Migration, Remittances and Capital Accumulation: Evidence from Rural Mexico Revision of FJDS-2011-Feb-0017 *

Vera Chiodi† Esteban Jaimovich‡ Gabriel Montes-Rojas§

This version: October 2011

Abstract

This paper studies the link between migration, remittances and asset accumulation for a panel of poor rural households in Mexico over the period 1997-2006. In a context of financial markets imperfections, migration may act as a substitute for imperfect credit and insurance provision (through remittances from migrants) and, thus, exert a positive effect on investment. However, it may well be the case that remittances are channelled towards increasing consumption and leisure goods instead. Exploiting within family variation and an instrumental variable strategy, we show that migration indeed accelerates productive assets accumulation. Moreover, when we look at the effect of migration on non-productive assets (durable goods), we find instead a negative effect. Our results then suggest that poor rural families resort to migration as a way to mitigate constraints that prevent them from investing in productive assets.

JEL Classification: O15, D31, J24, R23, F22.

Key Words: Migration; Remittances; Capital Accumulation; Rural Poverty.

*We would like to thank to the participants of the EALE/SOLE conference in London, June 2010, and seminars at City University London and Paris School of Economics for helpful comments and suggestions. We would also like to thank Michael Ben-Gad and Pablo Acosta for detailed comments.

†Paris School of Economics and Poverty Action Lab (J-PAL Europe), 48 Boulevard Jourdan, 75014 Paris, France. chiodi@pse.ens.fr

‡Corresponding Author: Collegio Carlo Alberto, Via Real Collegio 30, Moncalieri (TO) 10024, Italy. esteban.jaimovich@carloalberto.org

§City University London, Department of Economics, D306 Social Sciences Building, Northampton Square, London EC1V 0HB, United Kingdom. Email: Gabriel.Montes-Rojas.1@city.ac.uk

1 Introduction

The migration of labor out of agriculture has represented a fundamental issue in the early models of development economics (Lewis, 1954; Sen 1966; Harris and Todaro, 1970; see Ghatak, Levine and Wheatly Price, 1996, for an excellent survey). In these models, the agricultural sector is typically characterized by stagnation and under-productive use of labor, while the urban industrial sector is viewed as the one that contributes most to economic development and modernization. This literature has thus seen migration from the rural to the urban sector as a road out of backwardness and poverty, which are intrinsically linked to agricultural production.

However, recent work has argued that rural migration may also exert a positive effect on the rural sector itself. Migration and remittances may contribute to alleviate financial and productive constraints in the rural sector.[1] Migration may exert a positive effect on asset accumulation and, thus, help lift families permanently out of poverty. More specifically, Stark (1991) sustains that migrants may play the role of financial intermediaries, enabling rural households to overcome credit constraints and missing insurance markets. Furthermore, migration may mitigate the impact of agricultural income shocks by allowing families to relocate labor to the cities when that is needed (Lucas and Stark, 1985). Individuals in a household pool resources to finance migration of one of their members who later on repays by remitting a part of his/her income back to the family. Thus, households tend to optimally spread their labor force over different geographic markets in order to better pool risks. Household surveys also show that remittances tend to play a key role on the survival and livelihood strategies for many (typically rural) poor households (Rapoport and Docquier, 2005).

Our paper contributes to this latter stand of literature by assessing the effect of migration and remittances on physical asset accumulation, studying differences by *type* of asset, i.e. productive and non-productive. Using a unique panel database for Mexican rural households, the econometric results presented in this paper show that migration and remittances indeed open up a possibility for poor households to accelerate asset accumulation.

Several endogeneity issues need to be addressed in order to avoid potential biases. First, households may respond to adverse or positive shocks by changing the number of migrants or the nature of migration (temporal vs. permanent). Second, selection bias may occur if migrant households are intrinsically different from non-migrant ones (see for instance Jaeger et al., 2010). Third, dynamic specifications in short panels produce large biases in fixed-effects models. Following previous work on this subject (see Acosta, 2006, and McKenzie and Sasin, 2007) we deploy an instrumental variables strategy in order to cope with endogeneity issues based on migration networks. Our identification strategy relies on variation in aggregate migration across time and space. We also implement a GMM strategy to eliminate the dynamic panel bias that arises in short panels.

We frame the empirical results within a two-period model of investment and migration decisions of credit constrained rural households. The model shows that migration affects investment only for moderately poor households, while it leads to increasing consumption for the very poor and relatively rich households. The fact that rural households use remittances to increase the accumulation of assets represents an important and, at the same time, not obvious result. More precisely, it may well be the case that remittances are channelled instead towards increasing consumption and leisure, which may increase households' current well-being, but will not help to improve their dynamic prospects.

Migration and remittances have been largely studied in the microeconometric literature with respect to the accumulation of human capital. As argued in Hanson and Woodruff (2003) the additional income from remittances may allow children to delay entering the work force. Yang (2008) also finds a positive effect of remittances on child schooling and educational expenditure in Philippines using exchange rate shocks as a source of exogenous variation for remittances. However, it has been argued as well that migration may alter the family structure, raising child-rearing responsibilities and, therefore, having negative consequences on household welfare. Moreover, Acosta (2006) sustains that it may be expected that recipient families will expand their consumption of leisure (and reduce labor supply) and increase their dependence on external transfers.

The closest article to ours is Adams (1998) that studies the effect of remittances in rural Pakistan and found that they help to increase investment in rural assets by raising the marginal propensity to invest for migrant households. The topic addressed here is also related to the effect of credit constraints in the urban informal sector. Woodruff and Zenteno (2007) found a positive impact of remittances in Mexico (they are shown to be responsible for almost 20% of the capital invested). In the same vein, Mesnard and Ravaillon (2002) and Mesnard (2004) studied the temporary migration decision of workers who are credit constrained in Tunisia and evaluates the extent to which liquidity constraints affect self-employment decisions of returned migrants. There is also some evidence on this issue for the case of internal migration in India (Banerjee and Bucci, 1994). Our paper extends these results to rural poor households.

Finally, the effects of remittances on capital accumulation has also been studied at the macroeconomic level by Glytsos (1993) and Giuliano and Ruiz-Arranz (2009) who provide evidence that remittances tend to particularly foster growth in countries with less developed financial systems by helping them overcome liquidity constraints. Their results are thus consistent with ours based on household-level data.

The rest of paper is organized as follows. Section 2 presents a model that accounts for migration and investment decisions. Section 3 describes the unique dataset used to construct the panel of rural households. Section 4 presents the methodology used for constructing the asset indexes. Section 5 presents some descriptive statistics. Section 6 carries the econometric analysis showing the effect of migration on asset accumulation.

Section 7 concludes.

2 Migration and investment decisions in a two-period maximization problem

This section proposes a simple model to illustrate how poor families may resort to migration as a response to credit constraints that prevent them from investing in productive assets. In particular, the model aims at showing that poor families may, under certain conditions, choose to send migrants so as to use their remittances to overcome binding credit constraints.

We will first start with a two-period model in which the possibility of sending migrants is excluded. This will set a benchmark upon which we can then compare the optimal behavior of families when they do have the opportunity to send a migrant to a richer region or city, and receive positive remittances from the migrant.

2.1 No-migration regime

There is a continuum of rural families (or households) $i \in \mathcal{I}$ who live for two periods, $t = \{1, 2\}$. At the beginning of each period t each family i receives an amount of income equal to $y_{t,i}$, where $y_{t,i}$ is the realization of a random variable uniformly and independently distributed across families along the non-empty interval $[1, \overline{y}]$. For simplicity, and without any loss of generality, we henceforth let $\overline{y} = 2$. In addition, we assume that $y_{1,i} = y_{2,i} = y_i$; that is, income realizations are persistent within families. More broadly speaking, we could also interpret the variable y_i as capturing the effect of family specific productive assets (for example, different families may own plots of land that differ in terms of their level of fertility); in the econometric terminology used below, the variable y_i captures family-specific fixed-effects.

Families derive log-utility from consumption at the end of each period t and we assume no discount factor is applied on future consumption.[2] All families are credit-constrained, and then, they cannot increase current consumption by borrowing against future income. Families, however, have access to a storing technology (with no depreciation), hence they may transfer present income to the future in case they wish so.

All families have also access to an indivisible investment project (an investment in productive assets that increases productivity in the future, for example, investing in irrigation or buying a new tractor). In particular, in period 1 families can choose whether or not to invest in a project that requires 1 unit of capital as investment, and yields $R > 1$ units of income at the end of period 2.

The families' optimization problem may be approached by noting that it involves two different issues: first, choosing whether or not to invest in the project at the beginning of $t = 1$; second, choosing the optimal consumption flow, conditional on the former investment decision. We can then solve the problem for family i simply by comparing the maximum utility achieved in each of the two possible scenarios: (a) investing in the project; (b) not investing in it. We denote by $c_{t,i}$ consumption in period t and by $s_{1,i}$ the amount of income stored from $t = 1$ until $t = 2$.

Case (a): Invest in the project. Family i solves:

$$\begin{aligned} \max \quad : \quad & U_{i,I} = \ln(c_{1,i}) + \ln(c_{2,i}) \\ \text{subject to:} \quad & c_{1,i} = y_i - s_{1,i} - 1, \\ & c_{2,i} = y_i + s_{1,i} + R, \\ & s_{1,i} \geq 0. \end{aligned} \tag{1}$$

It is straightforward to observe that in problem (**??**) the constraint $s_{1,i} \geq 0$ will bind in the optimum (i.e., families would like to borrow against future income so as to smooth consumption, but they are not able to do so). Hence, families will optimally set $s^*_{1,i} = 0$, implying that: $c^*_{1,i,I} = y_i - 1$ and $c^*_{2,i,I} = y_i + R$. As a result, the maximum utility achieved by a family with income y_i that invests in the project is given by:

$$U^*_{i,I} = \ln(y_i - 1) + \ln(y_i + R). \tag{2}$$

Case (b): No investment. Family i solves:

$$\begin{aligned} \max \quad : \quad & U_{i,NI} = \ln(c_{1,i}) + \ln(c_{2,i}) \\ \text{subject to:} \quad & c_{1,i} = y_i - s_{1,i}, \\ & c_{2,i} = y_i + s_{1,i}, \\ & s_{1,i} \geq 0. \end{aligned} \tag{3}$$

Since the income flow is identical in both periods and future is not discounted, families will optimally consume y_i in each of the two periods, so as to achieve perfect consumption smoothing. That is, $c^*_{1,i,NI} = c^*_{2,i,NI} = y_i$, which in turn implies $s^*_{1,i,NI} = 0$. Hence, the utility achieved by a family with income y_i that decides *not* to invest is given by:

$$U^*_{i,NI} = \ln\left(y_i^2\right). \tag{4}$$

Finally, families will choose to invest if and only if that allows them to obtain higher intertemporal utility than not investing. Henceforth, we let $I = 1$ ($I = 0$) denote the choice *to invest* in the productive asset (*not to invest* in it) in $t = 1$. Then, comparing (**??**) and (**??**) implies:

$$I_i = 1 \quad \Leftrightarrow \quad y_i > R/(R-1). \tag{5}$$

The expression (**??**) stipulates that only families with (permanent) income larger than $R/(R-1)$ will invest in the project. The reason for this is that, in the presence of credit constraints, given that utility displays decreasing absolute risk aversion, only sufficiently rich families are willing to give away one unit of consumption in $t = 1$ in order to be able to invest and increase consumption $t = 2$ by R units.[3] Henceforth, we assume that $R > 2$, so that there exist a permanent income threshold $1 < \underline{y} < 2$ such that families whose $y_i \geq \underline{y}$ are willing to invest $I_i = 1$.

2.2 Migration allowed

Assume now that after observing the income realization y_i at the beginning of $t = 1$, family i could *choose* whether or not to send one of their members to a richer city or region in the first period. Sending a migrant imposes an "emotional" cost $M > 0$, measured in terms of utility.[4] Migration is treated as a risky asset when compared with the risk-free income in the village. The migrant may get a *good job* in the region he migrated to, which yields net income υ, where $1 \leq \upsilon < 1 + R$. Instead, if the migrant fails to find a good job, he receives net income equal to 0.[5] Notice that migration will naturally reduce households' labor income at the home village (due to the lowered domestic labor force). In that respect, we should henceforth interpret the 'net income' υ (when finding a good job) and 0 (when not finding it) as *net* of the concomitant reduced labor income at the home village.

We assume that local networks in the city where migrants move to make it easier for them to obtain a good job.[6] In particular, we postulate that the migrant from family i will manage to find good job with probability $p(n_i) = n_i$, where $n_i \in [0, 1]$ represents the 'network density' that family i has got in the recipient city. We assume that n_i is uniformly distributed along the interval $[0, 1]$ in the population, and that the correlation between n_i and y_i in the population equals zero.

We denote by $\widetilde{U}_i^*$ the utility achieved by family i if they choose to send a migrant (whereas, as before, U_i^* denotes the utility of family if they do not send a migrant).

Relatively rich families: Consider family i with network density $n_i \in [0,1]$ and income $y_i \geq R/(R-1)$. From the previous analysis, it follows that this family will *always* invest in the project. That is, it will invest regardless of whether it chooses to send a migrant or not, and, in the case they do send a migrant, regardless of whether the migrant finds a good job or not. As a result, if they do not send a migrant, their utility equals that stated in (**??**). On the other hand, if they do send a migrant, their utility is given by:

$$\widetilde{U}_{i,I}^{*,rich} = n_i \left[\ln\left(y_i + \upsilon - 1\right) + \ln(y_i + R)\right] + (1 - n_i)\left[\ln\left(y_i - 1\right) + \ln(y_i + R)\right] - M. \quad (6)$$

A family with $y_i \geq R/(R-1)$ will thus send a migrant if and only if $\widetilde{U}_{i,I}^{*,rich} > U_{i,I}^{*}$, which in turn leads to:

$$\text{If } y_i \geq R/(R-1)\,, \text{ send migrant iff: } \; n_i \left[\ln\left(y_i + \upsilon - 1\right) - \ln\left(y_i - 1\right)\right] \geq M. \quad (7)$$

Relatively poor families: Consider now the case of family i with $n_i \in [0,1]$ and $y_i < R/(R-1)$. From the previous analysis, it follows that such a family will not invest in the project if, after sending a migrant, this migrant fails to obtain a good job. Nor will they invest in the project when they do not send a migrant, as this situation is isomorphic to the no-migration regime.

The first question to address is then the following: should a family who sent a migrant invest in the project when the migrant obtains a good job? Consider such a family: the two expressions below show the utility achieved by the family, first, in the case it invests in the project and, second, in the case it does not.

$$\widetilde{U}_{i,I}^{*,poor} = n_i \left[\ln\left(y + \upsilon - 1\right) + \ln(y + R)\right] + (1 - n_i)\left[\ln\left(y_i^2\right)\right] - M, \quad (8)$$

$$\widetilde{U}_{i,NI}^{*,poor} = n_i \left[\ln\left(y_i + \tfrac{\upsilon}{2}\right)^2\right] + (1 - n_i)\left[\ln\left(y_i^2\right)\right] - M. \quad (9)$$

Hence, comparing (**??**) and (**??**), it follows that families with $y_i < R/(R-1)$ who send a migrant will invest in the project, if and only if the migrant finds a good job *and* the following condition holds:

$$y_i > \frac{R}{R-1} - \frac{\upsilon\left(R - \frac{\upsilon}{4}\right)}{R-1} \equiv \widehat{y}. \tag{10}$$

Notice that $\widehat{y} < R/(R-1)$. In fact, it may well be that $\widehat{y} < 1$.[7]

The second question to deal with is, bearing in mind equations (**??**) and (**??**), should a family with $n_i \in [0,1]$ and $y_i < R/(R-1)$ send a migrant or not? Answering this question demands comparing $U^*_{i,NI}$ to $\widetilde{U}^{*,poor}_{i,I}$ for those families with $y_i \in \left(\widehat{y}, \frac{R}{R-1}\right)$, whereas for those families whose $y_i \leq \widehat{y}$ we must compare $U^*_{i,NI}$ to $\widetilde{U}^{*,poor}_{i,NI}$. We can thus obtain the following two conditions:

If $y_i \in \left(\widehat{y}, \frac{R}{R-1}\right)$, send migrant iff: $n_i\left[\ln\left(y_i + \upsilon - 1\right) + \ln(y_i + R) - \ln\left(y_i^2\right)\right] \geq M$; (11)

If $y_i < \widehat{y}$, send migrant iff: $n_i\left[\ln\left(y_i + \frac{\upsilon}{2}\right)^2 - \ln\left(y_i^2\right)\right] \geq M.$ (12)

Since a larger network, n_i, increases the chances the migrant finds a good job (or, in other words, the expected return from sending a migrant increases with n_i), families with a larger n_i will naturally tend to be more prone to send a migrant. The following proposition states this result more formally.

Proposition 1 *There exists a continuous and strictly increasing function $\widetilde{n}(y) : \mathbb{R}_{++} \to \mathbb{R}_{++}$, such that for all $n_i \geq \widetilde{n}(y_i)$:*

*(i) If $y_i \in \left[\frac{R}{R-1}, 2\right]$, then condition (**??**) holds.*

*(ii) If $y_i \geq 1$ and $y_i \in \left(\widehat{y}, \frac{R}{R-1}\right)$, then condition (**??**) holds.*

*(iii) If $y_i \geq 1$ and $y_i \leq \widehat{y}$, then condition (**??**) holds.*

Furthermore, if $M \leq \ln(R)$, then for $y = \frac{R}{R-1}$, we have that $0 < \widetilde{n}\left(\frac{R}{R-1}\right) < 1$.

Proof. In Appendix A. ■

Proposition **??** states that, for each family i with income y_i there exists a threshold in the network density, $\widetilde{n}(y_i)$, such that if $n_i \geq \widetilde{n}(y_i)$ this family chooses to send a migrant. The network threshold $\widetilde{n}(y)$ is strictly increasing in y, implying that a larger mass of migrants will originate from relatively poor families than from relatively rich ones. The intuition for this is that the marginal utility of consumption is decreasing in the level of consumption, while the disutility from migration, M, is constant for any level of consumption. As a result, poorer families will be more eager to endure the emotional cost M, because their marginal return of migration in terms of (expected) utility of additional consumption is larger. Notice, finally, that Proposition **??** does not explicitly restrict $\widetilde{n}(y) \leq 1$. In fact, it may well be the case that $\widetilde{n}(y) > 1$ for some $y > 1$, implying that no migrants will originate from families with incomes above that level.

From now onwards we let $M \leq \ln(R)$ hold. This assumption can be read as saying that the emotional cost of migration, M, is not too large relative to the returns from investing in risky assets, R. Notice from the last sentence in Proposition **??** that, since $M \leq \ln(R)$ implies $\widetilde{n}\left(\frac{R}{R-1}\right) < 1$, then there will exist some families whose incomes are below the threshold level $R/(R-1)$ who will choose to send migrants.

The next step is to study how migration decisions interact with investment decisions. In particular, we are interested in studying whether families send migrants with the aim to increase their capacity to invest in the projects. By merging the migration results in Proposition **??** with the preceding discussion in this section, we can summarize households' optimal decisions concerning migration and investment in the following corollary.

Corollary 1

(i) *If* $R \geq \upsilon^{-1} + \frac{\upsilon}{4}$*. Then* $\widehat{y} \leq 1$*, and:*

a) For any $y \in \left[\frac{R}{R-1}, 2\right]$*: If* $n_i \geq \widetilde{n}(y)$ *and* $y_i = y$*, family* i *sends a migrant. If* $n_i < \widetilde{n}(y)$

and $y_i = y$, family i does not send a migrant. Family i always invests in the project.

b) For any $y \in \left[1, \frac{R}{R-1}\right)$: If $n_i \geq \widetilde{n}(y)$ and $y_i = y$, family i sends a migrant and invests in the project if and only if the migrant finds a good job. If $n_i < \widetilde{n}(y)$ and $y_i = y$, family i does not send a migrant and does not invest in the project.

***(ii)** If $R < \upsilon^{-1} + \frac{\upsilon}{4}$. Then $\widehat{y} > 1$, and:*

a) For any $y \in \left[\frac{R}{R-1}, 2\right]$: If $n_i \geq \widetilde{n}(y)$ and $y_i = y$, family i sends a migrant. If $n_i < \widetilde{n}(y)$ and $y_i = y$, family i does not send a migrant. Family i always invests in the project.

b) For any $y \in \left(\widehat{y}, \frac{R}{R-1}\right)$: If $n_i \geq \widetilde{n}(y)$ and $y_i = y$, family i sends a migrant and invests in the project if and only if the migrant finds a good job. If $n_i < \widetilde{n}(y)$ and $y_i = y$, family i does not send a migrant and does not invest in the project.

c) For any $y \in [1, \widehat{y}]$: If $n_i \geq \widetilde{n}(y)$ and $y_i = y$, family i sends a migrant. If $n_i < \widetilde{n}(y)$ and $y_i = y$, family i does not send a migrant. Family i never invests in the project.

The results from Corollary **??** can be visually summarized in Figure 1. The key insight of the corollary can be gleaned from point *b*), both for cases (*i*) and (*ii*) therein. The result in *b*) says there exist some families who use migration as a mechanism to mitigate credit constraints that prevent them from investing in projects that would raise their intertemporal income. Essentially, those families send a migrant, betting on the chance that this migrant finds a good job, which would increase their total income in $t = 1$ and, thus, place them in better position to undertake the unit investment that yields $R > 1$ units of income in $t = 2$.

2.3 Effect of migration on investment decisions

We now study the effect of migration on families' investment decisions. The migration effect results from calculating the difference in investment decisions between migrant and non-migrant families. First consider $E\left[I|\, m = 1, y\right] - E\left[I|\, m = 0, y\right]$, where I and m

are indicator functions regarding investment and migration decisions, respectively. In relation to the empirical results in this paper, we refer to this model as fixed-effects (FE) model, because by conditioning on y we are controlling for the family-specific FE. Note from Corollary **??** that, for any $y \geq \frac{R}{R-1}$, families choose $I = 1$ irrespective of their migration choice; while (in case (ii) of the corollary), for $y < \widehat{y}$, families always set $I = 0$, regardless of their migration choices. It follows then that migration has only an effect on the investment behavior of families with $\widehat{y} \leq y < \frac{R}{R-1}$; in particular:

$$\underbrace{E\left[I|\, m=1, \widehat{y} \leq y < \tfrac{R}{R-1}\right]}_{>0} - \underbrace{E\left[I|\, m=0, \widehat{y} \leq y < \tfrac{R}{R-1}\right]}_{=0} > 0 \tag{13}$$

Equation (**??**) makes it explicit that migration exerts a positive effect on investment decisions.[8] However, notice that a key feature of the problem is the fact that intrinsic family characteristics need to be taken into account when evaluating the effect of migration on investment. In fact, if those characteristics are not controlled for, the measured effect of migration on investment may turn out to be incorrect, because by simply comparing the average behavior of families with and without migrants, we may also be capturing the influence of other variables that somehow correlate with migration decisions. This idea is further developed in Appendix C.

3 Data

We make use of a unique new dataset available for poor rural households in Mexico. The data was collected for administrative purposes by the Oportunidades (ex Progresa) program. Launched in Mexico in 1997, it is a program whose main aim is to improve the process of human capital accumulation in the poorest communities by providing conditional cash transfers on specific types of behavior in three key areas: nutrition, health and education. Thanks to retrospective information, we managed to construct a panel of households based on three surveys. In December 2006, the Instituto Nacional de Salud Pública conducted a survey[9] of recipient households in the rural localities where the *Oportunidades* program started in 1997 with a 10% random sample, stratified by state. This database is then matched to another survey, the ENCASEH (Encuesta de Caracteristicas Socioeconomicas de los Hogares), carried out in 1997 and 1998, and to the ENCRECEH (Encuesta de Recertificación de los Hogares) carried out in 2001. This allows us to build a balanced panel database composed of three time observations (1997, 2001 and 2006) for 4,365 households from 130 rural localities. However, it should be noted that this database may not be representative of rural Mexico because it was designed to cover a particular subset of the population (i.e. those receiving Oportunidades). Therefore, the conclusions from the empirical results may only apply to this group.

This constructed database includes detailed information on each beneficiary household, including household demographics, income level and sources, education and several types of assets. It also includes locality-level data, mainly regarding infrastructure. Although it was not designed to evaluate migration patterns the database contains a few questions about household members that migrated. Moreover, from the income data we obtain information about remittances. Given the risk of attrition bias in our estimation, we compared the distributions between the balanced panel of 4,365 and the unbalanced panel. The distributions of the kernel density estimates appear to be very close to each other and this is confirmed by the results of Kolmogorov-Smirnov tests that we run on the hypothesis that the distributions of the balanced and unbalanced panels are the same for some key variables. The null hypothesis cannot be rejected across all tests[10].

4 The construction of an asset index

The first step in our empirical analysis is to reduce the household assets to unidimensional measures. This requires either complete knowledge of the market value of each asset owned or the construction of an asset index. Given that the prices of many assets owned by households are often unknown or difficult to determine, we construct the asset index using the methodology used by Adato et al. (2006): the household income[11] is regressed on the household's stock of assets. The household asset index is then the household income predicted from the estimated coefficients in the first year (1997), which are used to extrapolate to every year. The equation we estimate is of the form:

$$y_{i,1997} = \beta_0 + \beta_1 \mathbf{x}_{1i,1997} + \beta_2 \mathbf{x}_{2i,1997} + STATE_i + e_{i,1997}, \tag{14}$$

where $y_{i,t}$ is the per-capita income by household, $x_{1i,t}$ is a vector of household assets we are interested in, $x_{2i,t}$ is a vector of other household characteristics and STATE correspond to state dummy variables. The asset index is then constructed as

$$A_{i,t} = \hat{\beta}_1 \mathbf{x}_{1i,t}. \tag{15}$$

The asset index is standardized by its standard deviation. This simplifies the interpretation of the regression analysis results (i.e. a regression coefficient of one means one standard deviation of the index). First principal component analysis was also used with this data and results remain similar. For the sake of brevity results are not shown but they are available from the authors.

In poor regions, particularly where there is limited capacity to collect consumption, expenditure and price data, there is an asset-based alternative to the standard use of expenditures in defining well-being and poverty. Sahn and Stifel (2002) find that the construction of an asset index is a valid predictor of a crucial manifestation of poverty and that is measured as a proxy for a long-term wealth with less error than expenditures. We consider three asset indexes and four categories of assets. The distinction between productive and non-productive assets is based on Adato et al. (2006), where non-productive assets are considered as leisure and consumption:

- A_P: Productive assets: owner of a truck, agricultural land, irrigated land, working animals;

- A_{NP}: Non-Productive (leisure) assets: ownership of radios, TV, refrigerator, gas stove, washing machine and vehicles;

- A_T: Total assets: A_P and A_{NP};

- Other dwelling and household characteristics such as: electricity, earth floor, weak roof, domestic animals, own house, years of education of the household head.

We compute the asset indexes for the different periods in Table **??**. The table shows that there is a marked increase in asset accumulation for all households (HH) during the ten-year period.

5 Descriptive statistics

We take advantage of our detailed panel database to describe the economic role played by migration and remittances in the rural poor households. We construct a dummy variable at the household level that indicates whether the household has at least one member who is a migrant (i.e., working in another locality, state or abroad). In 1997, 5% of the households had a migrant member, while 3% had a member in the US. These percentages are somewhat reduced in 2001 (3% and 2%, respectively), but increase considerably in

2006 (10% and 7%, respectively). These results show that even when we follow the same households over a long period of time (10 years), there is considerable variation in migration statistics at the household level.

Table ?? presents summary statistics of other variables of interest for the balanced panel, pooled and separately for 1997, 2001 and 2006. The table shows that remittances represent less than 10% of the total income in the household (0.6/7.7). Surprisingly, this ratio is very similar for households with current migrants and for those without (the reason for this is that remittances may come from past migrants). The (pooled) average household has a household head with 3.3 years of schooling and has 1.4 male adults in the labor force. Both schooling and labor participation increase in 2006. The table also reports community level variables that will be used as IV in the next section. HH w/mig / #HH (at the community) is the proportion of households at the community level with at least one household member being a migrant. HH w/USmig / #HH (at the community) represents a similar ratio but for the case when the migrant lives in the US. As explained in the next section, the IV will work well if there is enough variation both across levels and across type of households. A visual inspection of the table reveals that this is indeed the case.

6 Econometric analysis

6.1 The model

Let A_{it} be an asset index for family i and year t. We are mostly interested in household-specific asset dynamics. Let $M_{i,t}$ be a variable that captures the migration-related nature of the household; X_{it} be household characteristics; and $(\mu_i + \epsilon_{it})$ be an error component with household-specific effects and idiosyncratic temporary shocks. We consider the following asset dynamics equation:

$$A_{i,t} - A_{i,t-1} = \alpha A_{i,t-1} + \beta M_{i,t} + \delta X_{i,t} + \mu_i + \epsilon_{i,t} \tag{16}$$

We are mostly concerned with $\beta \equiv \frac{\partial E[A_{i,t}|A_{i,t-1}, M_{i,t}, X_{i,t-1}, \mu_i, \eta_t]}{\partial M}$, which denotes the conditional effect of migration on asset accumulation. We extend this analysis to a multi-dimensional measure of assets $A = \{A_P, A_{NP}\}$, where A_P denotes productive assets and A_{NP} non-productive assets. As argued above, the question we want to address here is the effect of migration on the type of assets that families accumulate.

We study the effect of migration on asset accumulation using three different measures of migration. First, we consider a dummy variable for households that declare having at least one migrant member, Migrant HH (see Table **??**). Second, we use the number of migrants in the household, Number of Migrants by HH (see Table **??**). Third, we use remittances per capita (see Table **??**). In each case, we separately study the effect migration on: (*i*) total assets, (*ii*) productive assets, and (*iii*) non-productive assets. As additional covariates we can only select variables that change over time within HH, otherwise they became collinear with the fixed-effects. We use the number of HH male adults that correspond to a measure of the HH labor force.

6.2 Endogeneity and dynamic panel bias

Several endogeneity issues need to be addressed in order to avoid potential biases in this estimator. First, households may respond to adverse or positive shocks (ϵ) changing the number of migrants or the nature of migration (temporal vs. permanent). Second, selection bias may occur if migrant households are intrinsically different from non-migrant ones (see for instance Jaeger et al., 2010). Regarding the relationship between migration and self-selection, Borjas (1987, 1991) has formalized the endogeneity of the migration decision, showing that the welfare impact of immigrants is crucially dependent on the degree of transferability of their unobservable and observable variables, and that affects the labour market.

Acosta (2006) and Woodruff and Zenteno (2007) use migration networks and history (at the village or household level) as instruments for migration (or remittances) postulating that these variables have a positive impact on the opportunity to migrate but no additional impact on income, schooling, or nutrition at home. McKenzie and Sasin (2007) argue that these instruments are suitable to study the migration impact at the originary location as in our case.

Following previous work on this subject, the IV strategy we follow uses the historic percentage of migrants (to all destinations and to the US, separately) at the community level as an instrument for the household level decision. In particular, we use the ratio of migrant households to total households, lagged one period, at the community level, for all destinations and to the US as IV for our migrant variables at the household level. These are the variables HH w/mig / #HH (at the community) and HH w/USmig / #HH (at the community) in Table **??**. Because we have a panel data, and as long as there is variation across periods in communities, we can include these variables together with the fixed effects at the household level. Therefore, our identification strategy relies on variation in aggregate migration across time and space. We refer to this estimator as IVFE.

In order to evaluate the validity of the IV, we check for the joint statistical significance of these variables in the first-stage regressions (F-test), and for overidentifying restrictions (Sargan-Hansen test). In all specifications the F-test statistics for the joint significance of both instruments show that they are significantly correlated with the corresponding endogenous variables ($F > 10$). Moreover, the Sargan-Hansen tests show that we cannot reject the null hypothesis of exogeneity of the instruments at the usual 5% significance level. The first stage results appear in Appendix D.

In dynamic panel data models with unobserved effects, the treatment of the initial observations is an important theoretical and practical problem. As is well known, the usual within estimator is inconsistent, and can be badly biased. (See, for example, Hsiao, 1986, section 4.2.) We thus follow the Anderson and Hsiao (1981) and Arellano and Bond (1991) GMM strategy by taking first order differences and using lagged values of the dependent variable and other exogenous covariates in levels to instrument the autoregressive dependent variable. We also use the same IV for the migration variable.

6.3 Econometric results

Tables **??**, **??** and **??** report estimates for OLS, FE, IVFE and GMM estimators for migrant HH, number of migrants and remittances per capita, respectively. The asset index and remittances per capita are standardized to ease the interpretation of the results. The asset index A is divided by its pooled average (i.e. 0.5 in Table **??**). Therefore, all coefficients should be interpreted as the effect of a given covariate on units of the average asset index. Moreover, remittances per capita are divided by the pooled average total income per capita (i.e. 7.7 in Table **??**), and then, the effect of remittances per capita are measured in units of the average income per capita of the sample.

In all cases the OLS effect of migration on assets accumulation is negative and statistically significant. However, when we include the household-level FE this effect becomes non-significant, except for non-productive assets where it continues to display a negative sign and is statistically significant. The differences between OLS and FE show that total and productive assets have a positive correlation with migration (see also Appendix C).

Next, we follow the IV strategy described above. Both total assets and productive assets become positive and statistically significant while non-productive assets is, in general, negative and statistically significant. In all cases, the GMM estimates are smaller than the IVFE estimates, and this is our preferred specification.

Having a migrant household increases total asset accumulation by 0.249 standard deviation units. Moreover, one additional household migrant contributes to 0.035 total assets standard deviation units. Finally, increasing the amount of remittances by the same amount as the average HH income increases total asset accumulation by 0.039 standard deviation units. The magnitude and sign of the effect on productive assets follow closely that of total assets. Having a migrant household increases productive asset accumulation by 0.245 standard deviation units. Moreover, one additional household migrant contributes to 0.032 productive assets standard deviation units. Increasing the amount of remittances by the same amount as the average HH income increases productive asset accumulation by 0.030 standard deviation units. Finally, there is a negative IVFE effect on non-productive asset accumulation. However, the GMM estimates for this effect are non statistically significant in all specifications.

Overall the results show that migration can be seen as a long-term investment for the household. Therefore, the income sent back home by the migrant is used to accumulate productive assets, rather than non-productive assets.

7 Conclusion

This paper aims at explaining the link between migration and asset dynamics for a panel of poor rural households in Mexico over the period 1997-2006. Our results suggest that migration may be used by households as a mechanism to accelerate asset accumulation in productive assets. The general idea is that remittances may help alleviate credit constraints for poor households, thus allowing them to invest in productive assets that would be optimal under complete markets. Furthermore, our estimations also suggest that families who send migrants with the intention to channel remittances towards investment in productive assets, concomitantly reduce their accumulation of non-productive assets, possibly to further contribute to raising funds for physical investment.

An important caveat concerning our analysis is that it has abstracted from general equilibrium interactions, so as to focus exclusively on the direct effect of migration on capital accumulation via remittances. One specific general equilibrium effect that may be particularly relevant in our context is the fact that migration decisions will necessarily affect the aggregate labor supply at the home village. On the one hand, migration lowers aggregate labor supply at the village level, which in turn would raise equilibrium wages and household incomes (see Jaimovich, 2010, for a growth model where this mechanism is at play; also, see Mishra, 2007, for evidence of this general equilibrium effect in Mexico However, looking at the household level, sending out a migrant also means losing one of their workers (and, possibly, the most productive worker). Furthermore, it may well be the case that the wealth effect brought about by the migrant leads household members who remain at the village to increase their leisure consumption. In that regard, two remarks apply here. First, although we acknowledge that these effects imply that migration may influence accumulation also by other channels other than remittances, we are agnostic concerning the overall sign of these additional effects. Second, the above general equilibrium effect on the wage, which could be expected to induce an upwards bias on the effect of remittances, will be of significant magnitude only if the *total* number of migrants from the rural village varies substantially across our years of observations. In that respect, the results in Table 2 show that the percentage of families with at least one migrant ranges within 3% to 10% of the sampled households.

In a similar vein the effect of migration and remittances are both confounded. We should expect that remittances increase the probability of capital accumulation as it relaxes credit constraints. On the other hand, migration would decrease that probability because of the loss of household members and/or less incentives to work. Both effects could be further exploited, as for example studying whether results change or not when we analyze the impact of remittances for the sub-sample of migrant households *vis-a-vis* non-migrant households.

Notes

[1]See, for example, Stark and Levhari (1982), and Rozelle, Taylor and DeBrauw (1999, 2003).

[2]No future discounting is just a simplifying assumption, useful for the algebraic derivations but without any important implication. The log-utility is also assumed mainly for algebraic simplicity (in particular, it allows us to obtain a closed-form solution for the model), and could be replaced by a general CRRA utility function without changing the main insights of the model (as we will see below, it is important though that utility displays decreasing absolute risk aversion).

[3]Strictly speaking, there is no risk. Hence, the DARA property should be simply understood as an assumption on the degree of concavity of the utility function, which in turn governs the intertemporal elasticity of substitution, and therefore how willing agents are to transfer resources across the two periods.

[4]In the literature this is known as "psychological costs", and there exists some evidence for intra-European migration (Molle and van Mourik, 1988). We could also add to the model some pecuniary cost attached to sending a migrant (i.e. transportation costs), although it is important for our argument that pecuniary costs are not too large to prevent credit constrained households from affording to send out a migrant. In Appendix B we present an alternative version of the model where M is replaced by some pecuniary costs of migration.

[5]The lower bound, $\upsilon \geq 1$, essentially says that the *good* jobs are sufficiently productive, making migration (possibly) an attractive option. The upper bound, $\upsilon < 1 + R$, is just posed to focus only on those cases in which the credit constraint, $s_i \geq 0$, binds in the optimum (as we will see later on, $\upsilon < 1+R$ implies that total family income in $t = 1$ never exceeds that of $t = 2$).

[6]The role of networks on migration has been extensively studied in the literature (see for instance Munshi, 2003, and the references therein).

[7]More precisely, $\widehat{y} < 1$ whenever $R \geq \upsilon^{-1} + \frac{\upsilon}{4}$. Notice, too, that both a larger R and larger υ make this last inequality more likely to hold. This is quite intuitive, since the (expected) return from migration is increasing in R and υ; in the former case indirectly through investment returns, in the latter directly through earnings.

[8]The analytical expression for $E\left[I|\, m=1, \widehat{y} \leq y < \frac{R}{R-1}\right]$ is given by:

$$\left[{}_{\widehat{y}}^{R/(R-1)} \left[1-\widetilde{n}(y_i)\right] dy_i\right]^{-1}{}_{\widehat{y}}^{R/(R-1)} \frac{1+\widetilde{n}(y_i)}{2}\left[1-\widetilde{n}(y_i)\right] dy_i.$$

[9]Encuesta de "Re-evaluación de localidades incorporadas en las primeras fases del Programa (1997-1998)." INSP, 2006.

[10]Not shown but available from the authors upon request.

[11]Income aggregates were created and broken down into five categories: agricultural wage employment, non-farm wage employment, self employment, transfers and other (including income from rent and interests).

References

Acosta P. (2006) “Labor Supply, School Attendance, and Remittances from International Migration: The Case of El Salvador,” World Bank Policy Research Working Paper N.3903.

Adams R. (1998) “Remittances, Investment, and Rural Asset Accumulation in Pakistan,” Economic Development and Cultural Change 47:1, 155-173.

Adato, M., Carter, M.R. and May, J. (2006) “Exploring poverty traps and social exclusion in South Africa using qualitative and quantitative data,” Journal of Development Studies 42:2, 226 - 247.

Banerjee, B. and Bucci, G. A. (1994) “On-The-Job Search After Entering Urban Employment: An Analysis Based On Indian Migrants,” Oxford Bulletin Of Economics And Statistics 56, 1, 33-47.

Banerjee, A. and Newman, A., (1998) ”Information, the Dual Economy, and Development,” Review of Economic Studies, 65, 631-653.

Borjas, G. J. (1987) “Self-Selection And The Earnings Of Immigrants,” American Economic Review 77, 531-53.

Borjas, G. J. (1991) “Immigration And Self-Selection,” in Abowd and Freeman 27-96.

Carter, M. R. and Barrett C. (2006) “The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach,” Journal of Development Studies 42, 178-199.

Das Gupta, M. (1987) “Informal Security Mechanisms and Population Retention in Rural India,” Economic Development and Cultural Change 36, 101-120.

Durand, J. and Massey D. S. (2001) “Mexican Migration to the United States: a critical review,” Latin American Research Review 27, 3-42.

Ghatak, S., Levine, P. and Wheatly Price, S. (1996) “Migration Theories and Evidence: An Assesment,” Journal of Economic Surveys 10, 159-198.

Giuliano, P. and Ruiz-Arranz, M. (2009) “Remittances, financial development, and growth,” Journal of Development Economics 90, 144–152.

Glytsos, N. P. (1993) “Measuring The Income Effects of Migrant remittances: A Methodological Approach Applied to Greece,” Economic Development and Cultural Change 42, 131-168.

Hanson, G.H. and Woodruff, C. (2003) “Emigration and Educational Attainment in Mexico,” mimeo.

Harris, J.R. and Todaro, M.P. (1970) “Migration, Unemployment And Development: A Two-Sector Analysis,” American Economic Review 60, 126-142.

Jaeger, D.A., Bonin, H., Dohmen, T., Falk, A. and Huffman, D. (2010) “Direct Evidence on Risk Attitudes and Migration,” Review of Economics and Statistics, 92, 684–689

Jaimovich, E. (2010) “Adverse Selection and Entrepreneurship in a Model of Development,” Scandinavian Journal of Economics 112, March 2010.

Lewis, W.A. (1954) “Economics Development With Unlmimited Supplies Of Labor,” Manchester School of Economic and Social Studies 22, 139-191.

Lloyd-Ellis, H. and Bernhardt, D. (2000) ”Enterprise, Inequality and Economic Development,” Review of Economic Studies 67, 147-168.

Lucas, R.E.B. and Stark, O. (1985) “Motivations to Remit: Evidence from Botswana,’ Journal of Political Economy 93, 901-918.

McKenzie, D. and Sasin, M.J. (2007) “Migration, Remittances, Poverty, and Human Capital: Conceptual and empirical challenges,” World Bank Policy Research Working Paper N.4272.

McKenzie, D. and Woodruff, C. (2006) “Do entry costs provide an empirical basis for poverty traps? Evidence from Mexican microenterprises,” Economic Development and Cultural Change 55, 3-42.

Mesnard, A. (2004) ”Temporary migration and capital market imperfections,” Oxford Economic Papers 56, 242–262.

Mesnard, A. and Ravallion, M. (2006) “The wealth effect on new business startups in a developing economy,” Economica 73, 367–392.

Mishra, P. (2007) ”Emigration and wages in source countries: Evidence from Mexico,” Journal of Development Economics 82 (2007) 180– 199.

Molle, W. and Van Mourik, A. (1988) “International movements of labour under conditions of economic integration: the case of Western Europe,” Journal of Common Market Studies 26, 317-42.

Munshi K. (2003) “Networks in the modern economy: Mexican Migrants in the U.S. Labor Market,” Quarterly Journal of Economics 118, 549-599.

Montgomery, J. (1991) “Social Networks and Labor-Market Outcomes: Toward an Economic Analysis,” American Economic Review 81, 1408–1418.

Rapoport, H. and Docquier, F. (2005) “The Economics of Migrants’ Remittances”, IZA Discussion Paper No. 1531, chapter prepared for the Handbook on the Economics of Reciprocity, Giving and Altruism, Elsevier- North Holland, forthcoming (Editors: L.-A. Gerard-Varet, S.-C. Kolm and J. Mercier-Ythier).

Rapoport, H. (2002) “Migration, credit constraints and self-employment: A simple model of occupational choice, inequality and growth.” Economics Bulletin 15, 1-5

Rosenzweig, M.R. and Wolpin, K.I. (1993) “Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: invesment in bullocks in India,” Journal of Political Economy 101, 223–244.

Rozelle, S., Taylor, J.E. and DeBrauw, A. (1999) “Migration, Remittances, and Agricultural Productivity in China,” American Economic Review 89, 287-291.

Rozelle, S., Taylor, J.E. and DeBrauw, A. (2003) ”Migration and Incomes in Source Communities: A New Economics of Migration Perspective from China,” Economic Development and Cultural Change 52, 75-101.

Sahn D. E. and Stifel D. C., (2003) ”Exploring Alternative Measures of Welfare in the Absence of Expenditure Data,” Review of Income & Wealth, Wiley Blackwell, vol. 49(4), pages 463-489, December.

Sen, A.K. (1966) ”Peasants and Dualism with or without Surplus Labour,” Journal of Political Economy 74, 425-450.

Stark, O. (1991) “The Migration Of Labor,” Cambridge, Mass.: Basil Blackwell.

Stark, O. and Levhari, D. (1982) “On Migration and Risk in LDCs,” Economic Development and Cultural Change 31, 191-196.

Woodruff, C. and Zenteno, R. (2007) “Migration networks and microenterprises in Mexico,” Journal of Development Economics 82, 509-528.

Yang, D.. (2008) “International Migration, Remittances, and Household Investment: Evidence from Philippine Migrants’ Exchange Rate Shocks,” Economic Journal 118, 591-630.

Table 1: Asset Indexes, by HH migrant status

	All HH	**HH with migrants**	**HH without migrants**
		All years	
Asset Index	0.5	0.503	0.499
	[0.45]	[0.471]	[0.447]
N	13,095	1,443	11,652
		1997	
Asset Index	0.388	0.387	0.388
	[0.44]	[0.452]	[0.438]
		2001	
Asset Index	0.478	0.474	0.478
	[0.445]	[0.466]	[0.442]
		2006	
Asset Index	0.634	0.649	0.632
	[0.43]	[0.457]	[0.427]

Table 2: Summary Statistics

HH	All HH		HH w/mig		HH wo/mig	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
			All years			
Per capita inc	7.7	1.9	7.847	1.70	7.667	1.95
Remittances	0.6	3.3	1.694	8.17	0.462	1.96
Yrs educ (head)	3.362	2.079	3.977	2.23	3.271	2.45
HH male adults	1.436	1.18	1.784	1.31	1.393	1.15
#HH w/mig / #HH (at com.)	0.012	0.027	0.021	0.05	0.011	0.02
#HH w/USmig / #HH (at com.)	0.01	0.025	0.018	0.05	0.009	0.01
			1997			
Per Capita inc	7.289	2.536	7.424	2.275	7.272	2.566
Remittances	0.4	2.262	0.4	2.235	0.4	2.265
Yrs educ (head)	3.273	2.296	3.662	2.089	3.216	2.32
HH male adults	1.256	1.03	1.426	1.099	1.235	1.02
#HH w/mig / #HH (at com.)	0.011	0.031	0.018	0.05	0.011	0.028
#HH w/USmig / #HH (at com.)	0.008	0.026	0.015	0.05	0.008	0.021
			2001			
Per capita inc	7.776	1.502	7.925	1.198	7.757	1.535
Remittances	0.503	1.836	0.305	1.398	0.528	1.882
Yrs educ (head)	3.245	2.376	3.85	2.155	3.156	2.394
HH male adults	1.29	1.046	1.674	1.204	1.243	1.015
#HH w/mig / #HH (at com.)	0.008	0.021	0.015	0.049	0.007	0.013
#HH w/USmig / #HH (at com.)	0.006	0.019	0.012	0.048	0.005	0.011
			2006			
Per capita inc	7.997	1.503	8.193	1.334	7.972	1.521
Remittances	0.883	4.914	4.315	13.436	0.454	1.725
Yrs educ (head)	3.567	2.609	4.42	2.381	3.44	2.617
HH male adults	1.763	1.364	2.254	1.477	1.702	1.337
#HH w/mig / #HH (at com.)	0.017	0.029	0.029	0.068	0.015	0.019
#HH w/USmig / #HH (at com.)	0.014	0.027	0.026	0.067	0.013	0.016

Table 3: Growth of the Asset Index - Migrant Household

VARIABLES	Pooled OLS	FE	IVFE	GMM
ALL ASSETS				
Lag Total	-0.569***	-1.334***	-1.357***	-1.423***
	(0.00986)	(0.0126)	(0.0154)	(0.0124)
Migrant HH	-0.140***	0.0601	0.827***	0.249***
	(0.0414)	(0.0455)	(0.279)	(0.0614)
HH Male Adults	-0.0715***	0.0836***	0.0607***	0.00437
	(0.00783)	(0.0128)	(0.0156)	(0.0148)
Observations	8730	8730	8730	8730
R^2	0.282	0.729	0.712	
Number of HH		4365	4365	4365
F (first stage)			63.81	
Sargan			0.0942	0.149
PRODUCTIVE ASSETS				
Lag Prod	-0.553***	-1.349***	-1.367***	-1.442***
	(0.00981)	(0.0125)	(0.0148)	(0.0125)
Migrant HH	-0.136***	0.0596	0.689***	0.245***
	(0.0413)	(0.0444)	(0.267)	(0.0615)
HH Male Adults	-0.0799***	0.0538***	0.0347**	-0.0217
	(0.00781)	(0.0125)	(0.0151)	(0.0152)
Observations	8730	8730	8730	8730
R^2	0.274	0.738	0.726	
Number of HH		4365	4365	4365
F (first stage)			64.87	
Sargan			0.0965	0.101
NON PRODUCTIVE ASSETS				
Lag Non-Prod	-0.657***	-1.491***	-1.485***	-1.860***
	(0.0120)	(0.0161)	(0.0165)	(0.0208)
Migrant HH	-0.135***	-0.162***	-0.678**	0.103
	(0.0467)	(0.0543)	(0.300)	(0.0747)
HH Male Adults	-0.0516***	-0.0304**	-0.0113	0.00884
	(0.00885)	(0.0150)	(0.0187)	(0.0183)
Observations	8730	8730	8730	8730
R^2	0.258	0.664	0.657	
Number of HH		4365	4365	4365
F (first stage)			75.36	
Sargan			0.434	0.613

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. See text for variable definitions.

Table 4: Growth of the Asset Index - Number of Migrants by Household

VARIABLES	Pooled OLS	FE	IVFE	GMM
ALL ASSETS				
Lag Total	-0.569***	-1.333***	-1.357***	-1.417***
	(0.00986)	(0.0125)	(0.0158)	(0.0123)
Number of Migrants by HH	-0.0290***	0.00847	0.220***	0.0355**
	(0.00911)	(0.0101)	(0.0768)	(0.0138)
HH Male Adults	-0.0703***	0.0841***	0.0510***	0.00289
	(0.00790)	(0.0129)	(0.0180)	(0.0149)
Observations	8730	8730	8730	8730
R^2	0.282	0.729	0.702	
Number of HH		4365	4365	4365
F			41.93	
Sargan			0.0812	0.147
PRODUCTIVE ASSETS				
Lag Prod	-0.554***	-1.348***	-1.367***	-1.436***
	(0.00981)	(0.0124)	(0.0150)	(0.0124)
Number of Migrants by HH	-0.0299***	0.00826	0.182**	0.0322**
	(0.00909)	(0.00982)	(0.0732)	(0.0137)
HH Male Adults	-0.0784***	0.0543***	0.0266	-0.0227
	(0.00788)	(0.0126)	(0.0174)	(0.0152)
Observations	8730	8730	8730	8730
R^2	0.274	0.738	0.719	
Number of HH		4365	4365	4365
F			42.80	
Sargan			0.0844	0.112
NON PRODUCTIVE ASSETS				
Lag Non-Prod	-0.657***	-1.491***	-1.483***	-1.859***
	(0.0120)	(0.0161)	(0.0169)	(0.0208)
Number of Migrants by HH	-0.0211**	-0.0281**	-0.186**	0.0192
	(0.0103)	(0.0120)	(0.0820)	(0.0175)
HH Male Adults	-0.0516***	-0.0312**	-0.00241	0.00571
	(0.00893)	(0.0151)	(0.0213)	(0.0185)
Observations	8730	8730	8730	8730
R^2	0.258	0.663	0.650	
Number of HH		4365	4365	4365
F			49.78	
Sargan			0.480	0.599

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. See text for variable definitions.

Table 5: Growth of the Asset Index - Remittances per capita

VARIABLES	Pooled OLS	FE	IVFE	GMM
ALL ASSETS				
Lag Total	-0.570***	-1.334***	-1.371***	-1.413***
	(0.00986)	(0.0125)	(0.0238)	(0.0123)
Remittances	0.00189	0.0358***	0.795**	0.0388**
	(0.0118)	(0.0129)	(0.344)	(0.0153)
HH Male Adults	-0.0751***	0.0839***	0.0524**	0.00632
	(0.00778)	(0.0128)	(0.0222)	(0.0148)
Observations	8730	8730	8730	8730
R^2	0.281	0.730	0.517	
Number of HH		4365	4365	4365
F			5.539	
Sargan			0.207	0.162
PRODUCTIVE ASSETS				
Lag Prod	-0.554***	-1.349***	-1.381***	-1.433***
	(0.00982)	(0.0124)	(0.0224)	(0.0124)
Remittances	0.000104	0.0311**	0.668**	0.0296**
	(0.0118)	(0.0126)	(0.316)	(0.0134)
HH Male Adults	-0.0833***	0.0543***	0.0280	-0.0169
	(0.00776)	(0.0125)	(0.0204)	(0.0150)
Observations	8730	8730	8730	8730
R^2	0.274	0.738	0.586	
Number of HH		4365	4365	4365
F			5.540	
Sargan			0.185	0.138
NON PRODUCTIVE ASSETS				
Lag Non-Prod	-0.658***	-1.492***	-1.507***	-1.861***
	(0.0120)	(0.0161)	(0.0201)	(0.0209)
Remittances	-0.0241*	-0.00956	-0.613*	-0.00559
	(0.0133)	(0.0155)	(0.313)	(0.0195)
HH Male Adults	-0.0540***	-0.0358**	-0.00341	0.0187
	(0.00879)	(0.0149)	(0.0241)	(0.0180)
Observations	8730	8730	8730	8730
R^2	0.258	0.663	0.547	
Number of HH		4365	4365	4365
F			7.250	
Sargan			0.479	0.620

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. See text for variable definitions.

Figure 1: Migration and investment decisions

g:/Migration/cases.png

Appendix A

Proofs

Proof of Proposition ??.

Step 1: Let $y_i \in \left[\frac{R}{R-1}, 2\right]$ and define:

$$\widetilde{n}_1(y_i) \equiv \frac{M}{\ln(y_i + \upsilon - 1) - \ln(y_i - 1)}. \tag{17}$$

Notice first that $\widetilde{n}_1(y_i) > 0$ and finite, since both the numerator and denominator in (**??**) are strictly positive and finite. Secondly, differentiating (**??**) with respect to y_i yields:

$$\frac{d\widetilde{n}_1}{dy_i} = \frac{M}{\left[\ln(y_i + \upsilon - 1) - \ln(y_i - 1)\right]^2}\left(\frac{1}{y_i - 1} - \frac{1}{y_i + \upsilon - 1}\right) > 0,$$

where the result $\widetilde{n}_1'(y_i) > 0$ follows from the fact that $y_i - 1 < y_i + \upsilon - 1$. Finally, since the left-hand side in (**??**) is strictly increasing in n_i, it immediately follows that for any $n_i > \widetilde{n}_1(y_i)$ condition (**??**) holds.

Step 2: Let $y_i \geq 1$ and $y_i \in \left(\widehat{y}, \frac{R}{R-1}\right)$ and define:

$$\widetilde{n}_2(y_i) \equiv \frac{M}{\ln(y_i + \upsilon - 1) + \ln(y_i + R) - \ln(y_i^2)}. \tag{18}$$

Firstly, $\widetilde{n}_2(y_i) > 0$ and finite, because both the numerator and denominator in (**??**) are strictly positive and finite. Secondly, differentiating (**??**) with respect to y_i yields:

$$\frac{d\widetilde{n}_2}{dy_i} = \frac{M}{\left[\ln(y_i + \upsilon - 1) + \ln(y_i + R) - \ln(y_i^2)\right]^2}\left(\frac{2}{y_i} - \frac{2y_i + R + 2(\upsilon - 1)}{y_i^2 + R(y_i - 1) + y_i(\upsilon - 1) + \upsilon R}\right) > 0, \tag{19}$$

where $\widetilde{n}_2'(y_i) > 0$ obtains after some algebra on the second term in right-hand side of (**??**), which leads to the condition that $\widetilde{n}_2'(y_i) > 0$ iff $y_i(R-1) + y_i\upsilon + 2R(\upsilon - 1) > 0$. Lastly, since the left-hand side in (**??**) is strictly increasing in n_i, it immediately follows that for any $n_i > \widetilde{n}_2(y_i)$ condition (**??**) prevails.

Step 3: Let $y_i \geq 1$ and $y_i \leq \widehat{y}$ and define:

$$\widetilde{n}_3(y_i) \equiv \frac{M}{\ln\left(y_i + \frac{\upsilon}{2}\right)^2 - \ln\left(y_i^2\right)}. \tag{20}$$

As in the previous two cases, $\widetilde{n}_3(y_i) > 0$ and finite, as both the numerator and denominator in (**??**) are strictly positive and finite. Next, differentiating (**??**) with respect to y_i yields:

$$\frac{d\widetilde{n}_3}{dy_i} = \frac{M}{\left[\ln\left(y_i + \frac{\upsilon}{2}\right)^2 - \ln\left(y_i^2\right)\right]^2}\left(\frac{2}{y_i} - \frac{2y_i + \upsilon}{y_i^2 + \frac{\upsilon^2}{4} + y_i\upsilon}\right) > 0, \tag{21}$$

where $\widetilde{n}_3'(y_i) > 0$ obtains after some algebra on the second term in right-hand side of (**??**), which leads to the condition that $\widetilde{n}_3'(y_i) > 0$ iff $\frac{\upsilon^2}{2} + y_i\upsilon > 0$. Finally, since the left-hand side in (**??**) is strictly increasing in n_i, it trivially follows that for any $n_i > \widetilde{n}_3(y_i)$ condition (**??**) holds.

Step 4: Let now,

$$\widetilde{n}(y_i) = \begin{cases} \widetilde{n}_1(y_i) & \text{if } \frac{R}{R-1} \leq y_i \leq 2, \\ \widetilde{n}_2(y_i) & \text{if } y_i \geq 1 \text{ and } \widehat{y} < y_i < \frac{R}{R-1}, \\ \widetilde{n}_3(y_i) & \text{if } y_i \geq 1 \text{ and } y_i \leq \widehat{y}. \end{cases}$$

Replacing $y_i = \frac{R}{R-1}$ into (**??**) and (**??**), we can observe after some simple algebra that $\widetilde{n}_1\left(\frac{R}{R-1}\right) = \widetilde{n}_2\left(\frac{R}{R-1}\right)$. Similarly, from the definition of $\widehat{y}$ in (**??**), replacing $y_i = \widehat{y}$ into (**??**) and (**??**), it follows that $\widetilde{n}_2\left(\widehat{y}\right) = \widetilde{n}_3\left(\widehat{y}\right)$. As a consequence, it follows that $\widetilde{n}(y_i)$ portrays a continuous and strictly increasing function and $\widetilde{n}(y_i) : \mathbb{R}_{++} \to \mathbb{R}_{++}$.

Step 5: Finally, to prove that $\widetilde{n}\left(\frac{R}{R-1}\right) < 1$, notice that plugging $y_i = \frac{R}{R-1}$ into (**??**) leads to:

$$\widetilde{n}_1\left(\tfrac{R}{R-1}\right)=\frac{M}{\ln\left(\frac{1}{R-1}+\upsilon\right)-\ln\left(\frac{1}{R-1}\right)}=\frac{M}{\ln\left(\frac{\frac{1+\upsilon(R-1)}{R-1}}{\frac{1}{R-1}}\right)}=\frac{M}{\ln\left[1+\upsilon(R-1)\right]}.$$

Therefore, $\widetilde{n}_1\left(\frac{R}{R-1}\right)<1$ iff $M<\ln\left[1+\upsilon(R-1)\right]$, which is guaranteed by $M\leq\ln(R)$ together with $\upsilon\geq 1$ and $R>1$. ■

Appendix B

A Simple Version of the Two-Period Investment Model with Pecunary Cost of Migration

We show now that our main results of the benchmark model in Section **??** may also be derived from slightly different version of the model, where 'psychic costs' are replaced by monetary costs associated to migration decisions. In particular, we show that relatively poor households may choose to send a migrant, betting on the chance he finds a job with higher income and send back remittances to be invested in the productive asset. In addition, we show that under certain feasible parametric configurations, relatively poor families are more prone to send a migrant than relatively rich families. Notice that this happens despite the fact that the former are more risk-averse than the latter, and migration entails a risky choice. The reason is, again, that poorer families may have relatively more to gain from migration, as this helps them mitigate the effects of credit constraints.

To keep this alternative model as simple and concise as possible, we look at a case where there are only two (permanent) income levels; namely, our previous extreme values: $y_i=\{1,2\}$. As before, after observing the income realization y_i, family i may choose whether or not to send one of their members as a migrant in $t=1$. In order to send a migrant, the household must pay upfront a monetary cost $0 < c < 1$. The migrant gets a good job with probability n_i (which denotes, as before, the network density at destination), in which case receives net income $\widetilde{\upsilon} = \upsilon + c$, where $1 \leq \upsilon < 1 + R$. On the other hand, with probability $1 - n_i$ the migrant gets net income equal to 0.

Hereafter, we assume that migration costs are small enough to ensure that households with $y_i = 2$ will always invest in the risky asset, no matter their migration choices and migration outcomes. This requires that the following parametric assumption holds:

$$2 - c > R/(R - 1). \tag{22}$$

Relatively Rich Households: Assumption (**??**) ensures that these families always invest $I_i = 1$ in the risky asset. As a result, the condition for sending a migrant when $y_i = 2$ will be given by: $n_i [\ln(1 + \upsilon) + \ln(2 + R)] + (1 - n_i) [\ln(1 - c) + \ln(2 + R)] \geq \ln(1) + \ln(2 + R)$. This condition easily simplifies to:

$$\text{If } y_i = 2, \text{ send migrant iff: } \quad n_i \ln(1 + \upsilon) + (1 - n_i) \ln(1 - c) \geq 0. \tag{23}$$

Since $0 < (1 - c) < 1 < (1 + \upsilon)$, it follows that there exists a network threshold $0 < \widetilde{n}_{rich} < 1$, such that (**??**) holds if and only if $n_i \geq \widetilde{n}_{rich}$.

Relatively Poor Households: Consider now the case of family i with $y_i = 1$. Such a family will not invest in the project if the migrant fails to obtain a good job. Nor will they invest in the project when they choose not to send a migrant. Then, as in the benchmark model, the first question to address is the following: should a family that sent a migrant invest in the project when the migrant manages to find a good job? The two expressions below show the utility obtained in the case the household invests in the project when the migrant gets a good job and in the case it does not, respectively.

$$\begin{aligned}\widetilde{U}_{i,I}^{*,poor} &= n_i\left[\ln(\upsilon)+\ln(1+R)\right]+(1-n_i)\left[\ln(1-c)+\ln(1)\right],\\ \widetilde{U}_{i,NI}^{*,poor} &= n_i\left[\ln\left(1+\upsilon+\upsilon^2\right)\right]+(1-n_i)\left[\ln(1-c)+\ln(1)\right].\end{aligned}$$

Comparing these two expressions, it follows that a household with $y_i = 1$ who chooses to send a migrant will invest in the risky asset if and only if the migrant finds a good job and the following parametric condition holds:[12]

$$R \geq \frac{1}{\upsilon}+\frac{\upsilon}{4} \tag{24}$$

In order to just focus just on the case in which households with $y_i = 1$ resort migration as a way to mitigate credit constraints, we will restrict the analysis to cases when condition (**??**) holds.[13] In these cases, a household with $y_i = 1$ will then choose to send a migrant when $\widetilde{U}_{i,I}^{*,poor} \geq 2\ln(1)$. This, in turn, leads to the following condition:

$$\text{If } y_i = 1\text{, send migrant iff:}\quad n_i\ln\left[\upsilon(1+R)\right]+(1-n_i)\ln(1-c)\geq 0. \tag{25}$$

Given that $0 < (1-c) < 1 < \upsilon(1+R)$, it follows that there exists a network threshold $0 < \widetilde{n}_{poor} < 1$, such that (**??**) holds if and only if $n_i \geq \widetilde{n}_{poor}$. Hence, similarly to our benchmark model, whenever (**??**) holds, then some of the relatively poor families use migration as a mechanism to possibly overcome binding credit constraints.

Finally, comparing (**??**) and (**??**), we can observe that $\widetilde{n}_{poor} < \widetilde{n}_{rich}$. This results stems from the fact that:

$$\ln\left[\upsilon(1+R)\right] > \ln(1+\upsilon),$$

since both $\upsilon > 1$ and $R > 1$. As a result, it must be true that: $\widetilde{n}_{rich}\ln\left[\upsilon(1+R)\right] + (1-\widetilde{n}_{rich})\ln(1-c) > \widetilde{n}_{rich}\ln(1+\upsilon)+(1-\widetilde{n}_{rich})\ln(1-c) = 0$, implying that $\widetilde{n}_{poor} <$

$\widetilde{n}_{rich}$, since the LHS of (**??**) is strictly increasing in n_i. Therefore, similarly to our benchmark model, whenever (**??**) holds, poorer households are more prone to send migrants, which in turn implies that simple OLS regressions may well yield downwards biased estimations of the effect of migrations on investment in physical capital, in a similar fashion as previously illustrated in Proposition **??**.

Appendix C

Bias in OLS estimator.

To make this last argument more precise, consider now the overall association between migration and investment in the population; this results from calculating the difference, $E\left[I|\, m=1\right] - E\left[I|\, m=0\right]$. In parallel with the empirical results, we refer to this model as ordinary least-squares (OLS) effect. After some algebra we obtain

$$E\left[I|\, m=1\right] - E\left[I|\, m=0\right] = \underbrace{\Pr\left[\widehat{y} < y < \tfrac{R}{R-1}\middle|\, m=1\right] \cdot E\left[I\,\middle| m=1, \widehat{y} < y < \tfrac{R}{R-1}\right]}_{\text{positive}} + \underbrace{\left\{\Pr\left[y \geq \tfrac{R}{R-1}\middle|\, m=1\right] - \Pr\left[y \geq \tfrac{R}{R-1}\middle|\, m=0\right]\right\}}_{\text{negative}}, \tag{26}$$

where $\Pr\left[y \geq \frac{R}{R-1}\middle|\, m=1\right] < \Pr\left[y \geq \frac{R}{R-1}\middle|\, m=0\right]$ follows from the fact that the threshold-function $\widetilde{n}(y)$ is monotonically increasing in y.

The first thing that can be observed from (**??**) is that it is no longer true that families with migrants tend to invest more than families without migrants; that is, $E\left[I|\, m=1\right] - E\left[I|\, m=0\right] \lesseqgtr 0$. Furthermore, we can also show that OLS effect is always smaller that the FE effect. We refer to this difference as the OLS bias.

Proposition 2 *The OLS bias is negative, that is:*

$$\begin{aligned}&[E(I|\, m=1) - E(I|\, m=0)] - \\ &\qquad \left[E\left(I|\, m=1, \widehat{y} \le y < \tfrac{R}{R-1}\right) - E\left(I|\, m=0, \widehat{y} \le y < \tfrac{R}{R-1}\right)\right] < 0\end{aligned} \tag{27}$$

Proof. Note: The following proof is conducted for the case in which $\widehat{y} \le 1$. The proof for the case in which $\widehat{y} > 1$ is almost identical to this one, and it is available from the authors upon request.

The expression (**??**) can be re-ordered as follows:

$$\begin{aligned}\text{OLS bias} = &\underbrace{\left[E\left(I|\, m=0, \widehat{y} \le y < \tfrac{R}{R-1}\right) - E(I|\, m=0)\right]}_{A} \\ &- \underbrace{\left[E\left(I|\, m=1, \widehat{y} \le y < \tfrac{R}{R-1}\right) - E(I|\, m=1)\right]}_{B}.\end{aligned} \tag{28}$$

Recalling (**??**), we can observe that the first member of (**??**) simplifies to:

$$A = 0 - \Pr\left[y \ge \tfrac{R}{R-1}\middle|\, m=0\right] = -\Pr\left[y \ge \tfrac{R}{R-1}\middle|\, m=0\right].$$

In the case of the second member of (**??**), we have:

$$\begin{aligned}B &= E\left(I|\, m=1, \widehat{y} \le y < \tfrac{R}{R-1}\right) - \Pr\left(\widehat{y} \le y < \tfrac{R}{R-1}\middle|\, m=1\right) E\left(I \left|m=1, \widehat{y} \le y < \tfrac{R}{R-1}\right.\right) \\ &\qquad - \Pr\left(y \ge \tfrac{R}{R-1}\middle|\, m=1\right) \\ &= E\left(I|\, m=1, \widehat{y} \le y < \tfrac{R}{R-1}\right) \underbrace{\left[1 - \Pr\left(\widehat{y} \le y < \tfrac{R}{R-1}\middle|\, m=1\right)\right]}_{\Pr\left(y \ge \frac{R}{R-1}\middle| m=1\right)} - \Pr\left(y \ge \tfrac{R}{R-1}\middle|\, m=1\right) \\ &= -\Pr\left(y \ge \tfrac{R}{R-1}\middle|\, m=1\right)\left[1 - E\left(I|\, m=1, \widehat{y} \le y < \tfrac{R}{R-1}\right)\right]\end{aligned}$$

Therefore, we can in the end obtain:

$$A - B = -\Pr\left[y \geq \tfrac{R}{R-1}\middle|\, m=0\right] + \Pr\left(y \geq \tfrac{R}{R-1}\middle|\, m=1\right)\left[1 - E\left(I\middle|\, m=1, \widehat{y} \leq y < \tfrac{R}{R-1}\right)\right]$$

which is always strictly negative for the combined effect of the following two properties:
1) The monotonicity of $\widetilde{n}(y)$ implies that: $\Pr\left(y \geq \frac{R}{R-1}\middle|\, m=0\right) > \Pr\left(y \geq \frac{R}{R-1}\middle|\, m=1\right)$.
2) The fact that $E\left(I\middle|\, m=1, \widehat{y} \leq y < \frac{R}{R-1}\right) < 1$. This is because, among the families with $\widehat{y} \leq y < R/(R-1)$ and send migrants, only in those cases in which the migrant manages to find a good job (which occurs with probability n_i) do families invest in the project. ■

■

The OLS bias arises because the OLS regression underestimate the effect of migration on investment. This occurs because the family-specific level of income (y_i) and the migration decision cannot be separated. In consequence, it is important to control for the level of income y_i or other family-specific characteristics to get an unambiguous effect.

Appendix D

Table 6: First stage regressions

	Migrant HH			Number of Migrants by HH			Remittances		
VARIABLES	All assets	Prod. assets	Non-Prod. assets	All assets	Prod. assets	Non-Prod. assets	All assets	Prod. assets	Non-Prod. assets
Lag Total	0.0233***			0.0879***			0.0418***		
	(0.00414)			(0.0188)			(0.0147)		
Lag Prod		0.0216***			0.0792***			0.0436***	
		(0.00421)			(0.0192)			(0.0150)	
Lag Non-Prod			0.00988**			0.0502**			-0.0235
			(0.00442)			(0.0201)			(0.0157)
HH Male Adults	0.0269***	0.0274***	0.0320***	0.146***	0.148***	0.165***	0.0385***	0.0382**	0.0483***
	(0.00419)	(0.00420)	(0.00410)	(0.0191)	(0.0191)	(0.0186)	(0.0149)	(0.0149)	(0.0146)
HH w/mig / #HH (at com.)	0.774**	0.781**	0.853***	2.404	2.437*	2.704*	0.864	0.860	0.998
	(0.324)	(0.324)	(0.325)	(1.475)	(1.476)	(1.477)	(1.155)	(1.155)	(1.155)
HH w/USmig / #HH (at com.)	0.924***	0.931***	0.975***	3.856**	3.888***	4.048***	0.917	0.920	1.016
	(0.329)	(0.329)	(0.330)	(1.497)	(1.498)	(1.499)	(1.172)	(1.171)	(1.172)
Observations	8730	8730	8730	8730	8730	8730	8730	8730	8730
R^2	0.058	0.056	0.052	0.048	0.047	0.045	0.008	0.008	0.007
Number of HH	4365	4365	4365	4365	4365	4365	4365	4365	4365

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. See text for variable definitions.