $\delta > 0$.

2 and 7 provide the following information about the majority's preference: (a) $\hat{m}\mathsf{P}m \in [0, \overline{m}] \backslash \{\hat{m}\}$ if $L_0 + L_1 + R < L_2 + H$ and (b) $\overline{m}\mathsf{P}m \in [0, \overline{m})$ if $L_0 + L_1 + R > L_2 + H$. (Case II, e.g., Figure 6) Suppose $V_L(\hat{m}) < V_L(0) < V_L(\overline{m})$. Then, L_1 can be further divided into L_{11} and L_{12}: $V^i(\hat{m}) \equiv V_H^i(\hat{m}) < V^i(0) \equiv V_L(0) < V^i(\overline{m}) \equiv V_L(\overline{m})$ for L_{11} and $V^i(0) \equiv V_L(0) \leq V^i(\hat{m}) \equiv V_H^i(\hat{m}) < V^i(\overline{m}) \equiv V_L(\overline{m})$ for L_{12}. Lemma 2 and 7 imply the following information about the majority's preference:

(a) $\hat{m}\mathsf{P}m \in [0, \overline{m}] \backslash \{\hat{m}\}$ if $L_0 + L_{11} + L_{12} + R < L_2 + H$

(b) $\overline{m}\mathsf{P}m \in [0, \overline{m})$ if $L_0 + L_{11} + L_{12} + R > L_2 + H$

(c) $\hat{m}\mathsf{P}m \in [0, \hat{m})$ if $L_0 + L_{11} < L_{12} + L_2 + H + R$; and

(d) $0\mathsf{P}m \in (0, \hat{m}]$ if $L_0 + L_{11} > L_{12} + L_2 + H + R$

Note that (c) holds if (a) holds, and (b) holds if (d) holds. Also note (a) and (d) cannot be met simultaneously, but (b) and (c) could. Hence $L_0 + L_1 + R < L_2 + H$ is the key condition that determines whether the majority voting outcome is either $\hat{m}$ or $\overline{m}$. ■

8. Other cases than fixed θ and τ

Our analysis above assumed that the size of per capita income support, θ, and the payroll tax rate, τ, are exogenously given in (7) and (8) respectively. Here, we discuss the implications for the other cases.

Fixed θ and b

In this case, pensioners become indifferent because immigration does not influence their income via the pension scheme. In addition, the referendum outcomes are the same for both temporary and permanent immigration, as immigration does not affect the second period income. Accordingly, the referendum outcome depends on the preferences of workers. Since $\frac{d\tau}{dm} < 0$, the high-skilled lifetime income continues to be quasiconcave in immigration with a higher peak than our temporary case. the low-skilled income is likely to be quasiconvex. There might be an upward-sloping segment if the impact of immigration via τ is strong enough. The possible majority voting outcomes are then 0, $\overline{m}$ or some intermediate immigration ratio which maximises V_H.

Fixed μ and b

Again, pensioners become indifferent, and the referendum outcomes are the same for both temporary and permanent immigration. Fixing μ removes the adverse impact of immigration via the income support programme on high-skilled workers. Accordingly, V_H strictly increases in m. On the other hand, low-skilled workers are negatively affected because θ decreases as m increases. Again, there might be an upward-sloping segment of V_L, depending on how strong the positive impact of immigration via τ. A referendum outcome is either 0 or $\overline{m}$.

Fixed μ and τ

In this case, both V_H and V_R strictly increases in m, whether immigration is temporary or permanent, as w^H and b strictly increase in m. The utility, V_L, strictly decreases in temporary immigration, as both w^L and θ do so. Hence a referendum outcome over temporary policy is either 0 or $\overline{m}$. When immigration is permanent, V_L may be quasiconvex with a unique interior minimum over $[0, \overline{m}]$ because the positive impact of immigration via the pension scheme may dominate at high m. A referendum outcome is still either 0 or $\overline{m}$.

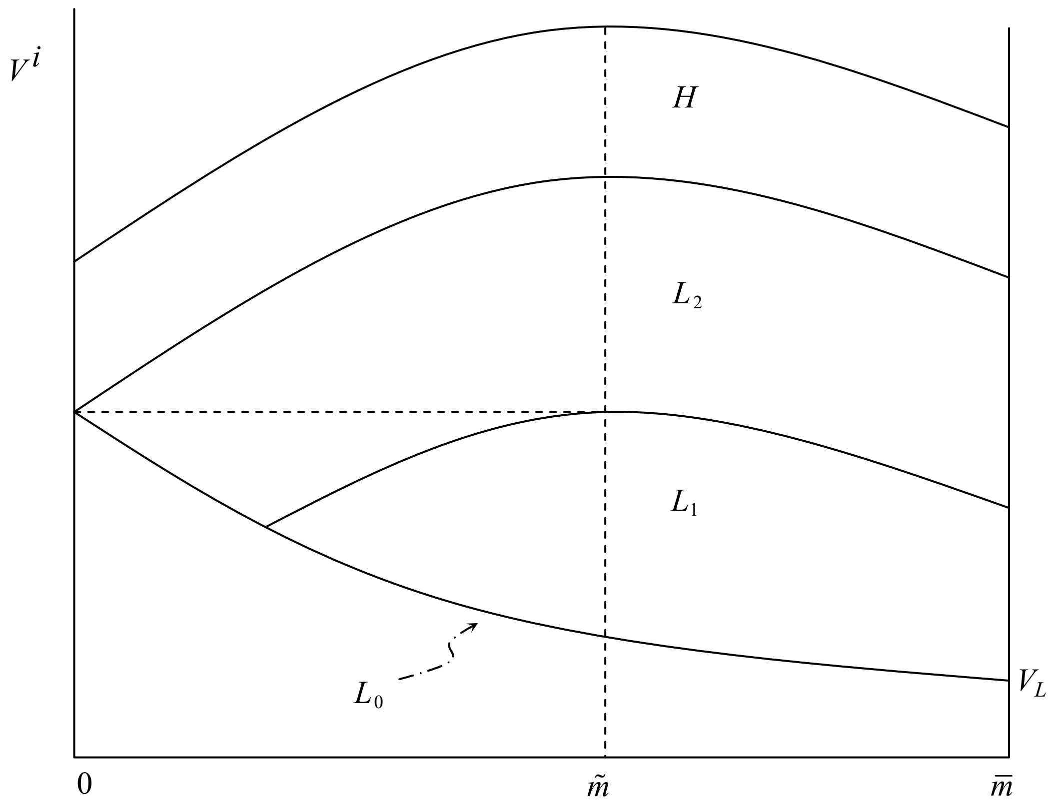


FIGURE 1. UTILITIES OF WORKERS WITH DIFFERENT COSTS OF SKILL ACQUISITION OVER TEMPORARY IMMIGRATION POLICY

NB: Young natives in group L_0 have an identical utility curve which is the lowest curve, V_L, in the diagram. An agent in group L_1 remains low-skilled when the labour market is closed but would be pushed out of the low-skilled workforce when immigration exceeds a certain proportion. When being pushed out, her/his utility switches from V_L to V^i_H without discontinuity, exhibiting a kink along the utility curve. The switching level of immigration depends on e^i and hence differs among agents. The utilities, V^i_H, are all parallel to each other. As expression (10') implies, the high-skilled lifetime income shifts down for a higher value of e^i. There are an infinite number of the utilities of such workers between the lowest and the second lowest curves. In the same way, the utilities of those who would be pulled to the high-skilled workforce, i.e., group L_2, are represented between the second and the third bottom curves. Between the top and the second top curves, we have workers who become high-skilled regardless of immigration, i.e., group *H*. They belong to $h(0)$. This note applies to all the subsequent diagrams with some modifications.

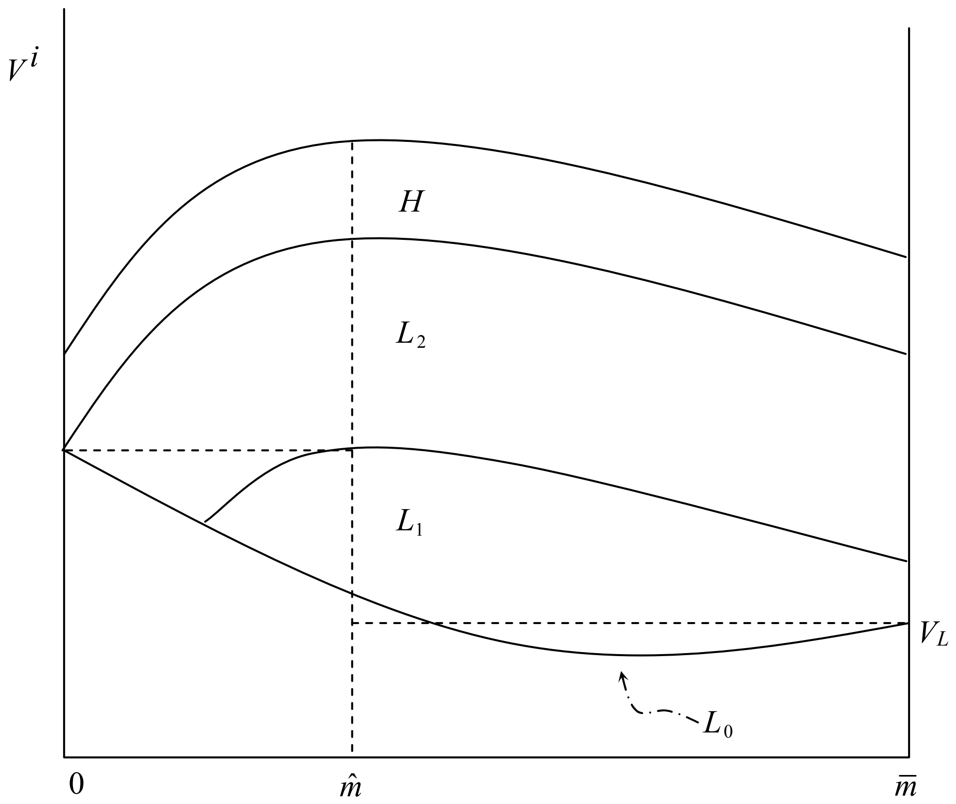


FIGURE 2. UTILITIES OF WORKERS WITH DIFFERENT COSTS OF SKILL ACQUISITION OVER PERMANENT IMMIGRATION POLICY

WHEN $V_L(\overline{m}) < V_L(\hat{m}) < V_L(0)$

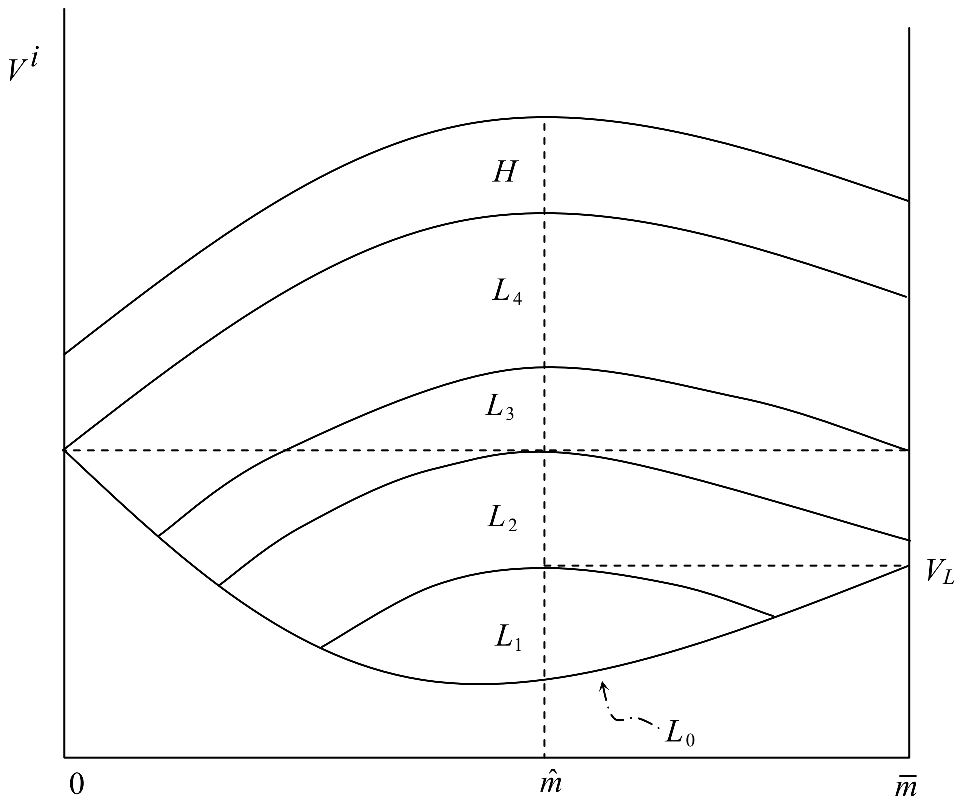


FIGURE 3. UTILITIES OF WORKERS WITH DIFFERENT COSTS OF SKILL ACQUISITION OVER PERMANENT IMMIGRATION POLICY

WHEN $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ AND $V_H(0) < V_H(\overline{m})$

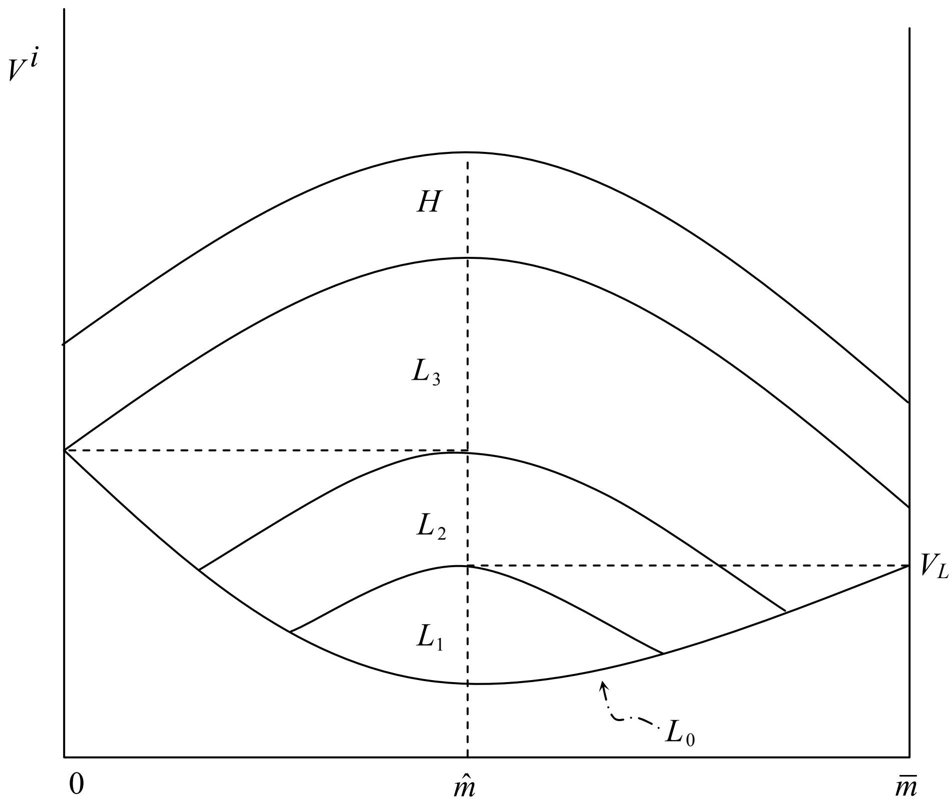


FIGURE 4. UTILITIES OF WORKERS WITH DIFFERENT COSTS OF SKILL ACQUISITION OVER PERMANENT IMMIGRATION POLICY

WHEN $V_L(\hat{m}) < V_L(\overline{m}) < V_L(0)$ AND $V_H(\overline{m}) < V_H(0)$

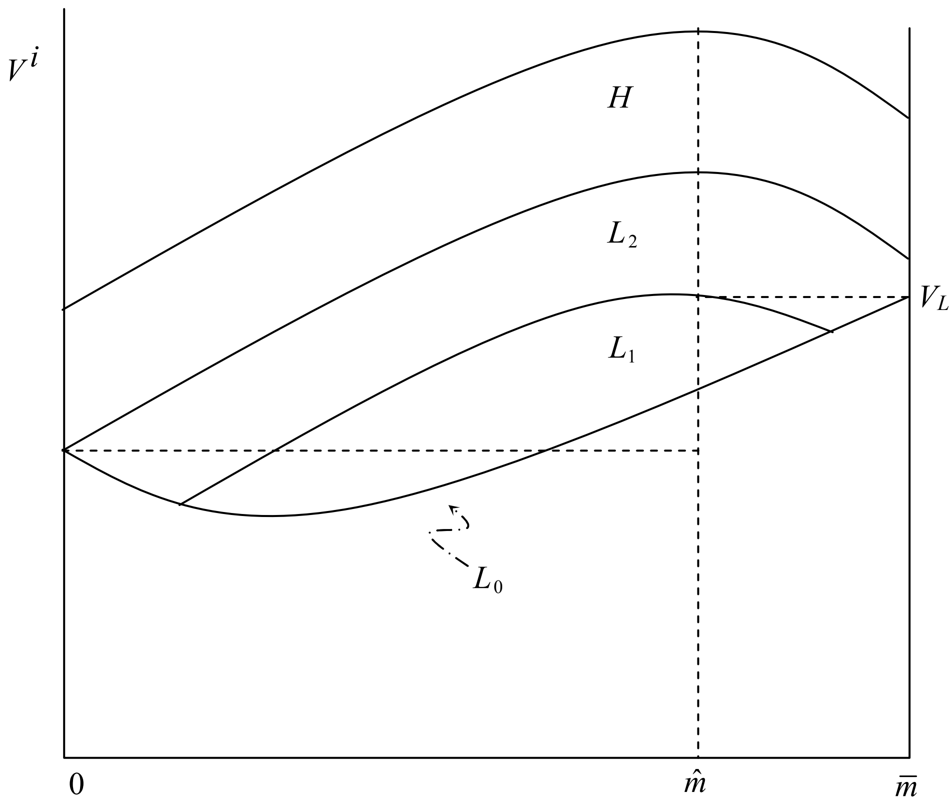


FIGURE 5. UTILITIES OF WORKERS WITH DIFFERENT COSTS OF SKILL ACQUISITION OVER PERMANENT IMMIGRATION POLICY

WHEN $V_L(0) < V_L(\hat{m}) < V_L(\overline{m})$

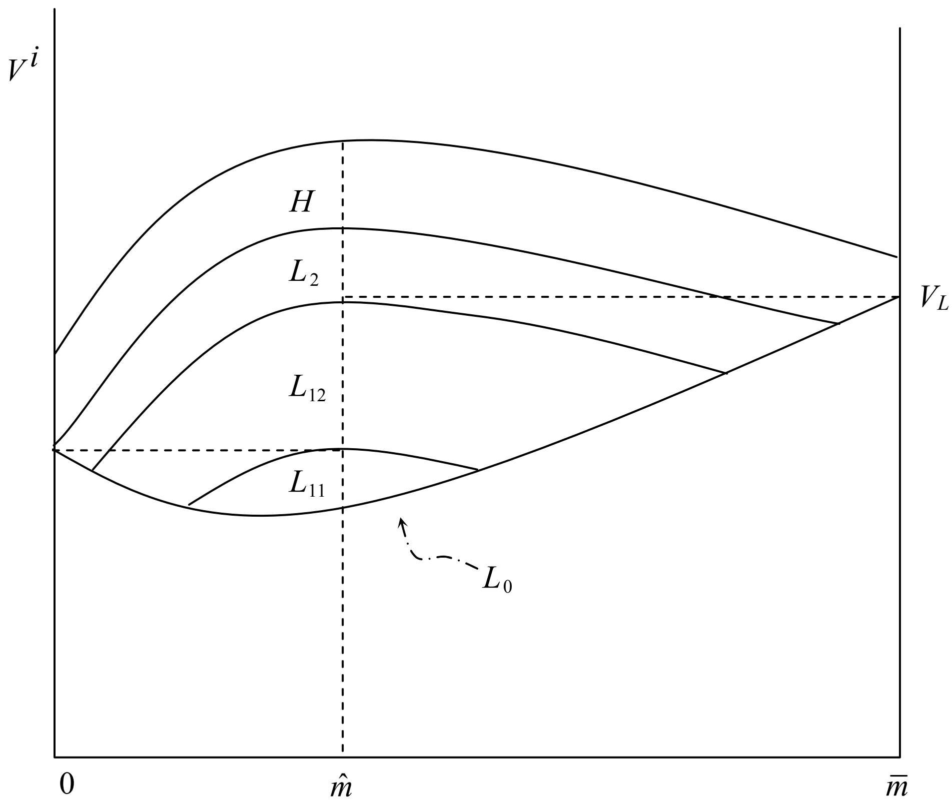
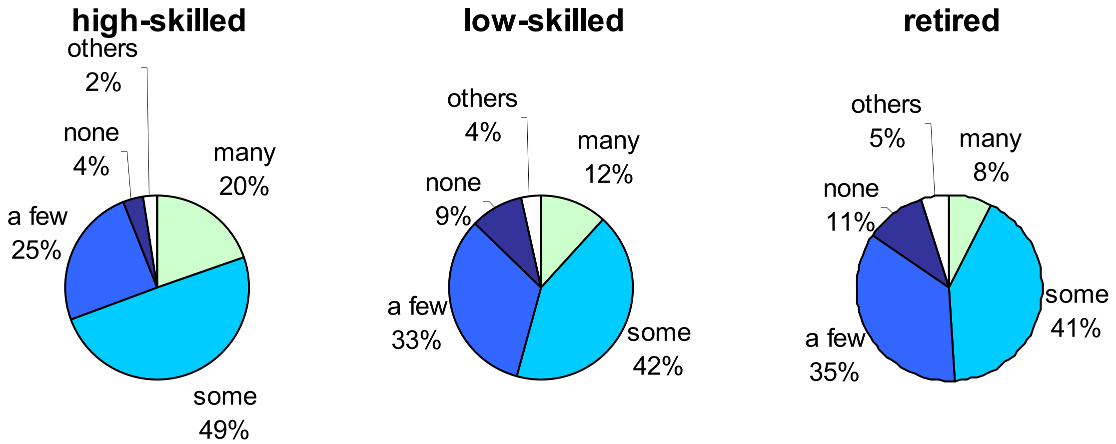
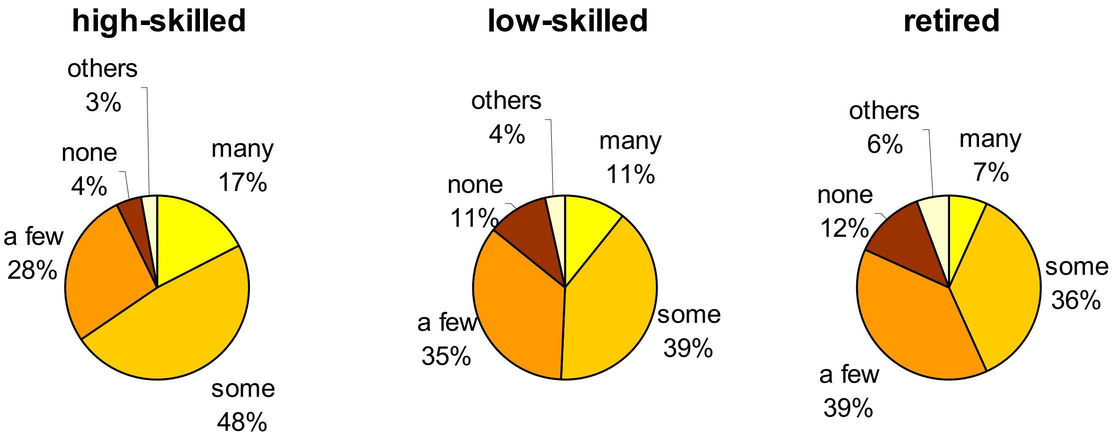


FIGURE 6. UTILITIES OF WORKERS WITH DIFFERENT COSTS OF SKILL ACQUISITION OVER PERMANENT IMMIGRATION POLICY

WHEN $V_L(\hat{m}) < V_L(0) < V_L(\overline{m})$



(a) From poorer European countries



(b) From poorer non-European countries

FIGURE 7. TO WHAT EXTENT DO YOU THINK YOUR COUNTRY SHOULD ALLOW PEOPLE FROM POORER COUNTRIES TO COME AND LIVE?

Source: European Social Survey 2002/03, edition 4.1, (http://ess.nsd.uib.no), Accessed: 10 June 2004

NB: 31,515 individual responses from Austria, Belgium, Denmark, Finland, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom are represented in the charts. Both population and design weights are applied to each response as recommended by the ESS project team. The category "others" includes no response, the responses "refusal to answer" and "don't know". The categories "high-skilled" and "low-skilled" consist of the non-retired respondents. The latter is defined as those whose highest level of education is upper secondary or lower than that, and the former's education level is higher than that. Neglecting the weights, the retired group consists of 21.5 percent of the sample. 83.7 percent of retirees are low-skilled. 71.3 percent of non-retirees are low-skilled.