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JEL classification: O 15

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Village level inequality, migration and remittances in rural Mexico: How do they change over time?

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Please do not quote

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Introduction

More than 200 million people worldwide (3% of world population) lived outside their country of birth in 2005 (Vargas-Lundius and Villarreal, 2008), and remittances are second only to FDI among foreign income sources for developing countries, surpassing $328 billion in 2008 (Ratha et al., 2009). Historically, centuries-long international migration promoted the convergence of living standards between sending and receiving countries more than did booming trade and capital markets (Williamson, 2006).

How remittances are distributed and how they shape income inequalities in migrant-sending areas has become a focus of economics research, for several reasons. One has to do

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with equity and social welfare. Another concerns interactions between inequality and growth in imperfect-market environments, including the possibility that inequality may reduce efficiency, create poverty traps, exacerbate government failures, decrease the expected returns from investments in human capital, and undermine social capital and cooperation (e.g., see Birdsall, 2001). The empirical literature on the effects of inequality on growth has produced conflicting results in different settings. It is widely accepted that inequality tends to decrease growth significantly in poorer countries (Barro, 2000; Amarante, 2008), especially in countries where market imperfections are widespread (Quintin and Saving, 2008). Given that market imperfections are common, and remittances constitute an increasing share of income in developing countries, understanding how remittances affect inequality is essential for designing rural development policies conducive to broad-based growth.

With few exceptions, empirical research on migration, remittances and inequality has used cross-sectional data to study an inherently dynamic relationship, due to a lack of panel data (McKenzie and Sasin, 2007). Taylor (1992) and McKenzie and Rapoport (2007) are exceptions; however, both use data from a small number of villages or municipalities, and thus their results can be taken as only as suggestive evidence. Cross-section studies provide conflicting findings. Remittances have been found to increase inequality in some settings (Milanovic, 1987; Adams, 1989; Barham and Boucher, 1998; Adams, Cuecuecha and Page, 2008), and decrease it in others (Taylor, 1992; Gustafsson and Makonnen, 1994; Ahlburg, 2004; Babatunde, 2008; Acosta et al., 2008). The migration diffusion theory of Stark, Taylor and Yitzhaki (1986) provides an explanation for the conflicting findings in the literature: At the beginning of the migration diffusion process, more well-off households can afford the costs and risks of migration, hence, remittances may have an unequalizing effect initially. As more households have migrants, both costs and risks of migration decrease for potential migrants, causing migration to diffuse to the lower parts of the income distribution and resulting in a more equalizing remittance impact. The authors provide empirical evidence supporting the migration diffusion theory and the role of networks in decreasing the cost and risk of migration based on data from two villages in Mexico. Taylor et al. (2008) find support for this hypothesis using a nationally representative sample of rural households in

Mexico. They also find that international remittances become more effective in reducing poverty along the migration diffusion path and suggest that networks play an important role in this process.

In this paper we test the migration diffusion hypothesis using novel panel data covering a nationally representative sample of rural households in Mexico. Matched-household data make it possible to estimate changes in village Gini coefficients and model these changes using fixed-effects methods that control for time-invariant village variables. Our data also permit us to explore the effects of whole-household migration on inequality. Migration may alter the sending-area income distribution if remittances are unequally distributed, and this has been the focus of most studies (cited above). Migration and remittances also may alter inequality by influencing income from other activities in migrant-sending households (Taylor, 1992) and, via general-equilibrium effects, income in non-migrant households (Taylor and Dyer, 2009; McKenzie and Rapoport, 2007). Finally, migration can affect inequality simply by removing some households from the income distribution. For example, if migration selects on whole households disproportionately from the extremes (middle) of the village income distribution, it would tend to decrease (increase) the village Gini coefficient over time, other things being equal. No study, to our knowledge, has considered how whole-household migration might influence inequality in migrant-sending areas.

Section 1 provides a brief conceptual and empirical overview of migration and inequality with emphasis on the migration diffusion hypothesis first proposed by Stark, Taylor and Yitzhaki (1986). Section 2 presents our modeling approach and data, and Section 3 presents the results of our income source decompositions of inequality and econometric analysis of changes in inequality over time. The last section discusses some implications of our findings and offers conclusions.

1. Migration, Remittances and Inequality in Mexico

Fourteen percent of Mexico's rural population was living in the US in 2002 (Taylor et al., 2005). Mexicans constitute the biggest migrant group in the US with 11.7 million migrants and made up 31% of all migrants in the US in 2007. This makes Mexico the largest migrant sending country in the World (Camarota, 2007). It is also one of the world's top receivers of remittances in absolute terms with 26.3 billion USD received in 2008 (Ratha et al., 2009).

Mexico has been one of the countries in Latin America, where inequality has not declined after years of liberalization policies. The Gini coefficient for the whole country has been almost stable around 0.49 for the last 10-15 years (Molina and Peach, 2005). According to the latest data available for 135 countries, Mexico is among the top 25 most unequal countries in the World.[2] The inequality is even higher in rural Mexico: the Gini coefficient of per capita income for the whole ENHRUM sample was 0.57 in 2007.

Inequality differs across regions within rural Mexico as well. It was the lowest in Northwest and highest in Northeast Regions in 2002, with Gini coefficients of 0.51 and 0.63, respectively. The effect of remittances (internal and international) on inequality also differed widely in 2002. Taylor et al. (2008) show that international remittances had an equalizing effect in the West-Central Mexico (the region with highest prevalence for international migration), but they had an inequality increasing effect in Southeast Mexico (the lowest migration region). These findings provide some support for the migration diffusion hypothesis based on the cross sectional variation in the first panel of the data set used in this paper.

2. Empirical Analysis

2.1. Data

We use data from two rounds of the Mexican National Rural Household Surveys (ENHRUM 1 and ENHRUM 2) that were conducted at the beginning of 2003 and 2008, respectively.[3] The sample covers 1,765 households in 5 regions, 14 states and 80 communities. The five regions are defined by INEGI, Mexico's national information and census office, as South-Southeast, Center, West-Center, Northwest, and Northeast. INEGI

[2] https://www.cia.gov/library/publications/the-world-factbook/fields/2172.html

[3] ENHRUM is the Spanish acronym for Encuesta Nacional a Hogares Rurales de Mexico.

designed the survey frame to provide a nationally and regionally representative sample of Mexico's rural population.[4] The sample is representative of more than 80 percent of the population in rural Mexico.

The data include detailed information on assets, socio-demographic characteristics, production, all income sources, and migration in both years. The first ENHRUM survey assembled complete migration histories from 1980 through 2002, for the household head, the spouse of the household head, all the individuals who lived in the household for at least three months in 2002, and a random sample of sons and daughters of either the head or his/her spouse who lived outside the household for longer than three months in 2002. For each of these individuals, the survey asked whether the individual had worked as an internal or international migrant, and if so, whether this work was for a wage or self employment and whether it was agricultural or nonagricultural. The second ENHRUM survey repeated the same exercise to cover the years from 1990 through 2007.

Although the ENHRUM sample was designed to be representative of rural Mexican population, this representativeness may not be guaranteed in the panel data if attrition is significant. During the second round of data collection, the surveyors were instructed to follow and re-interview the households in the first panel as best as they could, however this was not possible due to whole household migration in some cases. If whole household migration happens due to household characteristics that are correlated with income, analyzing the changes in the income distribution without paying attention to attrition may cause inconsistent estimates. Inverse probability weighting provides consistent estimates and is preferred to simple OLS, especially in cases of non-response in panel studies where all initial period covariates are observed (Wooldridge, 2002).

There were 209 cases of whole household migration between the two survey years. Table 1 shows the distribution of these households across regions. Almost forty-five percent

[4] The survey covers communities that have between 500 and 2,500 inhabitants. For reasons of cost and tractability, communities with fewer than 500 inhabitants were not included in the survey.

of attrition cases are in the Northeast followed by Northwest. Although the Western Central region is usually a high-migration region, whole household migration out of this region is less than that of the South-Southeast, which is the region with the least migration.

Table 1. Number of households that attrited and percentages across regions

Region	Observations	Percentage
South-Southeast	33	15.79
Central	14	6.70
Western Central	32	15.31
Northwest	36	17.22
Northeast	94	44.98
Total	**209**	**100.00**

In order to assess the extent of potential correlation of attrition with initial household income, we need to test whether the differences in income between attriters and non-attriters are statistically significant. Table 2 shows the averages of different sources of per capita income in 2002 for both groups. Although the total per capita income is not significantly different between the groups, the different components of income have different patterns. Attriters have significantly less per capita crop income and more livestock and transfer incomes. How attrition affects income distribution, however, does not depend on the averages but where the households stand in the income distribution. Figure 1 shows the per capita total income ranks of attriters and non-attriters in 2002. Attriters are not concentrated in certain parts of the income distribution, but are distributed all along the income range, making it difficult to assess how their disappearance in the second panel may affect the analyses of income distribution and the determinants of its change over time. We use the inverse probability weighting in our tables and estimations in the rest of the paper to control for the effect of whole household migration.[5]

[5] The weights are created using the predicted probabilities of being re-interviewed in 2007 for the households in the 2002 sample using a probit regression. The results of the probit regressions are reported in Appendix A.

Table 2. Averages of income components by attrition status

Variable	Non-attriters	Attriters	Signif.
Total income	13695.5	13754.6	
US remittances	2045.6	1990.5	
MX remittances	318.2	453.4	
Crop income	1912.8	877.4	
Livestock income	38.9	560.8	*
Farm wages	1777.6	1361.0	
Non-farm wages	4846.8	5372.6	
Off-farm income	1678.2	1520.9	
Transfer income	1077.3	1617.9	*
Observations	**1504**	**209**	

Note: * indicates that the different between the groups is significant at the 5% level.

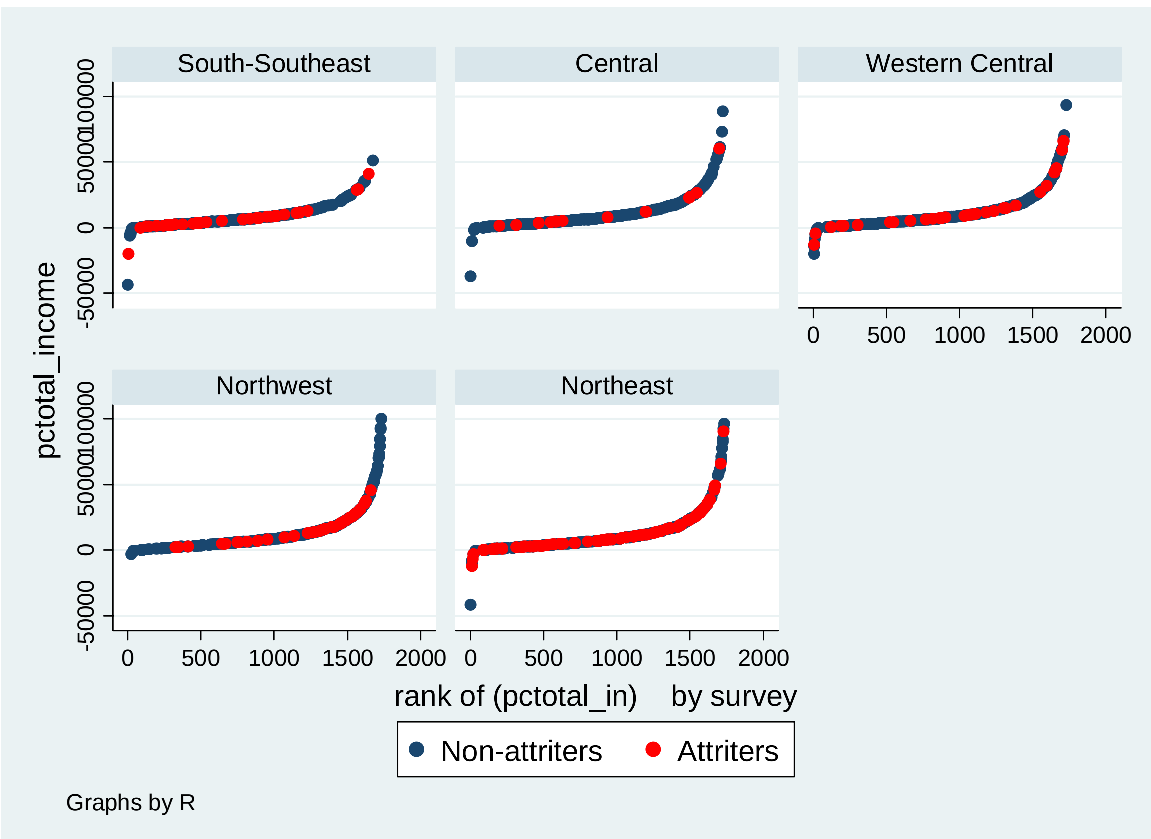

Figure 1. Per capita income ranks by attrition group and state, ENHRUM 1.

Tables 3 and 4 summarize, respectively, the percentage of migrant households and the number of migrants per household in the two survey years. The costs and risks of internal and international migration differ significantly in rural Mexico, therefore, we separate international and internal migration in our anlaysis. Both measures of migration prevalence have increased in all states between 2002 and 2007. South-Southeast region recorded the biggest increase with a 68% increase in the percentage of households with migrants in the US. This region, however, still has the smallest migration prevalence in the whole sample where only 16.5% of the households have at least a migrant in the US against the national average of 30%. Western Central region, on the other hand, is the region with the highest migration prevalence, where almost 44% of the households have at least a migrant in the US. The average numbers of migrants per household mirror closely the changes in the percentage of households with migrants. South-Southeast region has the lowest prevalence with 0.28 US migrants per household and Western Central region has 1.31 US migrants per household.

Table 3. Percentage of households with migrants in the US and other parts of Mexico

	US		**MX**	
Region	**2002**	**2007**	**2002**	**2007**
South-Southeast	9.80	16.50	50.70	58.40
Central	19.80	28.10	48.70	54.10
Western Central	41.00	43.90	35.00	42.00
Northwest	18.30	24.30	30.40	43.20
Northeast	30.30	42.20	23.10	30.90
Total	23.70	30.40	37.70	46.60

Table 4. Average number of migrants per household in the US and other parts of Mexico

	US		**MX**	
Region	**2002**	**2007**	**2002**	**2007**
South-Southeast	0.15	0.28	1.25	1.52
Central	0.36	0.61	1.18	1.38
Western Central	0.94	1.31	0.86	1.14
Northwest	0.34	0.52	0.69	1.09
Northeast	0.79	1.14	0.48	0.77
Total	0.51	0.75	0.90	1.20

The patterns of internal migration are very different from that of international migration. The prevalence of internal migration is the highest in the South-Southeast region and it decreases towards the north. These patterns suggest that international migration may be too costly and/or too risky for rural households in South-Southeast, which may lie on the upward sloping part of the international migration-inequality curve. Western-Central and Northeast regions, on the other hand, seem to have well functioning networks, where even the households in the lower parts of the income distribution can afford both the costs and the risks of international migration. We can expect international remittances to be inequality decreasing in these regions.

Taylor et al. (2008) use these distinct geographical patterns of migration prevalence across regions in the ENHRUM 1 data to test the migration diffusion hypothesis. They conclude that an increase in remittances from international migrants would increase inequality in the South-Southeast, but decrease it in the Western-Central. Their findings support the hypothesis that whereas remittances may increase inequality at the beginning of the migration process, they tend to decrease it as migration diffuses to the lower parts of the income distribution. These findings are based on the cross-sectional variation and may not correctly identify the exact relationships between remittances and inequality over time in each region. Using new data from ENHRUM 2, we analyze whether the observed changes in migration prevalence and income inequality followed the predictions in Taylor et al. (2008).

We construct per capita total income for each household using all income sources reported in the data. Table 5 presents the averages of per capita total income and all income components for 2002 and 2007. Unlike Taylor et al. (2008), we separate the crop income and livestock income, which are grouped in “family production” in their paper, because these two income sources have very different distributions from each other. All income components, but the per capita US remittances, crop and livestock incomes, increased significantly between 2002 and 2007. We use these income components in our Gini decompositions to understand how different income sources play a role in determining total income inequality.[6]

Table 5. Average per capita total income and its components (MX pesos)

Variable	2002	2007	Signif.
Total income	13695.5	20715.8	*
US remittances	2045.6	2288.3	
MX remittances	318.2	839.3	*
Crop income	1912.8	2215.8	
Livestock income	38.9	472.2	*
Farm wages	1777.6	3249.1	*
Off-farm wages	4846.8	6795.3	*
Other income	1678.2	3081.7	*
Transfer income	1077.3	1773.9	*

Note: * indicates that the difference between 2002 and 2007 is significant at the 5% level.

2.2. Gini Decomposition Analysis

The income source decomposition method is used to analyze the marginal contributions of different income sources to income inequality (Lerman and Yitzhaki, 1985; Stark, Taylor and Yitzhaki, 1986). One of the expressions of the Gini coefficient for total income inequality (G_0) is:

$$G_0 = \sum_{k=1}^{K} R_k G_k S_k \qquad (1)$$

Where R_k is the Gini correlation of income from source *k* with the distribution of total income, G_k is the Gini coefficient corresponding to the income from source *k*, and S_k represents the share of component *k* in total income. This formulation allows one to calculate the effect of a marginal change in any one of the income components on the Gini of total income. For example, if income from remittances (y_r) increases by a factor of *e* for each household, such that $y_r(e) = (1+e)y_r$, the effect of this change on the Gini of total income can be expressed as:

[6] The "other income" category includes income from natural resources, family businesses and other sources. "Transfer income" category combines all government transfers, the biggest part of which comes from Procampo and Opportunidades programs.

$$\frac{\partial G_0 / \partial e}{G_0} = \frac{R_r G_r S_r}{G_0} - S_r . \qquad (2)$$

Equation (2) states that the relative effect of a marginal percentage change in remittances equals the relative contribution of remittances to overall inequality minus their share in total income. Using this methodology, we can analyze the contribution of any income component on the distribution of total income.

Table 6 shows the Gini coefficients for 2002 and 2007. For 2002, we show the Gini coefficients both including and excluding attriters to better understand the effect of attrition on income inequality, and the change in inequality between the years for those households that are in both samples. The effects of whole household migration on inequality are different across regions. While income inequality is slightly lower among non-attriters in South-Southeast and Western Central regions, it is higher among non-attriters in Northwest and Northeast regions. In the Central region, inequality does not change when we exclude attriters. In all regions, the effect of whole household migration on income inequality is smaller than the changes in inequality among the remaining households between 2002 and 2007. Overall, per capita household income inequality has decreased from 0.61 to 0.56. The distribution of per capita income has changed in different ways in different regions. The Gini coefficient decreased in South-Southeast, Western-Central, Northeast and Northwest regions, while it increased in the Central region. The biggest change occurred in the Northeast region, followed by the South-Southeast region.

Table 6. Gini coefficients by region and changes in inequality due to attrition and over time

Region	2002 - Whole sample	2002 - Without attriters	2007	Diff from attrition	02-07 Diff for non-attriters	02-07 Total change
South-Southeast	0.61	0.60	0.56	-0.009	-0.04	-0.05
Central	0.56	0.56	0.57	0.001	0.01	0.01
Western Central	0.56	0.55	0.52	-0.011	-0.03	-0.04
Northwest	0.53	0.55	0.52	0.016	-0.03	-0.01
Northeast	0.62	0.64	0.56	0.020	-0.09	-0.07
Total	**0.60**	**0.61**	**0.56**	**0.006**	**-0.04**	**-0.04**

Table 7 presents the inverse probability weighted results of income source decompositions of per capita total household income for the whole ENHRUM sample in both survey years.[7] In 2007, remittances from the US constitute a smaller share of total income, they are more equally distributed and have a smaller correlation with total income as compared to 2002. These changes over the two years translate into a change in the marginal effect of US remittances on inequality. In 2002, a 10% increase in US remittances was associated with a 0.38% increase in total income inequality, but in 2007 its effect is only 0.02. Internal remittances remain inequality decreasing, though with a smaller marginal effect in 2007. None of the other marginal effects of other income sources have changed their sign, except for non-farm wages. Wages from non-farm occupations were unequalizing in 2002, while they were slightly equalizing in 2007. Government transfers seem to have improved their efficiency in reaching the poor: their Gini coefficient decreased and the already equalizing marginal effect almost doubled between the two years.

Table 7. Income source decompositions for the whole ENHRUM sample

	Sk		Gk		Rk		Marginal effect	
Income Source	**2002**	**2007**	**2002**	**2007**	**2002**	**2007**	**2002**	**2007**
US remittances	0.15	0.12	0.95	0.92	0.80	0.62	0.38	0.02
MX remittances	0.02	0.04	0.94	0.96	0.23	0.49	-0.14	-0.06
Farm income	0.14	0.10	1.15	1.09	0.74	0.72	0.54	0.40
Livestock income	0.01	0.02	10.51	2.90	0.29	0.51	0.18	0.36
Wages (farm)	0.13	0.16	0.81	0.83	0.34	0.47	-0.71	-0.50
Wages (non-farm)	0.35	0.33	0.82	0.80	0.72	0.71	-0.09	0.00
Non-farm income	0.12	0.14	1.03	1.00	0.65	0.67	0.11	0.27
Transfer income	0.08	0.09	0.79	0.74	0.51	0.35	-0.27	-0.48

Notes: 1. Marginal effect is the percentage change in the Gini coefficient of total income from a 10% change in the income source.
2. Gini coefficients of some income sources are greater than one. This is natural with the Gini coefficient when some households have negative cash incomes, as is common in rural areas.

Taylor et al. (2008) show that there is a considerable heterogeneity across ENHRUM regions in terms of the distribution and marginal effects of remittances. They show that the

[7] The decompositions are calculated using the `sgini` command in Stata 10 (van Kerm, 2009). This command allows for probability weights to control for attrition, unlike the `descogini` command. Detailed income source decompositions for each region are given in Appendix B.

marginal effect of international remittances is inequality decreasing in the region with the highest level of migration prevalence (Western Central), but it is inequality increasing in the region with the lowest level of migration prevalence (South-Southeast). They conclude that there is supporting evidence for the migration network hypothesis based on the cross sectional variation in ENHRUM 1 sample.

Based on both rounds of the ENHRUM data, we investigate whether this evidence still holds based on variations over time in each region. Table 8 presents the regional Gini coefficients of remittances and their marginal effects on total income inequality. It is striking that remittances from both the US and other parts of Mexico are highly unequally distributed. The Gini coefficients for all regions are between 0.87 and 0.99. Gini coefficients and the marginal effects of remittances on total income inequality, however, have changed in different ways across regions over time.

Table 8. Gini coefficients and marginal effects of remittances from the US and Mexico

	US Remittances				**MX Remittances**			
	Gini Coefficient		**Marginal effect**		**Gini Coefficient**		**Marginal effect**	
Region	**2002**	**2007**	**2002**	**2007**	**2002**	**2007**	**2002**	**2007**
South-Southeast	0.98	0.97	0.33	-0.06	0.91	0.92	-0.13	-0.09
Central	0.95	0.93	0.92	0.18	0.87	0.93	-0.34	0.08
Western Central	0.88	0.87	0.02	0.07	0.96	0.95	-0.06	-0.04
Northwest	0.94	0.95	-0.07	-0.14	0.96	0.96	-0.06	-0.04
Northeast	0.94	0.87	0.69	0.00	0.97	0.99	-0.02	0.04

The distribution of US remittances became more equal in all regions except the Northwest, where it did not change between 2002 and 2007. Their marginal effect on income inequality switched from unequalizing to equalizing in two regions: South-Southeast and Northeast. South-Southeast is still the region with the lowest level of migration prevalence in spite of the big increase between the two years. The fact that international remittances are now inequality decreasing indicates that, between the survey years this region passed the point where the network effects kick in to allow poorer households to migrate. The Northeast region shows similar changes in the effects of international remittances on inequality. A 10% increase in US remittances was associated with an increase of 0.71% in the Gini coefficient in 2002, whereas it had no effect on inequality in 2007.

In the Central region, US remittances were extremely unequalizing in 2002 with a marginal effect on total income inequality of 0.92%. Although they were still unequalizing in 2007, their marginal effect on total income inequality decreased to 0.18%. In the Northwest region, US remittances were already inequality decreasing in 2002 and even more so in 2007. This region has seen a 33% increase in the migration prevalence over these years.

The Western Central region, as mentioned by Taylor et al. (2008), is the region with the highest migration prevalence, where around 44% of households have at least one migrant in the US. This region has seen the smallest increase in the percentage of households with US migrants (only 7%).   The marginal effect of remittances from the US on total income inequality has become marginally more unequalizing over the years, though it is relatively small (0.07%). This may suggest that, network effects work up to a certain point of migration prevalence, after which the migration demand from a particular network may be saturated. Past this point remittances may have an unequalizing effect, if the distribution of migrants along the income scale stays stable. Based on data from central Zacatecas in Mexico, Jones (1998) finds that income inequalities increase as migrant households invest in businesses and lead the local economy during this third stage of migration.

Although the Gini decompositions are informative of the changes in the effects of income sources on inequality between the two years, they do not use the panel structure of the data. The percentage changes predicted by this method are for marginal changes at a given point in time. The method also does not control for other village level variables that may affect migration, remittances and inequality. The fixed effects models in the next section address these considerations controlling for time-invariant village level characteristics. The analysis in the remaining part of the paper is at the village level, given the fact that migrant networks are traditionally defined at the village (community) level in the literature on migration diffusion and network hypothesis.

2.3. Econometric Analysis

Most previous research on migration, remittances and inequality suffer from the lack of panel data as mentioned above. The two exceptions, i.e. Taylor (1992) and McKenzie and Rapoport (2007), suffer from data issues such as representativeness and richness, therefore only provide suggestive evidence. ENHRUM data allow us to analyze the linkages between village level inequality and migrant networks and remittances over time with a nationally representative sample of 80 villages in rural Mexico.

We first ignore the panel structure of the data and estimate simple OLS regressions to see whether we can obtain the inverse-U shaped relationship between inequality and migrant networks as in the previous literature. Then we turn to fixed effects regressions and control for time-invariant village characteristics that may affect both migration patterns and income.

OLS Specifications

In this sub-section we specify the relationship between per capita income inequality and migration with the following equation:

$$G_v = \beta_1 + \beta_2 M_v + \beta_3 M_v^{\ 2} + \mathrm{BZ}_v + D_{t=2} + \varepsilon_v \qquad (3)$$

as in McKenzie and Rapoport (2007). G_v is the Gini coefficient in village *v*, M_v is the migration variable measured by migration prevalence or remittances depending on the specification, Z is a vector of village characteristics (including regional dummies) and $D_{t=2}$ is a dummy variable that equals 1 if the observation is from the second panel to control for time trend. We would expect that β_2 >0 and β_3 < 0 if the migration network hypothesis holds.

Given the differences between internal and international migration discussed above, we define the migration prevalence and remittance variables separately for these two destinations. The migration prevalence is defined as the percentage of households in the village that have at least one migrant in the US (other parts of Mexico), and the remittance variable is the village average of per capita remittances received from the US (other parts of Mexico).

Table 9 summarizes the variables used in the empirical analysis. The village level Gini coefficients of total income did not change significantly between the two survey years.[8] Network variables for both domestic and international migrants have increased significantly. The change in remittances, however, is only significant for internal remittances. Although there was an increase in the per capita remittances from the US, this increase was not significant. Other significant changes over the years are in per capita total income and the age of the household head.

Table 9. Averages of village level variables for 2002 and 2007

Variable Definition	**Mean '02**	**Mean '07**	**Signif.**
Gini (pw) coefficient of per capita income	0.53	0.52	
Average % of village hhs with US migrants	23.93	31.19	*
Average % of village hhs with MX migrants	37.68	45.61	*
Average per capita US remittances	2151.20	2349.10	
Average per capita MX remittances	293.47	808.00	*
Average per capita income	13953.25	20824.13	*
Average education of household head	4.48	4.61	
Average age of household head	49.08	53.94	*
% of ag income in village's total income	10.55	9.71	
% of non-ag income in village's total income	13.51	14.17	
% of wage income in village's total income	68.80	65.05	
Number of villages	**80**	**80**	

Note: * indicates that the difference between the sample averages between years is significant at the 5% level.

We report the results of the OLS specifications defined in equation 3 in Table 10. The first part of the table uses per capita remittances and second part uses migration prevalence.[9] We run these regressions first for the whole ENHRUM sample and then divide the sample into low- and high-migration groups. Villages where less than 20% of the households have migrants are defined as the low-migration group.

[8] The average number of households per village is 20, therefore the Gini coefficients are corrected using the small sample correction method proposed by Deltas (2003) to prevent potential small sample bias.

[9] Per capita remittances are transformed using logarithms based on the results of a Box-Cox specification test.

Table 10. OLS specifications using ENHRUM 1 and ENHRUM 2 villages as a cross-section

Migration Variables	Whole Sample		Low Mig.(<20%)		High Mig.(>20%)	
	Coeff.	p-val.	Coeff.	p-val.	Coeff.	p-val.
Per capita remittances						
Log(per capita US remit.)	0.002	0.48	0.004	0.15	-0.007	0.04
Log(per capita MX remit.)	0.005	0.13	0.012	0.15	0.001	0.87
Squared log(per capita US remit.)	0.002	0.15	0.003	0.01	0.002	0.18
Squared log(per capita MX remit.)	-0.001	0.32	-0.001	0.64	0.000	0.98
Migration prevalence						
Percent of hhs with US migrants	0.000	0.98	0.003	0.60	-0.007	0.219
Percent of hhs with MX migrants	0.005	0.07	0.005	0.37	0.011	0.006
Squared % of hh with US migrants	0.000	0.76	0.000	0.66	0.000	0.257
Squared % of hh with MX migrants	0.000	0.03	0.000	0.40	0.000	0.029
Number of villages	**160**		**90**		**70**	

Note: All regressions include the percentages of village income from farm, non-farm, wage and transfer income, the average age and education of household head, regional and time dummies.

In the whole sample, the coefficients on both US and internal remittances are positive but not significant. Second order effects of remittances are not significant either, failing to support the network hypothesis. The only difference in the low migration sample is that the squared term of US remittances has a significant unequalizing effect on inequality. US remittances decrease inequality significantly in the high migration group. These differences between low- and high-migration groups based on the cross sectional variation seem to support the network hypothesis to some extent.

The second part of Table 10, presents the specifications with migration prevalence instead of remittances. International migration prevalence is not significant but internal migration prevalence first increases and then decreases inequality in the whole sample. Although the coefficient of US migration prevalence variable is positive for the low migration, and negative for the high migration villages, neither of these estimates are significant. We find that domestic migration prevalence variables are inequality increasing and have a slight inverse-U shape for the high migration group.[10] The results in Table 10 are robust to instrumentation using state level historical migration variables as in previous

[10] The significant coefficients on the squared internal remittances for the whole sample and the high migration sample are -0.000042 and -0.000123, respectively.

literature, or state level unemployment rates weighted by the proportion of household migrants in each state.[11]

These results closely mirror the findings in McKenzie and Rapoport, where they fail to find a significant inverse-U shaped relationship between international migration prevalence and inequality in their OLS and IV specifications using two different data sets (pp.20-21, 2007). They find that none of the squared terms are significant, and migration networks decrease inequality only in their high migration sample.

Fixed Effects Specifications

We now employ the panel structure of ENHRUM data to understand how the relationship between migration and inequality at the village level changes over time. We estimate two different specifications following McKenzie and Rapoport (2007).

$$\Delta G_v = \beta_1 + \beta_2 \Delta M_v + \beta_3 (\Delta M_v)^2 + \mathrm{B}\Delta \mathrm{Z}_v + \varepsilon_v \quad (4)$$

$$\Delta G_v = \gamma_1 + \gamma_2 \Delta M_v + \gamma_3 \Delta M_v * M_{v,02} + \Gamma \Delta \mathrm{Z}_v + u_v \quad (5)$$

Where ΔG_v denotes the change in the Gini coefficient, ΔM_v denotes the change in migration variables (defined by migration prevalence and per capita remittances depending on the specification), $M_{v,02}$ denotes the migration prevalence in 2002 and ΔZ_v is the change in the vector of time varying village characteristics between 2002 and 2007 in village *v*.

The first specification includes a squared term for the migration variables to test whether the relationship between migration, remittances and inequality is nonlinear. If inequality first increases and then decreases with migration and remittances, we would expect to find $\beta_2 > 0$ and $\beta_3 < 0$. The second specification includes an interaction term between the migration prevalence in the initial year (2002) and the changes in migration variables between the two years. These terms allow us to test for the migration diffusion hypothesis. If the migration diffusion hypothesis is correct, we would expect $\gamma_2 > 0$ and $\gamma_3 < 0$, i.e. an increase in remittances would increase inequality in communities with a low initial migration prevalence and decrease it in those with high initial migration prevalence.

[11] The results of the IV regressions are available upon request.

Table 11reports the results of different specifications of the regressions in equations 4 and 5 (columns 1, 2 and 3, 4 respectively). We find that US migration variables are not significant in specifications (1) and (2) where we use the change in the squared migration prevalence and remittances, respectively. Although McKenzie and Rapoport use differences over time in the variables of interest rather than fixed effects, they also find that changes in the squared international migration stocks do not affect changes in the inequality significantly.

Table 11. Fixed effects specifications

	Equation 4		**Equation 5**	
	Mig. prev.	**Remit.**	**Mig. prev.**	**Remit.**
Variables	**(1)**	**(2)**	**(3)**	**(4)**
Percent of hhs with US migrants	-0.004		-0.002	
Percent of hhs with MX migrants	0.003*		0.001*	
Squared % of hh with US migrants	0.000			
Squared % of hh with MX migrants	0.000			
Log(per capita US remit.)		0.000		0.000
Log(per capita MX remit.)		0.005		-0.003
Squared log(per capita US remit.)		0.001		
Squared log(per capita MX remit.)		0.000		
% of hhs with US mig*Mig. Prev02			0.000	
% of hhs with US mig*Mig. Prev02			0.000	
Log(p.c. US remit.)*Mig. Prev02				0.000
Log(p.c. MX remit.)*Mig. Prev02				0.000
Percent of village income from ag.	-0.006**	-0.005*	-0.006**	-0.005**
Number of villages	80	80	80	80

Note: All regressions include the percentages of village income from non-farm, wage and transfer income, the average age and education of household head and village fixed effects. (** p<0.05, * p<0.1)

Changes in internal migrant networks significantly increase inequality in column (1), where the squared network term is included to test for non-linear effects. The specifications with squared migration variables, however, need to be interpreted with caution, because using squared terms in fixed effects model may cause both linear and quadratic terms to be potentially biased (McIntosh and Schlenker, 2006). This follows from the fact that identification in fixed effects is based on deviations from the group mean, and a quadratic explanatory variable causes group means to reenter the identification. We cannot employ the suggested solution to this problem (i.e. demeaning the variable before squaring it) because our data covers only two years, therefore trust the specification in equation 5 more.

The changes in US migration prevalence and its interaction with the initial migration prevalence are not significantly correlated with changes in inequality controlling for village fixed effects (column 3). Changes in internal migrant networks are still significant and positive in this specification. None of the variables are significant in specification 4. One interesting observation is that the coefficient on the percentage of farm income in total village income is consistently negative and significant (i.e. equalizing) in all specifications. This indicates that time varying variations across villages in terms of agricultural income generation explain changes in income inequality.

Once we control for time invarying village level characteristics, we fail to observe significant and consistent network effects at the village level.[12] The channels through which migration and remittances affect income inequality seem to be correlated with time invarying village characteristics which are washed away in fixed effects regressions. We propose some explanations that may provide a better understanding of the changes in income distribution over time in villages that are at different points on the migration diffusion path.

2.4. Potential Drivers of Results

The analysis above does not capture all of the dynamics between migration, remittances and inequality. Gini coefficients capture only the income distributions at two different points in time and are indifferent to how specific individuals' rankings along the income distribution change over time. If the migration network hypothesis is correct, it may be the case that there is higher income mobility in high migration villages such that the final distribution of income conceals the positive effect of remittances on incomes of the poor relative to the rich. In other words, inequality can increase or stay the same, even though the overall income growth is pro-poor (Jenkins and Van Kerm, 2006). If remittances are disproportionately pro-poor but this effect is offset by a re-ranking of all individuals along

[12] It should also be kept in mind that 5 years may be short time period to observe significant changes in inequality, a caveat also relevant for the panel date exercise in McKenzie and Rapoport (2007).

the income scale, we may fail to detect a significant effect on income distribution as in the fixed effect models above. We decompose the changes in inequality in the ENHRUM villages using the method proposed by Jenkins and Van Kerm (2006).[13] According to this method, a change in the inequality measured by the Gini coefficient can be decomposed into re-ranking (R) and pro-poor growth (P) components, i.e. ΔG =R-P. Table 12 presents the results of such decompositions for the whole sample and the high- and low-migration groups. We report the percentage changes in inequality of total income and US remittances explained by these two components to facilitate comparison.

Table 12. Average re-ranking and pro-poor growth in income and remittances

	Whole sample	High migration	Low migration
% change in inequality of total income			
R-component	88.49	78.43	96.32
P-component	85.79	79.27	90.86
% change in inequality of US remittances			
R-component	67.74	68.30	66.69
P-component	72.32	73.29	70.48

There are significant re-ranking and pro-poor changes in the distribution of per capita income and US remittances in the whole sample. We find that both the re-ranking and pro-poor components of changes in total income inequality are higher in the low migration group. The opposite is true for per capita US remittances: high migration villages have higher re-ranking and pro-poor growth components of the changes in the distribution of US remittances. Analyzing inequality at the village level, therefore, cannot capture these movements of households along the income scale and the effects of migration and remittances on income distribution are better studied using household level income generation functions.

The second potential driver that may explain the findings in the fixed effects regressions relies on the difference between inequalities within and between villages. We find that most of the inequality stems from within group inequality in both years of the

[13] This decomposition is implemented using the `dsginideco` command in Stata (Jenkins, S. P. and Van Kerm, P., 2009).

survey as shown in table 13. Fixed effects analysis of changes in the Gini coefficients at the village level is based on the variation in time-varying characteristics between villages, hence falls short of capturing the effects of the within village inequalities.

Table 13. Percentage shares of within and between village inequalities in total village Gini[14]

	2002	2007
Within-village inequality	67.16	77.41
Between-village inequality	32.84	22.59

Given these observations, it is not surprising that we do not find robust and significant network effects using panel data methods at the village level.

3. Conclusions and Future Research

This paper tests the migration diffusion hypothesis using novel panel data from rural Mexico. We show that both international and internal migration prevalence have increased in all regions of the ENHRUM survey between 2002 and 2007. Our income source decompositions show that the effects of remittances on inequality differ notably across regions. The South-Southeast region recorded a big increase in migration prevalence and moved along the migration diffusion curve. The marginal effect of remittances on inequality changed from unequalizing to equalizing in this region. At the other extreme lies the Western Central region, which observed the smallest increase in prevalence and remittances switched from being equalizing to unequalizing, suggesting a third phase in the migration diffusion process where remittances may be slightly unequalizing while migration stays stable. This new insight should be substantiated with a theoretical model in future research.

Using fixed effects methods to control for time-invarying village characteristics, we do not find a robust relationship between migrant networks, remittances and income inequality measured by the Gini coefficient. However, this is not to say that networks and remittances do not affect income distribution. Most of the channels through which these

[14] These decompositions are calculated using the `anogi` command in Stata 10 (Frick et al., 2006).

effects work may be correlated with village characteristics that are time-invariant, hence do not show up in fixed effects models. We also show that most of the inequality in the ENHRUM data stems from within village inequality and there has been significant re-ranking and pro-poor growth in incomes over these five years. How networks and remittances affect both of these aspects of inequality cannot be captured by the change in the Gini coefficients. Future research should address these issues with detailed analyses of household income generation and how it's affected by migration and remittances.

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APPENDIX A:
Probit regression results to create inverse probability weights to control for whole household migration.

Probability of non-attrition	dF/dx	p-value
Asset index	0.007	0.22
% US migrant hhs in the village	-0.001	0.05
% MX migrant hhs in the village	0.001	0.10
Per capita total income	0.000	0.04
Small animals, 2002	0.001	0.07
Big animals, 2002	0.000	0.53
Total number of adults	0.037	0.00
Total number of children	0.014	0.00
Dummy if the head is <30	-0.064	0.02
Dummy if the head is >60	-0.025	0.18
Area owned	0.001	0.17
R2	0.057	0.03
R3	0.024	0.35
R4	0.002	0.94
R5	-0.095	0.01
Observations	**1752**	

APPENDIX B:
Income source decompositions of Gini coefficients in ENHRUM 1 and 2 by region

R1

ENHRUM 1 (2002)

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.08	0.98	0.88	0.03
pcremesasmex	0.06	0.91	0.50	-0.01
pcag_z	0.05	2.48	0.61	0.08
pclvsk_income	0.00	12.78	0.21	0.01
pcsal_campo	0.14	0.78	0.36	-0.08
pcsal_nocampo	0.20	0.88	0.70	0.00
pcnonfarminc	0.35	0.84	0.81	0.04
pctrans_income	0.12	0.64	0.32	-0.08
TOTAL	**1.00**	**0.60**	**1.00**	**0.00**

ENHRUM 2 (2007)

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.07	0.97	0.53	-0.01
pcremesasmex	0.06	0.92	0.52	-0.01
pcag_z	0.04	1.42	0.32	-0.01
pclvsk_income	0.00	26.78	0.38	0.04
pcsal_campo	0.16	0.85	0.53	-0.03
pcsal_nocampo	0.23	0.89	0.79	0.06
pcnonfarminc	0.24	0.87	0.69	0.02
pctrans_income	0.21	0.70	0.57	-0.06
TOTAL	**1.00**	**0.56**	**1.00**	**0.00**

R2

ENHRUM 1 (2002)

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.19	0.95	0.87	0.09
pcremesasmex	0.07	0.87	0.33	-0.03
pcag_z	0.14	1.23	0.72	0.08
pclvsk_income	0.01	3.72	0.21	0.00
pcsal_campo	0.15	0.79	0.37	-0.07
pcsal_nocampo	0.28	0.83	0.59	-0.04
pcnonfarminc	0.11	0.98	0.62	0.01
pctrans_income	0.05	0.64	0.18	-0.04
TOTAL	**1.00**	**0.56**	**1.00**	**0.00**

ENHRUM 2 (2007)

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.14	0.93	0.70	0.02
pcremesasmex	0.12	0.93	0.66	0.01
pcag_z	0.06	1.46	0.56	0.03
pclvsk_income	0.01	8.70	0.33	0.03
pcsal_campo	0.18	0.81	0.47	-0.06
pcsal_nocampo	0.26	0.84	0.67	0.00
pcnonfarminc	0.16	0.96	0.72	0.03
pctrans_income	0.08	0.70	0.29	-0.05
TOTAL	**1.00**	**0.57**	**1.00**	**0.00**

R3

ENHRUM 1 (2002)

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.18	0.88	0.63	0.00
pcremesasmex	0.01	0.96	0.28	-0.01
pcag_z	0.15	1.17	0.75	0.09
pclvsk_income	-0.01	-5.07	0.30	0.04
pcsal_campo	0.12	0.81	0.16	-0.09
pcsal_nocampo	0.38	0.75	0.67	-0.03
pcnonfarminc	0.09	1.11	0.68	0.03
pctrans_income	0.08	0.80	0.43	-0.03
TOTAL	**1.00**	**0.55**	**1.00**	**0.00**

ENHRUM 2 (2007)

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.17	0.87	0.62	0.01
pcremesasmex	0.02	0.95	0.42	0.00
pcag_z	0.14	1.01	0.76	0.07
pclvsk_income	0.01	3.04	0.36	0.01
pcsal_campo	0.11	0.85	0.36	-0.05
pcsal_nocampo	0.34	0.75	0.61	-0.04
pcnonfarminc	0.13	0.98	0.71	0.05
pctrans_income	0.07	0.72	0.27	-0.05
TOTAL	**1.00**	**0.52**	**1.00**	**0.00**

R4

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.05	0.94	0.50	-0.01
pcremesasmex	0.01	0.96	0.07	-0.01
pcag_z	0.16	0.99	0.81	0.07
pclvsk_income	-0.01	-2.82	0.36	0.02
pcsal_campo	0.16	0.74	0.30	-0.10
pcsal_nocampo	0.47	0.75	0.75	0.01
pcnonfarminc	0.09	1.07	0.60	0.01
pctrans_income	0.07	0.84	0.58	-0.01
TOTAL	**1.00**	**0.55**	**1.00**	**0.00**

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.02	0.95	0.22	-0.01
pcremesasmex	0.01	0.96	0.14	0.00
pcag_z	0.14	0.96	0.85	0.08
pclvsk_income	0.04	1.49	0.58	0.03
pcsal_campo	0.21	0.74	0.38	-0.10
pcsal_nocampo	0.47	0.69	0.77	0.01
pcnonfarminc	0.07	1.20	0.57	0.02
pctrans_income	0.04	0.80	0.29	-0.02
TOTAL	**1.00**	**0.52**	**1.00**	**0.00**

R5

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.25	0.94	0.88	0.07
pcremesasmex	0.00	0.97	0.38	0.00
pcag_z	0.13	1.01	0.72	0.02
pclvsk_income	0.03	3.40	0.30	0.02
pcsal_campo	0.10	0.86	0.23	-0.07
pcsal_nocampo	0.30	0.82	0.67	-0.04
pcnonfarminc	0.08	1.19	0.69	0.02
pctrans_income	0.10	0.82	0.68	-0.01
TOTAL	**1.00**	**0.65**	**1.00**	**0.00**

Source	Sk	Gk	Rk	% Change
pcremesasUSA	0.18	0.87	0.64	0.00
pcremesasmex	0.02	0.99	0.67	0.00
pcag_z	0.09	1.11	0.62	0.02
pclvsk_income	0.03	2.81	0.57	0.06
pcsal_campo	0.15	0.88	0.49	-0.04
pcsal_nocampo	0.27	0.78	0.54	-0.07
pcnonfarminc	0.17	1.01	0.74	0.06
pctrans_income	0.09	0.75	0.37	-0.05
TOTAL	**1.00**	**0.56**	**1.00**	**0.00**

Note: % change is given as the % change in the Gini with a 1% increase in the income source.