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Remittances and inequality: a dynamic migration model[¤]

by

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1 Introduction

The economic analysis of migrants' remittances has traditionally been divided into two parts.[1] At a micro level, an impressive body of work endeavors to understand remittance behavior and motivations to remit. Remittances are now well recognized as part of an informal familial arrangement that goes well beyond altruism, with benefits in the realms of mutual insurance, consumption smoothing, and alleviation of liquidity constraints.[2] At a macro level, the short-run effects of remittances have been analyzed mainly within the framework of trade-theoretic models (e.g., Djajic, 1986, McCormick and Wahba, 2000); at the same time, a series of recent studies have demonstrated the growth potential of migration in a context of capital market imperfections, with remittances and savings accumulated abroad allowing households at the middle-to-bottom end of the wealth distribution to accumulate productive assets (e.g., Lucas, 1987, Rozelle et al., 1999) and access to self-employment and entrepreneurship.[3] Another strand of the literature has been concerned with the impact of international migration on income inequality at origin. For example, Adams (1989) found that international migration tends to worsen economic inequality in rural Egypt, while the same author found a neutral effect in rural Pakistan (Adams, 1992). In the case of rural Mexico, Taylor and Wyatt (1996) showed that remittances are distributed almost evenly across income groups, hence inducing a direct equalizing effect in terms of economic inequality. In addition, they also showed

[1] For a survey on the economics of migrants' remittances, see Rapoport and Docquier (2003).

[2] In particular, the 'investment hypothesis', according to which remittances must be seen as repayments of familial loans aimed at financing investments in education and/or migration, has recently received strong empirical support (Lucas and Stark, 1985, Poirine, 1997, Cox *et al.*, 1998, Ilahi and Jafarey, 1999).

[3] For recent case-studies on return migration and access to entrepreneurship, see Ilahi (1999) on Pakistan, McCormick and Wahba (2001) on Egypt, Woodruff and Zenteno (2001) on Mexico, Mesnard and Ravallion (2001) on Tunisia, or Dustmann and Kirchkamp (2002) on Turkey.

that remittances have the highest shadow value for households at the middle-to-low-end of the income distribution; for such households indeed, remittances allow for accessing to productive assets (land) and/or complementary inputs; a second equalizing effect is thereby obtained. This suggests that the impact of remittances on rural development depends not only on the initial distribution of wealth in the origin community, but also on a host of factors affecting their shadow value (e.g., degree of liquidity of land rights, costs of complementary inputs, availability of local labor, etc.). In their study of remittances to a small coastal city of Nicaragua, Barham and Boucher (1998) also find that remittances apparently decrease income inequality. However, using different no-migration counterfactuals to control for self-selection into migration and local labor-force participation, they show that in reality remittances increase income inequality; this is explained by the fact that the potential home earnings of erstwhile migrants have a more equalizing effect on income distribution than remittances.

The impact of remittances in terms of economic inequality, however, needs not be monotonic. Stark, Taylor and Yitzhaki (1986 and 1988) emphasized that remittances tend to reduce economic inequality at origin, but suggested that the dynamics of migration and remittances may be represented by an inverse U-shaped relationship: in the presence of liquidity constraints and initially high migration costs, high-income groups only can access higher income opportunities abroad and, consequently, remittances tend to increase inter-household inequality; as the number of migrants increases, migration costs tend to decrease thanks to the role of migrants' networks, thus making migration affordable to low-income households so that ultimately economic inequality at origin decreases. Their analysis was based on the decomposition of a Gini index of household income per income sources, taking account of the correlations between different income components. The method was applied to household data from two Mexican villages, one with a relatively recent Mexico-to-US migration experience, and one with a longer migration history. The distributional impact of remittances was shown to depend on the village's migration history, which implicitly captures the magnitude of migration costs.[4] They showed that income dispersion was decreased in both villages once migrants' remittances were taken into account, but more so in the village characterized by a longer migration tradition. With a similar approach applied to Yugoslavia, Milanovic (1987) also tested for the possibility of such a "trickle-down" effect. Using inter-temporal data from the 1973, 1978 and 1983 Yugoslavian household surveys, Milanovic found no empirical support for this hypothesis. Indeed, his results were that remittances tend to raise income inequality, although their effects differ over the periods and social categories considered (it was mainly for agricultural households that such an inequality-enhancing effect over time was found). Finally, Taylor's (1992) longitudinal study of a Mexican village shows that remittances may well have an inequality-enhancing effect in the short-run and yet contribute to decrease income inequality in the long-run in allowing poor rural households to transform remittance income into productive assets.

On the whole, cross-sectional as well as panel data studies of remittances and inequality do not offer a decisive conclusion as to whether international migration increases or decreases economic inequality at origin. This may be attributed to the diversity of the environments studied in terms of initial inequality, as well as to differences in the empirical methodologies implemented: static v. dynamic

[4] Treating migration costs as exogenous may be adapted to situations where migration costs mainly include transportation and border crossing expenditures, but is clearly unsatisfactory when information costs (e.g., search process for a destination, and a job at destination) are substantial; in this case, it is well known that migration costs tend to decrease as the size of the relevant network at destination increases. Such network effects have first been recognized in the sociological literature (e.g, Massey et al., 1994) and, more recently, in the economic literature (Carrington et al., 1996, Munshi, 2003).

studies with or without endogenous migration costs, and whether remittances must be treated as a substitute for domestic earnings, in which case the effect of migration on domestic income sources must also be taken into account. In this paper we propose a dynamic framework that goes part of the way towards reconciling the conflicting results of the empirical literature. We first qualify different regimes of low, middle and high initial inequality which condition the dynamics of migration and inequality in the migrants' origin communities. A notable feature of the model is that we take into account the impact of migration on local (rural) wages, and investigate whether domestic wages responses reinforce or offset the inequality-effect of remittances per se. Finally, while we treat migration costs as exogenous, we also explore the effect of decreasing migration costs, possibly through migration network effects. Recall that the main implication of the network hypothesis is that the impact of remittances on economic inequality is likely to vary over time since migration may be viewed as a diffusion process with decreasing information costs. We complement this view in showing that the same results may be obtained in a dynamic framework with exogenous (i.e., constant) migration costs.

The remainder of this paper is organized as follows. In Section 2 we build a model with two classes of agents characterized by different wealth (e.g., land) endowments; this determines the household members' labor productivity, labor-supply or demand on the local labor market, and migration decisions. As to the dynamics of the model, we make the classical assumption that familial wealth is an asset accumulated over time and transmitted to future generations. In the rural regions, this asset generally takes the form of a plot of land, the quality and quantity of which determines the family's income potential and migration incentives. Obviously, migration incentives would seem to be stronger for poor households (since the productivity of their members in familial activities is lower), but richer households are less constrained; as a result, the exact composition of migration flows in terms of social origin is a priori unclear.[5] In Sections 3 and 4, we characterize three regimes of low, medium and high-inequality and investigate how migration and subsequent remittances affect the level of inter-household inequality. We show that migration always decreases the wealth inequality ratio (at least if poor households have a minimal access to migration) but may either increase or decrease income inequality, depending on the initial distribution of wealth. Moreover, short-run and long-run effects on the income distribution may be of opposite signs, meaning that the dynamics of intergenerational wealth accumulation may well generate an inverse U-shaped relationship between migration and income inequality. This is similar - but differently motivated - to the migration networks hypothesis, and suggests that the presence of such network effects must be tested for directly rather than inferred from the observation of lower inequality levels within communities with a longer migration tradition.

2 The model

Consider a rural economy with two classes of households characterized by different wealth endowments and, consequently, different intrinsic levels of productivity in the familial activity. Low-productivity households and high-productivity households are denoted by LP and HP, respectively. These households consist of a given number of one-period-lived agents making their living from agriculture. Without loss of generality, the size of each household is normalized to unity.

[5] Migrations decisions may also be affected by the level of information on foreign opportunities, which may be related to skills and income, or by incentive compatibility constraints (e.g., wealthy households have a stronger enforcement power to secure remittance through inheritance - see for example Hoddinott, 1994, or de la Briere et al., 2002). Although important, these aspects are not dealt with in this paper.

The proportion of LP households is time-invariant and denoted by ρ. Total familial output in agriculture depends on two elements:

- the quantity and quality of familial land: these characteristics are captured by a technological parameter α equal to $\overline{\alpha}$ for HP households and $\underline{\alpha}$ for LP households, with $\overline{\alpha} > \underline{\alpha} > 1$;
- the proportion of households members employed in the domestic activity. In a closed economy, there is no external migration but we assume that a fraction $n \in [0, 1]$ of LP households may be employed in HP farms.

We assume a quadratic production function for each family.[6] We write:

$$\underline{q}_t = \underline{\alpha}(1 - n_t) - \frac{(1 - n_t)^2}{2} \quad (1a)$$

$$\overline{q}_t = \overline{\alpha}(1 + \rho n_t) - \frac{(1 + \rho n_t)^2}{2} \quad (1b)$$

where the negative term captures the decreasing marginal productivity of labor. For mathematical convenience, we assume that the scale parameter α only affects the linear term.

LP households determine their labor supply (n_t^s) on the local (rural) labor market by maximizing total income, $\underline{y}_t = \underline{q}_t + n_t w_t$, where w_t measures the equilibrium wage rate on the local labor market at time t. This gives

$$n_t^s = \begin{array}{l} 0 \; if \;\; w_t \leq \underline{\alpha} - 1 \\ 1 + w - \underline{\alpha} \; if \; \underline{\alpha} - 1 < w_t < \underline{\alpha} \\ 1 \; if \;\; w_t \geq \underline{\alpha} \end{array} \quad (2)$$

HP households select their labor demand (n_t^d) on the local labor market by maximizing their profit, $\overline{y}_t = \overline{q}_t - \rho n_t w_t$. This gives

$$n_t^d = \begin{array}{l} 0 \; if \;\; w_t \geq \overline{\alpha} - 1 \\ \frac{\overline{\alpha} - w_t - 1}{\rho} \; if \; \overline{\alpha} - (1 + \rho) < w_t < \overline{\alpha} - 1 \\ 1 \; if \; w_t \leq \overline{\alpha} - (1 + \rho) \end{array} \quad (3)$$

[6] With a quadratic function, the marginal productivity of labor is bounded from above. This avoids unrealistic solutions where a very small proportion of household members stays in the familial farm with a very high marginal productivity.

Two types of solution may be obtained (see fig. 1):

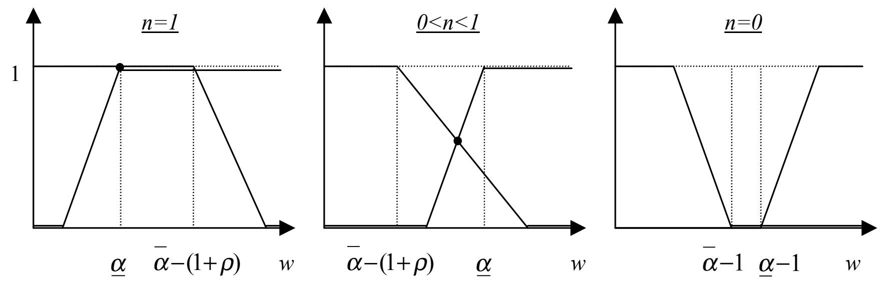
- if $\overline{\alpha} - (1+\rho) \geq \underline{\alpha}$ (the minimal marginal labor productivity in HP farms exceeds the maximal labor productivity in LP farms), all LP members are employed by HP households and receive a time invariant wage $\underline{\alpha}$ (see the left diagram on Fig. 1);

- if $\overline{\alpha} - (1+\rho) < \underline{\alpha}$, the proportion of LP households employed in HP farms is positive but lower than one (see the central diagram on Fig. 1). Equalizing the labor demand and supply gives:

$$\begin{aligned} w_t &= \frac{\overline{\alpha} + \rho\underline{\alpha}}{1+\rho} - 1 < \underline{\alpha} \\ n_t &= \frac{\overline{\alpha} - \underline{\alpha}}{1+\rho} < 1 \end{aligned}$$

- Note that a solution with $n = 0$ (or with negative labor flows) is ruled out by assumption since it would require $\overline{\alpha} < \underline{\alpha}$ (see the right diagram on Fig. 1).

Fig. 1. The closed economy labor market equilibrium



Since we are primarily interested in the characterization of inter-household inequality and not in the intra-household distribution of income, we assume that income is equally shared between the members of a given family. The utility function of each household depends on the consumption per member and on the assets bequeathed to the next generation. Assuming a Cobb-Douglas utility function:

$$\underline{u}_t = (\underline{x}_t - x_m)^{1-\sigma}\ \underline{b}_{t+1}^{\sigma} \tag{4a}$$

$$\overline{u}_t = (\overline{x}_t - x_m)^{1-\sigma}\ \overline{b}_{t+1}^{\sigma} \tag{4b}$$

where $\underline{x}_t$ and $\overline{x}_t$ represent the consumption per member in LP and HP households, $x_m \geq 0$ denotes a given minimum of subsistence for each agent, $\underline{b}_{t+1}$ and $\overline{b}_{t+1}$ measure the amounts bequeathed to generation $t+1$, and $\sigma \in [0,1]$ is a parameter of intergenerational altruism.

Utility is maximized subject to the closed economy budget constraint:

$$\underline{x}_t + \underline{b}_{t+1} = \underline{y}_t + \underline{b}_t \tag{5a}$$

$$\overline{x}_t + \overline{b}_{t+1} = \overline{y}_t + \overline{b}_t \tag{5b}$$

This gives:

$$\underline{x}_t = (1-\sigma)(\underline{y}_t + \underline{b}_t) + \sigma x_m; \quad \underline{b}_{t+1} = \sigma(\underline{y}_t + \underline{b}_t - x_m) \tag{6a}$$

$$\overline{x}_t = (1-\sigma)(\overline{y}_t + \overline{b}_t) + \sigma x_m; \quad \overline{b}_{t+1} = \sigma(\overline{y}_t + \overline{b}_t - x_m) \tag{6b}$$

These first order conditions determine the dynamics of assets transmission for each type of household. Since the closed economy wage rate is time invariant, the equilibrium flows of income are also time invariant ($\underline{y}_t = \underline{y}$ and $\overline{y}_t = \overline{y}$). Given that $\sigma < 1$, the steady state levels of wealth are given by $\underline{b}_{ss} = \frac{\sigma(\underline{y}-x_m)}{1-\sigma}$ and $\overline{b}_{ss} = \frac{\sigma(\overline{y}-x_m)}{1-\sigma}$, leading to the following wealth-inequality ratio:

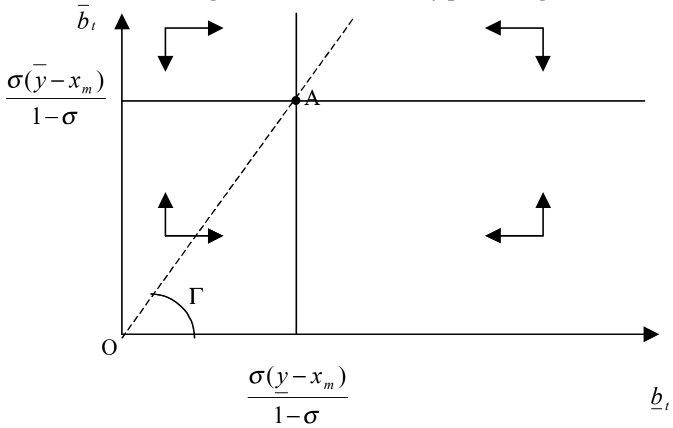
$$\Gamma_{ss}^{b} = \frac{\overline{b}_{ss}}{\underline{b}_{ss}} = \frac{\overline{y} - x_m}{\underline{y} - x_m} \tag{7}$$

Figure 2 represents the phase diagram for the closed economy: the steady state corresponds to point A. This wealth-inequality ratio can be measured by the slope of the segment OA. In the long-run, the relation between the wealth ratio and the income ratio ($\Gamma_{ss}^{y} = \underline{y}/\overline{y}$) is given by

$$(1-\gamma_{ss})\Gamma_{ss}^{b} = \gamma_{ss}\Gamma_{ss}^{y} - \gamma_{ss} \tag{8}$$

where $\gamma_{ss} = x_m/\underline{y}$ measures the share of the subsistence level of consumption in total income for LP households.

Fig. 2. The closed economy phase diagram



Using (6a-6b), the steady state amount of consumption equals the amount of income in each household. For each type of household, the steady-state level of utility may thus be written as:

$$\underline{u}_{ss} = \left[\frac{\sigma}{1-\sigma}\right]^{\sigma}(\underline{y}-x_m)$$
$$\overline{u}_{ss} = \left[\frac{\sigma}{1-\sigma}\right]^{\sigma}(\overline{y}-x_m)$$

Hence, the steady-state utility-inequality ratio equals to the steady-state wealth-inequality ratio ($\Gamma_{ss}^{u} = \frac{\overline{u}_{ss}}{\underline{u}_{ss}} = \Gamma_{ss}^{b}$). Both Γ_{ss}^{y} and Γ_{ss}^{b} are possible measures of inter-household inequality.

In the closed economy, the income-inequality ratio is time invariant. Using the above results, two cases emerge:

(i) if $\overline{\alpha} - 1 - \rho > \underline{\alpha}$ (and hence $n_t = 1$), we have

$$\Gamma_t^y = \Gamma_{ss}^y = \frac{\underline{\alpha}}{\overline{\alpha}(1+\rho) - \frac{(1+\rho)^2}{2} - \rho\underline{\alpha}}$$

(ii) if $\overline{\alpha} - 1 - \rho < \underline{\alpha}$ (and hence $n_t \in [0,1]$), we have

$$\Gamma_t^y = \Gamma_{ss}^y = \frac{\underline{\alpha}(1 - \frac{\overline{\alpha}-\underline{\alpha}}{1+\rho}) - \frac{1}{2}(1 - \frac{\overline{\alpha}-\underline{\alpha}}{1+\rho})^2 + \frac{\overline{\alpha}-\underline{\alpha}}{1+\rho}\left(\frac{\overline{\alpha}+\rho\underline{\alpha}}{1+\rho} - 1\right)}{\overline{\alpha}(1 + \rho\frac{\overline{\alpha}-\underline{\alpha}}{1+\rho}) - \frac{1}{2}(1 + \rho\frac{\overline{\alpha}-\underline{\alpha}}{1+\rho})^2 - \rho\frac{\overline{\alpha}-\underline{\alpha}}{1+\rho}\left(\frac{\overline{\alpha}+\rho\underline{\alpha}}{1+\rho} - 1\right)}$$

However, the households' assets and utility evolve over time according to the dynamics of wealth. The wealth ratio and the utility ratio are not time invariant. In the next section, we explore: (i) how the slope of the segment OA (measuring the steady state level of inequality) may be affected by migration and remittances, and, (ii) how inequality evolves on the transition path.

3 Openness to migration

Let us now assume that there is a migration possibility to a high-wage destination (foreign country or urban area). The foreign (or urban) wage per migrant, w^*, is given (i.e., the home country is small enough to keep foreign wages unaffected by migration). The familial motivation for sending out migrants is to increase total family income. Migration by some members is an implicit familial arrangement involving: (i) collective financing of migration costs, and, (ii) remittances from the migrants to the remaining household members.

Each migrant incurs a fixed migration cost c, and we assume the net-of-migration-cost foreign wage $(w^* - c)$ to be higher than $\underline{\alpha}$, the maximal wage rate in the closed domestic economy. Due to credit markets imperfections, migration costs must be financed using the family's financial assets.

Low-productivity households. The optimization problem of LP households consists in selecting their labor supply and share of migrants so as to maximize the total income of the group:

$$[n_t, \underline{m}_t] = Arg\max\left\{\underline{\alpha}(1-n_t-\underline{m}_t) - \frac{(1-n_t-\underline{m}_t)^2}{2} + n_t w_t + \underline{m}_t(w^*-c)\right\}$$

subject to $\underline{m}_t c \leq \underline{b}_t$. The first order conditions are given by:

$$-\underline{\alpha} + 1 - n_t - \underline{m}_t + w_t \gtreqqless 0 \quad (10a)$$

$$-\underline{\alpha} + 1 - n_t - \underline{m}_t + w^* - c \gtreqqless 0 \quad (10b)$$

Obviously, these two equations cannot be simultaneously solved with equality. If the liquidity constraint is not binding, and given the assumption that $w^* - c > \underline{\alpha} \geq w_t$, LP households would send all their members abroad. Assuming more realistically that LP households are liquidity-constrained (that is, $\underline{b}_t < c$), then $\underline{m}_t = \underline{m}_t^c = \underline{b}_t / c$.

The household's labor supply is then determined by condition (10a), so that:

$$n_t^s = \begin{matrix} 0 \quad if\ w_t \leq \underline{\alpha} - 1 + \underline{m}_t^c \\ 1 - \underline{m}_t^c + w_t - \underline{\alpha} \quad if\ \underline{\alpha} - 1 + \underline{m}_t^c < w_t < \underline{\alpha} \\ 1 - \underline{m}_t^c \quad if\ w_t = \underline{\alpha} \end{matrix} \quad (11)$$

High-productivity households. The optimization problem of HP households consists in selecting their labor demand and share of migrants so as to maximize profits:

$$[n_t, \overline{m}_t] = Arg\max\left\{\overline{\alpha}(1+\rho n_t-\overline{m}_t) - \frac{(1+\rho n_t-\overline{m}_t)^2}{2} - \rho n_t w_t + \overline{m}_t(w^*-c)\right\}$$

subject to $\overline{m}_t c \leq \overline{b}_t$. The first order conditions are given by:

$$\overline{\alpha} - 1 - \rho n_t + \overline{m}_t - w_t \gtreqqless 0 \quad (12a)$$

$$-\overline{\alpha} + 1 + \rho n_t - \overline{m}_t + w^* - c \gtreqqless 0 \quad (12b)$$

As for LP households, these two equations cannot be simultaneously solved with equality. If liquidity constraints are not binding, three cases arise:

(i) if $\overline{\alpha} \leq \rho n_t + w^* - c$ (we shall refer to this case as to the "low inequality case"), the net marginal return to migration is strictly positive: the optimal migration rate is $\overline{m}_t^* = 1$. No HP member remains in the rural region. Since this is obviously not realistic (and, in addition, this would invalidate our inequality measure), we will not consider in the rest of the paper the case where inequality is low *and* liquidity constraints are not binding for HP households;

(ii) if $\rho n_t + w^* - c < \overline{\alpha} < 1 + \rho n_t + w^* - c$ (we shall refer to this case as to the "medium inequality case"), the optimal migration rate is given by:

$$\overline{m}_t^* = 1 + \rho(1 - n_t) + w^* - c - \overline{\alpha} \in [0, 1] \tag{13}$$

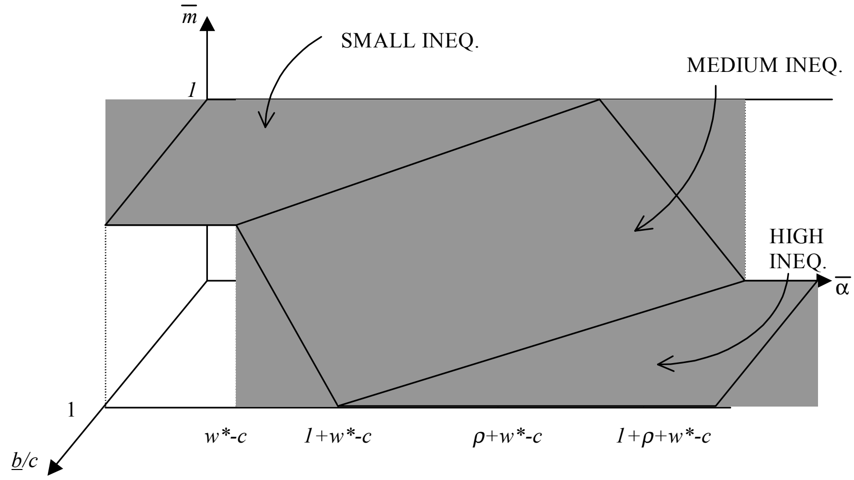
Substituting this result into condition (12a), it comes out that the net return of a marginal worker is strictly positive, implying $n_t^d = 1$;

(iii) if $1 + \rho n_t + w^* - c \leq \overline{\alpha}$ (we shall refer to this case as to the "high inequality case"), the net marginal return to migration is strictly negative: the optimal migration rate is $\overline{m}_t^* = 0$. Substituting this result into condition (12a) gives:

$$n_t^d = Max\left\{\frac{\overline{\alpha} - w_t - 1}{\rho}; 0\right\}$$

Figure 3 depicts these solutions. In the medium inequality case, the demand for labor exceeds the supply of labor: HP households employ all remaining LP members ($n_t = 1 - \underline{m}_t^c = 1 - \frac{b_t}{c}$). The medium inequality case occurs when $\rho(1-\frac{b_t}{c})+w^*-c < \overline{\alpha} < 1+\rho(1-\frac{b_t}{c})+w^*-c$. In that case, the optimal migration rate within HP households is a decreasing function of their productivity ($\overline{\alpha}$) and of the migration rate within LP households.

Fig. 3. HP households' optimal migration rate



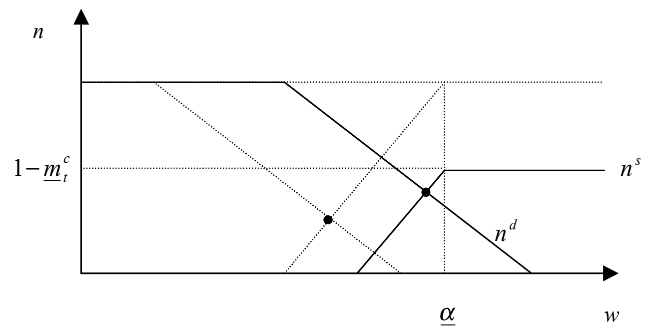
Liquidity constraints, however, are likely to modify the picture, at least in the low and medium inequality cases. If the liquidity constraint is binding for HP households ($\overline{b}_t < c$), then $\overline{m}_t = \overline{m}_t^c = \overline{b}_t/c$ and the labor demand is determined by condition (12a), so that:

$$n_t^d = Max\left\{\frac{\overline{\alpha} - w_t - 1 + \overline{m}_t^c}{\rho}; 0\right\} \tag{14}$$

The general result. In the remainder of this paper, we focus on the case where LP households are always liquidity constrained whereas for HP households, liquidity constraints are also binding if inequality is low but may or may not be binding in the cases of medium and high inequality. In other words, we only retain realistic situations where a positive fraction of LP and HP households stay put. With these understandings, it may be shown that migration unambiguously reduces the labor supply of LP households on the local labor market: the labor supply shifts downwards and reaches its maximum when the wage rate equals $\underline{\alpha}$. Comparing (2) and (11), it comes out that the slope of the labor supply curve does not change compared to the closed economy case, as apparent from Figure 4. The maximal employment level equals to $1 - \underline{m}_t^c$ (i.e., the remaining LP households' members).

In parallel, migration reduces self-employment in HP farms. Profit maximization then implies that HP households increase their demand for local labor (in a way that depends on their own migration rate). In the "high inequality case", however, since HP households do not migrate, the demand for labor is unaffected and remains the same as in the closed economy. In the "medium inequality case" with non-binding liquidity constraints, HP households migrate in optimal numbers. Given our quadratic production function, their labor demand becomes horizontal and equal to 1. Finally, in the low inequality case and in the medium inequality cases with binding liquidity constraints, HP households' migration rate is below the optimal level. The labor demand shifts upwards with a similar slope as in the closed economy.

Fig. 4. The open economy labor market equilibrium



As apparent from Figure 4, migration is likely to increase the wage rate but has an ambiguous effect on the quantity of labor exchanged. As in the closed economy, the maximal wage rate amounts to $\underline{\alpha}$, the wage above which the labor supply equals to $1 - \underline{m}_t^c$.

The remittances function. The equilibrium amount of remittances is given by the difference between the average income of the group and the domestic income per member in the home region. After simplification, the amount received by each remaining member may be written as:

$$\begin{aligned} \underline{r}_t &= \underline{m}_t \left[w^* - \frac{\underline{\alpha}(1-n_t-\underline{m}_t)}{1-\underline{m}_t} + \frac{(1-n_t-\underline{m}_t)^2}{2(1-\underline{m}_t)} - \frac{n_t w_t}{(1-\underline{m}_t)} \right] \\ \overline{r}_t &= \overline{m}_t \left[w^* - \frac{\overline{\alpha}(1+\rho n_t-\overline{m}_t)}{1-\overline{m}_t} + \frac{(1+\rho n_t-\overline{m}_t)}{2(1-\overline{m}_t)} + \frac{\rho n_t w_t}{1-\overline{m}_t} \right] \end{aligned}$$

This is the product of two terms, the migration rate and the income gap between migrants and remaining HP household members.

4 Remittances and inequality

We now characterize the dynamics of the model in the three cases of high, medium and low initial inequality.

4.1 The high inequality case

Recall that the high inequality case arises when $\overline{\alpha} \geq 1 + \rho(1 - \frac{b_{ss}}{c}) + w^* - c$, implying that there is no migration among HP households.

Lemma 1 *In the high inequality case, the post-migration equilibrium wage rate equals to* $\underline{\alpha}$

Proof. The condition $\overline{\alpha} \geq 1 + \rho(1 - \frac{b_{ss}}{c}) + w^* - c$ implies that $\overline{\alpha} \geq 1 + \rho(1 - \frac{b_{ss}}{c}) + \underline{\alpha}$. Using (11) and (14), it follows that the demand for labor exceeds the supply of labor. Therefore, the equilibrium wage rate is maximal and equals to $\underline{\alpha}$. ■

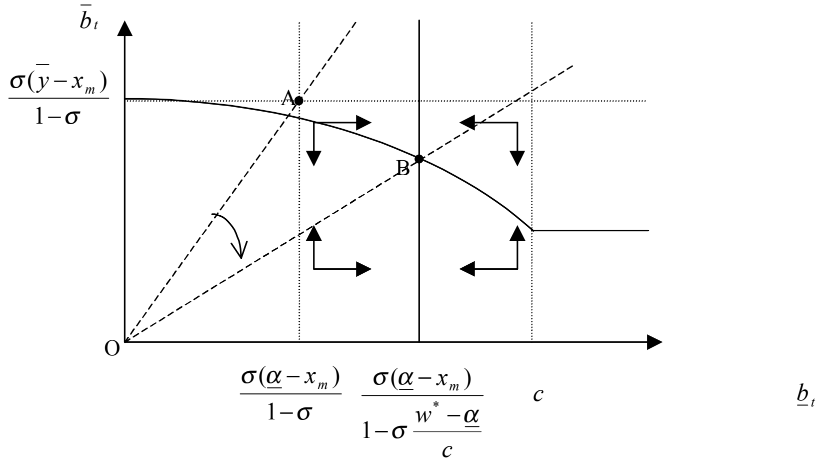
Clearly, nobody works in LP farms: all LP households' members either emigrate or sell their labor force on the local labor market and are employed on HP households' farms. The initially highly unequal rural society becomes totally polarized between a class of salaried agricultural workers and a class of rich landowners once migration is introduced. Since the wage rate equals to $\underline{\alpha}$ and given (6a)-(6b), the dynamics of wealth is characterized by the following system:

$$\underline{b}_{t+1} = \sigma\underline{\alpha}(1 - \frac{\underline{b}_t}{c}) + \sigma(w^* - c)\frac{\underline{b}_t}{c} + \sigma\underline{b}_t - \sigma x_m \tag{15a}$$

$$\begin{aligned} \overline{b}_{t+1} &= \sigma\overline{\alpha}\left[1 + \rho(1 - \frac{\underline{b}_t}{c})\right] - \frac{\sigma}{2}\left[1 + \rho(1 - \frac{\underline{b}_t}{c})\right]^2 \\ &\quad -\sigma\rho\underline{\alpha}(1 - \frac{\underline{b}_t}{c}) + \sigma\overline{b}_t - \sigma x_m \end{aligned} \tag{15b}$$

The phase diagram corresponding to the high inequality case is represented on Figure 5. As a benchmark, point A describes the closed economy case. For convenience, let us assume that the closed economy wage rate equals $\underline{\alpha}$. The possibility of migration leads LP households to send migrants abroad and accumulate financial wealth up to $\underline{b}_{ss} = \frac{\sigma(\underline{\alpha}-x_m)}{1-\sigma(w^*-\underline{\alpha})/c}$. The LP vertical phase line thus shifts to the right. As LP households labor supply decreases (i.e., as their financial assets increase), profits decrease in HP farms. The HP phase line ($\overline{b}_{t+1} = \overline{b}_t$) is therefore a decreasing and concave function of $\underline{b}_t$.

Fig. 5. The open economy phase diagram : the high inequality case



We thus obtain the following result:[7]

Proposition 1 *In the high inequality case, migration and remittances reduce HP households' assets and increase LP households' assets. Both the wealth-inequality ratio (Γ^b_{ss}) and the income-inequality ratio (Γ^y_{ss}) decrease compared to the closed economy.*

Proof. Assume that the closed economy wage rate equals to $\underline{\alpha}$. Migration reduces $\overline{y}_{ss}$ and increases $\underline{y}_{ss}$. The income-inequality ratio thus unambiguously decreases. The long-run amount of wealth is a linear function of the long-run amount of income: therefore, the wealth-inequality ratio decreases as well. If wages in the closed economy were lower than $\underline{\alpha}$, wage adjustments would reinforce the changes. ■

In the case of an initially highly unequal society, therefore, migration and remittances have a beneficial effect on economic (wealth and income) inequality. Moreover, remittances and internal adjustments on the labor market (i.e. wage

[7] Recall that $\underline{b}_{ss} < c$ if $\sigma(w^* - x_m) < c$. Otherwise, all LP households would leave the home region and our inequality measure would not make sense.

responses) are both reducing inequality. This suggests that empirical models based on Gini Index decomposition are likely to underestimate the impact of migration on inequality by considering that the distribution of domestic earnings is given.

4.2 The medium inequality case

The medium inequality case arises when $\rho(1-\frac{b_t}{c})+w^*-c<\overline{\alpha}<1+\rho(1-\frac{b_t}{c})+w^*-c$ (i.e., on a limited range of values for $\overline{\alpha}$). The equilibrium depends on whether liquidity constraints are binding for HP households.

Non-biding liquidity constraints for HP households. If liquidity constraints are not binding, HP households select their optimal migration rate $\overline{m}^*$ as given by equation (13). The demand for labor is the same as in the high inequality case. In such a situation, HP households want to employ all LP households' members ($n_t^d=1$) and this sets the wage rate at its maximal value $w_t=\underline{\alpha}$.

Given (6a)-(6b), the dynamics of wealth is characterized by the following system:

$$\underline{b}_{t+1} = \sigma\underline{\alpha}(1-\frac{\underline{b}_t}{c})+\sigma(w^*-c)\frac{\underline{b}_t}{c}+\sigma\underline{b}_t-\sigma x_m \quad (16a)$$

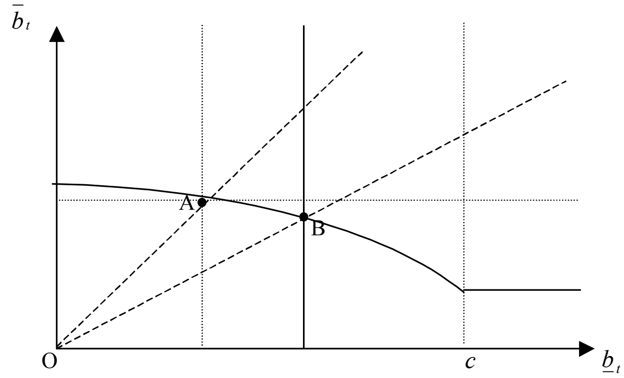
$$\overline{b}_{t+1} = \sigma\overline{\alpha}(1+\rho-\rho\frac{\underline{b}_t}{c}-\overline{m}^*)-\frac{\sigma}{2}(1+\rho-\rho\frac{\underline{b}_t}{c}-\overline{m}^*)^2 -\sigma\rho\underline{\alpha}(1-\frac{\underline{b}_t}{c})+\sigma\overline{m}^*(w^*-c)+\sigma\overline{b}_t-\sigma x_m \quad (16b)$$

where $\overline{m}^*=1+\rho(1-\frac{b_t}{c})+w^*-c-\overline{\alpha}\in[0,1]$ is the optimal migration rate of HP households.

The corresponding phase diagram is represented on Figure 6. The closed economy steady state equilibrium is at point A. The migration-and-remittances process leads LP households to accumulate the same level of financial wealth as in the high inequality case (the vertical LP phaseline shifts to the right).

As in the high inequality case, migration possibilities reduce LP households' labor supply on the domestic labor market and reduce the profits of HP farms. However, the main difference with the high-inequality case is that migration possibilities now enable HP households to increase their level of wealth. Therefore, the HP phase line, which is still a concave and decreasing function of $\underline{b}_t$, now starts at a higher level than in the closed economy.

Fig. 6. The open economy phase diagram: the medium inequality case
Liquidity constraints are not binding



Binding liquidity constraints for HP households. Let us now assume that the optimal migration rate in HP families cannot be attained due to liquidity constraints. If both LP and HP households are liquidity constrained, the equilibrium wage rate is lower than or equal to $\underline{\alpha}$. More precisely:

- If $w_t < \underline{\alpha}$ if $\frac{\overline{\alpha}-\underline{\alpha}-1+\overline{m}^c}{\rho} < 1-\underline{m}^c$ or, equivalently, if $\frac{\overline{b}_t}{c} > 1+\rho(1-\frac{\underline{b}_t}{c})-\overline{\alpha}+\underline{\alpha}$, there is an excess supply of labor at the wage rate $\underline{\alpha}$ and we have:

$$
\begin{aligned}
w_t &= \frac{\overline{\alpha}+\rho\underline{\alpha}-1-\rho+\frac{\overline{b}_t}{c}+\rho\frac{\underline{b}_t}{c}}{1+\rho} < \underline{\alpha} \\
n_t &= Max\left[0; \frac{\overline{\alpha}-\underline{\alpha}+\frac{\overline{b}_t}{c}-\frac{\underline{b}_t}{c}}{1+\rho}\right] \in [0,1]
\end{aligned}
$$

If $w_t = \underline{\alpha}$ if $\frac{\overline{\alpha}-\underline{\alpha}-1+\overline{m}^c}{\rho} > 1-\underline{m}^c$ or, equivalently, if $\frac{\overline{b}_t}{c} \leq 1+\rho(1-\frac{\underline{b}_t}{c})-(\overline{\alpha}-\underline{\alpha})$, there is an excess demand of labor at the wage rate $\underline{\alpha}$ and we have $n_t = 1-\underline{m}^c = 1-\frac{\underline{b}_t}{c}$.

For illustrative purpose, let us focus on the second case with $w_t = \underline{\alpha}$. Given (6a)-(6b), the dynamics of wealth is characterized by the following system:

$$
\begin{aligned}
\underline{b}_{t+1} &= \sigma\underline{\alpha}(1-n_t-\frac{\underline{b}_t}{c})-\frac{\sigma}{2}(1-n_t-\frac{\underline{b}_t}{c})^2 && \text{(17a)}\\
&\quad +\sigma n_t w_t+\sigma\frac{\underline{b}_t}{c}(w^*-c)\frac{\underline{b}_t}{c}+\sigma\underline{b}_t-\sigma x_m \\
\overline{b}_{t+1} &= \sigma\overline{\alpha}(1+\rho n_t-\frac{\overline{b}_t}{c})-\frac{\sigma}{2}(1+\rho n_t-\frac{\overline{b}_t}{c})^2 && \text{(17b)}\\
&\quad -\sigma\rho n_t w_t+\sigma\frac{\overline{b}_t}{c}(w^*-c)+\sigma\overline{b}_t-\sigma x_m
\end{aligned}
$$

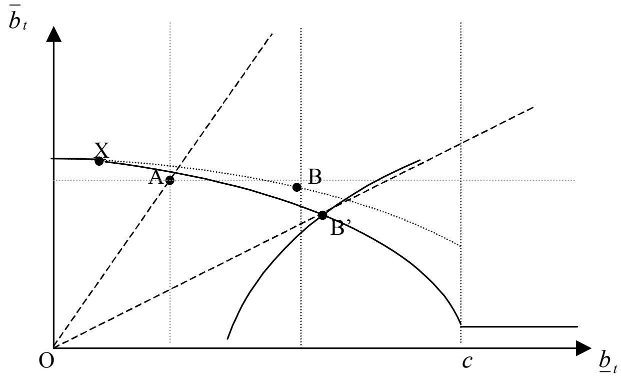
with w_t and n_t as defined above.

The dynamics is therefore non-linear. Both phase lines may be expressed as the positive root of a second degree polynomial in $\overline{b}_t$. The same qualitative results obtain when $w_t < \underline{\alpha}$.

The typical representation is given in figure 7. Point A represents the closed economy equilibrium. Point B is the open economy equilibrium when liquidity constraints are not binding for HP households (as depicted on figure 6). When liquidity constraints are binding, both phaselines are non linear and represented by continuous curves. They only correspond to the unconstrained curves when the assets of HP members exceed their "optimal" migration costs, $\overline{m}^*c$ (i.e., above point X). Therefore, on figure 7, liquidity constraints are only binding below X.

The impact of liquidity constraints is to displace the HP phase line downwards. Then point B' is the final steady state when liquidity constraints are binding. The effect of liquidity constraints on HP households, therefore, is to further reduce the long-run level of assets of HP households and to increase the level of assets within LP households. Hence, they reduce the wealth inequality ratio: The slope of OB' is lower than the slope of OB.

Fig. 7. The open economy phase diagram: the medium inequality case
Liquidity constraints are binding



General result. Inequality is always decreased in the "medium inequality case" independently of whether liquidity constraints are binding for HP households:

Proposition 2 *In the "medium inequality case", remittances and migration reduce the level of assets of HP households and increase the level of assets of LP households. Both the wealth-inequality ratio* (Γ_{ss}^{b}) *and the income-inequality ratio* (Γ_{ss}^{y}) *are reduced once migration opportunities are introduced compared to the closed economy.*

Proof. Let us denote the long-run effect of openness on HP households' assets by $\Delta\overline{b}_{ss}$. Let us assume that: (i) liquidity constraints are not binding (condition C1), and, (ii) both the pre- and post-migration local wages are given by $\underline{\alpha}$ (condition C2). C2 requires that $\rho < \overline{\alpha} - \underline{\alpha}$-1. After some manipulations, one obtains $\Delta\overline{b}_{ss} < \frac{\overline{m}^2 - \rho^2 \underline{m}^2}{2}$. Using $\overline{m} = 1 + \rho(1 - \frac{b}{c}) + w^* - c - \overline{\alpha}$ and

$\underline{m} = \frac{b}{c}$, it follows that $\Delta\overline{b}_{ss} < 0$ for $\rho(1-\frac{b}{c})+w^{*}-c < \overline{\alpha}$: the unconstrained HP amount of assets decreases. If C1 does not hold (i.e., HP households are liquidity constrained), the phase line shifts downwards and the effect is even stronger. If C2 does not hold (either the pre- or post-migration local wage is below $\underline{\alpha}$), a wage effect reinforces the redistribution from HP to LP households. Finally, since the long-run level of assets is a linear and increasing function of income, migration reduces $\overline{y}_{ss}$ and increases $\underline{y}_{ss}$: hence, Γ^{y}_{ss} unambiguously decreases. ∎

As in the high inequality case, openness to migration is not pareto-improving: it improves the situation of LP households but reduces HP households' income and wealth.

4.3 The low inequality case

The "low inequality case" holds for $\overline{\alpha} < \rho(1-\frac{b_t}{c}) + w^{*} - c$ (i.e., when the high income class is not too different from the low income class). We assume that the distribution of wealth is such that it cannot be that all HP members leave the country (i.e., $\overline{b}_t < c$). Analytically, the low inequality case is equivalent to the "medium inequality case" when liquidity constraints are binding. However, under the condition that $\overline{\alpha} < \rho(1-\frac{b_t}{c}) + w^{*} - c$, the predictions on inequality may be different. More precisely:

Proposition 3 *In the "low inequality case", remittances and migration increase the amount of assets of LP households and have an ambiguous effect on the amount of assets of HP households. However, the wealth-inequality ratio (Γ^{b}_{ss}) unambiguously decreases compared to the closed economy and the variation in the income-inequality ratio (Γ^{y}_{ss}) may be either positive or negative.*

Proof. Part 1. From Proposition 2, $\rho(1-\frac{b}{c})+w^{*}-c>\overline{\alpha}$ implies that $\Delta\overline{b}_{ss}\lesseqgtr 0$. Part 2. Let us assume that: (i) the post-migration amount of HP assets equals to the migration cost (C1), and, (ii) both the pre- and post-migration local wages are given by $\underline{\alpha}$ (C2). The property $\Gamma^{b}_{ss}<\Gamma^{b}_{0}$ (where the subscript 0 stands for the initial closed economy solution) may be rewritten as $c-\sigma w^{*}-\sigma\underline{\alpha}<\sigma\overline{\alpha}(1+\rho)-\frac{\sigma}{2}(1+\rho)^{2}-\sigma\underline{\alpha}\rho-\sigma x_{m}$. Using (17a) with $\overline{b}_{ss}=c$ (C1) and $1+\rho<\overline{\alpha}-\underline{\alpha}$ (C2), this property becomes $-\rho\frac{\underline{b}_{ss}}{c}<1$, which always holds. If either condition C1 or condition C2 do not hold, this reinforces the result: liquidity constraints within HP households or an increase in the wage rate both limit the rise in HP households' assets and stimulate the rise in LP households' assets. Part 3. Using (8), the variation in the income ratio may be expressed as:

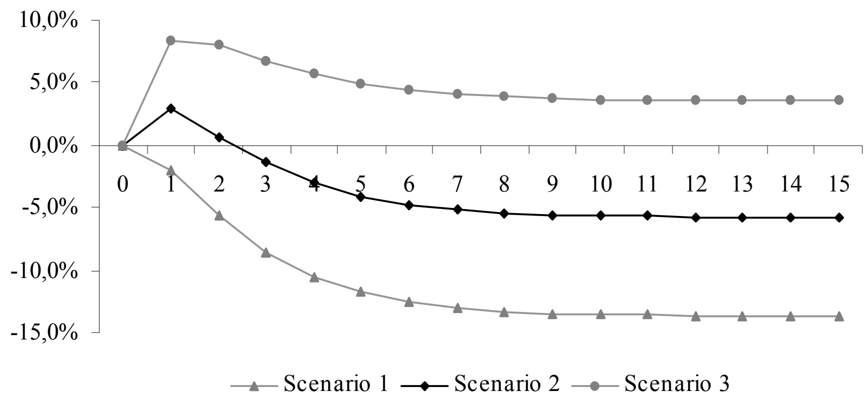
$$\Delta\Gamma^{y}=\Gamma^{y}_{ss}-\Gamma^{y}_{0}=(\gamma_{ss}-\gamma_{0})+(\Gamma^{b}_{ss}-\Gamma^{b}_{0})+(\gamma_{0}\Gamma^{b}_{0}-\gamma_{ss}\Gamma^{b}_{ss})$$

The first two terms are negative, meaning that the marginal propensity to save among LP households increases and wealth inequality decreases (see part 2). The third term is positive. The general effect on income inequality is thus ambiguous. ■

Fig. 7 also depicts the case of low initial inequality, except that the HP phase line may shift above the closed economy phase line. Migration and remittances can be pareto-improving compared to the closed economy solution. However, the slope of OB' is always lower than the slope of OA: wealth inequality is always lower with migration. The major difference with the medium inequality case is that, as indicated in the proof of Proposition 3 above, income inequality can be lower or greater than in the closed economy.

Numerical simulations illustrate these results. Consider the following parameters set: $\overline{\alpha}=4.0$, $\underline{\alpha}$=1.25, $\rho=1.5$, $w^{*}=7.5$, $c=2.0$, $\sigma=0.15$. Three scenarios are distinguished: $x_m = 0.2$ (scenario 1), $x_m = 0.4$ (scenario 2) and $x_m = 0.6$ (scenario 3). The income inequality path (Γ_t^y) is represented on Fig. 8. In scenario 1, LP households' marginal propensity to save is high; since migration and remittances give rise to an important wealth accumulation within LP households, wealth and income inequality are reduced in the long-run. In scenario 3, the opposite result emerges. In the intermediate scenario, the short-run impact of remittances on inequality is negative while the long-run impact is positive. This corresponds to the "trickle-down" effect suggested by Stark et al. (1986 and 1988). Nevertheless, such a phenomenon is not due to the dynamics of migration costs (which are kept constant in our simulations) but is fully determined by the dynamics of wealth accumulation.

Fig. 8. Income inequality path



In the low inequality case, the inequality impact of remittances, on the one hand, and of domestic wages, on the other hand, may be of opposite signs. While wage responses always reduce the level of inequality (see figure 4), remittances can have a detrimental effect on income dispersion. Most empirical models of Gini index decomposition are only capturing the second effect; however, evaluating the global impact of migration on inequality requires endogenizing wage dispersion as a function of migration flows.

5 Conclusion

Our analysis sheds light on the short-run and long-run impact of migration and remittances on economic inequality in the migrants' communities of origin. This impact largely depends on the initial distribution of wealth, which determines migration incentives and opportunities.

A first result is that in the case of an initially highly unequal society, openess to migration leads to a totally polarized economy with a class of poor salaried workers and a class of rich landowners, and to a redistribution of wealth from rich to poor households; since in our setting wealth and utility are identical in the long-run, the induced changes are therefore not pareto-improving. In a more homogenous society where rich households have an incentive to send some members out, openness to migration may be pareto improving. In all cases, however, migration and remittances bring about a decrease in wealth inequality at origin.

A second result concerns income inequality. The relationship between income and utility is linear but changes over time according to the evolution of the propensity to save within poor households. Income- and wealth-inequality responses to migration need not be identical in size and nature. In some realistic cases, income inequality may be increased while wealth inequality decreases. In addition, due to a combination of changes in people's income and propensity to save over time, income inequality may be characterized by a "trickle-down" transition path even if the dynamics of assets is basically monotonic. This could be reinforced by the evolution of migration costs thanks to the role of migrants' networks; however, migration network effects are not a necessary condition for observing such an inverse U-shaped inequality path.

A third result is that the inequality impacts of remittances, on the one hand, and of local wages adjustments, on the other hand, tend to reinforce one another when initial inequality is relatively high (high and medium inequality cases) but may be of opposite signs in the low inequality case. This has strong implications for empirical studies based on Gini Index decompositions with exogenous distributions of domestic incomes. Our framework suggests that such distributions should be treated as endogenous, as advocated by Adams (1989), Taylor (1992) or Braham and Boucher (1998). This also suggests that the lack of consensus in the empirical literature on the inequality impact of migration may be partly explained by the omission of labor market responses. Indeed, in a country such as Mexico where inequality is high by international standards, this omission is likely to lead to an underestimation of the inequality-reducing effect of migration, but not to a reversal of the sign of the effect. By contrast, in a country such as Yugoslavia where inequality is much lower, taking labor market responses into account could possibly reverse the findings of an inequality-enhancing effect.

Finally, it holds true that the evolution of migration costs is crucial for the determination of the long-run impact of migration and remittances. In all cases, a drop in migration costs induces strong inequality-reducing effects. The short-run impact, however, is ambiguous. If rich and poor households are both liquidity constrained, a drop in migration costs may well increase the inequality ratio in the short-run since rich households derive more profits from migration.[8]

[8] To illustrate this result, consider the numerical example of scenario 2 and compare the dynamic paths with respectively $c = 2.0$ and $c = 1.5$. As depicted in Table 1, a drop in migration costs raises the income ratio in period 1 and reduces the inequality rate thereafter, reinforcing the likelihood of observing a trickle down phenomenon.

Table 1: Policy analysis (effect of openness on the income ratio in percent)

Hence, a decrease in migration costs may generate higher inequality in the first stages of the migration history. In the long-run, however, lower migration costs are always beneficial in terms of reduced economic inequality. These results are consistent with the findings of the remittances-and-inequality empirical literature, but offer a different interpretation, with no need to endogenize migration costs through network effects.

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Period	0	1	2	3	ss
Scen. 2 (c=2.0)	0.0%	2.9%	0.7%	-1.4%	-5.8%
Scen. 2' (c=1.5)	0.0%	3.4%	-1.9%	-12.9%	-36.8%

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