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# Migration and Education Inequality in Rural Mexico

David McKenzie and  
Hillel Rapoport

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# MIGRATION AND EDUCATION INEQUALITY IN RURAL MEXICO

David McKenzie and Hillel Rapoport\*

*This paper examines the impact of migration on education inequality in rural Mexico. Using data from the 1997 National Survey of Demographic Dynamics (ENADID), we first examine the impact of migration on educational attainment for males and females aged 12-15 and 16-18. We then build on the results on attainments to compute education inequality indicators for a large sample of communities throughout Mexico. After instrumenting, we find no significant impact of migration on educational attainment of 12 to 15 year olds. In contrast we find evidence of a strong disincentive effect of migration on schooling levels of 16 to 18 year olds, resulting in less education. This effect is strongest for males and for children of highly educated mothers. As a result of this, migration tends to lower educational inequality, in particular for females, but changes in inequality are driven mainly by reductions in schooling at the top of the education distribution rather than by increases in schooling from relaxing liquidity constraints at the bottom.*

## I. INTRODUCTION

Economic inequality in Latin America is among the highest in the world,<sup>1</sup> for reasons that are in part deeply rooted in the region's history and partly due to the fact that until recently and with few exceptions, inequality reduction has hardly been a policy priority for Latin American governments. Among the many facets of inequality (in assets, in incomes), education inequality is of particular interest and importance as it is at the center of the debate on equality of opportunities. Indeed, education is both the main productive asset for most people and, therefore, a key determinant of their incomes, and it is also a determinant of people's ability to make informed choices and derive utility from public goods such as political freedom and democracy. In addition, as is well known, the social return to education is higher than its private return, meaning that if higher inequality prevents people from engaging in profitable education investments, the welfare loss to society is greater than the private value of the missed opportunities.

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<sup>1</sup> To give just one figure, the averaged Gini coefficient for Latin America is as high as 0.52, well above the coefficient for the other regions (de Ferranti *et al.* [2004]).

In Mexico, education inequality is large even by Latin American standards: the average person in the poorest fifth of the population has 3.5 years of schooling, compared with 11.6 years for the average person in the richest fifth (this is notwithstanding differences in the quality of education received). The gap between the top quintile and the bottom quintile is around the regional average for primary education but is among the highest for lower- and upper-secondary education. For example, Mexico is second only to Ecuador in education inequality rankings for 13 to 17 year-olds (de Ferranti *et al.* [2004]).

There is a growing understanding that efforts to reduce inequality should focus on equality of opportunities instead of outcomes. In the case of education, this means that emphasis should be put on improving access to education (and the quality of schools) rather than, say, on making school attendance mandatory below a certain age. If we push the rationale a little bit further, this also means for example that if children drop out of schools earlier, and disproportionately so for children from poor families, we should perhaps care less if this is by choice, because of their having better opportunities outside of schools, instead of by (liquidity) constraint.

This debate is anything but speculative. In fact, the other "opportunity" we have in mind in the case of Mexican teenagers is migration to the US. Indeed, this option is attracting an increasingly large fraction of the Mexican youth, possibly causing a substantial increase in the proportion of high-school dropouts. At the same time, thanks to remittance income, migration alleviates credit constraints that impede investment in human capital for households at the lower end of the income distribution. Therefore, for a given community, the exact impact of migration on the amount and distribution of education is a priori unclear and depends on how education and migration incentives balance out. Moreover, such a balance is likely to evolve over time as households and communities accumulate migration experience that reduces the costs and risks of migration to future migrants (Massey, Goldring and Durand [1994]).

Previous research on the impact of migration on education in developing countries has emphasized the potential for remittance income to improve access to education for the poor and to consequently lower education inequality.<sup>2</sup> For example, Hanson and Woodruff [2003] used the 2000 Mexican Census to evaluate the effect of migration on "accumulated schooling" (number of school grades completed) by 10-15 year-olds and found that children in households with a migrant member complete significantly more years of schooling, with an estimated increase that ranges from 0.7 to 1.6 years of schooling, depending on age and gender. Interestingly, the gain is the highest for the categories of children traditionally at risk of being dropped from school (*i.e.*, girls and 13 to 15-year olds). Cox Edwards and Ureta ([2003] pp. 429-461) reached similar conclusions for El Salvador. Their estimates of survival functions show that remittances significantly contribute to lower the hazard of leaving school. This effect would seem greater in the urban areas, but the mere fact of receiving remittances (irrespective of amounts) is shown to have a very strong effect in the rural areas. Two very recent papers would seem to further confirm these positive effects of remittances on education attainments: López Córdova [2004] uses the 2000 Mexican census to examine relationships at the municipality level and finds that remittances improve literacy levels and school attendance among 6 to 14 year olds; and Yang

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<sup>2</sup> See Rapoport and Docquier [2005] for a comprehensive survey of the remittances literature.

[2004] finds greater child schooling in families whose migrants receive larger positive exchange rate shocks in the Philippines.

While the above cited studies focus on the effect of past migration on current schooling, a new "brain drain" literature has emphasized a possible link between expectations of future migration and current schooling decisions. The underlying assumption in much of this literature is that education is needed to migrate, and since incomes abroad are much larger than at home, this raises the potential returns to schooling and can therefore increase human capital investment (Docquier and Rapoport [2004]). However, in the case of Mexican migration to the US, most first-time migration is illegal and involves no formal education requirement. As inequality is much greater in Mexico than in the US, one would expect higher returns to schooling in Mexico. Chiquiar and Hanson ([2005] pp. 239-281) provide evidence that returns to education are indeed higher in Mexico than for Mexicans in the US. As a result, in the context we study the possibility of migration may actually lower the anticipated returns to education and negatively affect education investment.

How migration is going to affect education outcomes and education inequality in a given community is therefore theoretically uncertain. In this paper, we first examine the impact of migration on educational attainment, and then use this to compute inequality measures for a large sample of communities in rural Mexico. The rest of this paper is organized as follows. Section II presents the dataset used for the empirical analysis, namely, the National Survey of Demographic Dynamics (*ENADID - Encuesta Nacional de Indicadores Demográficos*), and contrasts it to the 2000 Mexican Census which has been the dataset predominantly used by previous studies on migration and educational attainments in Mexico. Section III discusses the identification strategy and the results are presented in Section IV for education levels and Section V for education inequality. Section VI concludes.





## II. DATA

This paper uses data from the 1997 National Survey of Demographic Dynamics (ENADID - *Encuesta Nacional de la Dinámica Demográfica*) conducted by Mexico's national statistical agency (INEGI - *Instituto Nacional de Estadística, Geografía e Informática*) in the last quarter of 1997.<sup>3</sup> The ENADID is a large nationally representative demographic survey, with approximately 2000 households surveyed in each state, resulting in a total sample of 73,412 households. We restrict our analysis to rural communities, defined broadly here to be municipalities which are outside of cities of population 100,000 or more, with at least 50 households surveyed in each municipality. This gives a sample of 214 rural municipalities across all Mexican states. Within these communities we have a sample of 26,197 households, of which 9,758 households contain at least one child aged 12 to 18 years.

The ENADID asks whether household members have "ever" been to the US in search of work. This question is asked of all household members who normally live in the household, even if they are temporarily studying or working elsewhere. Additional questions ask whether any household members have gone to live in another country in the past five years, capturing migration for study or other non-work purposes in addition to work related migration. We define a household as having a migrant if they have a member aged 19 and over who has ever been to the US to work, or who has moved to the US in the last five years for any other reason.

Table 1 provides summary statistics for the key variables used in this study. Almost one quarter of all households in our sample with a child aged 12 to 18 have a migrant member.<sup>4</sup> Households with secondary school-aged children are more likely to have a migrant member than the general population: the migration rate is 16% in households without a child aged 12 to 18. The ENADID questions on migration within the last five years are identically worded to those used in the 2000 Mexican Census, which does not capture migration by household members outside of a five-year window. Table 1 shows that relying on the Census questions to define migrant status understates the proportion of households with migrant experience by almost fifty percent. Conversely, one in eight households classified by the Census definition as not having a migrant have a member who has ever been to the US to work. Since education is a cumulative process and migration may affect households' resources and choices years after the migration episode occurred, we believe our use of a broader definition of migrant status is appropriate for analyzing the effect of migration on education.

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<sup>3</sup> Survey methodology, summary tables, and questionnaires are contained in INEGI [1999].

<sup>4</sup> The sample proportion is 0.23. The survey provides sample weights designed for the purpose of obtaining state-level rates of demographic indicators, and using these weights gives a proportion of 0.21. After we restrict our sample to rural households in communities with more than 50 households which have secondary school-aged children, the sample weights provided are not designed to provide population estimates for this population, and so for the remainder of our analysis we do not use the population weights, report results for the large sample we have.

**TABLE 1**  
**SUMMARY STATISTICS OF KEY VARIABLES**

	Number of Observations	All Households		Migrant Households		Non-Migrant Households	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
<i>Household Variables (for households with a child aged 12 to 18)</i>							
Proportion of Households with a Migrant	9758	0.23	0.42	1.00	0.00	0.00	0.00
Proportion of Households with a Migrant by Census Definition	9758	0.12	0.33	0.53	0.50	0.00	0.00
Proportion Receiving Remittances	9758	0.05	0.22	0.18	0.38	0.01	0.12
Percentage Share of Income from Remittances	9336	3.15	15.40	11.62	28.13	0.71	7.11
<i>Individual Variables</i>							
Years of Schooling of Mother for Children Aged 12 to 18	14987	4.36	3.73	4.26	3.32	4.40	3.85
Years of Schooling of Males 12 to 15	5148	6.08	2.02	6.01	1.94	6.11	2.04
Years of Schooling of Males 16 to 18	3459	7.74	2.77	7.45	2.67	7.81	2.80
Years of Schooling of Females 12 to 15	5137	6.30	1.96	6.40	1.82	6.27	2.01
Years of Schooling of Females 16 to 18	3452	7.74	2.82	7.66	2.49	7.77	2.92

Community Level Variables	Number of Communities	All Communities		< Median Prevalence		> Median Prevalence	
		Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Community Migration Prevalence	214	0.213	0.202	0.047	0.046	0.379	0.154
Gini of Years of Education for Males 12 to 15	109	0.166	0.045	0.165	0.043	0.167	0.046
Gini of Years of Education for Males 16 to 18	45	0.186	0.057	0.176	0.057	0.200	0.054
Gini of Years of Education for Females 12 to 15	118	0.155	0.044	0.159	0.052	0.152	0.034
Gini of Years of Education for Females 16 to 18	49	0.177	0.052	0.186	0.053	0.169	0.050
State Migration Rate in 1924	214	0.006	0.008	0.003	0.006	0.010	0.009
Proportion of Rural Households Owning Land in 1910	210	2.746	1.973	2.356	1.997	3.121	1.884
Male School Attendance in 1930 (6 to 10 years old)	214	44.740	11.780	45.540	12.640	43.930	10.860
Female School Attendance in 1930 (6 to 10 years old)	214	43.520	13.110	42.940	13.390	44.090	12.870
Gini of Household Income in 1960	214	0.758	0.094	0.762	0.104	0.753	0.082
Number of Schools per 1000 Population in 1930	214	1.236	0.423	1.321	0.468	1.151	0.355
Gini of Years of Schooling for Males 15-20 in 1960	214	0.514	0.095	0.514	0.094	0.513	0.096
Gini of Years of Schooling for Females 15-20 in 1960	214	0.529	0.111	0.539	0.113	0.520	0.109
Average Male Years of Schooling in 1960	214	2.900	0.812	2.830	0.815	2.969	0.807
Average Female Years of Schooling in 1960	214	2.755	0.903	2.625	0.905	2.884	0.885

Note: Educations Ginis are only reported for communities with 20 or more children in the given age category.

Source: own calculation from ENADID 1997 communities with population < 100,000 and 50 or more households sampled.

The ENADID asks migrants who have ever been to the US for work a set of additional questions about their migrant experience, including the number of trips they have ever made, and whether they had legal documentation to work. Approximately 50% of all migrants have made more than one trip, with a mean of 2.8 trips per migrant. The vast majority of migrants in our sample had no legal documentation to work, especially on their first trip. Over 91% of first-time migrants who went to work in the US had no legal documentation to do so.

One downside of the ENADID is that the information it collects on remittances is not as comprehensive as that collected in some other sources of Mexican migration information, such as the Mexican Census. In addition to separate questions on labor income, the ENADID asks each individual whether they have received income in the past year from pensions, transfers from relatives within the country, transfers from relatives outside the country (remittances), rent, interest, scholarships, the *Procampo* program, and other sources. The interviewer reads this list of eight categories, and records up to two sources per individual. Therefore remittance income may or may not be collected for any individual receiving income from at least two other categories from this list, leading to an underrecording of remittance income. While it is difficult to gauge the exact extent or biases introduced by this underreporting, comparisons with the Mexican Census numbers reported by Hanson and Woodruff [2003] suggests an undercount of approximately 15 to 20% in the proportion of migrant households receiving remittances.<sup>5</sup> For this reason and for more substantial ones explained further in section III on identification, this paper will focus on the impact of migration, rather than of remittances *per se*.

Our main measure of education is based on years of schooling attained. Elementary education (grades 1 to 6) is compulsory in Mexico and is normally provided to children aged 6 to 14. Lower secondary education (grades 7 to 9) became compulsory in 1993 and is generally given to children aged 12 to 16 who have completed elementary education. This is followed by three years of upper secondary schooling (grades 10 to 12) and higher studies. Despite education being compulsory, there is still far from complete compliance and a lack of infrastructure in some of the more rural areas (*Secretaría de Educación Pública - SEP* [1999]). Approximately half of all 15 year olds with less than 9 years of attained schooling were not attending school in 1997. We focus our study on children aged 12 to 18, the ages at which children will be receiving the majority of their post-primary education, and the age range at which children start leaving school. 89% of 12 year olds in our sample were attending school in 1997, compared to 57% of 15 years old and 26% of 18 years old.

Table 2 provides a first exploration of the association between child schooling attainment and migration. We first test for a difference in mean years of schooling attained by age for males and females. There is no significant difference in mean years of schooling between boys aged 10 to 14 in migrant and non-migrant households, while boys aged 15, 17 and 18 have significantly lower mean schooling levels. The ENADID asks about all household members who usually live with the household, even if they are absent due to study or work, so these differences are not due

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<sup>5</sup> A first pass is to compare our results from Hanson and Woodruff [2003], who report that 38.2% of migrant households with children aged 10 to 15 receive remittances. Using the census definition of migrant status, the corresponding number is 28.6% for our sample and 31.6%, if we restrict our sample to communities of population size less than 15,000 as they do.

to more educated boys in migrant households being absent from the household. On average, 16 to 18 years old boys in migrant households have accumulated one-third of a year less schooling than boys in non-migrant households. The only significant difference, at the 10% level, between migrant and non-migrant household in girls schooling occurs for girls aged 12 and 13, who receive 0.15 to 0.20 years more schooling in migrant households.

**TABLE 2  
YEARS OF SCHOOLING BY MIGRANT STATUS**

Full sample Age of Child	Males			Females		
	Migrant Household	Non-Migrant Household	T-test p-value	Migrant Household	Non-Migrant Household	T-test p-value
10	3.34	3.24	0.11	3.57	3.39	0.01
11	4.22	4.01	0.01	4.44	4.27	0.02
12	5.03	4.82	0.01	5.33	4.98	0.00
13	5.80	5.53	0.01	5.96	5.65	0.00
14	6.36	6.22	0.19	6.67	6.29	0.00
15	6.79	6.63	0.25	7.05	6.82	0.10
16	7.26	7.06	0.18	7.41	6.99	0.01
17	7.13	7.25	0.50	7.54	6.99	0.00
18	7.25	7.21	0.84	7.43	7.04	0.04
12 to 15	5.96	5.76	0.00	6.27	5.91	0.00
16 to 18	7.21	7.17	0.69	7.46	7.00	0.00
<b>Children with Mother's Education 0-2 years</b>						
12 to 15	5.43	5.14	0.01	5.79	5.13	0.00
16 to 18	6.39	6.31	0.64	6.77	6.03	0.00
<b>Children with Mother's Education 3-5 years</b>						
12 to 15	5.93	5.80	0.15	6.23	6.06	0.08
16 to 18	7.31	7.32	0.92	7.65	7.53	0.47
<b>Children with Mother's Education 6 years or more</b>						
12 to 15	6.53	6.70	0.05	6.84	6.87	0.77
16 to 18	8.59	8.82	0.18	8.71	9.18	0.01

Note: Households in all communities with populations less than 50,000.

Source: Own calculations from ENADID 1997.

Hanson and Woodruff [2003] find that the effects of migration on schooling of 10 to 15 years old in the Mexican Census vary according to the level of maternal schooling. In our sample we do not have data on mother's education for 11.5% of children aged 12 to 18 in migrant households,<sup>6</sup> compared to 13.1% of children aged 12 to 18 in non-migrant households. In the bottom half of

<sup>6</sup> This difference is statistically significant at the 1% level. For 16 to 18 year olds, we are missing maternal education data for 15.8% of children in migrant households and 18.6% of children in non-migrant households.

Table 2 we test for differences in mean years of schooling for those children for whom maternal education is available. We present results by three groups of maternal education: 0 to 2 years (34% of mothers), 3 to 5 years (26% of mothers), and 6 or more years of education (40% of mothers). There is no significant difference between migrant and non-migrant households in mean years of schooling for boys with low-educated mothers, whereas girls in migrant households with mothers with 0 to 2 years of schooling have 0.38 to 0.47 more years of schooling than girls in non-migrant households with low-educated mothers. In contrast, we find migration to be associated with significantly lower levels of schooling of (1) 0.42 to 0.55 years for boys aged 16 to 18 whose mothers have 3 or more years of education; (2) 0.43 years for boys aged 12 to 15 whose mothers have 6 or more years of education; and (3) 0.55 years for girls aged 12 to 15 whose mothers have 6 or more years of education.



### III. IDENTIFICATION STRATEGY

As explained, migration affects education outcomes in a number of ways, of which current remittances received is only one part. It is difficult to think of variables which are not correlated with education decisions that allow one to identify why one migrant household will receive remittances and another will not, or why one migrant sending remittances sends more remittances than another migrant also sending remittances (McKenzie, [2005]). For this reason this paper will look at the impact of migration (that is, of being raised in a "migrant household" according to the broader definition exposed above) on children education outcomes rather than on the impact of receiving remittances. In addition, it is well known that unobserved characteristics or shocks which influence households' decisions to migrate may also play a role in their schooling decisions.

We therefore follow Woodruff and Zenteno [2001] and a number of subsequent studies<sup>7</sup> in using historic state-level migration rates as an instrument for current migration stocks. In particular, we use the US migration rate from 1924 for the state in which the household is located, taken from Foerster [1925].<sup>8</sup> These historic rates can be argued to be the result of the pattern of arrival of the railroad system in Mexico coupled with changes in US demand conditions for agricultural labor. As migration networks lower the cost of migration for future migrants, they become self-perpetuating. Hildebrandt and McKenzie [2005] show that the historic migration rate is a strong predictor of current migration rates, with a first-stage F-statistic of over 30.

Our identifying assumption is then that historic state migration rates do not affect education outcomes over 70 years later, apart from their influence through current migration. Instrumental variables estimation relies on this exogeneity assumption, and so it is important to consider and counteract potential threats to its validity.

One potential threat is that historic levels of inequality and historic schooling levels helped determine migration rates in response to the railroad expansion, and also influence current levels of schooling due to intergenerational transmission of schooling. To allow for this possibility we control for a number of historic variables at around the same time period as our historic migration measure. The controls are the proportion of rural households owning land by state in 1910 taken from McBride [1923],<sup>9</sup> and the number of schools per 1000 population by state in 1930, and male and female school attendance for 6 to 10 year olds by state for 1930, both taken from *Dirección General de Estadísticas* - DGE [1941].

A second possible threat to validity is that the development of the railroads in certain states and communities ushered in the subsequent development of other infrastructure, such as school facilities, and led to changes in the income distribution which themselves influenced the incentives and ability to invest in schooling. We include the following state-level controls for this possibility, all calculated from the public use sample of the 1960 Mexican Census: the Gini of

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<sup>7</sup> Hanson and Woodruff [2003]; McKenzie and Rapoport [2004]; López-Córdova [2004]; and Hildebrandt and McKenzie [2005] all employ historic migration rates as instruments for current migration.

<sup>8</sup> Thanks to Chris Woodruff for supplying these historic rates.

<sup>9</sup> Land ownership data were kindly provided by Ernesto López-Córdova.



household income, the Gini of years of schooling accumulated for males and females aged 15-20, and the average levels of years of schooling accumulated for males and females aged 15-20. Spearman rank-order correlation tests do indeed indicate some significant correlations between the 1924 migration rates and some of these controls: states with higher historic migration rates had higher average rates of schooling and lower inequality in schooling in 1960. This might represent the influence of migration over the 1924-1960 period, or the effects of concomitant trends, and so we prefer to include these 1960 education inequality and levels as controls. Even after controlling for these variables, historic migration rates remain a powerful predictor of current community migration prevalence, with a first-stage F-statistic of 28.<sup>10</sup>

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<sup>10</sup> The first stage is even stronger if we use the 1955-1959 migration rates used by Hanson and Woodruff [2003]. We choose to use the 1924 historic rates on the grounds that the greater period of time elapsing between these rates and present day migration strengthens the assumption of exogeneity needed for our instrumental variables procedure.

#### IV. THE EFFECT OF MIGRATION ON EDUCATIONAL ATTAINMENTS

At a theoretical level, one can think of the following main channels through which migration directly impacts on education decisions: the effect of remittances on the feasible amount of education investment (which is likely to be positive where liquidity constraints are binding); the effect of having parents absent from the household as a result of migration (which may translate into less parental inputs into education acquisition and maybe into more house and farm work by remaining household members, including children); and the effect of migration prospects on the desirable amount of education (which depends on how education incentives are affected by the prospect of migration).

The theoretical impact of migration on education is therefore unclear and is likely to depend on household resources. However, the ENADID only contains measures of current household assets, which are themselves affected by the household's migration decision. We therefore instead examine how the impact of migration varies according to maternal education. There is a large literature which finds that higher maternal education is associated with more education of future generations. Moreover, as discussed above, many of the interactions between household wealth and migration status in determining the impact of migration on schooling are likely to apply for maternal education as well, be it through constraints or through incentives. Furthermore, maternal education and household wealth are strongly correlated in our sample. Mother's years of schooling has a 0.46 correlation with an asset index formed as the first principal component of a number of asset indicators.

We estimate the following equation for  $S_{i,c}$ , the years of schooling completed by child  $i$  in community  $c$ :

$$(1) \quad S_{i,c} = \lambda_0 + \lambda_1 Mig_{i,c} + \lambda_2 Mig_{i,c} \times MidEduc_{i,c} + \lambda_3 Mig_{i,c} \times HighEduc_{i,c} \\ + \alpha_1 MidEduc_{i,c} + \alpha_2 HighEduc_{i,c} + \phi' X_{i,c} + \gamma' Z_c + \varepsilon_{i,c}$$

where  $Mig_{i,c}$  is a dummy variable taking the value one if child  $i$  lives in a household with a migrant member,  $MidEduc$  and  $HighEduc$  are dummy variables for child  $i$  having a mother with 3-5 years of schooling and 6 or more years of education respectively,  $X_{i,c}$  are a number of child controls, such as age and age squared, and  $Z_c$  are the set of state-level controls.

Equation (1) is estimated separately for four groups: males 12 to 15, males 16 to 18, females 12 to 15, and females 16 to 18. For each group we estimate equation (1) with and without the controls for maternal education. Ordinary Least Squares (OLS) results are compared with two-stage least squares results in which the 1924 state-level migration rate and its interactions with maternal education are used as instruments for whether a household has a migrant, and the interaction of migrant status with maternal education. Since this instrument only varies at the state level, we cluster our standard errors at the state level to allow for arbitrary correlation in the

error structure of individuals within a state.<sup>11</sup> This approach follows closely the work of Hanson and Woodruff [2003]. The two main differences are that we use the ENADID rather than the Mexican census, allowing us to classify households according to whether they have ever had a migrant, rather than on whether they have had a migrant in the last five years; and that we also consider 16 to 18 year olds. It is this latter group for whom we think the negative effects of migration on schooling will potentially be the strongest.

Table 3 presents the results of this estimation for males. Looking first at 12 to 15 years old, we see in columns 1 and 3 that the overall impact of migration is small and insignificantly different from zero. Columns 2 and 4 find a relatively large increase in years of schooling associated with maternal education: boys in a non-migrant household with a mother with 3 to 5 years of schooling have 0.54 to 0.66 years more schooling than boys in non-migrant households with a mother with 2 or fewer years of schooling, while boys with mothers with 6 or more years of schooling have 1.54 to 1.59 more years of schooling accumulated. This is a sizeable increase on the 5.4 mean years of schooling for boys whose mothers have two or fewer years of education. The interactions between mother's education and being in a migrant household are negative and, when coupled with the negative coefficient on migration status, seem to suggest that migration strongly reduces education for boys with more highly educated mothers. However, after instrumenting for migration status, these effects become insignificant.

The results for 16 to 18 years old males in Table 3 show a stronger impact of migration. Pooling across levels of maternal education results in an overall negative impact of migration, which becomes stronger after instrumenting. Being in a migrant household lowers average years of schooling by 1.4 years. Again we find higher levels of education for boys with more educated mothers, with the effects being larger than for 12 to 15 years old. After instrumentation we find that the interaction effects between education and migration status are negatives, and significant for boys with more highly educated mothers. The coefficient on being in a migrant household is also negative and significant, so migration lowers education for boys whose mothers have less education, and lowers it by even more for boys with more educated mothers. In terms of the coefficients in equation (1), the overall impact of migration is  $\lambda_1$  for children whose mothers have 0 to 2 years of education,  $\lambda_1 + \lambda_2$  for children with maternal education of 3 to 5 years, and  $\lambda_1 + \lambda_3$  for children with maternal education of 6 or more years. The foot of Table 3 reports p-values for Wald tests of significance of these effects.

Migration lowers schooling by more both in absolute and in relative terms for boys with higher maternal education. Migration lowers schooling by 3.05 years for boys with maternal education of 6 or more years. This represents a 33% drop compared to the 9.14 mean years of education for boys in non-migrant households with highly educated mothers, and completely erases the 2.8 years of educational gain associated with having a highly educated mother. In contrast, the 0.94 fall in years of schooling for boys with low-educated mothers, and 2.02 fall in schooling years for boys with mid-educated mothers represent falls of 14% and 26% compared to the mean schooling levels for boys in non-migrant households with these education levels.

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<sup>11</sup> As we run the regressions separately by gender and age group, very few households have multiple children within a given age-gender range. Nevertheless, clustering also allows for correlation in the error structure of individuals of the same age and gender range within a household.

**TABLE 3**  
**IMPACT OF MIGRATION ON MALE YEARS OF SCHOOLING**

	Ages 12 to 15				Ages 16 to 18			
	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) OLS	(6) OLS	(7) IV	(8) IV
Child is in a Migrant Household	-0.1285 (1.46)	-0.0332 (0.32)	0.0600 (0.13)	-0.1030 (0.23)	-0.3965 (2.21)*	0.0261 (0.07)	-1.4017 (2.91)**	-0.9404 (2.12)*
Migrant Household* Mother Has 3-5 Years Schooling		-0.0646 (0.52)		-0.4683 (0.96)		-0.4151 (1.09)		-1.0820 (1.40)
Migrant Household* Mother Has 6+ Years Schooling		-0.2960 (1.96)		-0.5194 (0.78)		-0.5498 (1.53)		-2.1113 (2.04)*
Proportion of Rural Households Owning Land in 1910	0.0010 (0.03)	-0.0190 (0.84)	-0.0005 (0.01)	-0.0185 (0.81)	0.0374 (0.81)	0.0439 (1.00)	0.0493 (0.97)	0.0671 (1.20)
Male School Attendance in 1930 (6 to 10 years old)	0.0008 (0.10)	-0.0004 (0.06)	0.0010 (0.12)	-0.0006 (0.10)	-0.0017 (0.19)	0.0038 (0.43)	-0.0010 (0.13)	0.0053 (0.86)
Gini of Income in 1960	2.0098 (4.13)**	0.8465 (2.61)*	1.9849 (4.36)**	0.8782 (2.60)**	3.8819 (5.97)**	1.3936 (1.48)	4.0527 (6.20)**	1.6217 (2.43)*
Number of Schools per 1000 Population in 1930	-0.1361 (1.01)	-0.1123 (1.25)	-0.1113 (0.87)	-0.1550 (1.89)	0.4691 (2.40)*	0.1989 (0.77)	0.3669 (1.95)	0.0506 (0.28)
Gini of Male Years of Schooling for 15-20 years old in 1960	-2.9661 (1.91)	-1.4797 (1.36)	-2.9447 (2.01)*	-1.6131 (1.56)	-2.0272 (1.38)	-1.8466 (1.10)	-2.0461 (1.54)	-1.6266 (1.27)
Average Male Years of Schooling in 1960 for 15-20 years old	-0.0294 (0.19)	-0.1021 (0.93)	-0.0421 (0.26)	-0.0908 (0.82)	0.1338 (0.67)	-0.2910 (1.29)	0.1791 (0.86)	-0.1905 (0.95)
Mother Has 3-5 Years Schooling		0.5400 (7.01)**		0.6571 (4.30)**		1.0784 (7.57)**		1.3074 (6.22)**
Mother Has 6+ Years Schooling		1.5361 (23.49)**		1.5886 (10.33)**		2.4809 (18.15)**		2.7563 (9.69)**
Observations	4995	4559	4995	4559	3336	2930	3336	2930
R-squared	0.16	0.27			0.04	0.17		
<b>P-value for testing the impact of migration is zero by mother's education</b>								
Mother Has 0-2 Years of Education		0.754		0.819		0.941		0.034
Mother Has 3-5 Years of Education		0.265		0.162		0.040		0.001
Mother Has 6+ Years of Education		0.010		0.169		0.015		0.003

Notes: All regressions also contain a constant, age and age squared, and controls for population size.  
T-statistics are in parentheses with standard errors clustered at the state level.  
Instruments are 1924 state-level migration rate and its interaction with mothers year of schooling categories.  
\* significant at 5%; \*\* significant at 1%.

**TABLE 4**  
**IMPACT OF MIGRATION ON FEMALE YEARS OF SCHOOLING**

	Ages 12 to 15				Ages 16 to 18			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
Child is in a Migrant Household	0.0666 (0.60)	0.4272 (2.62)*	0.0420 (0.12)	0.0138 (0.03)	-0.0970 (0.47)	0.5850 (2.37)*	-1.7059 (1.45)	-1.9298 (2.09)*
Migrant Household*Mother Has 3-5 Years Schooling		-0.3548 (1.70)		-0.1937 (0.42)		-0.7663 (2.51)*		-1.0127 (0.87)
Migrant Household*Mother has 6+ Years Schooling		-0.4856 (2.94)**		-0.4924 (0.74)		-1.1656 (3.98)**		-2.4555 (2.15)*
Proportion of Rural Households Owning Land in 1910	0.0258 (0.60)	0.0157 (0.49)	0.0260 (0.61)	0.0183 (0.55)	0.0149 (0.15)	0.0346 (0.35)	0.0402 (0.34)	0.0855 (0.68)
Female School Attendance in 1930 (6 to 10 years old)	0.0092 (2.27)*	0.0089 (2.59)*	0.0093 (2.26)*	0.0095 (2.99)**	0.0100 (1.04)	0.0049 (0.40)	0.0131 (1.31)	0.0085 (0.80)
Gini of Income in 1960	1.6037 (5.72)**	0.6672 (3.42)**	1.6166 (4.22)**	0.8659 (3.15)**	3.0006 (6.03)**	1.2839 (1.45)	3.7525 (4.50)**	2.6446 (2.73)**
Number of Schools per 1000 Population in 1930	0.0461 (0.63)	0.0811 (1.45)	0.0422 (0.44)	0.0241 (0.32)	0.3119 (1.52)	0.3916 (1.66)	0.0539 (0.17)	-0.0971 (0.27)
Gini of Female Years of Schooling for 15-20 years old in 1960	-0.9639 (1.00)	-1.3936 (1.91)	-0.9484 (0.98)	-1.1546 (1.43)	-2.3170 (1.00)	-1.7999 (0.80)	-0.9339 (0.37)	0.4432 (0.17)
Average Female Years of Schooling in 1960 for 15-20 years old	0.0637 (0.51)	-0.1889 (2.18)*	0.0676 (0.52)	-0.1272 (1.14)	0.1329 (0.45)	-0.2984 (1.24)	0.4472 (1.21)	0.2889 (0.68)
Mother Has 3-5 Years Schooling		0.7048 (6.16)**		0.6783 (4.30)**		1.2040 (6.24)**		1.2415 (3.19)**
Mother has 6+ Years Schooling		1.5397 (13.98)**		1.5321 (7.85)**		2.7650 (17.90)**		2.9581 (9.85)**
Observations	4981	4495	4981	4495	3332	2539	3332	2539
R-squared	0.19	0.31			0.05	0.20		
<b>P-Value for Testing the Impact of Migration is Zero by Mother's Education</b>								
Mother Has 0-2 Years of Education		0.014		0.972		0.025		0.037
Mother Has 3-5 Years of Education		0.658		0.516		0.516		0.011
Mother Has 6+ Years of Education		0.261		0.346		0.346		0.036

Notes: All regressions also contain a constant, age and age squared, and controls for population size.  
T-statistics are in parentheses with standard errors clustered at the state level.  
Instruments are 1924 state-level migration rate and its interaction with mothers year of schooling categories.  
\* significant at 5%; \*\* significant at 1%..

Table 4 presents the estimates of equation (1) for females. The overall impact of migration is found to be insignificant when we pool girls with different levels of maternal schooling. This is the case for both 12 to 15 year olds and 16 to 18 years old. The OLS results which allow for interactions with maternal education (columns 2 and 5) show that migration is associated with higher levels of education for girls whose mothers have 0-2 years of education, and has no effect on education for girls whose mothers have more years of education. However, these results change after we instrument for migration status. There is no significant impact of migration on education for girls 12 to 15, regardless of maternal education level. Migration is found to significantly lower education for girls aged 16 to 18, even in households with low maternal education. As with 16 to 18 years old boys, migration lowers education more for 16 to 18 years old girls with more highly educated mothers. The increases in years of schooling associated with higher maternal education in non-migrant households are similar in magnitude to those found for boys.

Hanson and Woodruff [2003] find a significant positive effect of migration on education of 13 to 15 years old whose mothers have two or fewer years of education, and no effect for girls of this age whose mothers have higher education, or for males aged 13 to 15. Our results for 12 to 15 years old broadly match their findings: we find no significant impact of migration on the schooling of boys aged 12 to 15, a positive impact on girls with low maternal education which is significant in our OLS estimation but insignificant after instrumenting, and insignificant effects on other 12 to 15 years old girls. Stronger results are found for the older 16 to 18 years old age group not considered by Hanson and Woodruff [2003], and it is for this group that migration appears to reduce child schooling.



## V. THE EFFECT OF MIGRATION ON EDUCATION INEQUALITY

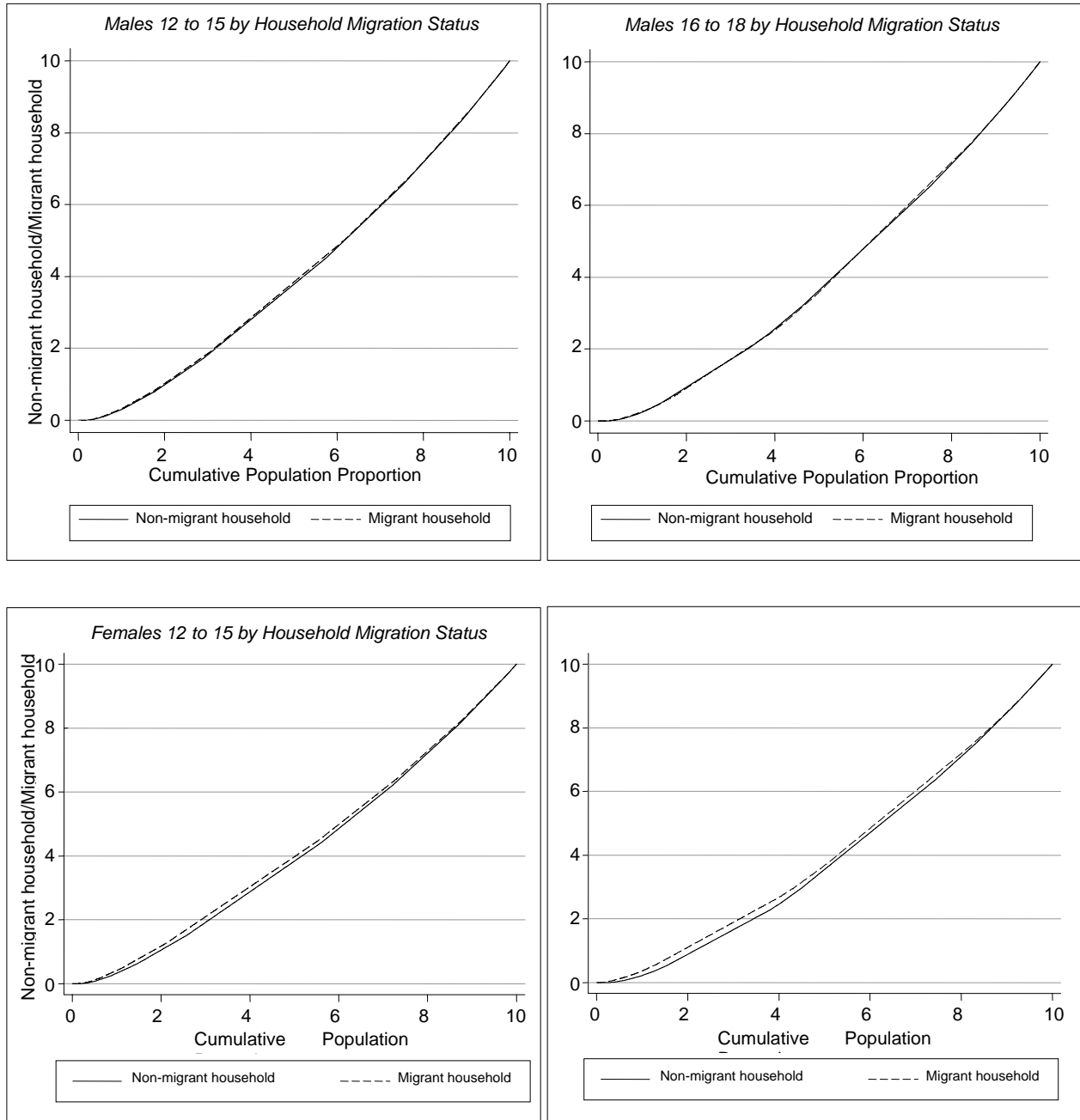
The results of the previous section suggest that we should see little impact of migration on inequality in the education of 12 to 15 years old, with greater potential impact for 16 to 18 years old. Migration lowers the education attained by 16 to 18 years old with high levels of maternal education by more than it does for those with lower levels of maternal education. As a result, we expect migration to lower educational inequality; however, this effect will depend on the degree to which mother and child's education are correlated, and on how education determines who migrates.

A descriptive look at the potential effect of migration on inequality comes from plotting Lorenz curves. Figure 1 plots Lorenz curves of years of schooling achieved for males and females aged 12 to 15 and 16 to 18 by household migration status. The Lorenz curves for males cross multiple times and almost lie exactly on top of each other. As a result, there appears to be visually no impact of migration on inequality in male education. In contrast, the Lorenz curves for females aged 12 to 15 and 16 to 18 in migrant households lie entirely above the curves for non-migrant households, suggesting that migration is indeed lowering inequality. The curve shifts more for the older group of females, suggesting a stronger inequality-reducing effect for this group. Of course these visual comparisons do not control for other characteristics which may influence both migration and inequality in education, and do not tell us whether any differences observed are statistically significant.

We therefore turn to regression-based analysis of the impact of migration on inequality. This requires us to construct an index of inequality in years of education for each community. Many of the municipalities in our sample have fewer than 30 children of a given gender and age group in our sample. We therefore measure inequality at the state level, allowing us to maximize the number of observations used. Thomas, Wang and Fan [2002] discuss several measures of education inequality. They note several of the standard measures of inequality, which involve taking logarithms, are not defined when the basic variable takes the value of zero. This is not a large problem in our data, since only 2.3% of 12 to 18 year olds in our sample have zero years of education. Nevertheless, in order to include these observations, we use three measures of inequality which allow for zero values.



**FIGURE 1**  
**LORENZ CURVES FOR EDUCATION IN MIGRANT AND NON-MIGRANT HOUSEHOLDS**



Our main measure is the Gini of attained years of schooling. For robustness we supplement this with the coefficient of variation and with the generalized entropy (0.5) measure. Then for each state  $s$  we construct an inequality measure  $I_s$  for years of schooling attained by a particular age group and carry out the following state-level regression:

(2)

$$I_s = \beta_0 + \beta_1 network_s + \phi' Z_s + v_s$$

where  $network_s$  is the state migration prevalence and  $Z_c$  are a set of state-level controls. Again we can instrument the current state migration network using the 1924 state migration rates. We can also allow for a quadratic term in the migration network, although this never turns out to be significant, so is not reported here.

However, Thomas *et al.* [2002] note that as years of schooling is bounded from below (zero years with no schooling) and from above (20 years, consisting of four years or more of graduate education), there is a strong mechanical negative correlation between education inequality and the average level of schooling. If migration affects the average level of schooling in a community, this will therefore in itself result in an effect on measured inequality. To neutralize this mechanical effect, we therefore add the average level of education in a state as an additional control to equation (2).

Table 5 presents the instrumental variable results using Gini of years of schooling to measure inequality. Columns 1 to 4 report the results for each of the four gender-age groups when the mean level of years of schooling is not included as a control, and Columns 5 through 8 report results controlling for the level of years of schooling. As expected, the coefficient on mean years of schooling is negative and strongly significant, so it is important to control for this mechanical effect of levels on inequality. After controlling for levels we find negative coefficients on migration prevalence for all four groups, but this effect is only significant (at the 10% level) for females aged 16 to 18. A one standard deviation increase in migration prevalence is estimated to lower the Gini of education for females aged 16 to 18 by 0.17 standard deviations, which is in line with the 0.2 standard deviation reduction in consumption inequality that McKenzie and Rapoport [2004] report to be the impact of increasing migration prevalence in the ENADID sample.

**TABLE 5**  
**IMPACT OF MIGRATION ON INEQUALITY**  
(Instrumental Variable Results using Gini of Years of Schooling as Dependent Variable)

	Not controlling for mean level of schooling				Controlling for mean level of schooling			
	(1) m 12-15	(2) m 16-18	(3) f 12-15	(4) f 16-18	(5) m 12-15	(6) m 16-18	(7) f 12-15	(8) f 16-18
State-level Migration Prevalence	-0.021 (0.36)	-0.006 (0.08)	-0.042 (1.02)	-0.006 (0.09)	-0.025 (0.90)	-0.050 (1.01)	-0.034 (0.96)	-0.052 (1.80)
Mean Level of Schooling in State					-0.055 (7.37)**	-0.050 (5.70)**	-0.033 (1.65)	-0.052 (6.78)**
Proportion of Rural Households Owning Land in 1910	0.001 (0.47)	0.003 (0.91)	-0.001 (0.61)	0.003 (0.52)	0.001 (0.42)	0.003 (1.18)	-0.000 (0.23)	0.001 (0.63)
School Attendance in 1930 (6 to 10 years old)	-0.001 (0.87)	0.000 (0.03)	-0.001 (1.93)	-0.001 (1.04)	-0.000 (1.41)	0.000 (0.74)	-0.000 (0.72)	-0.000 (0.80)
Gini of Income in 1960	-0.027 (0.55)	-0.141 (2.31)*	-0.003 (0.08)	-0.140 (2.36)*	0.031 (0.94)	0.001 (0.01)	0.046 (1.12)	0.002 (0.08)
Number of Schools per 1000 Population in 1930	0.022 (1.30)	-0.026 (1.31)	-0.006 (0.79)	0.002 (0.12)	0.012 (0.98)	-0.017 (1.29)	-0.006 (0.95)	0.008 (0.68)
Gini of Years of Schooling for 15-20 years old in 1960 <sup>1</sup>	0.227 (1.86)	0.098 (0.71)	0.169 (1.72)	0.218 (1.07)	0.044 (0.59)	-0.074 (0.52)	0.098 (1.07)	-0.041 (0.32)
Average Years of Schooling in 1960 <sup>1</sup>	0.017 (1.26)	-0.014 (0.90)	0.015 (1.19)	-0.004 (0.15)	0.008 (0.93)	-0.016 (1.21)	0.014 (1.49)	-0.010 (0.99)
Observations	29	29	29	29	29	29	29	29

Notes: Robust T-statistics are in parentheses  
Instruments are 1924 state-level migration rate  
\* significant at 5%; \*\* significant at 1%

Table 6 examines the robustness of these results to different specifications. It reports just the coefficient on migration prevalence for regressions analogous to Columns 5-8 in Table 5, where we control for average levels of education. The first row reports the OLS estimates for the Gini of education, the second row repeats the IV estimates from Table 5, and the third row reports the IV estimates when the only state-level control is the average level of education. As estimation is only at the state level for the 29 states with sufficient observations,<sup>12</sup> it is possible that the sample size is not large enough to justify the inclusion of these additional controls. Indeed, migration prevalence is significant at the 1% level when these additional controls are not added. However, migration prevalence is still found to have an insignificant negative effect on education inequality for males of both age groups, and for females aged 12 to 15.

The remaining rows of Table 6 present the coefficient on migration prevalence when the coefficient of variation and GE(0.5) measures of education inequality are used. The negative effect of migration on education inequality of females aged 16 to 18 is robust to the use of the coefficient of variation, with an estimated effect of 0.14 (with controls) to 0.24 (without controls) standard deviations reduction in inequality from a one standard deviation increase in migration prevalence. The coefficients for 16 to 18 years old females are also negative, but are statistically insignificant, for the GE(0.5) measure of inequality, with a point estimate of a 0.07-0.13 standard deviation reduction in inequality from a one standard increase in inequality. Using these other measures of inequality still yields insignificant effects of migration on education inequality for males, and for females aged 12 to 15.

**TABLE 6**  
**IMPACT OF MIGRATION ON INEQUALITY**  
(OLS and IV coefficients on State Migration Prevalence for different measures of inequality)

	Coefficient on state migration prevalence			
	(1) m 12-15	(2) m 16-18	(3) f 12-15	(4) f 16-18
<b>Gini of Years of Schooling:</b>				
OLS	-0.023 (1.30)	-0.013 (0.41)	0.001 (0.06)	-0.053 (2.53)*
IV	-0.025 (0.90)	-0.050 (1.01)	-0.034 (0.96)	-0.052 (1.80)
IV, No State-Level Controls Apart from Mean Education Level	-0.032 (1.29)	-0.033 (0.63)	-0.015 (0.48)	-0.090 (3.07)**
<b>Coefficient of Variation of Years of Schooling</b>				
IV	-0.014 (0.32)	-0.052 (0.64)	-0.038 (0.66)	-0.073 (1.54)
IV, No State-Level Controls Apart from Mean Education Level	-0.020 (0.39)	-0.044 (0.55)	0.003 (0.06)	-0.124 (2.88)**
<b>GE(0.5) of Years of Schooling</b>				
IV	0.022 (0.43)	0.021 (0.29)	-0.030 (0.59)	-0.028 (0.45)
IV, No State-Level Controls Apart from Mean Education Level	0.026 (0.33)	-0.035 (0.55)	0.013 (0.28)	-0.053 (0.83)

Notes: Robust T-statistics are in parentheses. Instruments are 1924 state-level migration rate.

\* significant at 5%; \*\* significant at 1%.

Controls are as in columns (5) - (8) of Table 5.

<sup>12</sup> Omitted are the Federal District (Mexico City), and Baja California North and South, which have insufficient rural observations.



## VI. CONCLUSION

Using historical migration rates by state to instrument for current migration, this paper examined the overall impact of migration on educational attainments and inequality in rural Mexico. Focusing first on education levels, we found evidence of a significant negative (or disincentive) effect of migration on schooling levels of 16 to 18 years old, which is greater for males and for children with highly educated mothers; this is consistent with migration prospects translating into lower expected returns to schooling, which are likely to impact mainly on prospective migrants whose education decisions are unconstrained (that is, males with relatively educated mothers). We also found evidence of a significant negative effect for female children of the same age group; since females are far less likely to migrate than males, we interpret this finding as pointing to a substitution effect between housework and schooling. In addition, migration was also found to significantly increase schooling attainments for girls from households with uneducated mothers, which is consistent with remittances alleviating credit constraints that impede education investments of poor households; this effect, however is no longer significant after instrumenting.

Building on these educational attainments results, we then computed state-level measures of inequality in education in rural communities. Our results point to a tendency for migration to lower inequality in education, but this inequality-reducing effect of migration is significant after instrumenting only for girls aged 16 to 18. Moreover, the changes in inequality that migration brings about seem to be driven mainly by reductions in schooling at the top of the education distribution, rather than by increases in schooling from relaxing liquidity constraints at the bottom.

As a final word we would like to mention a number of concerns that should be addressed in further analysis before policy implications may be derived. A first concern is the possibility that some children in rural areas may begin to leave home after age 15, either to work or to continue schooling. As mentioned previously, the ENADID asks about all household members who usually live with the household even if they are absent due to study or work. Therefore, we do not believe that the differences found in education attainments between 15-18 years old in migrant and non-migrant households are due to more educated children in migrant households being absent from the household. In future work we will apply bounds analysis to examine further the sensitivity of our results to this possibility.

A second concern is that there are certain natural stopping points (for example, primary school, junior secondary school, end of high school), and so moving from say 7 to 8 years of education is not the same as from 8 to 9. A related issue is that we observe children at a given point in time without knowing how far they will go in terms of educational attainment (censored observations). Ideally, these censoring and nonlinearities issues must be dealt with using econometric techniques allowing for discrete choices in education and for the fact that some children are still in school. Nevertheless, our findings do show that there are differences in educational attainment among school-age children, while in future work we will apply econometric methods which can enable us to estimate the impact of migration on final schooling levels.

The concerns just outlined are dealt with in ongoing work focusing on education levels (McKenzie and Rapoport [2005]).



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