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Repercussions of negatively selective migration for the behavior of non-migrants when preferences are social

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Repercussions of negatively selective migration for the behavior of non-migrants when preferences are social

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Abstract: We study how the work effort and output of non-migrants in a village economy are affected when a member of the village population migrates. Given that individuals dislike low relative income, and that migration modifies the social space of the non-migrants, we show why and how the non-migrants adjust their work effort and output in response to the migration-generated change in their social space. When migration is negatively selective such that the least productive individual departs, the output of the non-migrants increases. While as a consequence of this migration statically calculated average productivity rises, we identify a dynamic repercussion that compounds the static one.

Keywords: Social preferences; Distaste for low relative income; Work effort; Per capita output; Migration

JEL classification: D01; D31; J24; O15

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1. INTRODUCTION

The received literature on social preferences (in particular the branches that relate to status and income dispersion) and on endogenous work effort typically characterizes agents as homogeneous in their preferences (see, for example, Fang and Moscarini, 2005; Dur and Glazer, 2008; Stark and Hyll, 2011). A few researchers allow for heterogeneity of preferences, though in a partial sense as, for instance, do Bandiera et al. (2010) who assume that workers are heterogeneous in terms of the cost of their work effort, but not in terms of the benefit (utility) that they derive from their pay. In this paper we assume complete heterogeneity of preferences. We construct a model in which members of a small population, in this case a village, differ in the weights that they assign to the components of their utility functions, which include utility from consumption, disutility from exerting work effort, and disutility from having low relative income (income that is lower than the incomes of others with whom they compare themselves).

We apply the model to a particularly fitting setting: departures from a population. We refer to this as migration, and to the population as a village. A village is not only a spatially concentrated economy in commodity (inputs and outputs) space; it also constitutes a compact social space.[1] Compactness is conducive to preferences based on social comparisons, and these comparisons are more intense than they would be had the social space been loose. In a village, individuals do not need to expend effort to collect data on the incomes of others in order to calculate their relative income because incomes are largely known, and proxies such as size of house, size of plot, or size of herd are visible at no cost, and are easily available to everyone. A village setting enables us to make a direct contribution to the migration literature.

[1] The social compactness is affected by size. For example, in 2011 in India alone there were 236,000 villages with a population of fewer than 500 people (Government of India, 2011).

After all, migration changes the social environment in which people live: almost by definition, not only does migration change the social space of those who leave, it also modifies the social space of those who stay; a migration from a village changes the social space of the non-migrants. Because people routinely engage in comparisons with others, and are affected by these comparisons (especially when the comparisons are about levels of income, consumption, or wealth), revisions of their social comparison space brought about by migration impinge on their wellbeing and, consequently, on their behavior.[2] When some migrate from the village, those who stay in the village adjust their behavior to the consequent changes in their social space. Even though, in principle, a migrant might remain in the social comparison space of the non-migrants, in the current setting where each villager is taken to be a producer, our model applies because we assume that upon migration, the migrant's village production ceases.

Migration from agriculture to other activities has been viewed as an important source of productivity gains in developing countries. When workers relocate from rural areas, where the value of their marginal product is low, to urban areas, aggregate output increases. This effect and the underlying reasons for it have already been studied meticulously by Kuznets (1971), and require no detailed elaboration here. Suffice it to note that the "location" of the surge in productivity is urban, that it comes about even when workers are not matched with more production inputs (exposure to agglomeration economies is one source), let alone when they are matched with more and superior production inputs. There has been much less discussion however of the effect of departures from a village on the productivity of those remaining there.

[2] Empirical studies that marshal evidence regarding the role of interpersonal comparisons for people's behavior include Zizzo and Oswald (2001), Luttmer (2005), Fliessbach et al. (2007), Blanchflower and Oswald (2008), Takahashi et al. (2009), Card et al. (2012), and Cohn et al. (2014).

The standard approach to tackling the effect of migration from a village on the output of those who remain in the village is to trace the impact of migrants' remittances. Directly or indirectly, remittances can support the acquisition of productive or productivity-enhancing devices, implements, and protocols (Stark, 2009, and references provided therein). The received literature is reticent about the possibility that, without remittances, in the wake of migration the very revisions of the income distribution and of the social comparison space in the village will set in motion behavioral responses of the non-migrants, including changes in their work effort and, as a consequence, their output. In comparison with the considerable attention that is given to the role of remittances, the question of how, *in and by itself*, migration affects the behavior of the people who stay behind remains under-researched. We inquire how changes in social space brought about by migration impact on the non-migrants' optimal choice of how much work effort to exert. Inter alia, we specify conditions under which, in the wake of migration from a village by the least hard-working individual, the non-migrants will increase their work effort which, in turn, will yield an increase in the village's per capita output. This increase is distinct from the static arithmetic increase of the village per capita output brought about when a producer whose output is below the average output is omitted from the averaging. The increase arises even though output is not generated through joint production.

In one respect, however, the approach taken in this paper follows an earlier track, namely that migration from a village affects the risk-taking behavior of non-migrants: a diversified "demographic portfolio" allows households that have migrant members to undertake riskier projects (Taylor, 1986; Stark, 1993; Taylor and Adelman, 1996). And the riskier projects, which are characterized by higher average returns, increase the output of the non-migrants. Increased risk-taking by households with migrant members is not necessarily brought about in response to the receipt of remittances but, rather, as a response to the possibility of drawing on remittances in the event of failure of a risky project, like a sort of an insurance policy. That being said, as shown below, our model identifies a new channel via which migration affects the risk-taking behavior of the non-migrants.

It is worth adding that at the heart of earlier research on migration, in particular Stark and Bloom (1985), Lucas and Stark (1985), Rosenzweig and Stark (1989), and Stark (1993), lies the perception that the migration of a family member influences the constraints, endowments, and opportunities of the family members who stay behind. These texts, as well as many works that have developed the concepts and approach presented in the earlier research, focused on identifying and measuring the ways in which migration led to revision of the constraints, endowments, and opportunities. For example, the receipt of remittances was shown to relieve credit pressures and make it easier to adopt better farming technologies. However, that entire body of work failed to study the endogenous revision of effort independent of the increase in resources and the relaxation of credit and other constraints. Moreover, even if the said relaxation applied, an increase in work effort would naturally complement it: a shift to a technology that yields more valuable crops will invite putting in more effort on account that effort exertion becomes more rewarding. The approach taken in the current paper is novel in that the change of effort is brought about without changing the constraints, endowments, and opportunities, and in that the change is specific with regard to the position of the migrant in the income distribution at origin.

In the remainder of this paper we proceed as follows. In Section 2 we study the decisions of individuals with heterogeneous preferences as to how much work effort to exert. In Section 3 we apply the model to the setting of migration. We ask how negatively selective departures from a village affect the work effort of the non-migrants. In Section 4 we conclude.

2. A MODEL OF ENDOGENOUS WORK EFFORT IN AN ECONOMY WITH HETEROGENEOUS AGENTS

Let the utility function of individual i from population P that consists of n individuals take the form

$$U_i(c_i, e_i, RD_i) = \alpha_i f(c_i) - \beta_i g\left(e_i\right) - \gamma_i RD_i \,, \qquad \textbf{(1)}$$

where c_i denotes the consumption of individual i; e_i is the work effort of individual i; and RD_i is the relative deprivation (defined in **(2)** below) of individual i. We assume that $f'(\cdot) > 0,\ f''(\cdot) < 0$, that $g'(\cdot) > 0,\ g''(\cdot) > 0$, that $\lim_{e_i \to +\infty} \frac{\partial U_i(e_i)}{\partial e_i} < 0$, and that $\lim_{e_i \to 0} \frac{\partial U_i(e_i)}{\partial e_i} > 0$.[3] The three parameters $\alpha_i > 0$, $\beta_i > 0$, and $\gamma_i > 0$ assign weights to the individual's utility from consumption, to the individual's disutility from work effort, and to the individual's disutility from relative deprivation, respectively.

As stated, α_i, β_i, and γ_i are taken as (exogenous) parameters. The underlying idea behind the fixing of α_i, β_i, and γ_i is that, as tastes, they are taken to be stable, having been formed over a long period of time, and are the product of cultural norms and social conventions and, as such, are assumed not to change as a result of a marginal change in the composition of the population under study.

In order to represent the heterogeneity of the preferences of the individuals in P, the preference parameters are indexed by i. Consumption is constrained by the individual's income, y_i; that is, $c_i \le y_i$. Returns from work are the only source of income. The work effort exerted by an individual converts into income on a one-to-one basis; that is, $e_i = y_i$.

[3] We assume that in terms of the effect on the individual's utility, the exertion of an additional unit of effort is worse when the level of effort is high than the exertion of an additional unit of effort when the level of effort is low, hence, $g''(\cdot) > 0$.

Naturally, effort is not the only source of income and consumption; assets and savings contribute too. Ignoring inheritances, luck, and the like, assets and savings are determined by effort so, essentially, we are working our way backwards, developing a reduced-form model. We assume that the preferences of the individuals satisfy conditions that ensure the existence of an equilibrium in which the endogenously determined levels of work effort of the individuals in *P* can be ranked unambiguously: $e_1 < e_2 < ... < e_n$. This assumption enables us to refer to the individuals' rank in the distribution of effort as given. For example, the assumption fits well when there is a long-run equilibrium in which the individuals' effort and income are set and are publicly known, as noted in the Introduction. In this context, while when their social space changes (due to migration of an individual), individuals revise their effort, the adjustment takes place without a concurrent or a subsequent change in the initial hierarchy of the levels of effort. The work effort distribution maps onto the distribution of incomes in *P*, namely onto $y_1 < y_2 < ... < y_n$. From now on, we name the individuals according to their rank in the distribution of effort / income.

We define the relative deprivation of individual *i* as

$$RD_i \equiv \begin{cases} \frac{1}{n}\sum_{j=i+1}^{n}(y_j - y_i) & \text{for } i \in \{1,...,n-1\}, \\ 0 & \text{for } i = n. \end{cases} \quad \textbf{(2)}$$

Thus, relative deprivation is the aggregate of the income excesses divided by the size of the population. The measure of relative deprivation defined in **(2)** is cardinal: it is sensitive to changes in the income levels of individuals higher up in the income hierarchy even if the changes do not translate into revisions of ordinal rank. For example, in income distribution (10, 20), the ordinal measure of relative deprivation of the individual whose income is 10, namely the rank (position) $n, n-1, ..., 1$ of the individual as measured by the difference between the top rank and his position in the income hierarchy, is the same (second) as in income distribution (10, 11), whereas the cardinal measure is not the same (applying **(2)**, relative deprivation is 5 in income distribution (10, 20), and it is 0.5 in income distribution (10, 11)).[4] A rationale for, background to, and applications of the measure defined in **(2)** are provided in the appendix. As already stated, incomes are known to the members of the small population.

The measure defined in **(2)** can be multiplied and divided by $n-i,\ n>i$. This results in a slight rewrite of the definition of relative deprivation given in **(2)**:

$$RD_i = \begin{cases} \dfrac{n-i}{n}\left(\dfrac{1}{n-i}\sum_{j=i+1}^{n} y_j - y_i\right) & \text{for } i \in \{1,...,n-1\}, \\ 0 & \text{for } i = n. \end{cases} \tag{3}$$

The representation in **(3)** is interpreted as follows: the term $(n-i)/n$ in **(3)** is the fraction of the individuals in *P* whose income is higher than the income of individual *i*, and the bracketed term in **(3)** is the difference between the average income of the individuals higher up in the income hierarchy, and the income of individual *i*. Below, use of **(3)** will ease the derivations and aid interpretation, so we will use it rather than use **(2)**.

Noting that the constraint on consumption $c_i \leq y_i$ must be binding, inserting **(3)** into **(1)**, and recalling the assumption that work effort converts into income on a one-to-one basis, the utility function of individual *i* can be represented by

[4] A model of migration based on an ordinal measure of relative deprivation is in Stark (2017). It is worth noting that the results reported in the current paper depend on the cardinality of the measure of relative deprivation. This can be seen straightforwardly if, instead, relative deprivation were to be measured by rank, where rank deprivation is defined as the distance in terms of positions below the top rank *n*. In such a case, if the individuals are ranked as $n, n-1, ..., 1$, the departure of individual 1 will not affect the rank of any other individual, with the effort adjustments reported in the text not needed. However, even if rank is the yardstick, and if rank is measured as distance in terms of positions from the bottom - and analytically speaking this is feasible if intuitively not appealing - then results of the type reported in the paper will hold qualitatively, and even be strengthened because all the individuals will experience increased relative deprivation, individual *n* included. In addition, if in calculating their relative deprivation individuals assign significant weight to the individual at the top of the distribution and quantify their relative deprivation by the distance from that individual divided by the size of the population, then the departure of individual 1 will have an effect similar to the one reported in the text.

$$U_i(e_i) = \begin{cases} \alpha_i f(e_i) - \beta_i g(e_i) - \gamma_i \dfrac{n-i}{n}\left(\dfrac{1}{n-i}\sum_{j=i+1}^{n} e_j - e_i\right) & \text{for } i \in \{1,...,n-1\}, \\ \alpha_i f(e_i) - \beta_i g(e_i) & \text{for } i = n. \end{cases} \quad \textbf{(4)}$$

Then,

$$\frac{\partial U_i(e_i)}{\partial e_i} = \begin{cases} \alpha_i f'(e_i) - \beta_i g'(e_i) + \gamma_i \dfrac{n-i}{n} & \text{for } i \in \{1,...,n-1\}, \\ \alpha_i f'(e_i) - \beta_i g'(e_i) & \text{for } i = n, \end{cases} \quad \textbf{(5)}$$

and

$$\frac{\partial^2 U_i(e_i)}{\partial e_i^2} = \alpha_i f''(e_i) - \beta_i g''(e_i) \qquad \text{for } i \in \{1,...,n\}. \quad \textbf{(6)}$$

Because $\alpha_i > 0$, $\beta_i > 0$, $f''(\cdot) < 0$, and $g''(\cdot) > 0$, it follows that the right-hand side of **(6)** is negative, which implies that the utility function in **(4)** is concave in e_i. The conditions $\lim_{e_i \to +\infty} \frac{\partial U_i(e_i)}{\partial e_i} < 0$ and $\lim_{e_i \to 0} \frac{\partial U_i(e_i)}{\partial e_i} > 0$ presented just after introducing **(1)** can alternatively be expressed, respectively, as

$$\lim_{e_i \to +\infty} f'(e_i) < \frac{\beta_i \left(\lim_{e_i \to +\infty} g'(e_i)\right) - \gamma_i \dfrac{n-i}{n}}{\alpha_i} \quad \textbf{(7)}$$

and

$$\lim_{e_i \to 0} f'(e_i) > \frac{\beta_i \left(\lim_{e_i \to 0} g'(e_i)\right) - \gamma_i \dfrac{n-i}{n}}{\alpha_i}. \quad \textbf{(8)}$$

The properties of the utility function in **(5)** and **(6)** in conjunction with conditions **(7)** and **(8)** imply that there exists a unique solution for the optimal level of work effort, e_i*, $i \in \{1,...,n\}$, and that this solution is interior, $e_i* > 0$.

The optimal work effort of individual *i* is given implicitly by the first-order conditions obtained from **(5)**:

$$\begin{aligned} &\alpha_i f'(e_i^*) - \beta_i g'(e_i^*) + \gamma_i \frac{n-i}{n} = 0 &\quad \text{for } i \in \{1,\ldots,n-1\}, \\ &\alpha_i f'(e_i^*) - \beta_i g'(e_i^*) = 0 &\quad \text{for } i = n, \end{aligned} \qquad \textbf{(9)}$$

implying that

$$\begin{aligned} &e_i^* = e_i^*\left(\alpha_i, \beta_i, \gamma_i \frac{n-i}{n}\right) &\quad \text{for } i \in \{1,\ldots,n-1\}, \\ &e_i^* = e_i^*\left(\alpha_i, \beta_i\right) &\quad \text{for } i = n. \end{aligned} \qquad \textbf{(10)}$$

As seen in **(10)**, the optimal level of work effort of a member $i \in \{1,\ldots,n-1\}$ of the population is a function of the weight accorded to satisfaction about his own income; the weight accorded to dissatisfaction about work effort; and the weight accorded to dissatisfaction from relative deprivation, which is weighted by the fraction of the individuals higher up in the effort / income hierarchy. The work effort exerted by an individual in *P* determines the individual's output.

3. APPLICATION OF THE MODEL: MIGRATION

We now consider the case in which individuals migrate from population *P*. (For our current purposes, the particular reason for migration is not important; we can just assume that migration is enabled by the removal of some external barrier, as happens when a road is constructed, for example.) Changes in the composition of *P* modify the social comparison space of the individuals who remain in *P*. Specifically, when individuals depart from *P*, the social space of the remaining members of the population shrinks. The change in the social space brings about changes in the optimal levels of work effort exerted by (some) non-migrating individuals because, as seen in **(10)**, the optimal levels of work effort depend on the fraction of the individuals higher up in the effort / income hierarchy. We assume that the changes in work effort leave intact the order of the stayers by effort / income. As the work effort exerted by the individuals in P translates into their output, the population's per capita output will be affected.

Claim 1. *Let* $n > 2$. *Let the fraction of the individuals who are positioned higher than individual* i *in the effort / income hierarchy increase. Then* $e_i*(\cdot)$, *the optimal effort of individual* $i \in \{1,...,n-1\}$, *increases.*

Proof. To assess how changes in the fraction of the individuals higher up in the effort / income hierarchy influence the choice of work effort, we calculate the partial derivatives of $e_i*(\cdot)$ in **(10)** with respect to $\left(\frac{n-i}{n}\right)$, using the implicit function theorem.[5] The partial derivatives of $e_i*(\cdot)$ are obtained from

$$\frac{\partial e_i*}{\partial x_i} = -\frac{\frac{\partial Z_i(\cdot)}{\partial x_i}}{\frac{\partial Z_i(\cdot)}{\partial e_i*}}, \qquad \textbf{(11)}$$

where, referring to **(9)** and **(10)**, for $i \in \{1,...,n-1\}$:

$x_i = \left\{\alpha_i, \beta_i, \frac{n-i}{n}\right\}$ and $Z_i\left(e_i*, \alpha_i, \beta_i, \frac{n-i}{n}\right) \equiv \alpha_i f'(e_i*) - \beta_i g'(e_i*) + \gamma_i \frac{n-i}{n} = 0$,

and for $i = n$:

$x_i = \{\alpha_i, \beta_i\}$ and $Z_i(e_i*, \alpha_i, \beta_i) \equiv \alpha_i f'(e_i*) - \beta_i g'(e_i*) = 0$.

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[5] For a large n, $\frac{n-i}{n}$ is approximately a continuous variable. We calculate the derivatives of the optimal effort, e_i*, with respect to $\frac{n-i}{n}$, as an approximation, because our interest is merely to find out the sign of the change, rather than to determine the absolute value of the change.

Because for $i \in \{1,...,n-1\}$

$$\frac{\partial Z_i(\cdot)}{\partial e_i^*} = \alpha_i f''(e_i^*) - \beta_i g''(e_i^*), \tag{12}$$

and

$$\frac{\partial Z_i(\cdot)}{\partial\left(\frac{n-i}{n}\right)} = \gamma_i, \tag{13}$$

we obtain that

$$\frac{\partial e_i^*}{\partial\left(\frac{n-i}{n}\right)} = -\frac{\gamma_i}{\alpha_i f''(e_i^*) - \beta_i g''(e_i^*)} > 0, \tag{14}$$

where the inequality sign in **(14)** follows from the assumptions that $\alpha_i > 0$, $\beta_i > 0$, $\gamma_i > 0$, $f''(\cdot) < 0$, and $g''(\cdot) > 0$. The meaning of **(14)** is that changes in the social space which cause the fraction of the individuals higher up in the effort / income hierarchy to increase (decrease) induce the relatively deprived members of *P* who stay behind to exert more (less) work effort.[6] Q.E.D.

Suppose that a member of *P* migrates, leaving at the same time the social comparison space of the remaining members of the population. And suppose that the migrating individual was the least hard-working individual (individual 1). Then for individuals $i \in \{2,...,n-1\}$ remaining in *P*, the fraction of the individuals whose incomes are higher than theirs increases: $\frac{n-1-(i-1)}{n-1} = \frac{n-i}{n-1} > \frac{n-i}{n}$. Therefore, as implied by **(14)**, these individuals increase their work effort. Assuming that the increase in the work effort of individuals $2,...,n-1$ is such that

[6] As noted at the beginning of this section, we assume that adjustments to the work effort made in the wake of a departure leave unchanged the ordering by effort / income of the stayers.

individual *n* remains the individual who works hardest, the optimal work effort of individual *n* does not change. Consequently, in the wake of the departure, per capita output increases.

A lesson drawn from this possibility is that the output of the members of the population is affected by the migration of a member *even when the production of any member is not carried out jointly with the departing individual*. Because the per capita output of the population may increase on the departure of one of its members, the *aggregate* post-migration output of the population can increase as well.

The effect of migration on per-capita output in the case under discussion does not arise because individuals compare themselves with the least hard-working individual who migrates: as exhibited by the measure of relative deprivation, they compare themselves with the individuals who are higher up in the income hierarchy. An increase in relative deprivation arises from the increase in the fraction of those higher up.

Remark 1. The result reported in Claim 1 will hold if several of the least hard-working individuals also migrate, say individuals $1, 2,..., l-1, l$, where $l << n-1$. The effect on per capita output of such migration will be even stronger than the effect on per capita output of the migration of a single individual because the increase in the fraction of the individuals higher up in the income hierarchy will be larger.

Remark 2. The result reported above is robust to an alternative way of measuring relative deprivation. For instance, we can define relative deprivation as the distance from below the average effort of the population, namely as

$$RD_i \equiv \begin{cases} \bar{E} - e_i & \text{for } i : e_i < \bar{E} \\ 0 & \text{for } i : e_i \geq \bar{E}, \end{cases} \qquad \textbf{(15)}$$

where $\bar{E}$ is the average effort in the population. By construction, $\bar{E}$ depends on the effort of individual i. A departure from the population of any individual whose effort level is lower than $\bar{E}$ will result in first-order replacement of $\bar{E}$ with a higher value. In this case, the effect of migration on relative deprivation will be the same as that based on the measure of relative deprivation defined in **(2)**: migration of the least hard-working individual will increase relative deprivation and, consequently, will increase per capita output.

Remark 3. In the proposed model, departure from the village has consequences not only for the optimal effort of those staying behind, but also for their relative risk aversion. To see that, consider the standard Arrow-Pratt coefficient of relative risk aversion

$$r_i(e_i) = \frac{-e_i U_i''(e_i)}{U_i'(e_i)},$$

expressed here in terms of effort. Using equations **(5)** and **(6)** for $i \in \{1,...,n-1\}$, this coefficient can be written as

$$r_i(e_i) = -\frac{e_i\left(\alpha_i f''(e_i) - \beta_i g''(e_i)\right)}{\alpha_i f'(e_i) - \beta_i g'(e_i) + \gamma_i \dfrac{n-i}{n}}. \tag{16}$$

The derivative of $r_i(e_i)$ with respect to $\dfrac{n-i}{n}$ is given by

$$\frac{\partial r_i(e_i)}{\partial\left(\dfrac{n-i}{n}\right)} = \frac{\gamma_i e_i\left(\alpha_i f''(e_i) - \beta_i g''(e_i)\right)}{\left(\alpha_i f'(e_i) - \beta_i g'(e_i) + \gamma_i \dfrac{n-i}{n}\right)^2}. \tag{17}$$

As follows from the assumptions about the properties of the functions $f(e_i)$ and $g(e_i)$, the sign of this derivative is negative. (It is noteworthy that this negative sign will hold if, instead, we were to calculate the derivative at the optimal level of effort. The reason is that as follows from **(14)**, the optimal effort depends positively on the fraction of the harder-working individuals.) It follows then that migration of the least hard-working individual will reduce the relative risk aversion of other individuals in the village. In this case, there could be a compounding productivity-raising effect as when, for example, greater willingness to bear risks results in the adoption of riskier yet on average higher yields methods of production.

4. CONCLUSIONS

We showed how social interactions can lead to production externalities: even when individuals' production is not joint in the technical sense, social preferences render production joint in the sense that the presence in the population or the absence from the population of an individual affects the output of the other individuals in the population.

We model how individuals decide how much work effort to exert, taking into account heterogeneity of their preferences. We apply the model to departures, asking how departures impact on the work effort choices made by individuals whose social space is affected by the departures. We find that when individuals care about how, in terms of income, they fare in comparison with others, the individuals who stay adjust their work effort to the changes in their social space brought about by the departures. Consequently, output is affected. In particular, we show that when the least hard-working individual departs from the population, the per capita output of the remaining population increases.

Does the departure of the least hard-working individual not increase the per capita output of the remaining population because of the way in which per capita output is defined, namely as an average? Our social space modification effect can be differentiated quantitatively from the straightforward average effect, even though the two effects result in a move in the same direction. Suppose that we have individuals in the population who produce 1, 2, and 3. When the individual producing 1 leaves, average output goes up from two to two and a half. But if we observe that the average output goes up by more, which happens because the individual producing 2 experiences increasing relative deprivation (going up from one third to one half) and works harder to reduce the increased disutility from having low relative income, then we know that the social space modification effect is operating.

It is straightforward to see that a similar reasoning applies to the effect of the departure of the least hard-working individual on the inequality of the income distribution in the village; it is reduced two-fold.

Although we have studied negatively selective migration, an analogous reasoning applies to the case of positively selective migration where it is the hardest working individual who departs. As could be expected, in such a case the per capita output in the village will decline due to the decrease in the relative deprivation of the non-migrants. The formal reasoning is as follows. When the departing individual is individual *n*, then for every individual $i \in \{1,...,n-1\}$ remaining in *P*, the fraction of the individuals whose income is higher than his decreases: $\frac{n-1-i}{n-1} = 1 - \frac{i}{n-1} < 1 - \frac{i}{n} = \frac{n-i}{n}$. Therefore, as implied by **(14)**, these individuals decrease their work effort. Consequently, in the wake of the departure, per capita output decreases.

How does the modeling approach pursued in the current paper align with considerations of geographical space, social space, and comparison groups, as well as with notions of symmetry? In general, we can think of three types of migrating units: individuals, families, and individuals as members of families who stay behind. If the migrants who depart are of the first two types, then detachment from the village can be conceived as complete: the revision of geographical space coincides with the revision of the social space and the comparison group. If the migrants are members of families who stay behind and, as already noted, this characterization is at the heart of research alluded to in and following “The new economics of labor migration” (Stark and Bloom, 1985), then the migrant will not cease referring to the village of origin as a comparison group. But this consideration does not disrupt our reasoning. For our purposes what is important is that those who stay behind do not continue to refer to the migrant as if he were a fellow villager who stays behind (perhaps, and for example, because his income is not easily observed anymore). Nonetheless, will the validity of our finding in Claim 1 be compromised if we remove the assumption that the least hard-working migrating individual departs from the social comparison space of the remaining members of the population? Not necessarily. Suppose that the remaining members continue to consider the departing individual as "one of their own," and suppose that the individual's income increases upon migration, for example to a level higher than that of the remaining individuals. It follows that in terms of increased relative deprivation, the remaining individuals are "penalized" doubly; therefore, our finding in Claim 1 will merely be strengthened. There is a more subtle consideration to bear in mind here, which relates to the influence that migration can have on the preferences of the individuals who stay behind, for example by demonstrating that working harder is more rewarding than was believed before. By the model's construction, this consequence was not allowed to happen because, and as already noted, α_i, β_i, and γ_i are taken to be fixed. That said, one way of admitting the possible influence of migrants' experience, perceptions, and perspectives on the references of those who stay behind, while retaining the integrity of the analysis performed in the paper, would be to consider the latter as a short-term response, with a possibly reinforcing impact in the longer run.

Concern about low relative income can vary across societies and over time. When social comparisons are intense and concern about experiencing low relative income is strong, the effects described in this paper will be evident, less so when social comparisons are loose and relative income concerns are limited.

Although the effects highlighted in the paper relate to production in village and plausibly to other small economies, they can apply to other small populations, such as a community or a school class, where incentives are influenced by social comparisons. For example, in the case of a school class, the transfer of a poorly-performing student could induce the remaining students to study more diligently.

APPENDIX. BACKGROUND INFORMATION ON THE CONCEPT OF RELATIVE DEPRIVATION

A.1 A brief history of relative deprivation in economics

Considerable economic analysis has been inspired by the sociological-psychological concepts of relative deprivation (*RD*) and reference groups. Economists have come to consider these concepts as fitting tools for studying comparisons that affect an individual's behavior, in particular, comparisons with related individuals whose incomes are higher than his own income (consult the large literature spanning from Duesenberry, 1949, to, for example, Clark et al., 2008). An individual has an unpleasant sense of being relatively deprived when he lacks a desired good and perceives that others in his reference group possess that good (Runciman, 1966).[7] Given the income distribution of the individual's reference group, the individual's *RD* is the sum of the deprivation caused by every income unit that he lacks (Yitzhaki, 1979; Hey and Lambert, 1980; Ebert and Moyes, 2000; Bossert and D'Ambrosio, 2006; Stark and Hyll, 2011).

The pioneering study in modern times that opened the flood-gates to research on *RD* and primary (reference) groups is the 1949 two-volume set of Stouffer et al. *Studies in Social Psychology in World War II: The American Soldier.* That work documented the distress caused not by a given low military rank and weak prospects of promotion (military police) but rather by the pace of promotion of others (air force). It also documented the lesser dissatisfaction of black soldiers stationed in the South who compared themselves with black civilians in the South than the dissatisfaction of their counterparts stationed in the North who compared themselves with black civilians in the North. Stouffer's research was followed by a large social-psychological literature. Economics has caught up relatively late, and only

[7] In Runciman's (1966) theory of *RD*, an individual's reference group is the group of individuals with whom the individual compares himself (consult Singer, 1981).

somewhat. This is rather surprising because eminent economists in the past understood well that people compare themselves to others around them, and that social comparisons are of paramount importance for individuals' happiness, motivation, and actions. Even Adam Smith (1776) pointed to the social aspects of the necessities of life, and stressed the *relative* nature of poverty: "A linen shirt, for example, is, strictly speaking, not a necessary of life. The Greeks and Romans lived, I suppose, very comfortably, though they had no linen. But in the present times, through the greater part of Europe, a creditable day-laborer would be ashamed to appear in public without a linen shirt, the want of which would be supposed to denote that disgraceful degree of poverty […]" (p. 465). Marx's (1849) observations that "Our wants and pleasures have their origin in the society; [… and] they are of a relative nature" (p. 33) emphasize the social nature of utility, and the impact of an individual's relative position on his satisfaction. Inter alia, Marx wrote: "A house may be large or small; as long as the surrounding houses are equally small, it satisfies all social demands for a dwelling. But if a palace arises beside the little house, the house shrinks into a hut" (p. 33). Samuelson (1973), one of the founders of modern neoclassical economics, pointed out that an individual's utility does not depend only on what he consumes in *absolute* terms: "Because man is a social animal, what he regards as 'necessary comforts of life' depends on what he sees others consuming" (p. 218).

The relative income hypothesis, formulated by Duesenberry (1949), posits an asymmetry in the comparisons of income which affect the individual's behavior: the individual looks upward when making comparisons. Veblen's (1899) concept of *pecuniary emulation* explains why the behavior of an individual can be influenced by comparisons with the incomes of those who are richer. Because income determines the level of consumption, higher income levels may be the focus for emulation. Thus, an individual's income aspirations (to obtain the income levels of other individuals whose incomes are higher than his own) are shaped by the perceived consumption standards of the richer individuals. In that way, invidious comparisons affect behavior, that is, behavior which leads to "the achievement of a favourable comparison with other men [...]" (Veblen, 1899, p. 33).[8]

A.2 The rationale and construction of a measure of relative deprivation

Several recent insightful studies in social psychology (for example, Callan et al., 2011; Smith et al., 2012) document how sensing *RD* impacts negatively on personal wellbeing, but these studies do not provide a calibrating procedure; a sign is not a magnitude. For the purpose of constructing a measure, a natural starting point is the work of Runciman (1966), who, as already noted in the preceding section, argued that an individual has an unpleasant sense of being relatively deprived when he lacks a desired good and perceives that others with whom he naturally compares himself possess that good. Runciman (1966, p. 19) writes as follows: "The more people a man sees promoted when he is not promoted himself, the more people he may compare himself with in a situation where the comparison will make him feel deprived," thus implying that the deprivation from not having, say, income y is an increasing function of the fraction of people in the individual's reference group who have y. To aid intuition and for the sake of concreteness, we resort to income-based comparisons, namely an individual feels relatively deprived when others in his comparison group earn more than he does. An implicit assumption here is that the earnings of others are publicly known. Alternatively, we can think of consumption, which might be more publicly visible than income, although these two variables can reasonably be assumed to be strongly positively correlated.

[8] The empirical findings support the relative income hypothesis. Duesenberry (1949) found that individuals' savings rates depend on their positions in the income distribution, and that the incomes of the richer people affect the behavior of the poorer ones (but not *vice versa*). Schor (1998) showed that, keeping annual and permanent income constant, individuals whose incomes are lower than the incomes of others in their community save significantly less than those in their community who are relatively better off.

Let $y=(y_1,...,y_m)$ be the vector of incomes in population *N* of size *n* with relative incidences $p(y)=\left(p(y_1),...,p(y_m)\right)$, where $m\le n$ is the number of distinct income levels in *y*. The *RD* of an individual earning y_i is defined as the weighted sum of the excesses of incomes higher than y_i such that each excess is weighted by its relative incidence, namely

$$RD_N(y_i)\equiv\sum_{y_k>y_i}p(y_k)(y_k-y_i)\,. \qquad \textbf{(A1)}$$

We expand the vector y to include incomes with their possible respective repetitions, that is, we include each y_i as many times as its incidence dictates, and we assume that the incomes are ordered, that is, $y=(y_1,...,y_n)$ such that $y_1\le y_2\le...\le y_n$. In this case, the relative incidence of each y_i, $p(y_i)$, is $1/n$, and $RD_N(y_i)\equiv\sum_{y_k>y_i}p(y_k)(y_k-y_i)$, defined for $i=1,...,n-1$, becomes

$$RD_N(y_i)\equiv\frac{1}{n}\sum_{k=i+1}^{n}\left(y_k-y_i\right).$$

Looking at incomes in a large population, we can model the distribution of incomes as a random variable *Y* over the domain $[0,\infty)$ with a cumulative distribution function *F*. We can then express the *RD* of an individual earning y_i as

$$RD_N\left(y_i\right)=\left[1-F(y_i)\right]\cdot E\left(Y-y_i\mid Y>y_i\right). \qquad \textbf{(A2)}$$

To obtain this expression, starting from **(A1)**, we have that

$$
\begin{aligned}
RD_N(y_i) &\equiv \sum_{y_k > y_i} p(y_k)(y_k - y_i) \\
&= \sum_{y_k > y_i} p(y_k)y_k - y_i \sum_{y_k > y_i} p(y_k) \\
&= [1 - F(y_i)] \sum_{y_k > y_i} \frac{p(y_k)y_k}{[1 - F(y_i)]} - y_i[1 - F(y_i)] \\
&= [1 - F(y_i)]E(Y \mid Y > y_i) - [1 - F(y_i)]y_i \\
&= [1 - F(y_i)]E(Y - y_i \mid Y > y_i).
\end{aligned}
$$

The formula in **(A2)** states that the *RD* of an individual whose income is y_i is equal to the product of two terms: $1 - F\left(y_i\right)$, which is the fraction of those individuals in the population of n individuals whose incomes are higher than y_i, and $E(Y - y_i \mid Y > y_i)$, which is the mean excess income.

The formula in **(A2)** is quite revealing because it casts *RD* in a richer light than the ordinal measure of rank or, for that matter, even the ordinal measure of status, which have been studied intensively in sociology and beyond. The formula informs us that when the income of individual A is, say, 10, and that of individual B is, say, 16, the *RD* of individual A is higher than when the income of individual B is 15, even though, in both cases, the rank of individual A in the income hierarchy is second. The formula also informs us that more *RD* is sensed by an individual whose income is 10 when the income of another is 14 (*RD* is 2) than when the income of each of four others is 11 (*RD* is $\frac{4}{5}$), even though the excess income in both cases is 4. This property aligns nicely with intuition: it is more painful (more stress is experienced) when the income of half of the population in question is 40 percent higher, than when the income of $\frac{4}{5}$ of the population is 10 percent higher. In addition, the formula in **(A2)** reveals that even though *RD* is sensed by looking to the right of the income distribution, it is impacted by events taking place on the left of the income distribution. For example, an exit from the population of a low-income individual increases the *RD* of higher-income individuals (other than the richest) because the weight that the latter attach to the difference between the incomes of individuals “richer” than themselves and their own income rises.

Similar reasoning can explain the demand for positional goods (Hirsch, 1976). The standard explanation is that this demand arises from the unique value of positional goods in elevating the social status of their owners (“These goods [are] sought after because they compare favorably with others in their class.” Frank, 1985, p. 7). The distaste for relative deprivation offers another explanation: by acquiring a positional good, an individual shields himself from being leapfrogged by others which, if that were to happen, would expose him to *RD*. Seen this way, a positional good is a form of insurance against experiencing *RD*.

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