Mobility and Social Identity

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Abstract. We analyze a model with migration and endogenous social identities where individuals can migrate between different countries and can choose either a national or a class identity. Individuals choosing their social identity face a tradeoff between status and cognitive distance. We prove existence of an equilibrium and explore its structure. The model provides a foundation of standard models of labor mobility that exogenously assume the existence of (exogenous or endogenous) migration costs and the resulting patterns of externalities. In addition it allows to better understand the impact of migration on social identities.

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1 Introduction

Goldin and Reikert (2006) estimate that about 11 million or 1 in 600 individuals migrate each year. In total, about 175 million people or 2,9% of the world population lived outside their country of birth in 2000 (Facchini and Mayda 2008). The international organization for Migration predicts that the number of migrants will approach 250 million by the year 2050 (ILO, IOM and OHCHR 2001).

Traditional economic theory focusses attention on economic forces like income disparities between countries to explain migration and lobor mobility. This focus on narrow economic factors is in sharp contrast to the political debate[1] and the debate in other social sciences that discuss migration in the context of the social identities of migrants and residents of the host countries, xenophobia, or nationalism.[2] The 1990s and 2000s have witnessed major surge in anti-immigrant xenophobia, and parts of the media and some politicians have played upon public anxieties about the dangers of 'swamping', even though migration levels have not been as high as they were in the 1950s and 1960s. According to the UNESCO[3] *"Two causes are put forward to explain the resurgence of xenophobic and racist movements towards the end of the twentieth century. The first cause is new migration patterns that have developed as an effect of the gradual internationalisation of the labour market during the postcolonial era. [...] This cultivated a social and political climate that generated xenophobia and [...] nationalism [...]. The second cause believed to reinforce xenophobia and racism is globalisation."*

Facchini and Mayda (2008) analyze attitudes towards immigrants. They find that voters in all countries are more or less hostile to immigration. This findings is independent of whether the country is a net-immigration or a net-emigration country. In a standard model that focusses on economic factors like income, those groups who profit from migration in the sense of increased income should favor immigration or should migrate, respectively. For example in the case of two skill groups, high and low, high-skilled individuals should favor immigration if both skill groups are complementary and the "average" immigrant has below-average skills. By the same token, low-skilled individuals should favor immigration if the "average" immi-

[1] See for example ILO, IOM and OHCHR 2001.

[2] See for example Brubaker 2004, Portes and Borocz 1989, Joppke 2005, Wimmer 2002.

[3] See http://portal.unesco.org

grant has above-average skills. Hence, if the decisive voter is low-skilled, she should oppose the immigration of low-skilled and promote the immigration of high-skilled individuals. The universal reluctance to accept further immigration is therefore not consistent with the hypothesis that individuals follow their narrow economic interest when it comes to migration and labor mobility. Facchini and Mayda (2008) stress that their findings imply that non-economic factors most probably play a major role in explaining the preferenes for migration.

Nationalism and heterophobia rely on individuals that do not necessarily perceive each other as individuals but as members of well-defined and distinct social groups. Recent empirical, experimental as well as theoretical research indicates that this is in fact the case in a number of choice problems (Tajfel 1978). It has been repeatedly demonstrated that this social identity of an individual has important behavioral consequences.[4] Hence, the social identity of individuals may be of importance for the explanation of migration and international labor mobility, and migration may influence the social identities of individuals.

The concept of social identities is well established in social psychology. An important example is the so-called social-identity theory developed by Tajfel and Turner, among others (Tajfel, Billig, Bundy and Flament 1971, Tajfel and Turner 1979, Turner, Hogg, Oakes, Reicher and Wetherell 1987). According to this approach, individual behavior in a number of situations cannot be adequately understood if the individual is seen in isolation.[5] Individuals that are confronted with identical formal institutions ("rules of the game" in the sense of North (1990)) may act differently, depending on the social context. It is one of the most important results in this literature that the creation of a so called minimum-group situation where individuals are randomly assigned to groups according to arbitrary markers is sufficient to create

[4]For more recent studies see Buchan, Johnson, and Croson 2006, Eckel and Grossman 2005, Goette, Hufman, and Meier 2006, Gueth, Ploner and Regner 2008, McLeish and Oxoby 2007. For a comprehensive survey see Shayo 2009.

[5]In a game-theoretic model, Basu (2005) shows how a sense of identity can emerge out of arbitrary markers of social distinction that may have no innate significance, which can be interpreted as a theoretical foundation for the behavioral consequences of the minimum-group situation. Benabou and Tirole (2007) develop a cognitive model that helps explaining the formation of an individual identity as a problem of intra-individual opportunity costs. Fang and Loury (2004) develop a theory of identity as a specific expression of the individual's past. Multiple equilibria may lead to Pareto dominated (dysfunctional) group identities.

identification with the members of this group and antagonism towards members of other groups. The effect even holds if the participants know that they are randomly matched.[6]

Akerlof and Kranton (2000, 2005) have been very influential in establishing the recent trend to analyze the impact of social identities on individual behavior. They argue that the identity of a person, i.e., the perceived sense of an individual's self, influences its behavior. Identification with a group implies the adoption of certain group-specific rules that influence behavior. This adoption can help to overcome or at least mitigate incentive problems in organizations, especially in situations where the complexity of the task is so large that explicit incentive mechanisms and contracts would only work poorly. In these situations a sense of identification with the norms of the organization is the only means to internalize potential externalities. This approach is in line with Iannaccone (1988) and Coleman (1990) who see social norms as results of group-level optimization and Glaeser, Laibson, and Sacerdote (2002) who extend human-capital theory to investments in social skills and social interactions. Institutional economics started with the study of formal institutions but led to an inclusion of informal ones, and group-identification is one of them (Guiso, Sapienza and Zingales 2006).

The approach by Akerlof and Kranton is incomplete in two respects. First, social-identity theory stresses that the identity of a person has two effects, it may create affiliation towards individuals sharing the same identity, and it may create antagonism towards individuals with a different identity. Second, it is not explained why

[6]A number of experimental studies has challenged the minimum-group paradigm with mixed evidence so far. Charnes, Rigotti, and Rustichini (2007) were able to show that group membership has a significant effect on individual behavior, but that the minimum-group situation is not sufficient to generate the effect. Group membership rather has to be salient in order to induce its behavioral consequences. Buchan, Johnson, and Croson (2006) show that arbitrary symbols with cheap talk matter for American but not for Chinese players in trust games. Gueth, Levati, and Ploner (2008) show that arbitrary symbols without cheap talk do not matter in trust games. Chaserant (2006), on the contrary, shows that group identity and gender makes a strong difference in ultimatum games, even in a minimum-group situation. Eckel and Grossman (2006), on the other hand, show that a minimum-group situation is not sufficient to create behavioral effects in public-goods team production but that arbitrary goals that have to be achieved prior to production do the job. Goette, Huffman, and Meier (2006) perform PD experiments with swiss-army officers during a four-week period of training. They show that an arbitrary assignment to platoons matters for the feeling of identity and has long-term behavioral effects.

individuals identify with specific attributes and not with others. Every individual has a large number of 'markers' that create a specific identity (sex, religion, nationality, ethnicity, social class,...). In a pathbreaking paper, Shayo (2007, 2009) has closed these gaps. He has developed a theory of individual behavior with endogenous group identities that is based on a tradeoff between group-status and perceived distance between the individual and the group. According to this view, individuals tend to identify with high-status groups, but only if their perceived difference between certain attributes of the individual and the group is sufficiently small. This model unifies a large class of behavioral findings ranging from status preferences and conformity to inequality aversion and it is sufficiently tractable to be applied in different contexts (Shayo 2009, Klor and Shayo 2007, Lindqvist and Östling 2007).

We will use this theory and apply it to the problem of international labor mobility in order to better understand the impact of social identities on mobility and the influence of migration and the implied increase in national diversity on individual self perception. One question that we are able to ask is whether there is a link between the resurgence of patriotic or nationalistic values and globalization.

The standard workhorse model of migration and labor mobility assumes that labor is unrestrictedly and costlessly mobile (e.g. Ginsburgh, Papageorgiou, and Thisse 1985 and Myers 1990). Wildasin (2000) examines the degree of labor mobility in the European Union and concludes that while labor mobility is in fact substantial, it is too low to be compatible with the assumption of unrestricted and costless mobility. A way out of this anomaly is to introduce exogenous mobility costs (Sjaastad 1962). Hercowitz and Pines, 1991, and Myers and Papageorgiou, 1997, introduce a fixed cost of migration, whereas Mansoorian and Myers, 1993, and Hindriks, 1999, 2001 assume that migration costs are proportional to the migration distance.[7]

The introduction of mobility costs restricts migration, which allows it to dissolve the anomaly of models with unrestricted mobility. However, a shortcoming of this literature is that it does not focus on the sources of these transaction costs. Part of these costs are of course the costs of physically moving to another location, but there are other, less tangible sources that have to do with a (temporarily) loss of friends

[7]Guggenberger, Kaul and Kolmar (2002) assume that individuals are mobile in an exogenously given area around their 'location' and immobile elsewhere, which allows for a geographic interpretation in the narrow sense as well as for a more general interpretation including for example region-specific human capital.

and neighbors, the need to adopt cultuarlly to the new environment, and the challenging of the social identity of an individual. These sources of migration costs are specific in at least two important respects. First, they are endogenous with respect to the number emigrants. If a substantial number of people from the same destination country emigrates to the same host country, it is relatively easy to continue living in an environment that does not change much, which should reduce migration costs at least to some extend. Carrington, Detragiache, and Vishwanath (1996) endogenize migration costs by the introduction of network externalities: moving costs decrease in the number of migrants already settled in the destination.[8] Second, emigration from one country means immigration into another. If one agrees that there are cultural sources of migration costs, these costs cut both ways in the sense that the host country's population may also be affected by immigration, large-scale immigration weakens netwerk externalities among the natives because they are also confronted with and have to adopt to new social norms, languages, etc, and it may have an impact on the self-perception of both, natives and immigrants. Depending on whether multiculturalism is perceived as a virtue or a vice, there are utility gains or costs in the host countries' population. To our knowledge this type of externality has not been analyzed in the literature so far.

We develop a model of international migration that includes social identites of the individuals. In order to do so we merge a model of international labor mobility with the social-identity model by Shayo (2007, 2009). The contribution of this paper is twofold. We first develop a tractable model of labor mobility with endogenous social identities (Section 2). Then with prove existence of an equilibrium. Existence cannot be taken for granted because the Shayo model of endogenous social identites has some structural properties that make it impossible to apply standard fixed-point arguments when blended with a multi-country model with labor mobility. We show in a general model with a finite set of countries and a finite set of qualifications of individuals that under a weak condition on labor mobility (namely that in every group of individuals there is a strictly positive but arbitrarily small mass of individuals that is immobile) the existence of an equilibrium can be guaranteed (Section 3). Second we explore the structure of equilibria for the special case of two countries and two qualifications or skill levels. We proceed in three steps. We first analyze a social-identity equilibrium in a situation of autarky. This section allows it to connect

[8] Epstein (2008) complements this argument by introducing information cascades.

our model to the model of Shayo (2007, 2009). Second, we study the structure of migration equilibria if social identities are fixed (Section 4). This section builds a bridge to the standard models of labor mobility mentioned before. Third we analyze the effects of migration on identities. We start with a partial analysis of the impact of exogenous emigration and immigration on the identities in a country. We continue with an analysis of the structure of an equilibrium where both, migration and social identites are simulteneously determined. Section 5 concludes.

2 The Model

Given a finite set of countries, C, which is also the set of nationalities, and a set of qualifications Q. The interval $[0, N_{i,k}] \subset \mathbb{R}$, with a fixed $N_{i,k} > 0$, shall represent the continuum of individuals with nationality $i \in C$ and qualification $k \in Q$. Furthermore, we suppose that for each $(i, k, c) \in C \times Q \times C$ there is a number of individuals, $\bar{n}_{i,k,c} \in [0, N_{i,k}]$, who are perfectly immobile. This assumption is purely technical and allows it to establish the existence of an equilibrium. We do not have to further specify the number of immobile individuals when we prove existence. However, when we study the structure of an equilibrium we interpret the number of immobile individuals as being arbitrarily small, $\bar{n}_{i,k,c} > 0, \bar{n}_{i,k,c} \to 0$.

Let $f_k : [0, \sum_{i \in C} N_{i,k}] \to (0, \infty)$ be the payoff function for individuals with qualification $k \in Q$. It measures the material payoff (income). We assume that $f'_k < 0$, $\lim_{k \to 0} f'_k = \infty$.[9]

Definition 2.1 (Distribution of Individuals)**.** A vector

$$n \in D^* := \mathbb{R}^{\#C \times \#Q \times \#C} \text{ with } n = (n_{i,k,c})_{i \in C, k \in Q, c \in C}$$

is called a *distribution of individuals*, iff

$$\forall i \in C, k \in Q : \sum_{c \in C} n_{i,k,c} = N_{i,k} \text{ and } \forall i \in C, k \in Q, c \in C : n_{i,k,c} \geq \bar{n}_{i,k,c} \geq 0$$

hold. The set of distributions of individuals is denoted by D.

[9]This payoff function can be thought of as a reduced form for the wage rate received on a competitive labor market where wages are determined by the marginal productivity of labor with a production function with decreasing marginal productivity of labor.

Given a distribution of individuals $n \in D$, the number of individuals with nationality $i \in C$ and qualification $k \in Q$ in location $c \in C$ is denoted by $n_{i,k,c}$. Define

- the number of individuals with qualification $k \in \mathcal{Q}$ in location $l \in \mathcal{C}$ as $n_{\mathcal{N},k,c} := \sum_{i \in \mathcal{N}} n_{i,k,c}$,
- the number of individuals with nationality $i \in \mathcal{N}$ in location $c \in \mathcal{C}$ as $n_{i,\mathcal{Q},c} := \sum_{k \in \mathcal{Q}} n_{i,k,c}$,
- and the number of individuals with nationality $i \in \mathcal{N}$ and qualification $k \in \mathcal{Q}$ as $n_{i,k,\mathcal{C}} := \sum_{c \in \mathcal{C}} n_{i,k,c}$.

2.1 Groups of Identification

Following Shayo (2009), each individual has a set of attributes that determines its possible social identities. If an individual identifies with a certain attribute, a group and a reference group with which the group members compare themselves is determined. The following definitions make this intuition precise.

Definition 2.2 (Group)**.** Given a distribution $n \in D$ the set of groups for n is given by $G(n) := \{g \in D^* \backslash \{0\} \mid \forall t \in C \times Q \times C : g_t = 0 \vee g_t = n_t\}$. Then $g \in G(n)$ is called a *group*.

Definition 2.3 (Identity)**.** A continuous mapping $p : D \mapsto D^* \times D^*, n \longmapsto (g, r_g) \in G(n) \times G(n)$ is called an *identity*. It determines a group $g \in G(n)$ and its reference group $r_g \in G(n)$. Then for each individual of type $t \in C \times Q \times C$ there is a finite set I_t of such mappings called its set of possible identities.

We assume that an individual of type $(i, k, c) \in C \times Q \times C$ has the choice between two possible identities, i.e. two groups to identify with. First, its group of qualification in its location, $g^Q \in G(n)$, given by

$$g^Q_{j,q,d} := \begin{cases} n_{j,q,d} & , \text{if } (q,d) = (k,c) \\ 0 & , \text{otherwise} \end{cases} .$$

Second, the residents of its country of origin, $g^C \in G(n)$, given by

$$g^C_{j,q,d} := \begin{cases} n_{j,q,d} & , \text{if } d = i \\ 0 & , \text{otherwise} \end{cases} .$$

We denote these identities as $Q_{i,k,c}$ and $C_{i,k,c}$, respectively, and the individual's set of identities $I_{i,k,c}$ is then given by $I_{i,k,c} := \{Q_{i,k,c}, C_{i,k,c}\}$. An identity based on the group of individuals with identical qualification is called a *class identity*, and an identity based on the group of individuals living in acountry is called a *national identity*.[10]

2.2 Utility

We use Shayo's (2009) model of social identities that explains the choice of identities as a result of the tradeoff between group status and perceived distance between individual and group characteristics. Therefore, the utility functions of the individuals have three arguments, material payoffs as in standard choice theories, status from identifying with a group, and cognitive costs resulting from differences between group and individual attributes. We will define the three arguments in turn.

Definition 2.4 (Material payoff)**.** Given a distribution of individuals, $n \in D$, for an individual with nationality $i \in C$ and qualification $k \in Q$ in location $c \in C$ its material payoff, $y_{i,k,c}(n)$, is given by the qualification specific payoff in location $c \in C$, $y_{k,c}(n) := f_k(\sum_{j \in C} n_{j,k,c})$, i.e. $y_{i,k,c}(n) := y_{k,c}(n)$.

Definition 2.5 (Average payoff)**.** Given a distribution of individuals, $n \in D$, and a group of individuals, $g \in G(n)$, the average payoff of that group is given by

$$\bar{y}(g, n) := \sum_{t \in C \times Q \times C} \frac{g_t \cdot y_t(n)}{\sum_{s \in C \times Q \times C} g_s}.$$

Group status depends on a comparison of attributes of the group an individual identifies with and its reference group.

Definition 2.6 (Status)**.** Given a group of individuals g and the group's reference group r_g the status of group g is given by a function

$$s : D^* \times D^* \times D \to \mathbb{R}, (g, r_g, n) \longmapsto s(g, r_g, n)$$

[10]The reference group of an individual with a national identity could alternatively be the group of individuals with identical nationality, irrespective of whether these individuals live at home or abroad. The alternative concept that is based on the territory of a country seems to be more plausible to us because individuals seem to focus attention on the economic perormance within a given territory. The alternative specification would be slightly more complicated but would lead to similar results.

that is continuous on $D^* \times D^* \times D$.

The above definition is sufficient to prove existence of an equilibrium. We will use a more specific functional form when we explore properties of an equilibrium. Status will then depend on a comparison between the average income of the group g an individual identifies with, $\bar{y}(g,n)$, and the average income of the reference group r_g, $\bar{y}(r_g,n)$. Status is a function of $dy(g,r_g,n) =: \bar{y}(g,n) - \bar{y}(r_g,n)$, s is twice continuously differentiable, $s[0] = 0$, and $s'[.] > 0$.

The perceived distance between an individual and the group an individual identifies with depends on two factors, a comparison of the average group income and the individual income, and the national fragmentation of the group.

Definition 2.7 (Mass of foreigners)**.** Given a distribution of individuals, $n \in D$, a group of individuals, $g \in G(n)$, and a group member of type $(i,k,c) \in C \times Q \times C$. The mass of foreigners is given by $g_{-i} := \sum_{s \in C \setminus i \times Q \times C} g_s$.

Definition 2.8 (Distance)**.** The distance of an individual of type $(i,k,c) \in C \times Q \times C$ to a group g is given by $d_{i,k,c}(g,n) := d_1(g,n) + \delta \cdot d_2(g,n)$, with $\delta \in \{0,1\}$. $d_1 : \mathbb{R} \to \mathbb{R}$ is a mapping from $dy(m,g(m)) =: \bar{y}(g,n) - y_{i,k,n}(n)$ with the following properties: d_1 is twice continuously differentiable, $d_1[x] = d_1[-x]$, $d_1(0) = 0$, and $d_1'(x) > 0$ if $x > 0$, $d_1''(.) \geq 0$. $d_2 : R^2 \to R$ of g_{-i} and g_i with the following properties: d_2 is homogenous of degree zero, twice continuously differentiable in both variables, $d_2(g_{-i},0) = 0$, $\partial d_2 / \partial \bar{g}_{-i} > 0$, and $\partial d_2 / \partial g_i \leq 0$ with $\partial d_2(g_{-i},0)/\partial g_i = 0$.

In sum the preferences of an individual of type $(i,k,c) \in C \times Q \times C$ with group of identification g can be represented by a utility function

$$u_{i,k,c}(g,n) = \tilde{u}\left(y_{i,k,c}(g,n), s(g,n), d_{i,k,c}(g,n)\right),$$

where $\tilde{u}$ is continuous and additively separable in $y_{i,k,c}$, s, and $d_{i,k,c}$. We call preferences with $\delta = 1$ *heterophobic* in the following because in this case individuals dislike groups mixed with foreigners.[11]

[11] We use the term heterophobia instead of, for example, xenophobia because it allows for a more diverse interpretation of the sources that lead to aversion towards foreigners, for example network effects in groups with similar national or ethnic background (a common language). The strength of these network effects depend on the national, cultural and/or ethnic fragmentation of the reference group.

2.3 Equilibrium

We can distinguish between three types of equilibria in this model, a migration equilibrium for given social identities, a social-identity equilibrium for given a distribution of the population, and an equilibrium where both, social identities and migration is endogenously determined. The following definitions capture these concepts.

Definition 2.9 (Migration Equilibrium)**.** A *migration equlibrium* is a distribution of individuals $n \in D$ such that for all $(i, k, c) \in C \times Q \times C$, with $n_{i,k,c} > \bar{n}_{i,k,c}$, given an identity, $p_{i,k,c}$,

$$\forall d \in C : u_{i,k,c}(p_{i,k,c}(n), n) \geq u_{i,k,d}(p_{i,k,d}(n), n) \text{ holds.}$$

Definition 2.10 (Social-Identity Equilibrium)**.** A *social identity equilibrium* is a sequence of identities $(p_t)_{t \in C \times Q \times C}$ such that, for a given distribution of individuals $n \in D$,

$$\forall t \in C \times Q \times C \forall m \in I_t : u_t(p_t(n), n) \geq u_t(m(n), n).$$

Definition 2.11 (Equilibrium)**.** An *equilibrium* is a distribution of individuals $n \in D$ and a sequence of identities $(p_t)_{t \in C \times Q \times C}$, such that n is a migration equilibrium and (p_t) is a social identity equilibrium.

3 Existence of Equilibrium

Ginsburgh, Papageorgiou, and Thisse (1985) have proved that a migration equilibrium exists if individuals have standard preferences. This proof does not apply to our problem for two reasons. First, social identities constitute a discrete-choice problem. Second, the cognitive distance $d_{i,k,c}(g, n) = d_1(g, n) + \delta \cdot d_2(g, n)$ depends on average payoffs and groups that may not be well defined if the population converges to zero in a country if individuals can freely migrate. We solve this latter problem with the assumption of a perfectly immobile segment. The proof of the following theorem can be found in the appendix.

Theorem 1. *There is a distribution, $n \in D$, and a sequence of identities, $p = (p_t)_{t \in C \times Q \times C}$, such that, given p, n is a migration equilibrium and, given n, p is a social identity equilibrium.*

4 Properties of an equilibrium

In this section we explore the properties of a social-identity equilibrium for given distributions of individuals, of a migration equilibrium for given social identities of the individuals, and of an equilibrium with simultaneously chosen identities and places of residence. In order to do so we will restrict attention to a special case with two countries and two nationalities, a and b, and two levels of qualification (which we will also refer to as *classes* in the following), h and l.

Given the simplifying assumption that status $s[.]$ depends on income differences between the status and the reference group made in this section, there always exists a perfectly symmetric equilibrium (PSE) of the form $n_{a,l,a} = n_{a,l,b} = n_{b,l,a} = n_{b,l,b}$, $n_{a,h,a} = n_{a,h,b} = n_{b,h,a} = n_{b,h,b}$. This allocation equalizes payoffs of the same skill group across countries and thereby leads to identitcal average payoffs. In addition it creates identical population structures in both countries, $n_{a,l,a} + n_{b,l,a} = n_{b,l,b} + n_{a,l,b}$, $n_{a,h,a} + n_{b,h,a} = n_{b,h,b} + n_{a,h,b}$, $n_{a,l,a} + n_{b,l,a} + n_{a,h,a} + n_{b,h,a} = n_{b,l,b} + n_{a,l,b} + n_{b,h,b} + n_{a,h,b}$, which implies that individuals with heterophobic preferences cannot improve their utility by migrating to another country. This equilibrium is similar in sprit to a perfectly ordered neighborhood in Shelling's (1971) model of segregation. If one thinks of migration as a dynamic process, however, it is unclear if this equilibrium can be reached from a situation of autarky because it requires cross-migration between countries and a coordination on an equal population structure, a problem that most likely can only be solved by a central planner. If one thinks of migration as a spontaneous and dynamic process, it is more natural to look for equilibria with minimum migration from one country to another. A given tuple of payoffs $\{y_{a,l}, y_{b,l}, y_{a,h}, y_{b,h}\}$ can be generated by a continuous number of population distributions. For simplicity we assume that there are no emigrants in a situation of autarky, $n_{b,l,a} = 0$, $n_{a,l,b} = 0$, $n_{b,h,a} = 0$, $n_{a,h,b} = 0$.

Definition 4.1. A *minimum-migration allocation* (MMA) for payoffs $y = \{y_{a,l}, y_{b,l}, y_{a,h}, y_{b,h}\}$ is an allocation $n^{mma} \in \arg\min_{n \in D^*}(n_{b,l,a} + n_{a,l,b} + n_{b,h,a} + n_{a,h,b})$ such that n generates y.

We will focus on this type of allocations in the following, bearing in mind that a PSE exists as well. The following lemma will turn out to be useful in the following.

Lemma 1. *There cannot be positive migration from a to b and from b to a within the same skill group in a MMA,* $n_{b,k,a} > 0 \Rightarrow n_{a,k,b} = 0 \vee n_{a,k,b} > 0 \Rightarrow n_{b,k,a}$, $k = l, h$.

Proof. Assume not and denote the allocation of labor by $n' \in D^*$. The resulting payoffs are denoted by y'. Assume there is cross migration in group k. The payoffs of this group are equal to $f_k(n'_{a,k,a}+n'_{b,k,a})$, $f_k(n'_{b,k,b}+n'_{a,k,b})$. A reallocation $n'' \in D^*$ with associated payoffs y'' such that $n''_{a,k,a} = n'_{a,k,a} + \epsilon$, $n''_{b,k,a} = n'_{b,k,a} - \epsilon$, $n''_{b,k,b} = n'_{b,k,b} + \epsilon$, $n''_{a,k,b} = n'_{a,k,b} - \epsilon$, $\epsilon > 0$ is admissible and leads to the same payoffs, $y' = y''$. At the same time it reduces total migration, a contradiction. □

Please note that the restriction to MMA is not restrictive in the sense that it may be in conflict with the existence of an equilibrium. For example, PSE may be consistent with MMA if the equilibrium is unique. However, it allows it to solve the equilibrium-selection problem in a situation with multiple equilibria.

We assume that the income of an h-type individual exceeds the income of an l-type individual in autarky and make the following assumption:

Assumption 1. $y_{i,l} < y_{i,h}$ *in a migration equilibrium.*

This assumption guarantees that the material payoffs of the h- and l-types do not reverse when individuals migrate.[12] In addition we assume that b is the country with the larger income inequality, $y_{b,h} > y_{a,h} > y_{a,l} > y_{b,l}$, and the (weakly) higher average income, $\bar{y}(b) \geq \bar{y}(a)$. h-type individuals are a (weak) minority in the national (and therefore also in the total) population, $n_{i,h} \leq n_{i,l}, i = a, b$. The set of possible identities of an individual is either its class or its nationality, and the reference group of an individual with class identity working in a given country is the other class in this country, whereas the reference group of an individual with national identity is the population of the other country.

4.1 Autarky

In this section we determine the benchmark case without international mobility, which implies that individuals can only choose their social identities. This benchmark is helpful in order to be able to determine the impact of mobility on social identities and to relate our paper to Shayo (2007, 2009). We assume $n_{i,k,c} = 0$ if $i \neq c$, $k = h, l$ in autarky. Denote by $dy_i =: y_{i,h,i} - y_{i,l,i}$ the income difference and by

[12] With a more complicated notation but without any substantial additional insight this condition could also be stated in terms of the primitives of the model.

$\lambda_i =: n_{i,h,i}/(n_{i,h,i} + n_{i,l,i})$ the fraction of high skilled individuals in country i. The equilibrium of this game boils down to a social-identity equilibrium which has the following properties.

Proposition 1. *Assume that individuals choose a national identity in case of indifference. (1) If both countries have identical average incomes, $\bar{y}(a) = \bar{y}(b)$, h-type individuals never identify with their country, whereas l-type individuals identify with their country iff*

$$s[-dy(i)] \geq -d_1[\lambda_i dy(i)] \leq 0.$$

(2) If both countries differ in their average incomes, (i) the h-types in country b identify with their country iff

$$s[dy(b)] - s[\bar{y}(b) - \bar{y}(a)] + d_1[-(1-\lambda_b)dy(b)] \leq 0.$$

(ii) h-types in country a never identify with their country. (iii) l-types in country $i = a, b$ identify with their country iff

$$s[-dy(i)] - s[\bar{y}(i) - \bar{y}(-i)] + d_1[\lambda_i dy_i] \leq 0.$$

(iv) If low-skilled are in a majority in country b, high-skilled identify with their class if low-skilled identify with their class, and low-skilled identify with their nation if high-skilled identify with their nation.

Proof. Denote by Δ_i^k the utility difference between a national and a class identity of an individual with qualification k and nationality i. It is straightforward to show that the utility differences between a class and a national identity are as follows:

$$\Delta_i^k \leq 0 \Leftrightarrow s[y_{i,k,i} - y_{i,-k,i}] - s[\bar{y}(i) - \bar{y}(-i)] + d_1[\bar{y}(i) - y_{i,k,i}] \leq 0. \tag{1}$$

(1) With $\bar{y}(a) = \bar{y}(b)$ the second term of the above inequality cancels. It is then obvious that the utility difference for the h-types is always negative. For an l-type individual we can use the information that $\bar{y}(i) = \tilde{\lambda}_i y_{i,l,i} + (1-\tilde{\lambda}_i) y_{i,h,i}$. Inserting this condition into the above inequality and simplifying leads to $s[-dy_i] \geq -d_1[\lambda_i dy_i] \leq 0$.

(2) All three terms in (1) are positive for an h-type in country a, which immediately proves part (ii). The second term is negative for an h-type in country b, which implies that the inequality can be fulfilled if the difference between both countries'

average incomes overcompensates the difference between income levels in country a, corrected by the increased distance perceived by a national identity. This proves part (i). Part (iii) follows directly from (1). To prove part (iv) compare Δ_b^h and Δ_b^l,

$$\begin{aligned} \Delta_b^h &= s[dy_b] - s[\bar{y}(b) - \bar{y}(a)] + d_1[-(1-\lambda_b)dy_b], \\ \Delta_b^l &= s[-dy_b] - s[\bar{y}(b) - \bar{y}(a)] + d_1[\lambda_b dy_b]. \end{aligned}$$

A comparison of $d_1[-(1-\lambda_b)dy_b]$ with $d_1[\lambda_b dy_b]$ yields, using $d_1[x] = d_1[-x]$, $d_1[-(1-\lambda_b)dy_b] > d_1[\lambda_b dy_b] \Leftrightarrow (1-\lambda_b)dy_b > \lambda_b dy_b \Leftrightarrow (1-\lambda_b) > \lambda_b \Leftrightarrow \lambda_b < 1/2$, which is always fulfilled, given that l-types are a majority. It follows that the first and third terms are larger for the h-type, whereas the second term is identical in the above conditions. It follows that $\Delta_b^l > 0 \Rightarrow \Delta_b^h > 0$ and $\Delta_b^h < 0 \Rightarrow \Delta_b^l < 0$. □

Part 1 of the proposition is similar to Shayo (2007, Proposition 3), who has demonstrated that it is the group with below-average income that is potentially attracted by a national identity, whereas the group with above-average income always identifies with their social class. The l-types gain in status compared to their class identity by identifying with their country. If this increase in relative status is larger than the increase in cognitive distance resulting from their comparison with the national average income, a national identity is their dominant choice. On the contrary, h-type individuals lose status and increase their cognitive distance if they identify with their country.

Part 2 of the proposition shows that this clear-cut intuition does not necessarily carry over to the case of countries with different average incomes. Whereas the intuition remains intact for the poor country (in the sense of average incomes), it need not be true for the rich. Both, l- and h-type individuals may find it optimal to identify with their country. Ceteris paribus, the status gain of the l-type individuals is larger than the status gain of the h-type individuals. However, the cognitive costs depend on the relative group size. If the fraction of h-type individuals is relatively large, their cognitive costs of a national identity are relatively small, contrary to the cognitive costs of an l-type individual. As a consequence, all patterns of identities can emerge in the rich country.

4.2 Mobility with given identities

There are four factors that influence the incentives of the individuals to migrate for given identities of the individuals.

1. Differences in income between countries.
2. Differences in relative status because of differences in income.
3. Differences in the cognitive distance to the group with shared identity based on differences in income.
4. Differences in the cognitive distance to the group with shared identity based on differences in the fraction of individuals of different nationality in the country of residence.

The first two factors are unambiguously push factors because they induce emigration if income abroad is higher than at home. The effects of the third and fourth factor are ambiguous in general. A higher foreign income reduces the cognitive distance if the distance between average income of the reference group and foreign income is smaller than the distance between average income of the reference group and income abroad. In this case the first source of cognitive distance ($d_1[.]$) is a push factor, otherwise not. With small numbers of emigrants, cognitive distance based on the national composition of the reference groups ($d_2[.]$) is a pull factor. However, this effect can be reversed as soon as the number of emigrants and immigrants becomes substantial.

We start the characterization of migration equilibria by anchoring our model in the standard literature on labor mobility.

Proposition 2. *Without social identities individuals migrate until the marginal productivities of both groups are equalized between countries.*

Proof. Without any motive to identify with its class or nation, individuals maximize income $y_{i,k,j}, i = a, b, k = h, l$ by the choice of a country of residence, $j = a, b$. Given that no other impediments to mobility exist, individuals will migrate if $y_{a,k} \neq y_{b,k}, k = h, l$. On the other hand, if $y_{a,k} = y_{b,k}, k = h, l$ no individual has an incentive to migrate to another country. □

This equilibrium is also production efficient (as well as Pareto efficient with standard preferences).

4.2.1 Both groups have a class identity

Class identities can have an ambiguous effect on mobility. Given that only those groups will migrate that can increase their income, migration will c.p. also result in an increase in relative status. This effect bolsters the incentive to migrate. On the other hand, migration changes the composition of the reference group, and this effect is negative as long as emigrants of the same class remain a minority abroad. The next proposition shows how these effects interact.

Proposition 3. *Assume that both groups have a class identity in both countries. (1) If preferences are non-heterophobic, $\delta = 0$, the productivities of each group are equalized in a MME, $y_{h,a} = y_{h,b}, y_{l,a} = y_{l,b}$. (2) If preferences are heterophobic, $\delta = 1$, migration within each group is always from the low- to the high-productivity country. The productivity of the immigration country always exceeds the productivity of the emigration country in a MME.*

Proof. Denote by $\Delta_k^{i,-i}$ the difference in utility of an individual of nationality i with qualification k living in country $-i$. (1) If $\delta = 0$ it is equal to $\Delta_k^{i,-i} = (y_{i,k} - y_{-i,k}) - d_1[\bar{y}_{i,k} - y_{i,k}] + d_1[\bar{y}_{-i,k} - y_{-i,k}] + s[y_{i,k} - y_{i,-k}] - s[y_{-i,k} - y_{-i,-k}] = (y_{i,k} - y_{-i,k}) + s[y_{i,k} - y_{i,-k}] - s[y_{-i,k} - y_{-i,-k}]$ because $\bar{y}_{i,k} = y_{i,k}$ etc.. If $y_{a,h} = y_{b,h}, y_{a,l} = y_{b,l}$, it is straightforward to see that $\Delta_k^{i,-i} = 0$ for all groups. In addition, $\Delta_l^{a,b} = -\Delta_l^{b,a}, \Delta_h^{a,b} = -\Delta_h^{b,a}$, which implies that $y_{a,h} = y_{b,h}, y_{a,l} = y_{b,l}$ is the only equilibrium. (2) If $\delta = 1$, and using again the fact that $\bar{y}_{i,k} = y_{i,k}$, utility differences become

$$\begin{aligned} \Delta_k^{i,-i} = & \quad (y_{i,k} - y_{-i,k}) + s[y_{i,k} - y_{i,-k}] - s[y_{-i,k} - y_{-i,-k}] \\ & + \quad d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, n_{-i,k,i}]. \end{aligned} \tag{2}$$

Denote by $\hat{y} = \{\hat{y}_{i,k}\}_{k \in Q, i \in N}$ the vector of income levels in autarky. At this point, (2) reduces to

$$\Delta_k^{i,-i} = (\hat{y}_{i,k} - \hat{y}_{-i,k}) + s[\hat{y}_{i,k} - \hat{y}_{i,-k}] - s[\hat{y}_{-i,k} - \hat{y}_{-i,-k}] + d_2[0, n_{-i,k}]$$

because $d_2[n_{i,k}, 0] = 0$. This condition may or may not be fulfilled, which implies that a degenerate migration equilibrium with no one actually migrating cannot be ruled out. Assume that migration occurs in equilibrium and assume that $y_{a,h} = y_{b,h}, y_{a,l} = y_{b,l}$. At this point, (2) reduces to

$$\Delta_k^{i,-i} = d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, n_{-i,k,i}].$$

We know that there can be no cross migration within the same skill group in an equilibrium that fulfills MMA and assume w.l.o.g. that high-skilled individuals migrate from a to b, whereas low-skilled individuals migrate from b to a. We get

$$\begin{aligned}\Delta_h^{a,b} &= d_2[n_{a,h,b}, n_{b,h}] - d_2[n_{a,h} - n_{a,h,b}, 0] = d_2[n_{a,h,b}, n_{b,h}] > 0,\\ \Delta_l^{b,a} &= d_2[n_{b,l,a}, n_{a,l}] - d_2[n_{b,l} - n_{b,l,a}, 0] = d_2[n_{b,l,a}, n_{a,l}] > 0,\end{aligned}$$

which implies that given the continuity of all functions this cannot be an equilibrium. Next it will be shown that there can be no overshooting in the sense that the immigrant country ends up with a smaller productivity than the emigration country. With overshooting (2) becomes

$$\begin{aligned}\Delta_k^{i,-i} = &\underbrace{(y_{i,k} - y_{-i,k})}_{>0} + \underbrace{s[y_{i,k} - y_{i,-k}] - s[y_{-i,k} - y_{-i,-k}]}_{>0}\\ &+ d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, n_{-i,k,i}],\end{aligned}$$

which implies that overshooting can only be fulfilled if $d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, 0]$ becomes negative. We already know that it is positive when productivities are equalized. In addition, in the extreme case when all individuals migrate, $d_2[n_{i,k}, n_{-i,k}] - d_2[0,0] = d_2[n_{i,k}, n_{-i,k}] > 0$. To complete the argument,

$$\begin{aligned}\frac{\partial(d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, 0])}{\partial n_{i,k,-i}} &= \frac{\partial d_2[n_{i,k,-i}, n_{-i,k,-i}]}{\partial n_{i,k,-i}} + \frac{\partial d_2[n_{i,k,i}, 0]}{\partial n_{i,k,-i}}\\ &= \frac{\partial d_2[n_{i,k,-i}, n_{-i,k,-i}]}{\partial n_{i,k,-i}} < 0\end{aligned}$$

is monotonic, which implies that $d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, 0]$ cannot become negative in an overshooting allocation.

□

We will discuss the relevance of Proposition 3 after (the qualitatively similar) Proposition 4.

4.2.2 Low-skilled have a national identity

In this part we analyze the structure of a migration equilibrium if the low-skilled individuals have a national identity. In order to do so it is useful to define by $\frac{n_{i,-i}}{n_{-i,-i}}$ the immigrant-native fraction in country $-i$ and by $\frac{n_{i,i}}{n_{-i,i}}$ the native-immigrant fraction in country i. If $\frac{n_{i,-i}}{n_{-i,-i}} \leqslant \frac{n_{i,i}}{n_{-i,i}}$ the fraction of individuals from i is larger in i than in j. We consider this to be the empirically relevant case, while we cannot rule out the opposite case from purely theoretical reasoning. We make the following *native-majority assumption* (NMA):

Assumption 2. $\frac{n_{i,-i}}{n_{-i,-i}} \leqslant \frac{n_{i,i}}{n_{-i,i}}$ *at* $y_{i,k} = y_{-i,k} \quad \forall k = l, h \quad \forall i = a, b.$

Proposition 4. *Assume that low-skilled individuals have a national identity. (1) If preferences are non-heterophobic,* $\delta = 0$*, there is a migration equilibrium if and only if the productivities of each group are equalized,* $y_{a,h} = y_{b,h}, y_{a,l} = y_{b,l}$*. (2) If preferences are heterophobic,* $\delta = 1$*, and NMA is fulfilled, migration within each group is always from the low- to the high-productivity country. For the low-skilled individuals the productivity of the immigration country always exceeds the productivity of the emigration country,* $y_{a,l} > y_{b,l}$ *(undershooting). For the high-skilled individuals the productivity of the immigration country may be smaller, equal, or larger than the productivity of the emigration country,* $y_{a,h} \lesseqqgtr y_{b,h}$*.*

Proof. Assume that h-type individuals have a higher productivity in b whereas l-type individuals have a higher productivity in a in autarky. Denote by $\Delta_k^{i,-i}$ the difference in utility of an individual of nationality i with qualification k living in country $-i$. Using $\bar{y}_{i,k} = y_{i,k}$ it is equal to

$$\begin{aligned} \Delta_k^{i,-i} = & \quad (y_{i,k} - y_{-i,k}) + s[y_{i,k} - y_{i,-k}] - s[y_{-i,k} - y_{-i,-k}] \\ + & \quad \delta(d_2[n_{i,k,-i}, n_{-i,k,-i}] - d_2[n_{i,k,i}, n_{-i,k,i}]) \end{aligned} \tag{3}$$

for individuals with a class identity and

$$\begin{aligned} \Delta_k^{i,-i} = & \quad (y_{i,k} - y_{-i,k}) + d_1[\bar{y}(i) - y_{-i,k}] - d_1[\bar{y}(i) - y_{i,k}] \\ + & \quad \delta(d_2[n_{i,-i}, n_{-i,-i}] - d_2[n_{i,i}, n_{-i,i}]) \end{aligned} \tag{4}$$

for individuals with a national identity.

(1) If $\delta = 0$, and using the property that there can be no cross migration within the same skill group in a MMA equilibrium, $n_{b,h,b} = n_{b,h}, n_{a,l,a} = n_{l,a}$, the above

conditions reduce to

$$\Delta_h^{a,b} = (y_{a,h} - y_{b,h}) + s[y_{a,h} - y_{a,l}] - s[y_{b,h} - y_{b,l}],$$

$$\Delta_l^{b,a} = (y_{b,l} - y_{a,l}) + d_1[\bar{y}(b) - y_{a,l}] - d_1[\bar{y}_b - y_{b,l}],$$

with

$$\bar{y}(b) = \frac{(n_{b,h} + n_{a,h,b})y_{b,h} + (n_{b,l} - n_{b,l,a})y_{b,l}}{(n_{b,h} + n_{a,h,b}) + (n_{b,l} - n_{b,l,a})}.$$

If $y_{a,h} = y_{b,h}, y_{a,l} = y_{b,l}$, it is straightforward to see that $\Delta_k^{i,-i} = 0$ for all groups. In order to check that there are no other equilibria, the condition for the marginal low-skilled migrant who is indifferent between a and b implies

$$y_{b,l} - y_{a,l} = d_1[\bar{y}(b) - y_{b,l}] - d_1[\bar{y}(b) - y_{a,l}], \quad y_{a,l} - y_{b,l} = d_1[\bar{y}(a) - y_{a,l}] - d_1[\bar{y}(a) - y_{b,l}],$$

and therefore $d_1[\bar{y}(b) - y_{b,l}] - d_1[\bar{y}(b) - y_{a,l}] = d_1[\bar{y}(a) - y_{a,l}] - d_1[\bar{y}(a) - y_{b,l}]$. This condition can only be fulfilled if $y_{a,l} = y_{b,l}$. Note that $\Delta_h^{A,B} = -\Delta_h^{B,A}$ implies $y_{a,h} = y_{b,h}$ if $y_{a,l} = y_{b,l}$.

(2) $\delta = 1$. We first concentrate on h-type individuals with a class identity. In this case, (3) becomes

$$\Delta_h^{a,b} = (y_{a,h} - y_{b,h}) + s[y_{a,h} - y_{a,l}] - s[y_{b,h} - y_{b,l}] + (d_2[n_{a,h,b}, n_{b,h,b}] - d_2[n_{a,h,a}, n_{b,h,a}]),$$
$$\Delta_h^{b,a} = (y_{b,h} - y_{a,h}) + s[y_{b,h} - y_{b,l}] - s[y_{a,h} - y_{a,l}] + (d_2[n_{b,h,a}, n_{a,h,a}] - d_2[n_{b,h,b}, n_{a,h,b}]).$$

We first show that it is not rational for h-type individuals from b to start migrating to a if h-type individuals from a are in a migration equilibrium, $\Delta_h^{a,b} = 0$, in a situation without cross migration. Note that

$$\begin{aligned}\Delta_h^{b,a} &= d_2[n_{a,h,b}, n_{b,h,b}] - d_2[n_{a,h,a}, n_{b,h,a}] + d_2[n_{b,h,a}, n_{a,h,a}] - d_2[n_{b,h,b}, n_{a,h,b}] - \Delta_h^{a,b} \\ &= d_2[n_{a,h,b}, n_{b,h,b}] - d_2[n_{a,h,a}, n_{b,h,a}] + d_2[n_{b,h,a}, n_{a,h,a}] - d_2[n_{b,h,b}, n_{a,h,b}].\end{aligned}$$

If there is no migration of high skilled from b to a, $n_{b,h,b} = n_{b,h}$, $n_{a,h,a} = n_{a,h} - na, h, b$, $n_{b,h,a} = 0$. At this point, migration of high skilled from b to a is profitable if

$$(d_2[n_{a,h,b}, n_{b,h}] - d_2[n_{b,h}, n_{a,h,b}]) + (d_2[0, n_{a,h} - n_{a,h,b}] - \underbrace{d_2[n_{a,h} - n_{a,h,b}, 0]}_{=0}) < 0,$$

or alternatively

$$d_2[n_{a,h,b}, n_{b,h}] - d_2[n_{b,h}, n_{a,h,b}] < -d_2[0, n_{a,h} - n_{a,h,b}].$$

However, $d_2[0, n_{a,h} - n_{a,h,b}] = \max_{x_1,x_2} d_2[x_1, x_2]$ given homogeneity of degree zero, which contradicts the assumtion that migration is profitable.

Next we check whether $y_{a,h} < y_{b,h}$ (undershooting) or $y_{a,h} > y_{b,h}$ (overshooting) can be a MMA equilibrium. If $y_{a,h} = y_{b,h} = y_h$, $\Delta_h^{a,b}$ is equal to

$$s[y_h - y_{a,l}] - s[y_h - y_{b,l}] + d_2[n_{a,h,b}, n_{b,h}] - \underbrace{d_2[n_{a,h} - n_{a,h,b}, 0]}_{=0}.$$

This condition implies that $y_{a,h} = y_{b,h}$ can only be an equilibrium if $y_{b,l} < y_{a,l}$ (undershooting of l-types). By the same argument, if $y_{b,l} = y_{a,l}$ we get $y_{a,h} < y_{b,h}$ (undershooting of h-types). As a consequence, there is no MMA equilibrium without cross migration with equalization of productivities. To complete the analysis, overshooting of h-types occurs if $s[y_h - y_{b,l}] - s[y_h - y_{a,l}] > d_2[n_{a,h,b}, n_{b,h}]$. A necessary condition for this inequality to be fulfilled is that $y_{b,l} < y_{a,l}$, there is undershooting of l-types.

Next we analyze l-type individuals with a national identity. In this case, (4) becomes

$$\Delta_l^{b,a} = (y_{b,l} - y_{a,l}) + d_1[\bar{y}(b) - y_{a,l}] - d_1[\bar{y}(b) - y_{b,l}] + d_2[n_{b,a}, n_{a,a}] - d_2[n_{b,b}, n_{a,b}],$$
$$\Delta_l^{a,b} = (y_{a,l} - y_{b,l}) + d_1[\bar{y}(a) - y_{b,l}] - d_1[\bar{y}(a) - y_{a,l}] + d_2[n_{a,a}, n_{b,b}] - d_2[n_{a,a}, n_{b,a}].$$

Economic forces induce migration from b to a. We first check the conditions for under- and overshooting of l-types from b and assume that there is no cross migration of l-types from a (which still as to be verified). Overshooting (undershooting) will occur if $\Delta_l^{b,a}$ is smaller (larger) than zero at $y_{b,l} = y_{a,l}$. The condition reduces to

$$\Delta_l^{b,a} = d_2[n_{b,a}, n_{a,a}] - d_2[n_{b,b}, n_{a,b}]$$

at this point. Given homogeneity of degree zero it follows that

$$\Delta_l^{b,a} \gtreqless 0 \Leftrightarrow \frac{n_{b,a}}{n_{a,a}} \gtreqless \frac{n_{b,b}}{n_{a,b}}.$$

NMA implies that the above condition is negative. Hence, there is undershooting.

□

Propositions 3 and 4 build a bridge to and extend models with exogeous and endogenous migration costs (Hercowitz and Pines, 1991, and Myers and Papageorgiou, 1997, Mansoorian and Myers, 1993, Hindriks, 1999, 2001, Carrington, Detragiache, and Vishwanath 1996). In models with exogenous migration costs, migration does not lead to an equalization of marginal productivities because it is assumed that individuals face exogenous costs of living abroad (the attachment to home). Our model gives a possible motive for such an attachment, which is summarized in the 'heterophobic' part of the preferences, namely the cognitive costs of living in an 'unfamiliar' social environment, given ones social identity. In addition, the model by Carrington, Detragiache, and Vishwanath our approach endogenizes the associated mobility costs in a plausible way: costs of migration crucially depend on the cultural similarity the emigrants face in their host country. The larger the number of emigrants, the easier it is to reestablish cultural ties, and the smaller the cognitive costs of migration. At the same time, our approach focusses attention on an additional type of externality that results from migration: migration does not only impose cognitive costs upon emigrants, the native population of the immigration country may also be affected by immigration if they have heterophobic preferences. This type of heterophobia seems to be the more rule rather than the exceptionas has been empirically shown for example by Facchini and Mayda (2008). In addition our analysis has shown that there is a potential for multiple equilibria (in addition to a PSE): heterophobic costs of migration depend inversely on the mass of emigrants. Hence, it is possible that an allocation without and a situation with substantial migration are an equilibrium.

4.3 Endogenous identities

In this section we analyze the effect of mobility on identities. We compare the autarkic equilibrium with the equilibrium with mobile households in order to understand if and how mobility has an influence on social identities.

4.3.1 Exogenous migration

In this part we focus on the impact on identities of immigration to and emigration from a given country without focussing on individual incentives to migrate. These "comparative-static" effects of mobility allow it to better understand how migration effects the tradeoff in the choice of identities. In order to do so we focus on country a and treat country b passiveley as 'the rest of the world' assuming that migration to and from country a has no influence on incomes in country b (country a is 'small' compared to the rest of the world).

The utility difference Δ_a^k between a class and a national identity of high- and low-skilled individuals in country a is equal to

$$\begin{aligned}\Delta_a^h = \quad & \underbrace{s[y_{a,h,a} - y_{a,l,a}] - s[\bar{y}(a) - \bar{y}(b)] + d_1[\bar{y}(a) - y_{a,h}]}_{=\Delta_a^h(\delta=0)} \\ & \underbrace{-\delta(d_2[n_{a,h,a}, n_{b,h,a}] - d_2[n_{a,h,a} + n_{a,l,a}, n_{b,h,a} + n_{b,l,a}])}_{=\Delta_a^h(d_2)}, \\ \Delta_a^l = \quad & \underbrace{s[y_{a,l,a} - y_{a,h,a}] - s[\bar{y}(a) - \bar{y}(b)] + d_1[\bar{y}(a) - y_{a,l,a}]}_{=\Delta_a^l(\delta=0)} \\ & \underbrace{-\delta(d_2[n_{a,l,a}, n_{b,l,a}] - d_2[n_{a,h,a} + n_{a,l,a}, n_{b,h,a} + n_{b,l,a}])}_{=\Delta_a^l(d_2)}.\end{aligned}$$

For simplicity we assume that migration starts from a situation of autarky, $n_{b,h,a} = n_{b,l,a} = 0$.

Emigration: We first consider the situation of an emigration country. In this case, we can neglect $\Delta_a^k(d_2)$ because emigration has no influence on the mass of foreigners in the emigration country. Consider an h-type first. Denote by $s'[.]$ and $d_1'[.]$ the partial derivatives of both functions. If l-types emigrate, Δ_a^h changes as follows:

$$-s'[.]\frac{\partial f_l}{\partial n_{a,l}} - s'[.]\frac{\partial \bar{y}(a)}{\partial n_{a,l}} + d_1'[.]\frac{\partial \bar{y}(a)}{\partial n_{a,l}}.$$

Given that h is the high-income class, $d_1'[.] < 0$ at $\bar{y}(a) - y_{a,h}$. In addition, $\partial f_l/\partial n_{a,l} < 0$ and $\partial \bar{y}(a)/\partial n_{a,l} < 0$, which implies that the above expression is unambiguously positive. Hence, the *emigration* of low-skilled *decreases* Δ_a^h.

Things are more complicated if h-types emigrate. In this case, Δ_a^h changes as follows:

$$s'[.]\frac{\partial f_h}{\partial n_{a,h}} - s'[.]\frac{\partial \bar{y}(a)}{\partial n_{a,h}} + d_1'[.]\left(\frac{\partial \bar{y}(a)}{\partial n_{a,h}} - \frac{\partial f_h}{\partial n_{a,h}}\right).$$

The effect is ambiguous in general. However, we can get more insight if we restrict attention to a linear specification of $s[.]$ and $d_1[.]$, assuming $s[.]' = 1$, $d_1'[.] = -1$. In this case, the above condition reduces to

$$\begin{aligned}& 2\left(\frac{\partial f_h}{\partial n_{a,h}} - \frac{\partial \bar{y}(a)}{\partial n_{a,h}}\right) \\ = \quad & 2\left(\frac{n_{a,l}}{n_{a,l} + n_{a,h}}\frac{\partial f_h}{\partial n_{a,h}} - \frac{n_{a,l}(f_h[.] - f_l[.])}{(n_{a,l} + n_{a,h})^2}\right),\end{aligned}$$

which is unambiguously negative. Hence, the *emigration* of high-skilled *increases* Δ_a^h.

Next consider an l-type. If l-types emigrate, Δ_a^l changes as follows:

$$s'[.]\frac{\partial f_l}{\partial n_{a,l}} - s'[.]\frac{\partial \bar{y}(a)}{\partial n_{a,l}} + d_1'[.]\left(\frac{\partial \bar{y}(a)}{\partial n_{a,l}} - \frac{\partial f_l}{\partial n_{a,l}}\right).$$

Given that l is the low-income class, $d_1'[.] > 0$ at $\bar{y}(a) - y_{a,h}$. In general, the effect of emigration of l-type individuals on the identity-choice of the remaining l-types is ambiguous: It increases their income, which increases the relative status of this class, but it increases the average income as well, which increase the relative status of the nation. The relative importance of both effects on relative status and cognitive distance is unclear. If we, as above, restrict attention to a linear specification of $s[.]$ and $d_1[.]$, assuming $s[.]' = 1$, $d_1'[.] = 1$, the total effect is equal to

$$\frac{\partial f_l}{\partial n_{a,l}} - \frac{\partial \bar{y}(a)}{\partial n_{a,l}} + \frac{\partial \bar{y}(a)}{\partial n_{a,l}} - \frac{\partial f_l}{\partial n_{a,l}} = 0.$$

Hence, the incentives for identity choice are unchanged by the emigration of low-skilled.

If h-types emigrate, Δ_a^l changes as follows:

$$-s'[.]\frac{\partial f_h}{\partial n_{a,h}} - s'[.]\frac{\partial \bar{y}(a)}{\partial n_{a,h}} + d_1'[.]\frac{\partial \bar{y}(a)}{\partial n_{a,l}}.$$

The effect is ambiguous in general because a reduction of $n_{a,h}$ has an ambiguous effect on $\bar{y}(a)$: high-skilled income increases, but the fraction of high-skilled individuals is reduced. Again, for the linear case the condition reduces to

$$-s'[.]\frac{\partial f_h}{\partial n_{a,h}} > 0,$$

the *emigration* of high-skilled *decreases* Δ_a^h.

Given that there are three types of social-identity equilibria in autarky, the following proposition follows immediately for the linear case.

Proposition 5. *1. If both groups have a class identity in autarky, the emigration of high-skilled individuals has no influence on the identity of the high skilled and may change the identity of the low-skilled from class to national. The emigration of low-skilled has no influence on identities.*[13] *2. If both groups have a national identity*

[13]The latter property may need clarification. Emigration of low-skilled reduces Δ_a^h, but a national identity of the high-skilled together with a class identity of the low skilled is incompatible with the primitives of our model.

in autarky, the emigration of high-skilled individuals has no influence on the identity of low-skilled and may change the identity of high-skilled from national to class. The emigration of low-skilled has no influence on identity choices. 3. If the low skilled have a national and the high skilled have a class identity in autarky, the emigration of high-skilled individuals has no influence on identities. The emigration of low-skilled has no influence on low-skilled but may change the identity of high-skilled from class to national.

Immigration: The case of immigration mirrows the case of emigration with the exception that heterophobic preferences may play a role in identity choices, if they exist. We omit an explicit analysis of the case of non-heterophobic preferences because it leads to a simple inversion of the results portrayed in Proposition 5. Restricting attention to the heterophobic part of the preferences, the opportunity costs of a class identity of the individuals are

$$\Delta_a^h(d_2) = -d_2[n_{a,h,a}, n_{b,h,a}] + d_2[n_{a,h,a} + n_{a,l,a}, n_{b,h,a} + n_{b,l,a}],$$
$$\Delta_a^h(d_2) = -d_2[n_{a,l,a}, n_{b,l,a}] - d_2[n_{a,h,a} + n_{a,l,a}, n_{b,h,a} + n_{b,l,a}].$$

Given homogeneity of degree zero of $d_2[.]$, it follows that $d_2[n_{a,h,a}, n_{b,h,a}] > d_2[n_{a,h,a} + n_{a,l,a}, n_{b,h,a} + n_{b,l,a}]$, $d_2[n_{a,l,a}, n_{b,l,a}] > d_2[n_{a,h,a} + n_{a,l,a}, n_{b,h,a} + n_{b,l,a}]$ respectively, and the following conclusion can be drawn immediately:

- For the high skilled, a national (class) identity becomes c.p. more attractive if there is high- (low-)skilled immigration.
- For the low skilled, a national (class) identity becomes c.p. more attractive if there is low- (high-)skilled immigration.

This leads to the following preliminary conclusion.

Proposition 6. *Assume that immigration does not influence country a's income levels, $\Delta_a^k(\delta = 0), k = h, l$, and that preferences are heterophobic. Then, a national identity becomes more attractive for a class that faces immigration of individuals of the same class. A class identity becomes more attractive for a class that faces immigration of individuals of the opposite class.*

Immigration of a skill group has a larger impact on the national composition of the skill group than on the nation. Hence, given that heterophobic preferences apply to the group of identification, immigration of the same skill group is worse if one has a class identity and vice versa.

Combining with the effects immigration has on incomes for the linear case, we find the following pattern:

1. Immigration of high skilled increases $\Delta_a^l(\delta = 0)$ as well as $\Delta_a^l(d_2)$.
2. Immigration of high skilled decreases $\Delta_a^h(\delta = 0)$ as well as $\Delta_a^h(d_2)$.
3. Immigration of low skilled leaves $\Delta_a^l(\delta = 0)$ unchanged and decreases $\Delta_a^l(d_2)$.
4. Immigration of low skilled increases $\Delta_a^h(\delta = 0)$ as well as $\Delta_a^h(d_2)$.

This list shows that heterophobic preferences boost forces that result from the non-heterophobic part of the preferences in all cases except case 3. This case has been a boundary case before, and heterophobic preferences change the tendency in a direction to make this case consistent with the other cases. We can therefore conclude with the following Proposition that characterizes the linear case.

Proposition 7. *Assume Individuals have heterophobic preferences. 1. If both groups have a class identity in autarky, the immigration of high-skilled individuals leaves the identities of low- and high skilled individuals unchanged. The immigration of low-skilled has no influence on the identity of high skilled but may change the identity of low-skilled from class to national. 2. If both groups have a national identity in autarky, the immigration of high-skilled individuals has no influence on the identity of high-skilled and may change the identity of low-skilled from national to class. The immigration of low-skilled has no influence on the identity of low-skilled but may change the identity of high-skilled from national to class. 3. If the low skilled have a national and the high skilled have a class identity in autarky, the immigration of high-skilled individuals may change the identity of low-skilled from national to class or the identity of high-skilled from class to national, but not both. The immigration of low-skilled has no influence on identities.*

Propositions 5 and 7 allow it to draw some interesting conclusions about the impact of imigration on the self-perception of individuals and thereby ultimalely on their behavior in for example elections.[14] Emigration of high-skilled as well as

[14]See Shayo (2009) who analyzes the impact of identities on voting behavior.

immigration of low-skilled individuals creates a tendency towards more nationalistic positions within the group of low-skilled individuals. Both tendencies reduce the relative status of their class. Hence, a prediction of the model is that the upcoming of nationalism in the low-skilled classes may be especially likely in countries that face immigration of low skilled and emigration of high-skilled individuals. Countries that face immigration of both skill groups but with a specific emphasis on high-skilled immigration face to some extend the opposite effect: the stronger pressure on high-skilled incomes makes a class identity for the low-skilled relatively more attractive and it may lead to an increase in nationalism among the high-skilled group. Countries facing the emigration of high-skilled individuals are especially challanged by the increased nationalism of the low-skilled, whereas emigration of low-skilled can have an opposite effect on their identity because it improves their relative economic position.

4.3.2 Equilibrium

In this section we deliver a negative result with respect to the determinacy of the influence of migration on social identities. The type of social-identity equilibrium prevalent in autarky has no predictable impact on the type of social-identity equilibrium in a migration equilibrium, with the exception of nationalistic high skilled, every possible tupel of identities in autarky is compatible with every possible tuple of identities in a migration equilibrium. In order to show this indeterminacy and make it precise we can restrict attention to non-heterophobic preferences and identical average incomes in autarky, $\bar{y}(a) = \bar{y}(b)$. If the social-identity equilibrium is indeterminate in this special case, it is indeterminate in the general case as well.

We know from Propositions 3 and 4 that in the case of non-heterophobic preferences productivities will be equalized in a migration equilibrium, irrespective of the identities of the individuals. An immediate implication of this property is that the economic conditions for both types of qualifications are the same in any migration equilibrium. Given that the place of residence has no influence on the identity-induced utility of individuals if their preferences are non-heterophobic, it is immediately clear that each skill group will end up with the same identity. This identity in turn depends on the post-migration distribution of incomes. The following proposition summarizes the main findings.

Proposition 8. *If $\delta = 0$ and $\bar{y}(a) = \bar{y}(b)$ the high-skilled have a class identity in autarky as well as in a migration equilibrium. The low-skilled can have a class or a national identity in a migration equilibrium, independent of their identity in autarky.*

Proof. Note that average incomes are identical in a migration equilibrium with equalization of productivities because the payoff functions $f_k(.)$ are identical in both countries. Denote them by $\bar{y}$. Given Proposition 1, h-type individuals always choose a class identity in autarky as well as in a migration equilibrium. We can therefore restrict attention to the low-skilled individuals. Given the assumptions of this section, (1) can be written as

$$\begin{aligned}\Delta_a^l(n,c) &= s[y_{a,l,a} - y_{a,h,a}] + d_1[\bar{y}(a) - y_{a,l,a}],\\ \Delta_b^l(n,c) &= s[y_{b,l,b} - y_{b,h,b}] + d_1[\bar{y}(b) - y_{b,l,b}]\end{aligned}$$

for the case of autarky and

$$\Delta^l(n,c) = s[y_l - y_h] + d_1[\bar{y} - y_l]$$

in a migration equilibrium. This shows that low-skilled individuals have the same identity irrespective of their nationality or place of residence. In order to demonstrate the indeterminacy of social identities it is sufficient to show it for the special case of hyperbolic payoff functions, $f_l[n] = 1/n, f_h[n] = \kappa/n, \kappa > 1$, and populations $n_a^l + n_b^l = 1, n_a^h + n_b^h = 1$. In this case, skill-specific payoffs are equalized between countries if $n_a^l = n_b^l = 1/2, n_a^h = n_b^h = 1/2$. Denote by $n_a^l = 1/2 - \alpha^l, n_b^l = 1/2 + \alpha^l$, $n_a^h = 1/2 + \alpha^h, n_b^h = 1/2 - \alpha^h$, $\alpha^l \in [0, 1/2), \alpha^h \in [0, 1/2)$ the distribution of individuals in autarky in a situation where country a has less inequality, $y_b^l < y_a^l < y_a^h < y_b^h$. Given that

$$\begin{aligned}\bar{y}(a) &= \frac{(1/2-\alpha^l)f_l[1/2-\alpha^l] + (1/2+\alpha^h)f_h[1/2+\alpha^h]}{(1/2-\alpha^l)+(1/2+\alpha^h)} = \frac{(1+\kappa)}{(1+\alpha^l-\alpha^b)},\\ \bar{y}(b) &= \frac{(1/2+\alpha^l)f_l[1/2+\alpha^l] + (1/2-\alpha^h)f_h[1/2-\alpha^h]}{(1/2+\alpha^l)+(1/2-\alpha^h)} = \frac{(1+\kappa)}{(1-\alpha^a+\alpha^b)},\\ \bar{y} &= \frac{1/2 f_l[1/2] + 1/2 f_h[1/2]}{1} = (1+\kappa),\end{aligned}$$

it follows immediately that $\bar{y}(a) = \bar{y}(b)$ implies $\alpha^l = \alpha^h$. This finding allows it to establish the following ordering. To simplify notation denote $s_a^l = s[y_{a,l,a} - y_{a,h,a}]$, $s_b^l = s[y_{b,l,b} - y_{b,h,b}]$, $d_a^l = d_1[\bar{y}(a) - y_{a,l,a}]$, $d_b^l = d_1[\bar{y}(b) - y_{b,l,b}]$, $s^l = s[y_l - y_h]$, $d^l = d_1[\bar{y} - y_l]$, and we get $s_b^l < s^l < s_a^l < 0$, $0 < d_a^l < d^l < d_b^l$. The proof is complete

$\Delta^l_a(n,c)$	$\Delta^l_b(n,c)$	$\Delta^l(n,c)$	parameter constellations
<0	<0	<0	$d^l_b \leq -s^l \wedge s^l_a < -d^l_a$
			$\vee -s^l < d^l_b < -s^l_b \wedge d^l < -s^l \wedge s^l_a < -d^l_a$
<0	<0	>0	$-s < d^l_b < -s^l_b \wedge -s^l < d^l \wedge 0 < d^l_a < -s^l \wedge s^l_a < -d^l_a$
<0	>0	<0	$d^l_b > -s^l_b \wedge 0 < d^l < -s^l \wedge s^l_a < -da$
<0	>0	>0	$d^l_b > -s^l_b \wedge -s^l < d^l \wedge d^l_a < -s^l \wedge s^l_a < -d^l_a$
>0	<0	<0	$d^l_b \leq -s^l \wedge -d^l_a < s^l_a$
			$\vee -s^l < d^l_b < -s^l_b \wedge d^l < -s^l \wedge -d^l_a < s^l_a$
>0	<0	>0	$-s^l < d^l_b < -s^l < d^l \wedge d^l_a \leq -s^l \wedge -d^l_a < s^l_a$
			$\vee -s^l < d^l_b < -s^l_b \wedge -s^l < d^l \wedge -s^l < d^l_a$
>0	>0	<0	$d^l_b > -s^l_b \wedge d^l < -s^l \wedge -d^l_a < s^l_a$
>0	>0	>0	$-s^l < d^l_b < -s^l_b \wedge -s^l < d^l \wedge d^l_a \leq -s^l \wedge -d^l_a < s^l_a$
			$\vee -s^l < d^l_b < -s^l_b \wedge -s^l < d^l \wedge -s^l < d^l_a$

Table 1: Parameter constellations generating different types of equilibria.

if we are able to determine parameter constellations for all possible combinations of identities in autarky and in a migration equilibrium. Table 1 shows the results The table shows that every combination of identities in autarky and in a migration equilibrium is compatible with some combination of parameter values. Given that this indeterminancy holds for a special case, it holds for the general case with more general payoff functions, different average incomes and heterophobic preferences as well. □

5 Conclusions

The main hypothesis of this paper is that social identities are an important factor to understand international migration. We have developed a model of international mobility with individuals inhering different skills and potentially different social identities. The first important finding of our analysis has been that under a mild assumption on the mobility of individuals (there is a positive but arbitrarily small fraction of immobile individuals in each skill group in each country) an equilibrium where individuals choose their location as well as their social identity exists.

There are two qualitatively different types of migration equilibria with exogenous identities. If individuals have non-heterophobic preferences, productivities are always equalized in a migration equilibrium. Hence, the standard results from the literature on costless and unrestricted labor mobility carry over to this case. The identity of migration patterns between these two classes of models, however, does not imply that social identities do not matter. On the contrary it can be expected that migration will have an impact on the identities of the different types of individuals, and this result has consequences for welfare analysis and allows it to better understand the economic forces that drive phenomena like nationalism.

If individuals have heterophobic preferences, productivities will not be equalized in a migration equilibrium. If all groups have a class identity there is always too little migration in equilibrium because the fact that emigrants leave their cultural and personal networks and are confronted with a large fraction of foreigners (what they don't like) acts as an impediment to mobility. This model is able to explain and endogenize the concept of mobility costs and an attachment to home. In addition it focusses attention to an additional cost of migration, namely the loss if utility of the native population that is confronted with foreigners. The main flavor of our results remains the same if the poor have a national identity. The only difference is that we cannot rule out overshooting of h-types. This case may occur when there is undershooting of l-types and individuals are very status sensitive. In this case, the increase in status may induce high-skilled individuals to emigrate up to a point where the productivity abroad is smaller than at home.

6 Appendix

In this appendix we prove existence of an equilibrium.

Remark. Given a sequence of identities, $(p_t)_{t \in C \times Q \times C}$, a distribution, $n \in D$, is a migration equilibrium, iff for all $(i,k,c) \in C \times Q \times C$:

$$u_{i,k,c}(p_{i,k,c}(n), n) \leq u_{i,k}(p,n) \equiv \sum_{e \in C} \frac{(n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k,e}(p_{i,k,e}(n), n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}}.$$

Proof. (1) Be $(p_t)_{t \in C \times Q \times C}$ a sequence of identities and $n \in D$ a migration equilibrium, then by definition for all $(i,k,c) \in C \times Q \times C$ with $n_{i,k,c} > \bar{n}_{i,k,c}$

$$\forall d \in C : u_{i,k,c}(p_{i,k,c}(n), n) \geq u_{i,k,d}(p_{i,k,d}(n), n) \text{ holds.}$$

And therefore, we have that $\forall (i,k,c) \in C \times Q \times C \; \forall d \in C \; (n_{i,k,d} > \bar{n}_{i,k,d})$:

$$u_{i,k,c}(p_{i,k,c}(n), n) \leq u_{i,k,d}(p_{i,k,d}(n), n).$$

Then, for all $(i,k,c) \in C \times Q \times C$, we get

$$\sum_{d \in C} (n_{i,k,d} - \bar{n}_{i,k,d})\, u_{i,k,c}(p_{i,k,c}(n), n) \leq \sum_{e \in C} (n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k,e}(p_{i,k,e}(n), n)$$

$$\Leftrightarrow u_{i,k,c}(p_{i,k,c}(n), n) \leq \sum_{e \in C} \frac{(n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k,e}(p_{i,k,e}(n), n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}}.$$

(2) Be $(p_t)_{t \in C \times Q \times C}$ a sequence of identities and $n \in D$ a distribution such that, for all $(i,k,c) \in C \times Q \times C$:

$$u_{i,k,c}(p_{i,k,c}(n), n) \leq u_{i,k}(p,n) \equiv \sum_{e \in C} \frac{(n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k,e}(p_{i,k,e}(n), n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}}.$$

Then, for all $(i,k,c) \in C \times Q \times C$ with $n_{i,k,c} > \bar{n}_{i,k,c}$, the following holds:

$$u_{i,k}(p,n) = \sum_{e \in C} \frac{(n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k,e}(p_{i,k,e}(n), n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}}$$

$$\Leftrightarrow u_{i,k}(p,n) \leq \sum_{e \in C,\, e \neq c} \frac{(n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k}(p,n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}} + \frac{(n_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k,c}(p_{i,k,c}(n), n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}}$$

$$\Leftrightarrow u_{i,k}(p,n) - \sum_{e \in C,\, e \neq c} \frac{(n_{i,k,e} - \bar{n}_{i,k,e})\, u_{i,k}(p,n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}} \leq \frac{(n_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k,c}(p_{i,k,c}(n), n)}{\sum_{d \in C} n_{i,k,d} - \bar{n}_{i,k,d}}$$

$$\Leftrightarrow \frac{(n_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k}(p,n)}{\sum_{d\in C} n_{i,k,d} - \bar{n}_{i,k,d}} \leq \frac{(n_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k,c}(p_{i,k,c}(n), n)}{\sum_{d\in C} n_{i,k,d} - \bar{n}_{i,k,d}}$$

$$\Leftrightarrow (n_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k}(p,n) \leq (n_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k,c}(p_{i,k,c}(n), n)$$

$$\Leftrightarrow u_{i,k}(p,n) \leq u_{i,k,c}(p_{i,k,c}(n), n).$$

□

Lemma 2. *Given a sequence of identities $p = (p_t)_{t\in C\times Q\times C}$ a distribution $n \in D$ exists such that n is a migration equilibrium.*

Proof. Be $p = (p_t)_{t\in C\times Q\times C}$ a sequence of identities. Then define

$$v_{i,k,c}(p,n) \equiv \max\{0, u_{i,k,c}(p_{i,k,c}(n), n) - u_{i,k}(p,n)\}$$

$$\text{and } F_{i,k,c}(p,n) \equiv \frac{n_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,n)}{\sum_{d\in C}(n_{i,k,d} - \bar{n}_{i,k,d} + v_{i,k,d}(p,n))} \left(N_{i,k} - \sum_{d\in C} \bar{n}_{i,k,d} \right) + \bar{n}_{i,k,c}$$

for $(i,k,c) \in C \times Q \times C$, such that

$$F : D \to D \text{ with } F(p,\cdot) \equiv (F_{i,k,c}(p,\cdot))_{(i,k,c)\in C\times Q\times C}$$

is a continuous function. With Brouwer's fixed point theorem there is a fixed point, $\tilde{n} \in D$, i.e. $F(p,\tilde{n}) = \tilde{n}$. Then for all $(i,k,c) \in C \times Q \times C$ we have:

$$\begin{aligned}
&\tilde{n}_{i,k,c} = \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,\tilde{n})}{\sum_{d\in C}(\tilde{n}_{i,k,d} - \bar{n}_{i,k,d} + v_{i,k,d}(p,\tilde{n}))} \left(N_{i,k} - \sum_{d\in C} \bar{n}_{i,k,d} \right) + \bar{n}_{i,k,c} \\
\Leftrightarrow\ & \tilde{n}_{i,k,c} - \bar{n}_{i,k,c} = \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,\tilde{n})}{\sum_{d\in C}(\tilde{n}_{i,k,d} - \bar{n}_{i,k,d} + v_{i,k,d}(p,\tilde{n}))} \left(\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d} \right) \\
\Leftrightarrow\ & \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c}}{\left(\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}\right)} = \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,\tilde{n})}{\sum_{d\in C}(\tilde{n}_{i,k,d} - \bar{n}_{i,k,d} + v_{i,k,d}(p,\tilde{n}))} \\
\Leftrightarrow\ & \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c}}{\left(\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}\right)} \sum_{d\in C} (\tilde{n}_{i,k,d} - \bar{n}_{i,k,d} + v_{i,k,d}(p,\tilde{n})) \\
& = \tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,\tilde{n}) \\
\Leftrightarrow\ & \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c}}{\left(\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}\right)} \sum_{d\in C} (\tilde{n}_{i,k,d} - \bar{n}_{i,k,d}) + \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c}}{\left(\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}\right)} \sum_{d\in C} v_{i,k,d}(p,\tilde{n}) \\
& = \tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,\tilde{n}) \\
\Leftrightarrow\ & \tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + \frac{\tilde{n}_{i,k,c} - \bar{n}_{i,k,c}}{\left(\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}\right)} \sum_{d\in C} v_{i,k,d}(p,\tilde{n}) = \tilde{n}_{i,k,c} - \bar{n}_{i,k,c} + v_{i,k,c}(p,\tilde{n}) \\
\Leftrightarrow\ & (\tilde{n}_{i,k,c} - \bar{n}_{i,k,c}) \frac{\sum_{d\in C} v_{i,k,d}(p,\tilde{n})}{\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}} = v_{i,k,c}(p,\tilde{n}).
\end{aligned}$$

Suppose that for some $(i,k) \in C \times Q$

$$\frac{\sum_{d\in C} v_{i,k,d}(p,\tilde{n})}{\sum_{d\in C} \tilde{n}_{i,k,d} - \bar{n}_{i,k,d}} > 0,$$

then, for all $c \in C$, $\tilde{n}_{i,k,c} - \bar{n}_{i,k,c} > 0$ implies $u_{i,k,c}(p_{i,k,c}(\tilde{n}),\tilde{n}) > u_{i,k}(p,\tilde{n})$ such that

$$\sum_{c\in C} (\tilde{n}_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k,c}(p_{i,k,c}(\tilde{n}),\tilde{n}) > \sum_{c\in C} (\tilde{n}_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k}(p,\tilde{n})$$
$$= \sum_{c\in C} (\tilde{n}_{i,k,c} - \bar{n}_{i,k,c})\, u_{i,k,c}(p_{i,k,c}(\tilde{n}),\tilde{n}),$$

a contradiction. Therefore, we have

$$\forall (i,k,c) \in C \times Q \times C:\ u_{i,k,c}(p_{i,k,c}(\tilde{n}),\tilde{n}) \leq u_{i,k}(p,\tilde{n}),$$

such that $\tilde{n}$ is a migration equilibrium according to the earlier remark. □

Lemma 3. *Given a distribution $n \in D$ there is a sequence of identities $p = (p_t)_{t\in C\times Q\times C}$ such that p is a social identity equilibrium.*

Proof. Given $n \in D$, define $p = (p_t)_{t\in C\times Q\times C}$ as

$$p_t(n) \equiv \arg\max_{g\in G_t(n)} \big\{u_t(g,n)\big\}.$$

Note, that since $G_t(n)$ is finite, p exists. Then, $\forall t \in C \times Q \times C$, $m \in I_t$:

$$u_t(p_t(n),n) = \max_{g\in G_t(n)} \big\{u_t(g,n)\big\} \geq u_t(m(n),n),$$

such that p is a social identity equilibrium. □

Theorem 1. *There is a distribution, $n \in D$, and a sequence of identities, $p = (p_t)_{t\in C\times Q\times C}$, such that, given p, n is a migration equilibrium and, given n, p is a social identity equilibrium.*

Proof. According to Lemma 3, for all $n \in D$, there is a sequence of identities, $g = (g_t)_{t\in C\times Q\times C}$, such that g is a social identity equilibrium. Then, define $p : D \to D^*$ such that, for all $n \in D$, $p(n)$ is a social identity equilibrium. We can write p as

$$p_t(n) \equiv \arg\max_{g\in G_t(n)} \big\{u_t(g,n)\big\}.$$

Since we have

$$\forall n \in D:\ u_t(p_t(n),n) = \max_{g\in G_t(n)} \big\{u_t(g,n)\big\},$$

$u_t(p(\cdot),\cdot)$ is continuous in $n \in D$. Therefore, according to Lemma 2, there is a distribution $\tilde{n} \in D$ such that, given social identities $p(\tilde{n})$, $\tilde{n}$ is a migration equilibrium. This concludes the proof, since $p(\tilde{n})$ is a social identity equilibrium by definition. □

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