Journal of Development Economics 95 (2011) 229–241

Contents lists available at ScienceDirect

Journal of Development Economics

journal homepage: www.elsevier.com/locate/devec

Remittances and banking sector breadth and depth: Evidence from Mexico ☆

Asli Demirgüç-Kunt [a], Ernesto López Córdova [b], María Soledad Martínez Pería [a,*], Christopher Woodruff [c]

[a] The World Bank, United States
[b] Inter-American Development Bank, United States
[c] University of California, San Diego, United States

ARTICLE INFO

Article history:
Received 16 June 2009
Received in revised form 22 March 2010
Accepted 7 April 2010

JEL classification:
F37
G21
016

Keywords:
Remittances
Financial development
Banking sector depth and breadth

ABSTRACT

Despite the importance of remittances to developing countries, their impact on banking sector breadth and depth in recipient countries has been largely unexplored. We examine this topic using municipality-level data on the fraction of households receiving remittances and on measures of banking breadth and depth for Mexico. We find that remittances are strongly associated with greater banking breadth and depth, increasing the number of branches and accounts per capita and the amount of deposits to GDP. These effects are significant both statistically and economically, and are robust to the potential endogeneity of remittances, inclusion of a wide range of controls and even municipal fixed effects specifications using an alternative panel data set from a sample of municipalities.

1. Introduction

Migrants working outside their country of birth returned more than US$338 billion to family members in their countries of origin in 2008 (World Bank, 2009). Recent research suggests these remittances have important implications for the economies of remittance-recipient countries. Numerous studies analyze their impact on poverty, inequality, growth, education, infant mortality, and entrepreneurship.[1] However, surprisingly little attention has been paid to the question of whether remittances affect the financial sector in recipient economies. This issue is important because financial systems perform the key functions of mobilizing and intermediating savings (Levine, 2005). Financial development has been shown to foster growth and reduce poverty.[2] Burgess and Pande (2005) show that by allowing households to accumulate savings and to secure loans for long-term productive investments the expansion of the banking sector in particular can have a very large impact on poverty levels and growth. Furthermore, the link between remittances and the banking sector is important because intermediating remittances through the banking sector may magnify the developmental impact of remittance flows. (see Hinojosa Ojeda, 2003; Terry and Wilson, 2005; World Bank, 2006; Ashraf et al., 2009)[3].

This paper analyzes the impact of remittances on the breadth (or outreach) and depth of the banking sector in Mexico. There are several reasons why remittances might affect banking sector breadth and depth. First, the fixed costs of sending remittances make the flows lumpy, providing households with excess cash for some period of time.[4] This might potentially increase their demands for banking services (and, hence, foster banking outreach and depth), since banks offer households a safe place to store this temporary excess cash. Second, interbank and wire transfers that might be collected in bank branches are an important means of receiving remittances. Banks

☆ The views expressed in this paper are those of the authors and do not represent the opinions of the Inter-American Development Bank or The World Bank Group.

* Corresponding author. Finance Research Group, World Bank, 1818 H St., N.W., MSN MC 3-300, Washington D.C. 20433, United States.
E-mail address: mmartinezperia@worldbank.org (M.S.M. Pería).

[1] For a review of the literature on remittances see López Córdova and Olmedo (2006). For the specific case of Mexico, Amuedo-Dorantes, Sainz and Pozo (2007) consider the impact on healthcare expenditures; Esquivel and Huerta-Pineda (2007) look at the impact on poverty; Hanson (2007) looks at labor force participation; Hanson and Woodruff (2003) analyze the impact on schooling; Hildebrandt and McKenzie (2005) and Kanaiaupuni and Donato (1999) consider infant mortality; López Córdova (2005) analyzes the impact of remittances on schooling, infant mortality and poverty; Woodruff and Zenteno (2007) and Woodruff (2007) look at entrepreneurship.

[2] See King and Levine (1993), Beck, Levine and Loayza (2000a,b), and Beck, Demirgüç-Kunt and Levine (2007).

[3] In particular, using data from a randomized field experiment in El Salvador, Ashraf et al. (2009) show that when migrants and remittance recipients are given the option to save by using banking products, savings increase significantly. The increases are larger if migrants are given control over the accounts that recipients use to save the remittances they receive.

[4] For example, a survey conducted in Mexico in 2003 by the Inter-American Bank and the Pew Hispanic Center finds that on average Mexicans receive remittances 7 times throughout the year. See http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=555870.

0304-3878/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.jdeveco.2010.04.002

charge processing fees for these transactions, which can be a significant source of income for commercial banks in remittance-receiving countries. The potential to collect these fees might induce banks to expand their outreach and locate close to remittance recipients. Third, a substantial portion of remittances flow to households that are likely to be unbanked—households in the middle and lower parts of the income distribution. Thus, banks acting as remittance paying agents are well-positioned to offer other services to unbanked households receiving remittances. Fourth, processing remittance flows provides banks with information on the income of recipient households. This information may make banks better able to extend loans to otherwise opaque borrowers. On the other hand, since remittances might help relax households' financing constraints, the demand for and the overall level of credit might fall as remittances increase. Regardless of remittance recipients' demand for credit, overall credit levels might still increase in remittance receiving areas if banks channel the increased liquidity from remittance deposits to previously unfunded or underfunded projects.

Mexico is an interesting case to study the link between remittances and banking sector breadth and depth because the country is among the top recipients of remittances worldwide, with more than $26.3 billion in flows in 2008. Remittances also flow disproportionately to rural and semi-urban areas in Mexico, which have been traditionally unbanked. Rural households are more than three times as likely to receive remittances: 13.8% versus 4.7% of households in larger communities. Furthermore, remittance flows are geographically concentrated within the Mexican territory. Over 40% of Mexican households receiving remittances, are located in the Central Western states of Aguascalientes, Colima, Guanajuato, Jalisco, Michoacán, Nayarit, San Luis Potosí, and Zacatecas. In those states, 12.4% of all households receive remittances, more than twice the national average.[5] The geographical concentration of remittance flows, which is tied to early 20th century migration patterns, is important for identifying the impact of remittances on the banking sector. Also, while most remittances are channeled through money transfer companies such as Western Union or Moneygram, Orozco (2004) reports that 55% of remittance collection points in Mexico are commercial bank branches.[6] This implies that banks play a key role in the distribution of remittances and are well-positioned to offer other financial services to individuals that visit banks to collect remittances. Finally, while remittance transaction costs have declined as the flow of remittances has increased, fees remain at close to 6% of transfers,[7] providing a substantial incentive for banks to expand their outreach in order to capture a larger share of the remittance market and the fee revenue associated with these transactions.

To study the impact of remittances on banking sector breadth and depth in Mexico, we combine municipality-level data on the percentage of households that receive remittances obtained from the 2000 Population Census with information from the banking regulatory authority (Comision Nacional Bancaria y de Valores or CNBV) on the location of every branch of registered privately-owned commercial banks in the country as of 2000, as well as data on the number of accounts and the peso value of deposits and loans at each municipality.[8] In our estimations, we explore the connection between remittances and the number of branches and deposit accounts per capita, both of which are measures of outreach or breadth, and the volume of deposits and credit to GDP, both traditional indicators of depth.

Of course, while remittances may lead to an expansion of banking sector depth and breadth, the causation may also go in the opposite direction. Better access to financial institutions in Mexico may lower the cost of sending remittances, leading to larger and more frequent flows. Or remittances and banking sector breadth and depth might both be driven by other, unmeasured, factors. Since we are interested in showing a causal link *from* remittances *to* banking sector development, we conduct estimations instrumenting for remittances. In particular, following López Córdova (2005) and Woodruff and Zenteno (2007), we use the placement of rail lines before the first wave of migration during the 1920s as an instrument for remittances.

The distribution within Mexico of the points of origin of early migrants to the United States is closely associated with the location of rail lines which went northward to the Texas border. These rail lines were used by US recruiters under the *Bracero* — or guest worker — *Program* to attract Mexican workers to the US. Though railroads are no longer the most important means of transport for US bound migrants, the location of the early rail lines remains closely associated with modern migration and remittances, since the early migrants formed the foundation for migration networks that facilitate migration and remittances to the present day.[9]

Of course, because rail lines stimulate economic activity,[10] they may also have a direct effect on the development of the banking sector. We separate the direct effect of rail lines from the migration effect by including as a control distance to the rail network as it existed in 1998. Hence, we rely on differences in the rail network in 1920 and the rail network in 1998. Since migration flows depend on networks developed early in the 20th century, only the early rail network should affect migration, while modern rail lines constructed any time before 2000 will have an effect on the level of economic activity in the municipality. We also show the results are robust to excluding municipalities located within 50 km of a rail line, where we expect the direct effects of rail lines to be most important, and to measuring financial development as the difference between the presence of bank branches in 1952 and the presence in 2000. The earlier date is well after the establishment of the rail lines, but before the largest wave of migration to the United States.

We find that remittances have produced a broader and deeper banking sector in Mexico. Our most conservative estimate suggests that a one standard deviation change in the percentage of households receiving remittances — roughly a doubling of the mean remittance rate — leads to an increase of 1 branch per 100,000 inhabitants (against a mean of 1.79), 31 accounts per one thousand residents (relative to mean of 42 accounts), and an increase of 3.4 percentage points in the deposit/GDP ratio (compared to a mean of 4.2). The results on bank credit (as a percentage of GDP) are much less robust and do not survive after we instrument for remittances.

An important limitation of our estimations using the CNBV data is that the data are for only one year (2000). Hence, we are unable to control for unobserved municipality characteristics that might affect remittances and financial breadth and depth. Therefore, as a robustness check, we also use data from the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH). The ENIGH is a household survey representative at the national level and repeated every two years which asks both about receipt of remittances and use of financial services by the household. The ENIGH is a repeated cross section of households, but we construct a municipal level pseudo panel for municipalities in which 15 or more households are surveyed.

[5] Calculations based on *Encuesta Nacional Ingreso-Gasto de los Hogares*, 2008.

[6] According to Banco de México's website, electronic transfers accounted for almost 98% of all remittance transactions in 2009, up from 55% in 1995, and 76% in 2000.

[7] Figures on the average cost of remittances in Mexico come from data collected by the Payment Systems Group of the World Bank during the third quarter of 2009. See http://www.remittance prices.org.

[8] In Mexico, a *municipio* is the smallest geographic and administrative subdivision to have its own democratically elected representatives. It is equivalent to a municipality in Europe, but closer to a county in the US, where the term municipality refers to a single urban area. A Mexican *municipio* may include multiple communities which may be urban, rural, or a mixture of the two. Throughout the paper, we use the term "municipality" in place of *municipio*.

[9] For example, Woodruff (2007) shows that the correlation between migration in the 1950s (during the second Bracero program) and migration in the 1990s was 0.7.

[10] See Donaldson (2008) for an interesting analysis of the role of rail networks on early 20th century development in India.

Using the ENIGH data for the even-numbered years between 1992 and 2008, we run regressions of the use of banking services on receipt of remittances, municipal level and year fixed effects, and a variety of controls including household income and schooling attainment of the head of household. The ENIGH panel confirms the findings from the 2000 census data: there is a robust association between the use of bank accounts and remittances.

We are aware of only one existing study that investigates the causal relationship between remittances and banking sector development. Using aggregate cross-country data, Aggarwal, Demirgüç-Kunt and Martínez Peria (2006) find evidence that remittances are associated with banking sector development across a broad set of countries.[11] However, several concerns bear mention. First, the study only captures remittances reported in balance of payments statistics, which often neglect remittances received through means other than banks and are, therefore, measured with error. Second, the cross-country estimations in Aggarwal et al. (2006) are subject to at least one source of endogeneity which our within-country data avoid: the fact that countries with more developed financial institutions may process and report a larger share of remittance flows through the formal financial system. Because our remittance data come from household surveys, they are less subject to measurement error and to reverse causation.[12] Finally, Aggarwal et al. (2006) only examine the impact of remittances on banking depth, ignoring the implications for outreach, which our paper studies.

The reminder of the paper is organized as follows. Section 2 motivates our empirical specifications with a simple model and a discussion of the factors affecting the profitability of bank branches and the use of banking services. Section 3 describes the census and CNBV data. Section 4 presents the main empirical specifications and the corresponding results. As a robustness check, Section 5 presents results using the ENIGH data. Section 6 concludes.

2. Factors affecting bank breadth and depth

In this section we sketch out a simple model of bank location and demand for financial services to analyze the role that remittances play in determining bank breadth and depth. The model is by no means comprehensive and is only intended to fix ideas and motivate our empirical specifications.

All of the branches in our data correspond to privately-owned banks.[13] We therefore begin with the assumption that banks exhibit profit maximizing behavior, opening a branch in a given location only when the bank expects that branch to be profitable. Beginning from this supposition, we examine the factors that affect the demand for and use of banking services by households and household enterprises. We focus on households and small scale enterprises, rather than larger enterprises, because the latter generally conduct banking transactions in Mexico City and in a handful of other large cities. Households and small enterprises are likely to be the determining factor in the placement of branches in smaller municipalities.

The expected profitability of a given branch, and hence the decision to open it, depends on the expected costs of and revenues from operating the branch. Some of the bank's cost to open a branch will be one-time fixed costs. However, for notational simplicity, we express these costs as an annual carrying cost. We denote the sum of the up front and annual fixed operating costs as C_B. Banks also pay a variable administrative cost per client, which we denote as c. Finally, banks pay interest on money deposited by account holders at a rate of r_d. Though theoretically r_d could depend on local conditions, in practice banks appear to pay the same interest rate at all branches. We therefore fix r_d at the national level.

The revenues of the branch come from investing the money deposited by clients and from fees charged for services. Banks can lend funds deposited in a branch to local clients, or transfer the funds to headquarters to be invested. The latter sets a floor on the returns from investing deposits. We assume the local lending is more profitable when the demand for credit is sufficient under the terms required by the bank. Denoting the return on invested funds r_L and the share of deposits which are loaned out locally as L, we refer to the earnings rate on deposits as a bank's average earnings on money deposited as $r_L(L)$, with $r_L'>0$. Note that some part of the deposits is held as cash for transactions purposes, some part is loaned to clients of this or other branches, and some part is invested by headquarters in other assets. $r_L(L)$ represents a weighted average return on deposits used for all of these purposes.[14]

On deposits, net earnings depend on the interest rate spread — the difference between the rate earned on investments $r_L(L)$ and the rate paid on deposits r_d — and the total level of deposits. We denote total deposits as $N\ D_i$, where N represents the expected steady-state number of clients and D_i the expected steady-state average deposit per client. Banks also earn income from fees. We denote two types of fees — account fees f_a and transaction fees f_r. The account fees depend on the number of accounts opened and the transaction fees on the number of transactions, R. We assume that individuals can process remittances without opening an account, as in fact, many households in Mexico do.

Taking all of these elements together, the bank's expected profit from a prospective branch is then:

$$E(\pi) = [(r_L(L) - r_d)N\ \bar{D}_i + f_a N + f_r R] - [C_b + cN] \quad (1)$$

The terms in the first set of brackets represent the bank's expected revenue. Those in the second set of brackets represent the expected cost of operating the branch. Revenues are increasing in the number of accounts, the average balance held in each account, the number of fee transactions, and the interest rate spread. The first three of these depend on factors which are specific to a given location. The spread has a floor level which is determined by national conditions, but local demand for credit may raise profitability at a given branch above this level. Costs depend on the fixed cost of operating in a given location.

The number of accounts is a function of the number of households near the prospective branch and the percentage of those households which choose to open an account. In the regressions discussed below, we control for the number of households near the branch by measuring the population density in the municipality. The percentage of households in a given municipality opening an account (which measures outreach), and the average balance in the accounts (which will affect bank depth) is determined by households' demand for banking services.

The demand for banking services is assumed to be a function of long term savings, which in turn result from an excess of income over expenditures over a period of time. Long term savings may be motivated by life cycle savings, or by savings to purchase high cost goods — housing

[11] Giuliano and Ruiz-Arranz (2009) also shows a positive correlation between the level of remittance flows and measures of bank deposits, but much weaker correlations between remittances flows and bank credit. Orozco and Fedewa (2007) show that households receiving remittances in five Latin American countries are more likely than non-recipient households to have bank accounts. The differences are large in Guatemala, El Salvador, Ecuador and Honduras, but much smaller in Mexico, where 19% of remittance-receiving households have accounts compared with 16% of non-recipient households. Neither study makes any claim about the causality of the associations they report.

[12] In many countries balance of payments statistics on remittances are compiled exclusively from data gathered by banks. This causes an obvious link between remittances and banking sector development. Because household surveys ask about remittances received through any means, this "automatic" link between remittances and banking sector development is less likely to influence the estimated effects.

[13] The ENIGH data we use in Section 5 employs a broader definition of banks, and is not limited to commercial banks. In Mexico, private banks are much more prevalent than public banks. Aggregate CNBV data indicate that private bank assets, deposits, and loans are almost 6 times larger than those of the government-owned banks and there are 18 times as many private bank branches. Finally, while private commercial banks have operations in 800 localities, government-owned banks have branches only in 349.

[14] We assume that the marginal branch is small relative to the total bank operation. That is, r_L is not affected by the decision to open the marginal branch.

and durable goods, for example. In either case, we expect that long term savings are an increasing function of income levels. Wealthier households spend a smaller portion of their income on goods purchased weekly (e.g., food) or monthly (e.g., electricity, telephone), and a higher portion of their income on good purchased less frequently (e.g. housing, automobiles). The demand for banking services is therefore increasing in income. Purchases of durable goods and housing may increase the household's demand for credit as well. In our estimations, we control for income by including per capita GDP at the municipality level.

In the context of rural and semi-urban Mexico, household demand for banking services may also depend on how well households understand the benefits of having an account. We conjecture that this depends on the education level of household heads and on their Spanish language abilities, the latter because banks conduct most information campaigns in Spanish. In our estimations, we control for these factors by measuring schooling levels and the percentage of households in which the head speaks an indigenous language.

Familiarity with banking services, and, hence, the demand for such services might also be higher, other things equal, for households that reside closer to the US border, since banking sector depth and breadth is significantly higher in the US than in Mexico. Thus, to account for this possibility and also to control for the fact that proximity to the US might foster overall economic development and, as a result, increase demand for services, our estimations include distance to the US border as a separate regressor.

The cost of operating a branch may also vary across municipalities. Though we lack information on real estate prices and other factors affecting operating costs, we do know how far each municipality is from Mexico City, where the banks' headquarters are located. Distance from Mexico City might proxy for operating and monitoring costs. We expect these costs to affect the number of branches and credit but perhaps to be less important in terms of the number of deposit accounts and the volume of deposits conditional on there being at least one branch.

Remittances might affect the use of banking services in at least three ways. First, the fixed costs of sending remittances imply that remittances are likely to arrive infrequently.[15] Remittances thus generate a transactions demand for financial services. Banks also earn fees from processing remittances, and the fee income may be an important factor in the profitability of a branch. Finally, from the bank's perspective, remittances allow them to get to know and screen potential credit clients, reducing the risk in lending in the area. On the other hand, by helping to relax financing constraints, remittances might have a negative impact on the demand for credit among households receiving these flows.

In sum, in addition to our primary variable of interest, remittances, we control in some regressions for population density, GDP per capita, average education levels, the percentage of households speaking an indigenous language, the distance from Mexico City, and the distance to the US border. Of course, several of these variables could reasonably be endogenous to financial development. We do not have enough instruments to address all of the endogeneity issues simultaneously. Instead, we focus on the potential endogeneity of the variable of interest, remittances, and show that the results with respect to remittances are robust to the inclusion or exclusion of the other variables.

Also note that Eq. (1) implies that in communities which are very small, bank branches may not be profitable, even if there is a demand for accounts from households, because their profitability requires that enough households have accounts or use services to cover the fixed cost of opening the branch. Hence, higher levels of remittances might not be associated with more bank branches in the very smallest communities. In our empirical estimations, we consider this possibility by excluding those municipalities where the share of rural population (i.e., the percentage of the population residing in communities with less than 2500 people) is 100%.

[15] Survey data for Mexico reveal that the average Mexican receiving remittances does so 7 times a year. See http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=555870.

3. Data

We draw on data from various sources. Data on the number of branches, number of accounts, and volume of deposits and credit for each of Mexico's roughly 2500 municipalities in the year 2000 come from the *Comisión Nacional Bancaria y de Valores* (CNBV), the banking regulatory and supervisory agency in Mexico. Summary statistics for these and other key variables are shown on Table 1. We eliminate Mexico City, since many large firms maintain centralized accounts there and the aggregate data are affected by this. Also, to minimize the influence of outliers we eliminate observations in the top 1% of the distribution for the number of branches, number of accounts, and volume of deposits and credit.

There is an average of 1.79 bank branches per 100,000 people and 42.1 accounts per 1000 people across all of the municipalities in our sample. Also, across all municipalities, the deposit to GDP ratio is 4.24% and the credit to GDP ratio is 0.65%.[16] But only 24% of municipalities in Mexico in 2000 have one or more bank branches. The lack of bank branches is particularly notable in municipalities in which all of the population resides in rural communities. Only 0.66% of municipalities where 100% of the population resides in communities with less than 2500 people have bank branches.

Data on GDP per capita in 1999/2000 come from the *Consejo Nacional de Población* (CONAPO), a Mexican government agency in charge of tracking population and other important statistics.[17] The average GDP per capita in our sample is US$ 3388. Note that the GDP data include remittance receipts. For the country as a whole, remittances represented only about 2% of GDP in 2000. While the effect of remittances on income levels is clearly much higher in some municipalities, the 2000 data are the only GDP figures available to us. If part of the impact of remittances is operating through income, then controlling for GDP may slightly bias downward our estimate of the impact of remittances on banking development.

Our primary independent variable of interest is the percentage of households in each municipality receiving remittances.[18] We measure this using the 2000 Population and Housing Census, implemented by the *Instituto Nacional de Estadística Geografía e Informática* (INEGI). We use data from a sub-sample of Mexican households that responded to an "extended questionnaire" (*cuestionario ampliado*), which, in addition to basic information on demographic and housing characteristics collected of all households, included questions on migration and non-wage sources of income, such as remittances. The sub-sample covered around 2.2 million households, or 10% of all households in the country, and was designed to be representative at the municipality level.[19] Not every household had an equal chance of being surveyed, but we use sample weights provided by the census to aggregate all information to the municipality level, including the percentage of households receiving remittances. The data on Table 1 indicate that on average 6.54% of households in a municipality reported receiving remittances.[20] The data show wide variance in remittance receipts among the municipalities. Almost 7% of municipalities have no households reporting they receive

[16] The sample excludes Mexico City, which is the most banked city in the country, and includes municipalities with no banking activity. This explains why the ratios are much lower than those for the country as a whole.

[17] GDP in 1999 pesos is divided by population numbers from the 2000 census converted into U.S. dollars and adjusted for purchasing power differences between Mexico and the US. See explanation provided by CONAPO at http://www.conapo.gob.mx/00cifras/6c.htm.

[18] We also ran regressions with the average amount of remittances per capita received by households in each municipality. The results are very similar to those shown and are available upon request. We prefer the share of households receiving remittances because remittance amounts are more likely to be much noisier and are subject to a very extended upper tail.

[19] INEGI (2000) provides a detailed description of the sampling methodology used to implement the extended questionnaire.

[20] This is an unweighted mean of the municipio level data. The percentage of households reporting remittances in Mexico is less than 6.58% because those residing in smaller municipios are more likely to say they receive remittances.

Table 1
Variable definitions and descriptive statistics. This table reports the definition of the variables used in Tables 2 through 5B, along with descriptive statistics for the sample that includes all municipalities.

Variable	Description	Observations	Mean	Median	Standard deviation	Minimum	Maximum
Deposits to GDP (%)	Deposit volume year 2000 to 1999 GDP in current pesos	2392	4.24	0	9.39	0	54.86
Credit to GDP (%)	Credit volume year 2000 to 1999 GDP in current pesos	2392	0.65	0	2.00	0	15.84
Branches per capita	Branches per 100,000 inhabitants	2392	1.79	0	3.84	0	22.00
Accounts per capita	Accounts per 1000 inhabitants	2380	42.13	0	95.69	0	610.39
Households receiving remittances (%)	Percentage of households receiving remittances from overseas	2392	6.54	3.45	7.71	0	53.71
GDP per capita	GDP per capita (dollars)	2391	3,388	2,776	2,535	149	27,695
Density	Population per square kilometer	2392	172.29	46.19	757.88	0.22	19773.74
Indigenous language (%)	Percentage of household heads who speak an indigenous language	2392	24.21	2.41	35.54	0.00	100.00
Schooling	Average years of schooling completed by household heads	2392	4.46	4.23	1.62	0.00	13.57
Distance to Mexico City	Distance between each municipality and Mexico City	2392	462.80	357.33	370.31	7.62	2270.40
Distance to the US border	Direct distance from each municipality to the US border	2392	750.12	787.85	264.42	0.50	1346.44
Distance to the modern railroad	Distance to closest railway line in 1998	2392	2443.78	2251.21	1269.08	2.50	6221.63
Minimum of distance to border along the 1920s rail and distance to border	Minimum of distance to the border along the 1920s railroad (where we consider distance to the railroad and from there to the border) and direct distance to the US border	2392	153.06	127.45	130.88	0.00	879.11

Table 2
Basic municipality-level Tobit estimations including all municipalities. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively. See Table 1 for a description of the variables used in the estimations below.

Variables	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)	(2.8)
	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP
Households receiving remittances (%)	0.1564	3.9704	0.4437	0.0151	0.2375	6.1426	0.662	0.0564
	[4.09]***	[4.20]***	[4.59]***	[0.89]	[6.65]***	[6.85]***	[6.84]***	[3.54]***
GDP per capita					2.1059	51.4631	4.3635	1.0399
					[16.80]***	[16.25]***	[12.14]***	[12.87]***
Density					0.0007	0.0243	0.0025	0.0006
					[3.31]***	[3.59]***	[3.93]***	[3.22]***
Constant	−8.6058	−221.3261	−21.3552	−4.4699	−15.77	−402.1896	−38.8721	−8.141
	[16.03]***	[16.26]***	[16.22]***	[15.40]***	[21.31]***	[20.76]***	[18.92]***	[17.71]***
Observations	2392	2380	2392	2392	2391	2379	2391	2391
Log likelihood	−3020.72	−4784.71	−3522.3	−2450.55	−2736.05	−4512.17	−3320.96	−2184.21

remittances, while in more than 23% of municipalities the share of households receiving remittances exceeds 10%.

We also control for the density of population within the municipality. Some municipalities have much larger land areas than others. For a given population, having a larger land area (that is, having lower population density) is associated with longer distances to any point in the municipality. Longer distances imply longer travel times to and higher costs of using a bank branch. Hence, we expect that density should be positively associated with measures of bank branch development, bank breadth and depth. Land area is taken from INEGI. The average population density for Mexican municipalities in our sample is 172 inhabitants per squared kilometer.[21]

Data on the percentage of household heads who speak an indigenous language and information on the average years of schooling of household heads also comes from the 2000 census. On average, 24.2% of household heads speak an indigenous language. The average years of schooling received by household heads is 4.46. Finally, our estimations also control for the distance of each municipality to Mexico City, where most bank headquarters are located, and distance to the US border. We calculated the distances from data on the geographical coordinates of each municipality used by López Córdova (2005), and originally obtained from INEGI.[22] The average distance to Mexico City is 463 km, while the average distance to the US border is 750 km.

4. Empirical specifications and results

Our baseline empirical specifications follow Eq. (2) below:

$$Banking\ \ Breadth_i(\text{or}\,Depth_i) = \alpha_0 + \alpha_1\,\text{Remittances}_i + \alpha_2 GDP\ per\ capita_i + \alpha_3\,Density_i + \varepsilon_i \quad (2)$$

where *i* refers to the municipality identifier. *Banking Breadth* is measured by the number of branches and, separately, deposit accounts per capita. *Banking Depth* refers to the ratio of the amount (in pesos) of deposits to GDP and loans to GDP. *GDP per capita* is measured in thousands of dollars and *Density* refers to the ratio of population to area.

We first estimate Eq. (2) over the entire sample of municipalities outside of Mexico City. Because there is a mass of municipalities without bank branches, deposits, etc., we estimate Eq. (2) using a Tobit specification. Given the fact that only a handful of the municipalities in which all of the population resides in rural communities have bank branches, we also estimate the regressions on the sample excluding these all-rural municipalities. We then check for robustness by including

[21] Population density in 2000 for the country as a whole was 51 inhabitants per squared kilometer. The larger number we obtain reflects the fact that municipalities with smaller land area are more densely populated.

[22] We calculated distances in kilometers using Stata's *sphdist* command.

Table 3
Basic municipality-level Tobit estimations excluding all-rural municipalities. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Estimations also exclude all-rural municipalities — those where the share of localities with less than 2500 inhabitants is 100. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively. See Table 1 for definitions of the variables used in the estimations below.

Variables	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)	(3.7)	(3.8)
	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP
Households receiving remittances (%)	0.2139	5.3976	0.6296	0.0184	0.307	7.89	0.8444	0.0717
	[5.14]***	[5.23]***	[5.89]***	[0.98]	[7.84]***	[8.01]***	[7.87]***	[4.05]***
GDP per capita					1.683	40.8493	2.9729	0.8759
					[13.71]***	[13.49]***	[9.54]***	[10.47]***
Density					0.0003	0.0149	0.0016	0.0004
					[2.15]**	[3.08]***	[3.34]***	[2.79]***
Constant	−3.6425	−99.0378	−9.6372	−2.1537	−11.0329	−283.6331	−24.4406	−6.1407
	[8.05]***	[8.80]***	[8.97]***	[9.29]***	[15.45]***	[15.60]***	[12.77]***	[13.59]***
Observations	1483	1470	1483	1480	1482	1469	1482	1479
Log likelihood	−2644.19	−4391.19	−3138.59	−2136.85	−2464.38	−4220.75	−3039.52	−1972.95

additional controls in the regressions — the percentage of household heads who speak an indigenous language, the average years of schooling attained by household heads, the distance between each municipality and Mexico City, and the direct distance to the US border.

Table 2 columns (2.1) through (2.4) report results for each of the measures of banking depth and breadth when we include only the percentage of households receiving remittances as a regressor. The association between remittances and bank branches, accounts, and deposits is significant both statistically and economically. The coefficient on bank branches per capita is 0.16 in the first specification, indicating that a 1 point change in the percentage of households receiving remittances is associated with a 0.16 increase in the number of bank branches per 100,000 residents. A one standard deviation increase in the percentage of households receiving remittances (7.7 percentage points) is therefore associated with an additional bank branch per 100,000 residents in the municipality (against a mean of 1.79). Remittances have effects of similar magnitude on the number of accounts per 1000 residents and the deposit to GDP ratio. A one standard deviation change in the percentage of households receiving remittances is associated with an increase of 31 accounts per one thousand residents (against a mean of 42 accounts), and an increase of 3.4 percentage points in the deposit to GDP ratio (against a mean of 4.2). Hence, for deposits, branches, and accounts, we find that the impact of remittances is considerable and highly significant.[23] For credit, however, we find a much smaller and statistically insignificant effect.

Remittances are more likely to flow to lower income municipalities: there is a modest but negative correlation between income per capita and the percentage of households receiving remittances (−0.035). Higher income is likely to be highly correlated with banking breadth and depth. Because the first results do not control for income or population density, they may understate the magnitude of the impact of remittances on the banking sector. Admittedly, we face something of a dilemma here. On the one hand, higher income causes higher bank breadth and depth. On the other hand, there is an extensive literature showing the impact of financial services on income. Later in the paper, we will suggest instruments to address the potential endogeneity of remittance receipts. But we do not have additional instruments to address simultaneously the endogeneity of income.[24]

With this caveat in mind, columns (5) through (8) of Table 2 show the results for regressions adding controls for GDP per capita and population density. For bank branches, accounts per capita, and the deposit-GDP ratio, the controls increase the magnitude of the effect of remittances by at least 40%. All of these effects remain significant. Per capita GDP and density both have the expected positive sign and are highly significant. Remittances now have a significant effect on the credit to GDP ratio as well, with a measured effect more than three times larger than in the first regression. Relative to the mean credit to GDP ratio, the effect of remittances on credit is smaller than on the other dependent variables. A one standard deviation increase in the percentage of households receiving remittances is associated with 0.43 increase in the credit to GDP ratio, about two-thirds of the mean for this variable (0.65). A similar increase results in a change of almost twice that level in each of the other three dependent variables. While the magnitude of the effects of remittances on banking depth and breadth are clearly quite sensitive to controlling for GDP per capita, we find that a single dummy variable indicating that the municipality has per capita income above the 75th percentile results in measured effects of nearly identical magnitude. (see appendix Table A.1.) The presence of banks may alter the income levels in the municipality, but the presence of bank branches by itself is unlikely to cause a large number of municipalities to change classification from below the 75th percentile to above the 75th percentile. This simpler control is, therefore, arguably less subject to endogeneity concerns.

In close to 40% of Mexico's municipalities, the share of the population residing in communities with fewer than 2500 residents is 100%. As we noted above, bank branches are very rare in these all-rural municipalities. Though remittances tend to flow disproportionately to rural communities, the small population density in these municipalities makes it difficult for banks to cover the fixed costs of operating a branch. Table 3 shows the effect of dropping 909 municipalities which have entirely rural populations from the sample, using the same specifications reported in Table 2. We see that the coefficients are roughly 30 to 40% larger than those on Table 2. We note that the means of the dependent variables are also about 50% larger when we exclude the all-rural municipalities. Thus, while remittances have a larger absolute impact on bank breadth and depth in the sample excluding all-rural municipalities, the relative impact is very similar to that which we found in the full sample.[25]

The discussion in Section 2 of the factors affecting bank breadth and depth suggests that other variables aside from GDP per capita and population density might influence our banking sector indicators. Table 4 presents Tobit specifications including some of these additional controls. In particular, we control for the average years of schooling among household heads in each municipality and for the percentage of household heads that speak an indigenous language, since these variables might impact the ability of households to understand the benefits of using banking services. We also control for distance to the US border. Since

[23] The estimated effects are not unreasonably large though, given that the standard deviation in the percentage of households receiving remittances is larger than the mean.

[24] However, in Table A.3 we show that results do not change when the dependent variables are averaged over 2001-2005 and regressors are pre-determined, measured as of 2000.

[25] For the remainder of the paper, we report results based on the sample excluding all-rural municipalities. The findings do not change in any significant way if we include these municipalities.

Table 4
Tobit estimations with additional controls excluding all-rural municipalities. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Estimations also exclude all-rural municipalities — those where the share of localities with less than 2500 inhabitants is 100. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively. See Table 1 for definitions of the variables used in the estimations below.

Variables	(4.1)	(4.2)	(4.3)	(4.4)
	Branches per capita	Accounts per capita	Deposits per capita	Credit per capita
Households receiving remittances (%)	0.3236	8.5041	0.9121	0.094
	[7.79]***	[8.12]***	[8.11]***	[5.05]***
GDP per capita	0.8283	18.7849	0.8134	0.3235
	[6.62]***	[6.57]***	[3.05]***	[4.62]***
Density	−0.0001	0.0011	0.000	0.0001
	[1.11]	[0.35]	[0.03]	[1.26]
Indigenous language	−0.0457	−1.0922	−0.1044	−0.0199
	[3.48]***	[3.22]***	[2.95]***	[2.79]***
Schooling	1.8889	51.8442	5.5458	1.297
	[7.25]***	[7.95]***	[8.55]***	[8.15]***
Distance to the US border	0.0003	0.0128	0.0039	0.0007
	[0.30]	[0.50]	[1.58]	[1.09]
Distance to Mexico City	0.0016	0.0246	0.0015	0.0013
	[2.64]***	[1.56]	[0.97]	[3.29]***
Constant	−17.3857	−461.0968	−45.6412	−11.2214
	[10.12]***	[10.39]***	[10.35]***	[10.04]***
Observations	1482	1469	1482	1479
Log likelihood	−2406.12	−4159.8	−2977.8	−1898.88

banking services are much more developed in the United States, we might expect that households in northern Mexico would be more familiar with the benefits of bank accounts, even if they have not migrated to the US. Finally, we include the distance between each municipality and Mexico City. Given that most banks' headquarters are located in Mexico City, this variable may proxy for the cost to banks of monitoring their operations outside of the capital. Alternatively, distance to Mexico City might serve as a proxy for the input costs of bank operations.

We find that years of schooling and indigenous language are highly significant and have the expected sign — municipalities in which household heads have an additional year of schooling and a smaller proportion of household heads speak an indigenous language have higher measures of banking depth and breadth. Distance to the US border appears not to be associated with bank breadth nor depth, after controlling for other variables.[26] Distance to Mexico City does influence the number of branches and the volume of credit but not deposits. However, the direction of the effect is not what we would have expected if we interpret this variable as a proxy for monitoring costs. This may suggest that a more appropriate interpretation for this variable is as a proxy for operating costs, since these are lower in areas more distant from Mexico City, as rents and wages may also be lower.

Most importantly for our purposes, including these additional controls has little effect on the magnitude and has no effect on the significance of the coefficients on remittances. We continue to find that remittances have a positive impact on bank branches and accounts and on the ratio of deposits and credit to GDP (compare to Table 3 columns 5 through 8).

4.1. Potential endogeneity of remittances

The results reported on Tables 2–4 ignore the potential endogeneity of remittances. There are numerous sources of endogeneity, with suggested biases running in either direction. First, the presence of financial institutions may cause higher remittance flows, either because banking development allows people to finance migration, and hence increases migration flows and remittances, or because the presence of financial institutions is associated with lower costs of sending remittances, and hence a greater propensity to do so. Neither of these seems to be a first order concern. Commercial banks in Mexico are an unlikely source of credit to finance migration. While better access to financial networks might facilitate receipt of remittances, the primary channel appears to be from migration flows to banking sector depth and breadth. We check this by using municipality level data on migration rates rather than remittance rates. The 2000 population census asks whether any member of the household has migrated outside of Mexico in the past five years, and if so, to which country. We calculate the percentage of households with at least one emigrant to the United States. Appendix Table A.2 shows that we obtain nearly identical results when we use this variable in place of remittance flows. Thus, the effect appears to be driven by migration flows, which cause remittance flows.

Our findings are likewise unaffected by reverse causation arising from the fact that we measure bank branches and remittances at the same point in time. Data on banking breadth and depth are available from the Banco de Mexico for the 2001–2005 period. These later data exclude some of the municipalities,[27] though the excluded municipalities account for less than 3% of the Mexican population. When we regress the mean of branches and deposits per capita as well as the average deposits and credit to GDP ratios over the period 2001–2005 against our measure of remittances for 2000, we obtain very similar results to those reported in Tables 3 and 4 (see appendix Table A.3).

A second source of endogeneity is the fact that some portion of the migrants out of Mexico returns after a period abroad. These return migrants may return with knowledge of U.S. financial markets, and hence have higher demand for financial services in Mexico. We view this channel as primarily affecting the interpretation of the results. If knowledge of financial markets acquired abroad is an important factor in increasing demand for banking services in Mexico, then the coefficient on remittances should be interpreted as reflecting the broader impact of migration on bank depth and outreach.

A final source of endogeneity appears to be more serious. The lack of financial services may cause a lack of economic development, or both may be related to some omitted third factor. The lack of development, in turn, might lead to out migration and, subsequently, higher remittance flows. That is, our regression may be mis-specified because we lack a control for municipalities with "bleak futures."

[26] Log distance is similarly insignificant for three of the four measures of financial development. It is positive and significant only for deposits, and even there has no effect on the measured impact of remittances on financial breadth and depth.

[27] There are more than 2400 municipalities in Mexico. However, the data provided by the Banco de México aggregate the branches, deposits, and loans for some of the smaller municipalities into a broader category labeled "others". There are 29 states which report this "other" category.

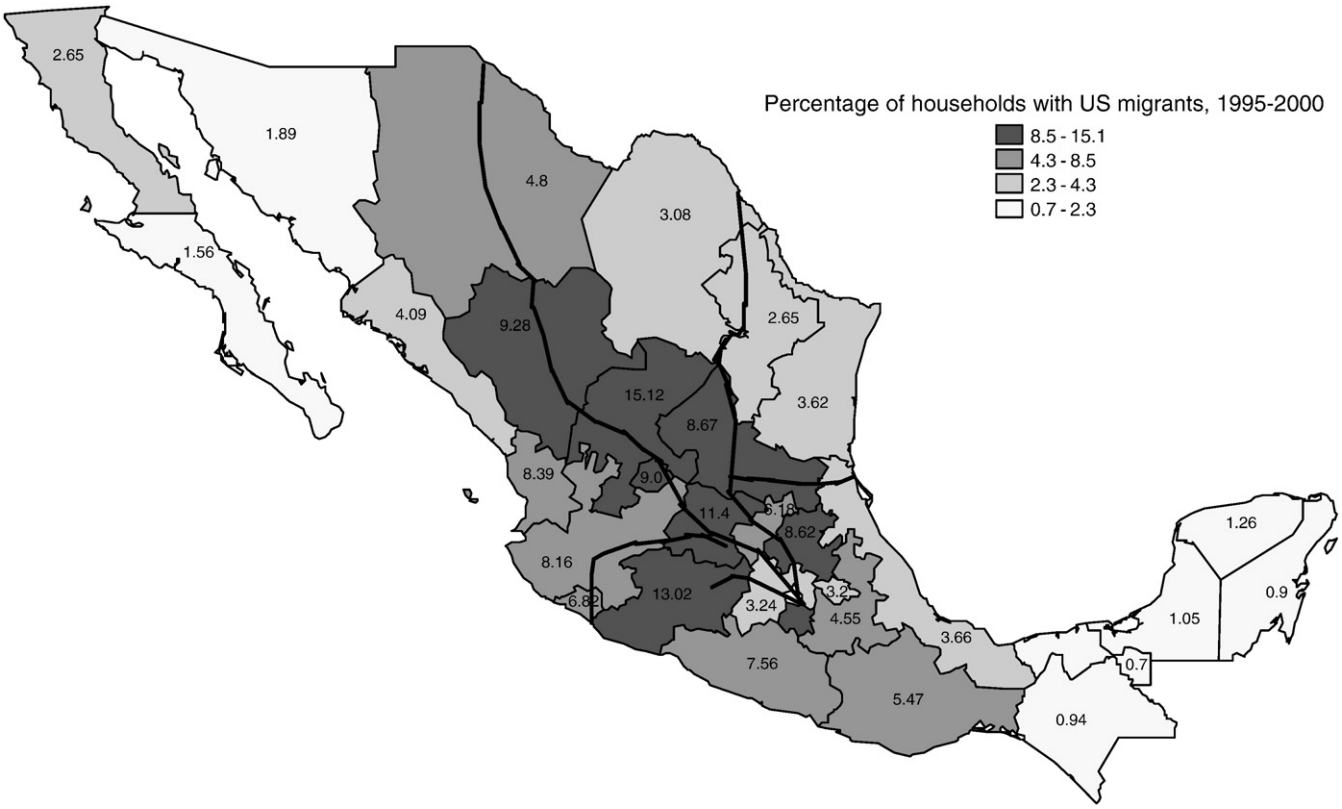

Fig. 1. The placement of the 1920s rail lines and migration rates in Mexican states.

We address the endogeneity concerns using instrumental variables. Following several others (see, for example, Hildebrandt and McKenzie, 2005; McKenzie and Rapoport, 2007; López Córdova, 2005; Woodruff and Zenteno, 2007), we exploit the fact that migration has deep historical roots in Mexico. Early migration in connection with the 1920s and 1950s *Bracero* — guest worker — Programs were centered in central-western Mexico, around the city of Guadalajara. As described in Woodruff and Zenteno (2007), the geographical origin of this early migration was related to the placement of rail lines. Our instrument is derived from this relationship. We use the distance of each municipality from the rail network as it existed in 1920 and then the distance from that point on the rail network to the US border (measuring distance along the railroad). Fig. 1 is a map of Mexico with the 1995–2000 migration rates shown for each state. The rail lines as they existed in 1920 are superimposed on the map. The map shows the connection between the historical rail lines and migration rates at a much later point in time.

Coatsworth (1972) estimates that rail travel cost one-third to one-sixth as much as other land transportation options during this period. We, therefore, multiply the distance from the municipality to the rail by five and add it to the distance traveled along the rail network to the border. We use as an instrument the minimum between this sum and five times the direct distance to the US border. In municipalities near the US border but far from the rail network, migrants would have traveled over land rather than by rail. The resulting variable, which we label *minimum distance*, measures the cost of migrating in the 1920s, when the migration networks were established.[28]

The most apparent reason to be concerned with whether the instrument meets the exclusion restriction is that the placement of the rail lines in the 1920s might affect banking sector breadth and depth through channels other than facilitating migration to the United States. Most notably, railroads might generate commercial activity in the towns through which they pass. We address this concern in two ways. First, we control in our estimations for the presence of a rail line in modern times (1998). The early rail lines had a disproportionate effect on patterns of migration, because they determined the geographical pattern of the first wave of Mexican–US migration prior to and during World War I. The initial migration established migration networks which persist to the present time (see Woodruff and Zenteno, 2007; Munshi, 2003). While the rail lines constructed at a later date will still have a direct effect on demand for financial services, they will have less effect on patterns of migration. Therefore, when we use distance to the US border via the 1920 rail network as an instrument, we also include distance to the nearest rail line in 1998 as an additional control that would capture the economic benefits of being close to the railroad in modern times.[29]

Second, we expect that the effect of the rail lines on commercial activity and general development will be concentrated in the municipalities through which the rail line passes. The effect of the rail line on commercial activity, and through that on financial development, will dissipate with distance from the rail line. We therefore exclude from the data municipalities within a given distance of the rail line. We find that the results are robust to excluding municipalities within any distance from 0 to 100 km. We report results excluding the municipalities within 50 km of the rail line.

Using the historical rail network as an instrument isolates the exogenous component of remittances that comes from the historical migration patterns. We should, therefore, interpret results from this

[28] The results are not qualitatively different if we simply add the distance to the rail line and the distance traveled along the rail line.

[29] The correlation between distance to the rail in the 1920s and distance to the rail in 1998 is 0.53, indicating considerable change in the network during the 20th century.

Table 5A
First stage instrumental variables estimations excluding all-rural municipalities and those within 50 km of the 1920s rail. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Estimations also exclude all-rural municipalities — those where the share of localities with less than 2500 inhabitants is 100 — and municipalities within 50 km of the 1920s rail. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively. See Table 1 for definitions of the variables used in the estimations below.

Variables	Dependent variable: households receiving remittances (%)							
	(5A.1)	(5A.2)	(5A.3)	(5A.4)	(5A.5)	(5A.6)	(5A.7)	(5A.8)
	Branches per capita equation	Accounts per capita	Deposits to GDP	Credit to GDP	Branches per capita	Accounts per capita	Deposits to GDP	Credit to GDP
GDP per capita	−0.2092***	−0.2212***	−0.2144***	−0.2120***	0.1411*	0.1384*	0.1310	0.1135
	[3.022]	[3.165]	[3.182]	[3.015]	[1.706]	[1.663]	[1.586]	[1.370]
Density	−0.0015***	−0.0014***	−0.0013***	−0.0015***	−0.0007***	−0.0007***	−0.0007***	−0.0008***
	[2.968]	[2.974]	[3.313]	[2.842]	[3.105]	[3.115]	[3.463]	[3.013]
Indigenous language					−0.0689***	−0.0684***	−0.0676***	−0.0702***
					[11.35]	[11.20]	[11.22]	[11.49]
Schooling					−1.3756***	−1.3700***	−1.3449***	−1.3779***
					[8.895]	[8.896]	[8.836]	[8.844]
Distance to Mexico city					0.0053***	0.0052***	0.0053***	0.0057***
					[7.889]	[7.780]	[7.999]	[8.149]
Distance to the border					0.0242***	0.0240***	0.0241***	0.0247***
					[14.87]	[14.77]	[14.86]	[15.15]
Min(distance to border along 1920s railroad, direct distance border)	−0.0020***	−0.0020***	−0.0020***	−0.0021***	−0.0063***	−0.0063***	−0.0063***	−0.0065***
	[12.63]	[12.66]	[12.55]	[12.99]	[18.07]	[17.92]	[17.98]	[18.43]
Distance to modern rail	0.0009	0.0008	0.0009	0.0013	0.0076***	0.0075***	0.0075***	0.0079***
	[0.745]	[0.689]	[0.798]	[1.068]	[5.512]	[5.381]	[5.473]	[5.692]
Constant	12.4530***	12.4978***	12.2852***	12.6843***	7.9034***	7.9719***	7.7277***	7.9623***
	[20.97]	[20.83]	[20.72]	[21.09]	[7.310]	[7.400]	[7.236]	[7.324]
Observations	1227	1219	1224	1226	1227	1219	1224	1226
Log likelihood	−5887	−7153	−6285	−5512	−5667	−6936	−6067	−5269
Kleibergen-Paap F-statistic for weak identification	158.9	159.7	157	168.2	324.5	319.2	321.2	337.5

IV as identifying the long-term impact of remittances on commercial banking sector depth and breadth. Table 5A shows the results from the first-stage of the IV estimations. We report results from two specifications. The first controls only for GDP per capita, population density, and distance to the modern rail network. The second includes schooling, indigenous language, distance to the border, and distance to Mexico City as additional controls. We find that our instrument, *minimum distance*, has a negative impact on remittances. In other words, in municipalities that are further away from the US through the 1920 rail network, a smaller share of households receives remittances. The effect of distance on remittances is significant in each specification. Furthermore, the Kleibergen–Paap *F* statistics for weak identification always exceed the Stock and Yogo (2005) critical values so we are able to reject the null that our instrument is weak.[30]

Second stage IV results are shown in Table 5B. Consistent with our suspicion that the Tobit results are biased downward, we find modestly larger impacts of remittances on banking breadth and depth when we instrument for remittances and use the more parsimonious specification. However, the IV results are very close in magnitude to the Tobit results when we include the measures of schooling, indigenous population, distance to the border, and distance to the rail. The standard errors are somewhat larger as well. We continue to find that remittances have a positive impact on banking sector breadth (measured via the number of branches or deposit accounts). However, remittances have a significant effect on depth only for the measure of deposits to GDP; the effect on credit is no longer significant. Note that distance to the present-day rail network has generally weak effects on banking sector breadth and depth.[31] Where significant (for deposits in the leaner specification), the coefficient indicates that banking sector depth is higher in municipalities located closer to the rail lines, as expected.

We provide further evidence in support of the validity of the instrument by obtaining data on bank branches in 1952.[32] This is the earliest year for which we were able to locate municipal level data, but it is an ideal benchmark given that the data come several decades after the rail lines were established but before the largest flows of migrants participating in the *Bracero* program. Only 207 municipalities had a bank branch in 1952, compared with more than 609 municipalities in 2000. Given the large wave of migration during the second half of the 1950s, controlling for the presence of a bank branch in 1952 also addresses the concern that financial development might cause migration, for example by financing for the costs of migration. The 1952 data are more limited than the 2000 data, showing only the number of bank branches by locality. We aggregate the locality data to the municipal level, and examine the relationship between remittances and changes in the presence of a bank branch between 1952 and 2000. Table 6 uses the sample of municipalities without branches in 1952, after excluding municipalities located within 50 km of a 1920s rail line and those with only rural localities.[33] Importantly, for this sample there is no correlation between distance to the 1920 rail network and presence of a bank branch in 1952 (rho = −0.01, $p = 0.61$). We find a strong positive relationship between the percentage of households receiving remittances in the 1995–2000 period and the establishment of the first bank branch in the municipality between 1952 and 2000.

[30] The Kleibergen-Paap *F*-test is a test for weak instruments. Weak identification arises when the excluded instruments are correlated with the endogenous regressors, but only weakly. Estimators can perform poorly when instruments are weak. When errors are assumed to be i.i.d., the test for weak identification automatically reported by Stata is an F version of the Cragg-Donald Wald statistic When the i.i.d. assumption is dropped the Cragg-Donald-based weak instruments test is no longer valid. Instead Stata reports a correspondingly-robust Kleibergen-Paap Wald rk *F* statistic (see Kleibergen and Paap, 2006).

[31] Our results do not change significantly if we exclude the distance to the modern rail.

[32] The data are from the Asociación de Banqueros de México publication *Anuario Financiero de México*, Vol. 13 (1952).

[33] The basic results are robust to including all municipalities, and to using an ordered probit which allows us to consider the handful of municipalities that had a branch in 1952 but no branch in 2000.

Table 5B
Second stage instrumental variables estimations excluding all-rural municipalities and those within 50 km of the 1920s rail. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Estimations also exclude all-rural municipalities — those where the share of localities with less than 2500 inhabitants is 100 — and municipalities within 50 km of the 1920s rail. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively. See Table 1 for definitions of the variables used in the estimations below.

Variables	(5B.1)	(5B.2)	(5B.3)	(5B.4)	(5B.5)	(5B.6)	(5B.7)	(5B.8)
	Branches per capita	Accounts per capita	Deposits to GDP	Credit to GDP	Branches per capita	Accounts per capita	Deposits to GDP	Credit to GDP
Household receiving remittances (%)	0.3602**	11.3828***	0.9899**	0.0523	0.2013**	7.3795***	0.8570***	−0.0245
	[2.326]	[2.745]	[2.429]	[0.601]	[2.287]	[3.230]	[3.541]	[0.499]
GDP per capita	1.9346***	46.4897***	3.9612***	0.9640***	1.0023***	21.3423***	1.3041***	0.3652***
	[13.57]	[12.35]	[10.32]	[9.684]	[6.543]	[5.709]	[3.607]	[4.374]
Density	0.0003	0.0195*	0.0021*	0.0004	−0.0003	−0.0012	0.0003	−0.0000
	[0.894]	[1.678]	[1.953]	[1.458]	[0.831]	[0.157]	[0.409]	[0.0426]
Indigenous language					−0.0540***	−1.1883***	−0.1039**	−0.0288***
					[3.107]	[2.699]	[2.238]	[2.930]
Schooling					1.7789***	51.7207***	5.7152***	1.1444***
					[5.501]	[6.288]	[6.798]	[6.414]
Distance to Mexico city					0.0024***	0.0458**	0.0042*	0.0018***
					[2.613]	[2.025]	[1.777]	[3.151]
Distance to the border					0.0012	0.0282	0.0061*	0.0008
					[0.885]	[0.795]	[1.680]	[1.053]
Distance to modern rail	−0.0036	−0.0999	−0.0114*	−0.0012	−0.0025	−0.0558	−0.0063	−0.0007
	[1.604]	[1.519]	[1.872]	[0.899]	[1.002]	[0.862]	[0.950]	[0.489]
Constant	−12.5252***	−332.2399***	−30.1671***	−6.4671***	−17.8607***	−489.8812***	−52.3637***	−10.1179***
	[8.511]	[8.155]	[7.744]	[7.799]	[7.574]	[7.960]	[8.292]	[7.550]
Observations	1227	1219	1224	1226	1227	1219	1224	1226
Log likelihood	−5887	−7153	−6285	−5512	−5667	−6936	−6067	−5269

Table 6
Likelihood of having a bank present in the municipality in 2000 given no presence in 1952. This table shows probit estimations for the likelihood of having a bank present in the municipality in 2000, given no presence in 1952. The dependent variable is 1 if a municipality had a bank branch in 2000 but no bank branch in 1952 and 0 otherwise (i.e., if it never had a branch). Marginal coefficients are shown. Robust *z*-statistics are in brackets. Estimations exclude all-rural municipalities (i.e., those where share of localities with less than 2500 inhabitants is 100) and those municipalities within 50 km of the 1920s rail. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively.

Variables	Dummy for whether a municipality had a bank in 2000 given no presence in1952			
Household receiving remittances (%)	0.0082***	0.0091***	0.0079***	0.0081***
	[4.630]	[5.026]	[4.238]	[4.350]
GDP per capita		0.0715***	0.0432***	0.0431***
		[7.222]	[4.081]	[4.121]
Density		0.000	0.0000	0.000
		[1.032]	[0.634]	[0.610]
Indigenous language			−0.0019***	−0.0021***
			[3.126]	[3.192]
Schooling			0.0409***	0.0431***
			[2.748]	[2.815]
Distance to Mexico city			0.0001**	0.0001**
			[2.138]	[2.297]
Distance to the border				0.0001
				[1.211]
Observations	1096	1095	1095	1095
Log likelihood	−625.9	−563.2	−547.4	−546.5

5. Robustness tests using pseudo panel data

Because the results reported using CNBV and census data only refer to the year 2000, we cannot with these data dispel the concern that omitted municipality level characteristics might be driving the link between remittances and banking sector breadth and depth. Hence, as a robustness check, we report additional estimations using a municipal level pseudo panel data set we construct from the Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH). The ENIGH data differ from the CNBV data in several significant ways. First, they represent household responses to surveys rather than administrative data. As such, they may be subject to additional noise. The question related to use of financial services is also asked with regard to a much wider range of financial institutions, including non-bank financial institutions (e.g., *cajas de ahorro*) and ROSCAs. Finally, our sample is limited to municipalities in which a reasonable number of households were interviewed in more than one year. We include a municipality/year observation when 15 or more households were surveyed, though the results are robust to using higher cutoffs. As a result, the sample is weighted much more toward larger municipalities. The result of all of these is a much higher implied penetration rate, with around 30% of households saying they made deposits or withdrawals from "financial institutions."[34]

Using ENIGH data for the even-numbered years between 1992 and 2008, we run linear OLS regressions, which are reported on Table 7. Because our instrument is measured at the municipal level, we cannot use an IV approach to deal with issues of endogeneity. However, the reported regressions include both municipal level fixed effects and year dummies. To allow for correlation within municipalities over time, we cluster standard errors at the municipal level. As controls, we include mean

[34] The CNBV data for the sample of municipalities included in the ENIGH sample also shows a higher penetration of commercial banks. There is an average of 8.5 bank accounts per 100 individuals in these municipalities, twice the average in the full sample. Given an average household size of around 4, this suggests that commercial bank accounts are likely the majority of accounts represented in the ENIGH data.

Table 7
Results using the ENIGH pseudo panel dataset. This table shows estimations using a municipal pseudo panel constructed from the ENIGH household surveys for the even-numbered years between 1992 and 2008. Regressions are OLS estimations of the use of banking services on the percentage of households that receive remittances. Estimations include municipal level and year fixed effects. Robust *t*-statistics (clustered at the municipality level) are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively.

Variables	% of households in municipality that use bank accounts			
Households receiving remittances (%)	0.1591***	0.1706***	0.1940***	0.1935***
	[3.716]	[4.110]	[4.716]	[4.649]
Mean household income		0.0003***	0.0002***	0.0002***
		[6.446]	[5.029]	[5.000]
Mean schooling attainment, household head			0.0279***	0.0279***
			[6.529]	[6.536]
Percentage of households in rural localities				0.0013
				[0.113]
Constant	0.2997***	0.2215***	0.1237***	0.1232***
	[53.72]	[17.24]	[7.058]	[6.857]
Observations	3663	3663	3663	3663
R-squared	0.151	0.196	0.21	0.21
Number of municipalities represented	780	780	780	780
Log likelihood	2496	2596	2629	2629

household income, the average of an index of schooling attainment of the head of household, and a measure of the percentage of households residing in localities with less than 2500 inhabitants (the common cutoff for rural localities), all measured at the municipal level.[35] We find a robust association between remittances and the use of bank accounts even after we control for municipality level fixed effects as well as time effects. A one percentage point increase in the share of households that receive remittances increases the percentage of households that use financial services by 0.16 to 0.19 percentage points. Comparing the magnitude of the effect to that shown in Table 2 above, a one percentage point increase in households receiving remittances results in an increase of 10% of the mean number of accounts per household in the CNBV data (an increase of 4 from a mean of 40), and about 6% in the ENIGH data. By this measure, the ENIGH data suggest results of only slightly smaller magnitude.

6. Conclusion

Remittance flows are an increasingly important source of income for households in lower income countries. Economists are just beginning to understand how remittances affect local economic outcomes in the recipient countries. Using municipality-level data for Mexico, this paper contributes to the literature by focusing on a question that has been largely ignored: how remittances affect banking sector breadth and depth. Mexico makes an excellent case study because remittance flows are large and geographically concentrated. Also, in Mexico, banks play an important role in the collection of remittances by recipients. They earn fees from these services and gain potential clients for other banking products.

We find that remittances are strongly associated with the depth and breadth of banking services in Mexico. The effects are significant both statistically and economically. The most robust impacts relate to the number of branches, accounts, and the deposit to GDP ratio. We sometimes find a positive impact on credit as well, though here the results are much less robust, and in particular, do not hold up to instrumenting for remittance receipts, and to accounting for the presence of a bank branch in 1952.[36] Results from a municipal-level pseudo panel from the 1990s and 2000s also indicate a relationship between remittances and bank accounts. The measured effect using the pseudo panel is slightly smaller than the results from the data on which our main findings are based.

Will the expansion of banking services caused by remittances result in additional development in the remittance recipient communities? This is a critical question, and an area for future research. The work of Burgess and Pande (2005) suggests that we might expect to find important effects on poverty and growth. The fact that we find some evidence of an association between remittances and credit suggests that banks may allow households to leverage remittance incomes for the purchase of durable goods or for investment in enterprises. But a more complete answer to the question will require more detailed data on the use of banking services in communities receiving remittances.

Acknowledgements

We thank Soledad López, Florencia Moizeszowicz, and Natalia Teplitz for their excellent research assistance at different stages of the project. We are grateful to Gordon Hanson (editor) and two anonymous referees for useful comments on the paper.

Appendix A

Table A1
Basic Tobit estimations replacing GDP per capita with a dummy for GDP per capita>than 75 percentile. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively. Estimations also exclude all-rural municipalities — those where the share of localities with less than 2500 inhabitants is 100.

Variables	(A1.1)	(A1.2)	(A1.3)	(A1.4)
	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP
Households receiving remittances (%)	0.2425	6.2940	0.6754	0.0603
	[6.51]***	[6.82]***	[6.84]***	[3.64]***
Dummy GDP per cap. 75th percentile	11.6144	286.8822	26.0744	5.8151
	[21.76]***	[20.52]***	[19.79]***	[15.56]***
Density	0.0006	0.0228	0.0023	0.0005
	[2.55]**	[2.77]***	[3.13]***	[2.65]***
Constant	−11.7566	−301.4885	−30.4166	−6.1000
	[19.69]***	[19.78]***	[20.19]***	[17.33]***
Observations	2392	2380	2392	2392
Log likelihood	−2789.55	−4554.82	−3335.49	−2220.47

[35] The index of schooling is 1 if the head of household has no formal education, 2 if he has preschool education, 3 if he has an incomplete primary education, 4 if he has completed primary school, 5 if he has an incomplete secondary education, 6 if he has completed secondary school, 7 if he has an incomplete tertiary education, 8 if he has completed a tertiary degree, 9 if he has an incomplete college education, 10 if he has completed a college degree, and 11 if he has a post-graduate education.

[36] Woodruff (2006) also finds a positive association between receipt of remittances and the likelihood of having a loan using household data from a sample of households which have accounts in non-bank financial institutions in Mexico.

Table A2
Basic Tobit estimations replacing remittances for the percentage of households with a migrant. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively.

	(A2.1)	(A2.2)	(A2.3)	(A2.4)	(A2.5)	(A2.6)	(A2.7)	(A2.8)
	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP	Branches per capita	Accounts per capita	Deposits to GDP	Credits to GDP
Households with at least one migrant overseas (%)	0.1038 [2.86]***	2.6173 [2.92]***	0.3274 [3.61]***	−0.0105 [0.61]	0.2238 [6.70]***	5.7399 [6.90]***	0.6202 [6.86]***	0.0491 [3.14]***
GDP per capita					2.1427 [16.70]***	52.4208 [16.17]***	4.4535 [12.03]***	1.0452 [12.87]***
Density					0.0006 [3.20]***	0.0233 [3.55]***	0.0024 [3.87]***	0.0006 [3.20]***
Constant	−8.3856 [15.32]***	−215.6095 [15.65]***	−20.9768 [15.68]***	−4.2817 [14.87]***	−16.0311 [20.85]***	−408.686 [20.47]***	−39.5045 [18.40]***	−8.1464 [17.50]***
Observations	2392	2380	2392	2392	2391	2379	2391	2391
Log likelihood	−3025.09	−4789.29	−3527.07	−2450.69	−2738.22	−4514.93	−3323.45	−2185.32

Table A3
Basic Tobit estimations where measures of depth and breadth are averaged over 2001–2005. Sample excluding all-rural municipalities. Regressions exclude outliers (observations in the top 1% of the distribution for the dependent variables). Mexico City is excluded. Robust *z*-statistics are in brackets. The symbols *,**, and *** denote significance at 10, 5 and 1% levels, respectively.

Variables	(A3.1)	(A3.2)	(A3.3)	(A3.4)	(A3.5)	(A3.6)	(A3.7)	(A3.8)
	Branches per capita average 2001–2005	Accounts per capita average 2001–2005	Deposits to GDP average 2001–2005	Credit to GDP average 2001–2005	Branches per capita average 2001–2005	Accounts per capita average 2001–2005	Deposits to GDP average 2001–2005	Credit to GDP average 2001–2005
Households receiving remittances (%)	0.1383 [4.28]***	3.5939 [3.52]***	0.8169 [6.32]***	0.0107 [0.79]	0.2006 [6.03]***	6.546 [6.31]***	1.0653 [7.90]***	0.0358 [2.59]***
GDP per capita	1.1119 [12.00]***	38.308 [11.78]***	1.5281 [6.33]***	0.3767 [7.31]***	0.4206 [4.29]***	14.895 [4.53]***	−0.3959 [1.52]	0.085 [1.93]*
Density	0.0001 [0.57]	0.0145 [2.17]**	0.0012 [1.99]**	0.0004 [2.32]**	−0.0003 [2.47]**	−0.0068 [1.51]	−0.0007 [1.56]	0.0001 [0.73]
Indigenous language					−0.0115 [1.17]	0.1733 [0.43]	−0.0087 [0.23]	−0.0062 [1.22]
Schooling					1.8589 [9.68]***	77.7116 [11.41]***	6.8221 [10.20]***	0.9197 [8.59]***
Distance to US border					−0.0001 [0.11]	0.0574 [2.20]**	0.0078 [3.05]***	0.0003 [0.68]
Distance to Mexico City					0.0014 [2.78]***	0.0016 [0.10]	0.0002 [0.11]	−0.0003 [1.15]
Constant	−2.1912 [4.04]***	−85.5148 [4.58]***	−1.3966 [0.80]	−1.2167 [4.43]***	−9.658 [7.44]***	−446.0059 [9.79]***	−35.3478 [7.67]***	−4.8304 [7.44]***
Observations	1003	1004	1003	1003	1003	1004	1003	1003
Log likelihood	−2548.67	−5021.59	−3463.48	−2014.39	−2493.31	−4952.15	−3417.8	−1964.92

References

Aggarwal, Reena, Demirgüç-Kunt, Asli, Martínez Peria, Maria S., 2006. Do workers' remittances promote financial development? World Bank Policy Research Working Paper 3957.

Amuedo-Dorantes, Catalina, Sainz, Tania, Pozo, Susan, 2007. Remittances and healthcare expenditure patterns of populations in origin communities: evidence from Mexico. Integration & Trade Journal 27, 159–184.

Ashraf, Nava, Diego Aycinena, Claudia Martinez, and Dean Yang, 2009. "Remittances and the Problem of Control: A Field Experiment Among Migrants from El Salvador". Mimeo.

Beck, Thorsten, Levine, Ross, Loayza, Norman, 2000a. Financial intermediation and growth: causality and causes. Journal of Monetary Economics 46, 31–77.

Beck, Thorsten, Levine, Ross, Loayza, Norman, 2000b. Finance and the sources of growth. Journal of Financial Economics 58, 261–300.

Beck, Thorsten, Demirgüç-Kunt, Aslı, Levine, Ross, 2007. Finance, inequality, and the poor. Journal of Economic Growth 12 (1), 27–49.

Burgess, Robin, Pande, Rohini, 2005. Do rural banks matter? Evidence from the Indian social banking experiment. American Economic Review 95 (3), 780–795.

Coatsworth, John, 1972. *The Impact of Railroads on the Economic Development of Mexico, 1877-1910*, PhD Dissertation, University of Wisconsin.

Donaldson, David, 2008, "Railroads of the Raj: Estimating the Impacts of Transportation Infrastructure," Mimeo, London School of Economics.

Esquivel, Gerardo, Huerta-Pineda, Alejandra, 2007. Remittances and poverty in Mexico: a propensity score matching approach. Integration & Trade Journal 27, 45–71.

Giuliano, Paola, Ruiz-Arranz, Marta, 2009. Remittances, financial development, and growth. Journal of Development Economics 90 (1), 141–152.

Hanson, Gordon H., 2007. Emigration, remittances, and labor force participation in Mexico. Integration & Trade Journal 27, 73–103.

Hanson Gordon H., and Christopher Woodruff, 2003. "Emigration and Educational Attainment in Mexico." Mimeo, University of California, San Diego.

Hildebrandt, Nicole, McKenzie, David J., 2005. The effects of migration on child health in Mexico. Economía 6, 257–284 (Fall).

Hinojosa Ojeda, Raul, 2003. Transnational migration, remittances and development in North America: globalization lessons from the Oaxaca-California Transnational Village/Community Modeling Project. Paper prepared for presentation at a Conference on "Remittances as a Development Tool in Mexico" organized by the Multilateral Investment Fund (MIF) of the Inter-American Development Bank (IDB), Mexico City, Mexico, October 28, 2003.

INEGI (Instituto Nacional de Estadística, Geografía e Informática), 2000. *XII Censo General de Población y Vivienda 2000. Tabulados de la muestra censal. Cuestionario ampliado.* Available at: http://www.inegi.gob.mx.

Kanaiaupuni, Shawn Malia, Donato, Katherine M., 1999. Migradollars and mortality: the effects of migration on infant survival in Mexico. Demography 36 (3), 339–353.

King, Robert, Levine, Ross, 1993. Finance and growth: Schumpeter might be right. Quarterly Journal of Economics 108, 717–737.

Kleibergen, Frank, Paap, Richard, 2006. Generalized reduced rank tests using the singular value decomposition. Journal of Econometrics 133, 97–126.

Levine, Ross, 2005. Finance and growth: theory and evidence. Philippe Aghion and Steven Durlauf, eds. *Handbook of Economic Growth*. Elsevier Science, The Netherlands.

López Córdova, Ernesto, 2005. Globalization, migration, and development: the role of Mexican migrant remittances. Economía 6, 217–245 (Fall).

López Córdova, Ernesto, Olmedo, Alexandra, 2006. International remittances and development: existing evidence, policies, and recommendations. Proceedings of

the G-20 Workshop on Demographic Challenges and Migration, Sydney, Australia, August 2005. Commonwealth of Australia.
McKenzie, David, Rapoport, Hillel, 2007. Network effects and the dynamics of migration and inequality: theory and evidence from Mexico. Journal of Development Economics 84, 1–24.
Munshi, Kaivan, 2003. Networks in the modern economy: Mexican migrants in the US labor market. Quarterly Journal of Economics 118 (2), 549–599.
Orozco, Manuel, 2004. The remittance marketplace: prices. policy, and financial institutions. Pew Hispanic Center Report.
Orozco, Manuel, Fedewa, Rachel, 2007. Leveraging efforts of remittances on financial intermediation. Integration & Trade Journal 27, 211–239.
Stock, James, Yogo, Motohiro, 2005. Testing for weak instruments in linear IV regression. In: Andrews, D.W.K., Stock, J.H. (Eds.), Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge University Press, Cambridge, pp. 80–108.
Terry, Donald F., Wilson, Steven R., 2005. Beyond Small Change: Making Migrant Remittances Count. Inter-American Development Bank, Washington, D.C.
Woodruff, Christopher, 2006. Characteristics of the Unbanked and Banked in the Popular Financial Sector in Mexico: An Analysis of the BANSEFI Household Panel Survey. Report prepared for BANSEFI, Mexico City.
Woodruff, Christopher, 2007. Mexican microenterprise investment and employment. Integration & Trade Journal 27, 185–209.
Woodruff, Christopher, Zenteno, René, 2007. Migration networks and microenterprises in Mexico. Journal of Development Economics 82 (2), 509–528.
World Bank, 2006. Global economic prospects: economic implications of remittances and migration. Washington, D.C.
World Bank, 2009. People Move, World Bank, Washington D.C. (http://peoplemove.worldbank.org/en/content/remittance-flows-to-developing-countries. Accessed on April 16, 2009.).