

## **A Remittance-Based Estimate of the Mexican Foreign-Born Population Resident in the United States**

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**Abstract.** Estimates of foreign-born populations are often constructed using household survey data, but these estimates may undercount the foreign-born, particularly when there is a significant unauthorized population. A notable example in this regard is the Mexican foreign-born population resident in the United States. Many believe that the official estimate of this population is too low due to a significant rate of nonparticipation of the unauthorized in the household survey on which the estimate is based, the American Communities Survey (ACS.) A significant undercount would cause estimates of the unauthorized population that are based on the “residual” methodology to be too low. I use data on the remittance flow from the U.S. to Mexico and estimates of parameters of remitting behavior obtained from surveys to develop a remittance-based estimate of the Mexican foreign-born population. This is completely independent from the ACS-based estimate and can serve as a crosscheck on the degree of undercount in the latter. Development of a remittance-based estimate reveals that the way questions are asked about remitting behavior introduce a high level of uncertainty in the estimate, and that survey questions could be modified and augmented to greatly reduce this uncertainty. If an “average” remittance-based estimate of the Mexican foreign-born population is compared to the ACS-based estimate, results suggest that the ACS-based estimate is unlikely to have a high degree of undercount.

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## I. Remittance Transactions and the Foreign Born Population

Residents in a country that have ancestral or birth ties with another country often send flows of money termed remittances to relatives and friends in their ancestral or birth country. Remittance flows are determined by the size of the underlying remitting population and their remitting behavior. An underlying remitting population will typically consist of a large component of people who were born in the country to which they send remittances, and a smaller component of people who were not born in that country but retain ties to it. If information is available on the number of remittance transactions and parameters of remitting behavior, an estimate of the underlying remitting population can be developed from data on remittance flows. This estimate can be refined into an estimate of the foreign-born population of a particular ancestral country if further information is available.

In this paper, we develop a remittance-based estimate of the Mexican foreign-born population resident in the United States in 2007. It is useful to construct such an estimate for this foreign-born population, because it contains a large component of people who are living in the U.S. without authorization to do so. The official estimate of the Mexican foreign-born population is based on a household survey administered by the U.S. Bureau of the Census (the American Communities Survey), and it is believed that there might be a significant undercount of this population due to lower rate of participation in the survey by the unauthorized. A significant undercount has important implications for estimates of the unauthorized population.<sup>2</sup> A remittance-based estimate is developed using data that is completely independent of the data used to make the ACS-based estimate and thus can serve as an independent crosscheck.

The mathematical relationship between remittances and the underlying sending population is straightforward. In the Mexico-U.S. case, if we define the following variables:

$T$  is the total number of remittance transactions;

$F$  is the Mexican foreign-born population resident in the U.S.;

$P$  is other population resident in the U.S. that could potentially send remittances to Mexico;

$R_F$  is the propensity of the Mexican foreign-born population to remit (the fraction of individuals that send remittances);

$R_P$  is the propensity of the other population to remit;

$Q_F$  is the frequency, or average number of remittance transactions, that the typical Mexican foreign-born remitter sends to Mexico each year;

$Q_P$  is the frequency that the typical other remitter sends to Mexico each year,

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<sup>2</sup> See Passel (2007) and Hofer et al (2011) for a review of how estimates of the total unauthorized immigrant population resident in the U.S. based on the residual methodology are constructed, and how undercount in the foreign born affect these estimates. It has often been assumed that there is an undercount rate of 10% in household survey-based estimates of the foreign born population.

then  $R_F F$  and  $R_P P$  are the number of Mexican foreign-born and other-population that send remittances to Mexico, respectively, and  $R_F F Q_F$  and  $R_P P Q_P$  are the number of remittances sent by these populations. The total number of remittances sent is therefore:

$$(1) \quad R_F F Q_F + R_P P Q_P = T.$$

Rearranging (1) shows how the underlying Mexican foreign-born population can be estimated from remittance flows:

$$(2) \quad F = \frac{T - R_P P Q_P}{R_F Q_F}$$

If empirical values for the variables on the right-hand-side of equation (2) can be obtained, then  $F$  can be estimated on the basis of remittance flows. This paper estimates  $T$  using data from the Central Bank of Mexico and remittance propensity and frequency parameters from surveys of Latino households resident in the U.S. The resulting remittance-based estimate of  $F$  can then be compared to other estimates of  $F$  based on population surveys.

## II. Remittance Flows from the U.S. to Mexico

Populations resident in one country that have ancestral or birth ties with another country typically send flows of money to relatives and friends in the ancestral or birth country. These monetary flows are termed remittances, and national statistical authorities record them as a distinct flow in the balance of payments accounts. The flow of remittances from the United States to Mexico is one of the larger such flows in the world, and the remittance corridor between the two countries has been extensively studied. Because this inflow is significant for the Mexican economy, the Central Bank of Mexico (CBM) has made significant efforts to accurately and comprehensively measure remittance inflows.<sup>3</sup>

The CBM records three distinct types of remittance transactions: electronic transfers, money-order transfers, and direct-delivery transfers. Money-order and electronic transfers are recorded on the basis of reports from banks, wire transfer firms, and other financial institutions. Prior to 2000, estimates of these flows were made on the basis of a sample of these institutions. In 2000, the CBM launched a major effort to improve the comprehensiveness of its coverage of remittance transactions.<sup>4</sup> Since November 2002, remittance-intermediating firms have been legally required to report their transactions to the CBM on a monthly basis. The CBM is confident that the large majority of these firms report transactions, and that the systems of these firms are designed for personal remittances and thus do not co-mingle these flows with other commercial transfers.<sup>5</sup> The CBM also estimates “direct delivery” remittances, which are transfers done through informal couriers or returning family members or friends. Direct-delivery transfers are “from one person to another with no intermediaries” and are estimated using data collected by the CBM’s Survey of International Travelers, which asks those entering Mexico who are resident in the U.S. if they are visiting relatives, and if so, how much cash and/or presents they are bringing to their relatives.<sup>6</sup> It is important to note that the direct-delivery channel estimates the flow of remittances through informal channels to Mexico.

Table 1 below summarizes CBM data on the value of remittances received by Mexico, the number of remittance transactions, and the average value of a remittance transaction. An important aspect of the CBM remittance data for the purpose of this study is that CBM provides both the number of remittance transactions as well as their value. Since 1995, over 90% of remittance transactions as recorded by the CBM have been channeled through electronic transfers and money orders, and since 2001, electronic transfers alone have accounted for 90% or more of all transactions. In the 2000s, only 1% of transactions were recorded as being sent through informal channels (direct delivery.)<sup>7</sup> During January

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<sup>3</sup> Since 1960, annual remittance inflows have equaled between 5-10% the value of total annual exports.

<sup>4</sup> The effort initially focused on banks and then widened to other intermediary businesses. The CBM effort also induced changes in record-keeping practices and market awareness of the intermediaries. See Güémez (2005), Cañas et al (2006), Tuiran-Gutiérrez et al (2006), and Cervantes (2007).

<sup>5</sup> See U.S. Government Accountability Office (2006), p.16.

<sup>6</sup> International Monetary Fund (2006), p.2. This estimate does not appear to include informal transfers made by hired courier and is thus possibly incomplete.

<sup>7</sup> Personal checks always constituted an insignificant share of transactions and were recorded as being at zero starting in June 2003.

2001-June 2009, the value of an electronic transfer remittance transaction has been very stable around an average value of \$323, which is close to the average value for all transactions of \$331 as electronic transfers have been 90% or more of all transactions.<sup>8</sup>

Figure 1 graphs quarterly values of remittance transactions from 1995 through the first half of 2009. Growth in transactions was particularly strong in 2003 and 2004, when annual transactions grew by 42% and 20% respectively. Economic and demographic developments cannot fully explain this growth. Appendix A explores this issue in more depth and concludes that the CBM remittance transactions series is characterized by a structural break in the series' behavior due to the changes in data collection methodologies that were implemented by the CBM in late 2002, when an effort was made to substantially increase coverage of remittance flows.<sup>9</sup> The appendix also shows that during 2004-2006, growth in CBM transactions was significantly more consistent with underlying fundamentals. It thus appears that the impact on the series of the structural break associated with methodology change had dissipated by 2006, as suggested by simple inspection of figure 1 below.

In addition to undercounting prior to the full realization of coverage improvements due to the 2002 collection methodology changes, there is another possible source of undercounting in CBM remittance transactions:

- *Informal-channel transactions are under-measured.* “Direct delivery” transactions is the CBM’s estimate of remittances that flow into Mexico through informal channels and is estimated to comprise 1% of total remittance transactions in the 2000s (table 1). This is a very small share and is not consistent with survey evidence (as will be discussed further below);

However, there are also possible sources of overcounting in CBM transactions:

- *Non-U.S. country sources.* Remittance inflows might come into Mexico from countries other than the United States. The CBM does not break remittance inflows down by source country. Available evidence suggests that the number of Mexican-born residents in other countries is small and probably numbered less than 100,000 in the mid-2000s;<sup>10</sup>

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<sup>8</sup> The standard deviation of for the average electronic transfer remittance value during January 2001-June 2009 was 15.4, so that the coefficient of variation was 0.06, which is a very low value.

<sup>9</sup> In a 2005 presentation on remittance flows, a Sub-Governor of the CBM attributed rapid growth in 2003 and 2004 to “both better statistical coverage of those transactions and an increase in inflows.” See Güémez (2005).

<sup>10</sup> Statistics on the number of Mexican-born residents in countries around the world are available from country censuses. Although Mexican migration to Canada has grown in the 2000s, the number of Mexican foreign-born resident in 2006 was 61,470 (which includes 11,550 non-permanent residents such as students and guest workers.) In Europe, Spain could be expected to have the largest Mexican diaspora; the Spanish census of 2001 indicates that the Mexican-born resident population is less than 26,000. Censuses conducted during 2000-02 in other developed countries show that the Mexican-born resident population was 721 in Austria, 79 in the Czech Republic, 153 in Finland, 363 in Greece, 601 in Ireland, 1,593 in the Netherlands, 429 in Norway, 116 in Poland, and 1,328 in Sweden. In developing countries, the same figure is 1,697 for Chile, 246 for the Philippines, 154 for Turkey, and 10 for Bulgaria. (Source: United Nations Statistics Division, Demographic Yearbook, Special Census Topics, Foreign-born

- *Money laundering.* Remittance flows might include transactions that are a component of the flow of money associated with criminal activity in the U.S. back to Mexico such as sales of illegal drugs. Available evidence on money laundering from the U.S. to Mexico suggests that it takes place through physical movement of cash across the border rather than through monetary transactions.<sup>11</sup>
- *Accidental inclusion of commercial transactions.* Remittance flows as recorded by the CBM in the balance of payments accounts are intended to include only flows from a physical person resident abroad to a physical person resident in Mexico. Some analysts have argued that even though the methodologies used by the CBM are intended to prevent leakage of commercial transactions into recorded remittances, such leakage cannot be entirely prevented.<sup>12</sup> Microenterprise transfers, repatriation of human smuggling receipts, and NGO transfers have been cited as potentially being included accidentally in CBM remittance flows.<sup>13</sup>

An estimate of the Mexican foreign-born population based on remittance transactions will be too low if undercount biases are not corrected for, and too high if overcount biases are not corrected for. In order to correct for undercounting prior to the change in CBM collection methodologies, we will make population estimates for the year 2007. As discussed in Appendix A, evidence suggests that by 2007, expansion in coverage of transactions due to methodology changes had been fully realized. A correction will also be made for undercount due to incomplete coverage of informal transactions.

For sources of overcount, no data is available to correct for possible inclusion of money laundering and commercial transactions in recorded remittance flows, and we will not attempt to correct for it. It should be noted that not correcting for this means that if there is in fact any significant overcount due to this source, our remittance-based population estimate will be too high. We will develop a correction factor for remittances coming from non-U.S. countries.

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population by country or area of birth:

[http://unstats.un.org/unsd/demographic/products/dyb/DYBcensus/V3\\_Table2.pdf](http://unstats.un.org/unsd/demographic/products/dyb/DYBcensus/V3_Table2.pdf) )

<sup>11</sup> The U.S. Drug Enforcement Administration (DEA) and Department of Justice (DOJ) cite cross-border physical shipment of cash as the primary method of money laundering by Mexican crime syndicates (see DEA testimony in 2000 at <http://www.usdoj.gov/dea/pubs/cngrtest/ct062300.htm>, and DOJ's *National Drug Threat Assessment*, various years.) DEA and DOJ both note that cash is wired internally in the U.S. to consolidation points near the southwest border, smuggled physically into Mexico, and then often converted into pesos at "Money Service Businesses" (wire remittance services, cashier check companies, and money exchange houses) and introduced into the Mexican domestic financial system. The degree to which such transactions might leak into remittance inflows recorded in the balance of payments depends on the degree to which the CBM can identify cross-border payment transactions versus domestic payment transactions.

<sup>12</sup> See Tuiran-Guitérrez et al (2006), who develop an estimate of remittance inflows into Mexico based on the Mexican National Survey of Household Income and Expenditures that is 18-33% the level of the CBM remittance flow in 2004. Comparison of remittance estimates in the balance of payments and based on household survey data shows that the latter are usually significantly less than the former, suggesting that this is a typical pattern and reflects more an issue of undercount in household-survey based estimates due to underreporting and sampling issues (see, for example, Acosta et al 2008, who find that for a sample of 11 Latin American countries in the 2000s, balance-of-payments estimates are on average 70-75% larger than household-survey-based estimates (p.46))

<sup>13</sup> See Tuiran-Guitérrez et al (2006), p.144.

**Table 1**  
**U.S.-Mexico Remittance Transfers**

	<i>Value of remittances (billion nominal US\$)</i>					
	<i>Total</i>	(growth)	Electronic transfers	Money orders	Direct delivery	Personal check
1995	3.67		1.89	1.46	0.30	0.03
1996	4.22	15%	2.22	1.52	0.41	0.07
1997	4.86	15%	2.64	1.73	0.42	0.08
1998	5.63	16%	3.25	1.87	0.44	0.06
1999	5.91	5%	3.94	1.45	0.47	0.05
2000	6.57	11%	4.64	1.43	0.49	0.01
2001	8.90	35%	7.78	0.80	0.30	0.01
2002	9.81	10%	8.80	0.69	0.32	0.01
2003	15.04	53%	13.11	1.67	0.25	0.01
2004	18.33	22%	16.23	1.87	0.23	0.00
2005	21.69	18%	19.67	1.75	0.27	0.00
2006	25.57	18%	23.85	1.36	0.35	0.00
2007	26.07	2%	24.82	0.86	0.39	0.00
2008	25.14	-4%	24.11	0.60	0.43	0.00
	Share in total					
1995-2000	100%	-	60%	31%	8%	1%
2000-2008	100%	-	91%	7%	2%	0%
2008	100%	-	96%	2%	2%	0%
	<i>Number of remittance transactions (thousand transactions)</i>					
1995	11,263		6,145	4,421	637	60
1996	13,208	17%	8,163	4,227	708	110
1997	15,369	16%	9,636	4,865	788	80
1998	19,420	26%	13,060	5,656	622	82
1999	20,937	8%	16,578	3,680	620	59
2000	17,999	-14%	13,737	3,603	644	15
2001	27,744	54%	25,246	1,904	584	10
2002	29,954	8%	27,704	1,780	459	10
2003	42,504	42%	37,651	4,498	348	7
2004	51,129	20%	46,203	4,603	323	0
2005	59,784	17%	55,372	4,067	345	0
2006	67,891	14%	64,404	2,845	642	0
2007	68,777	1%	66,409	1,586	782	0
2008	58,035	-16%	56,056	1,365	614	0
1995-2000	100%	-	69%	27%	4%	0%
2000-2008	100%	-	93%	6%	1%	0%
2008	100%	-	97%	2%	1%	0%

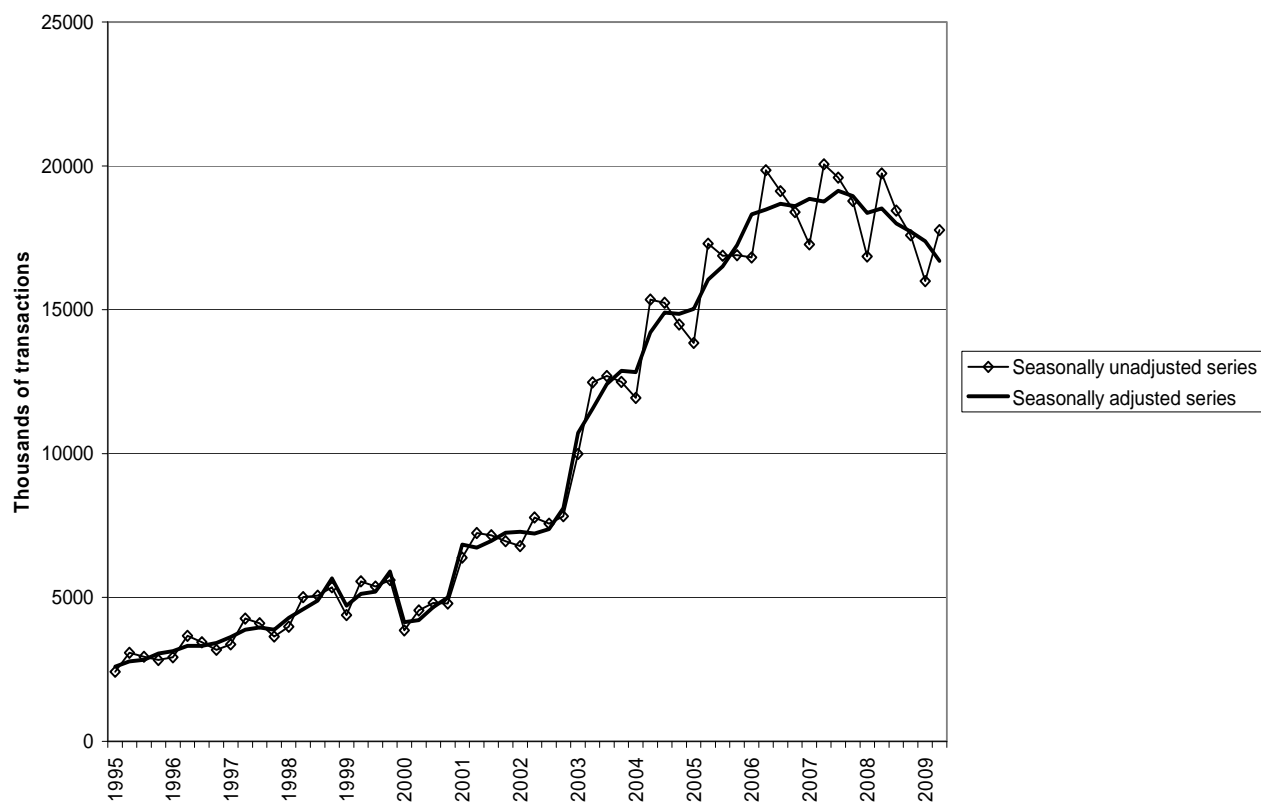
**Table 1 (cont.)**

	<i>Value of average transaction (U.S. dollars)</i>					
	<i>All types</i>	(growth)	Electronic transfers	Money orders	Direct delivery	Personal check
1995	\$326		\$308	\$329	\$469	\$433
1996	\$320	-2%	\$272	\$360	\$575	\$679
1997	\$317	-1%	\$274	\$355	\$533	\$984
1998	\$290	-9%	\$249	\$331	\$715	\$753
1999	\$282	-3%	\$237	\$394	\$766	\$870
2000	\$365	29%	\$338	\$398	\$757	\$561
2001	\$321	-12%	\$308	\$422	\$511	\$997
2002	\$328	2%	\$318	\$386	\$696	\$961
2003	\$316	-4%	\$306	\$370	\$731	\$936
2004	\$322	2%	\$312	\$406	\$724	-
2005	\$334	4%	\$325	\$430	\$791	-
2006	\$345	3%	\$337	\$478	\$550	-
2007	\$344	0%	\$338	\$542	\$502	-
2008	\$346	1%	\$342	\$442	\$541	-

Source: Central Bank of Mexico



**Figure 1**  
**Mexico Remittance Inflows: Quarterly Transactions**



### III. Remittance Behavioral Parameters: Evidence From Surveys

Data on remittance behavior parameters such as the propensity to remit and frequency of sending are available from several surveys of adult Hispanics resident in the U.S. that were carried out during 2001-2008. The Pew Hispanic Center conducted 5 surveys that included questions on remitting behavior, and the consulting firm Bendixen and Associates also conducted 5 such surveys.<sup>14</sup> Table 2 below summarizes basic characteristics of these surveys. The Pew surveys comprise three National Latino surveys and two surveys of Mexican-born U.S. residents only. The Bendixen surveys were conducted to support development of estimates of remittance flows from the U.S. to Latin America by the Inter American Development Bank.

The Pew and Bendixen surveys differ in that the Pew surveys usually include in their samples not just foreign-born Latino immigrants to the U.S., but also persons of Latino descent who were born in the U.S. However, most of the Pew surveys asked remittance-related questions only of the foreign-born. Only the 2006 Pew National Latino Survey asked remittance questions of both foreign-born and U.S.-born. This is of key importance for obtaining an estimate of remittances sent to Mexico by U.S. residents who were not born in that country (the term  $R_pPQ_p$ ).

The Pew Hispanic Center also makes the individual response data from these surveys publicly available on its website, so that it is possible to generate tabulations and various parameter estimates that are not necessarily in published reports on survey findings. Bendixen provides publications but not the raw data, so that insight into remitting parameters is limited to what is cited in these publications.

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**Table 2**  
**Pew Hispanic Center Latino Surveys**

	<b>Dates survey was carried out</b>	<b>Implementation method</b>	<b>Sample</b>	<b>Number of persons interviewed:</b>	<b>of which:</b>			<b>Remittance questions asked of:</b>
				<b>Latinos</b>	<b>Mexican origin</b>	<b>Foreign born - all countries</b>	<b>Foreign born - Mexico</b>	
2002 National Survey of Latinos	April 4-June 11 2002	Telephone interviews	Adult Hispanics 18 years or older	2,929	1,047	1,838	636	Foreign-born only
2004(03) National Survey of Latinos	August 7-October 15 2003	Telephone interviews	Adult Hispanics 18 years or older	1,508	964	779	517	Foreign-born only
2004 Survey of Mexican Migrants	July 12 2004-January 28 2005	Field interviews of matricula consular applicants in 7 U.S. cities	Adult Mexican citizens resident in the U.S.	4,836	4,836	4,836	4,836	Foreign-born only
2006 Survey of Mexicans on absentee voting	January 16-February 6 2006	Telephone interviews	Adults of Mexican origin or descent who live in the U.S. 18 years or older	987	987	987	987	Foreign-born only
2006 National Survey of Latinos	June 5-July 3 2006	Telephone interviews	Adult Hispanics 18 years or older	2,000	713	1,429	513	Foreign-born and U.S.-born

**Table 2 (continued)**  
**Bendixen Latino Surveys**

	<b>Dates survey was carried out</b>	<b>Implementation method</b>	<b>Sample</b>	<b>Number of persons interviewed:</b>	<b>of which:</b>		
				<b>Latinos</b>	<b>Mexican origin</b>	<b>Foreign born - all countries</b>	<b>Foreign born – Mexico</b>
2001 Survey of Remittance Senders to Latin America	November-December 2001	Not stated (probably telephone interviews)	Latin American immigrants living in U.S. who have family in home country	1,000	na	1,000	na
2003 Survey of remittance recipients in Mexico	September-October 2003	Face-to-face interviews	Adult remittance receivers	583	583	583	583
2004 State-by-State survey of U.S. remittance senders to Latin America	January-April 2004	Not stated (probably telephone interviews)	Latin American adult immigrants 18 years or older	3,802	na	3,802	na
2006 Public Opinion Research Study of Latin American remittance senders	May 3-25 2006			2,511	na	2,511	na
2007 Survey of Mexican and Central American Immigrants in the U.S.	June 2007			900	na	900	Na
2008 Survey of Latin American Immigrants in the U.S.	February 9-23 2008			5,000	Na	5,000	Na

## Propensity to Remit

Table 3 below presents values for the propensity to remit derived from Pew and Bendixen surveys for two population groups: for only those of Mexican origin, and for all Latinos sampled by the survey. Results suggest generally that the propensity to remit for Mexican immigrants resident in the U.S. and Latino immigrants is above 50%. Mexican immigrants have a slightly lower propensity to remit than Latino immigrants generally.<sup>15</sup>

The specific question asked by each survey on whether or not a respondent had sent money to their ancestral country varies, and this variation can affect results. The 2002 and 2004(03) Pew surveys asked if the respondent “regularly” sends money, but the two Pew surveys conducted in 2006 asked if the respondent had sent money back in the past year. The former questions would be expected to result in a lower rate of affirmative responses than the latter questions, because people sending remittances infrequently or irregularly over the past year might answer “no” to the former question but “yes” to the latter question. Empirical results confirm this hypothesis, as the propensity to remit is less than 50% for the 2002 and 2004(03) surveys but above 50% for the 2006 surveys.

The Bendixen surveys generally suggest a significantly higher propensity to remit than the Pew surveys for both population groups. The 2001 and 2006 Bendixen survey questions ask the respondent “have you ever sent money” to the home country, which will necessarily lead to a higher affirmative response rate than the 2006 Pew survey questions. This is confirmed by results of the 2008 Bendixen survey, which asks a question that is quite similar to those of the 2002 and 2004(03) Pew surveys and results in a much lower propensity to remit value. However, Bendixen survey results for all Latinos during 2001-2006 show percentages of those who report regularly remitting at 60% or higher.

The 2004 Pew Mexican migrant survey indicates a much higher propensity to remit (82%) than any of the other surveys. However, this survey sampled from a population of matricula consular card applicants, a subpopulation that is not representative of the underlying remitting population as a whole and is more heavily weighted towards individuals making remittance transfers.

Taking all of these factors into consideration, we will consider two values for the propensity to remit of foreign-born Mexicans. The 2006 Pew National Latino survey value of 54% will be used as a lower bound, and the 2007 Bendixen survey result for “Yes, regularly” of 64% will be used as an upper bound. The 2006 Pew question is more precisely and appropriately phrased for the purposes of this study than the 2002 and 2004(03) Pew surveys, and a 54% value is consistent with the value for the 2006 Pew Mexican voter survey of 58%. The survey was also carried out in the year prior to 2007,

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<sup>15</sup> Comparison of propensities for these two groups for the same survey reveal that the propensity for Mexican immigrants only is 0-4% less than for Latino immigrants generally.

and the propensity to remit was unlikely to have changed significantly from 2006 to 2007.<sup>16</sup>

The Pew 2006 National Latino survey also provides the only evidence on the propensity to remit of people born in the U.S. who identify themselves as having Mexican ancestry. This is very important in terms of quantification of transactions sent to Mexico by U.S. residents who were not born in Mexico. This group's propensity to remit of 20% is significantly below the propensity to remit of the Mexican foreign-born, as would be expected.

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<sup>16</sup> The propensity to remit might vary with the business cycle. However, the current U.S. recession did not begin until 2008. Roache and Gradzka (2007) also show through econometric analysis that remittance flows from the U.S. to Latin America are relatively insensitive to fluctuations in the U.S. business cycle.

**Table 3**  
**Propensity to Remit**

	Question	Mexican Origin Only				
		Yes	(Yes, regularly)	(Yes, but not in last year)	No	No answer
<b>Pew Surveys</b>						
2002 National Latino Survey	Do you regularly send money back to country in which you were born?	47%	47%		52%	0%
2004(03) National Latino Survey		39%	39%		60%	1%
2004 Mexican Migrant Survey	Do you send money to Mexico?	82%			14%	4%
2006 Survey of Mexicans on absentee voting	Did you send money to Mexico in the last year?	58%		42%		0%
2006 National Latino Survey	Have you sent money to anyone in (country of origin) over the past year?					
	-Mexican foreign born only	54%		45%		1%
	-U.S.-born of Mexican descent only	20%		78%		3%
<b>Bendixen Surveys</b>						
2001 survey	Have you ever sent money to family in your home country?	65%	na	na	35%	0%
2006 survey	Have you ever sent money to your family member in Latin America?	76%	71%	5%	24%	0%
2007 survey	"Percentage of Mexican immigrant adults that sends remittances"	Na	64%	na	na	Na
2008 survey	Do you currently send money on a regular basis to your family member in ( )?	Na	48%	na	na	na

Table 3 (continued)

		All Latino Foreign Born				
	Question	Yes	(Yes, regularly)	(Yes, but not in last year)	No	No answer
<b>Pew Surveys</b>						
2002 National Latino Survey	Do you regularly send money back to country in which you were born?	49%	49%		51%	0%
2004(03) National Latino Survey		40%	40%		59%	1%
2006 National Latino Survey	Have you sent money to anyone in (country of origin) over the past year?	54%		44%		1%
<b>Bendixen Surveys</b>						
2001 survey	Have you ever sent money to family in your home country?	69%	59%	10%	31%	0%
2004 survey	"Percentage of immigrant adults that send remittances regularly"		61%	14%	25%	0%
2006 survey	Have you ever sent money to your family member in Latin America?		73%	5%	22%	0%
2008 survey	Do you currently send money on a regular basis to your family member in ( )?		50%			



## Frequency of Remitting

Table 4 below presents values for the frequency of remitting (average number of transactions per year) derived from Pew and Bendixen surveys for Mexican-origin and Latino respondents. Survey respondents were required to choose among several frequency bins or categories in making their response, and surveys have differed in the frequency categories presented to respondents.<sup>17</sup> In order to convert the distribution of responses across frequency categories into an average annual transactions number, it is necessary to make an assumption about the average annual transaction level that each frequency category is associated with. The memo item at the bottom of table 4 shows what assumptions are made. For most categories, setting the level is straightforward (eg “once a week” implies 52 transactions a year.) For categories that span a range, the midpoint of that range is chosen. For the category “a few times a year”, the annual number of transactions is set at 6.

Average annual transactions levels are sensitive to what frequency categories a respondent was presented with. The 2006 Pew Mexican voter survey did not present respondents with “once a week” or “twice a week” options, and its category structure probably biases the yearly frequency estimate down. On the other hand, the 2003 Bendixen survey of remittance recipients in Mexico only permitted a choice between “once a week” and “once a month” and did not include a “twice a week” option, which helps explain why its yearly frequency estimate is so high.<sup>18</sup> In 2008, Bendixen moved away from the traditional categories and asked respondents to choose in terms of remittances per year, which may have caused respondents to think more carefully about the number of transactions that they actually made.

Although there is substantial variance in estimated average transactions per year, which results at least in part from differences in frequency category structure, results for the 2004(03) and 2006 Pew National Latino surveys are quite close for Mexican foreign-born respondents at 13.6 and 13.1 transactions per year, respectively. Results for all Latinos for the 2004 and 2006 Bendixen surveys are also close to a level of roughly 13 transactions per year (at 13 and 12 respectively.) We therefore will use the frequency values derived from the 2006 Pew National Latino survey, which are 13.1 for Mexican foreign-born and 16.8 for U.S. citizens of Mexican origin.

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<sup>17</sup> No survey has permitted a respondent to state a value for the number of transactions made over the past year.

<sup>18</sup> Presumably some or many of those remitting twice a month chose the “once a week” option.

**Table 4**  
**Frequency of Remitting**

	Question	Mexican Origin only									
		Once a week	Twice a month or more	Couple of times a month	Once a month or more	Once a month	A few times a year	Once a year	Less than once a year	No response/ do not remember	Estimated average transactions per year
<b>Pew Surveys</b>											
2004(03) National Latino Survey	How often do you send money back to the country in which you were born?	4%	18%			44%	27%	5%	3%	1%	13.6
2004 Mexican Migrants survey	How often do you send money to Mexico?	11%		23%		32%	22%	6%	6%	1%	17.0
2006 Mexican voter survey	How often did you send money to anyone in Mexico in the past year?				33%		59%	6%		1%	9.8
2006 Latino survey	How often have you sent money to anyone in country of origin over the past year?										
	-Foreign-born	5%			52%		33%	8%		3%	13.1
	-U.S.-born	15%			45%		28%	13%		0%	16.8
<b>Bendixen Surveys</b>											
2003 survey	¿Con qué frecuencia se comunica usted con su familiar que le envía remesas?	31%				36%	28%			5%	23.3

**Table 4**  
**(continued)**

	Question	All Latinos														
		Once a week	Twice a month or more	Couple of times a month	Once a month or more	Once a month	A few times a year	Every 2 to 3 months	Every 3 months	Every 4 to 6 months	Every 6 months	Once a year	Less than once a year	No response/do not remember	Estimated average transactions per year	
Pew Surveys																
2004(03) National Latino Survey	(see above)	5%	15%			46%	27%					4%	2%		13.8	
2006 National Latino Survey		7%			49%		29%					11%		4%	13.6	
Bendixen Surveys																
2001 survey	How often do you send money to family in your home country?					44%			22%		10%	9%	9%	6%	9.8	
2004 survey					61%			21%		9%		5%		4%	13.0	
2006 survey			23%			38%		17%		8%		7%	4%	3%	12.0	
2007 survey <sup>A</sup>																
2008 survey		Times per year														11.6
		1 to 3	4 to 6	7 to 11	12 to 15	16 or more	No answer									
	15%	18%	12%	32%	16% <sup>B</sup>	7%										
Memo: assumed transactions per year for frequency categories																
		52	26	26	18.2 <sup>C</sup>	12	6	5	4	2.5	2	1	0.5			

A : Remitting frequency data not publicly reported.

B : Calculated using Pew 2004(03) survey weights for weekly and twice a month.

C : Calculated using Pew 2004(03) survey weights for weekly, twice a month, and monthly

## Remittance Channels

The Pew and Bendixen surveys also ask respondents about the remittance channel that they primarily use to send money home. Survey evidence on remittance channels is summarized in table 5 below. The large majority of remittances sent to Mexico by the U.S.-resident Mexican foreign born is sent through formal financial channels, which is consistent with the CBM remittance data summarized in Table 1 above. However, the surveys suggest that in the mid-2000s, roughly 8% of respondents primarily used the informal “people traveling” channel. This channel corresponds to the CBM’s “direct delivery” channel, which accounts for only 1% of CBM-recorded transactions. There is thus a significant discrepancy between CBM and survey evidence on the use of informal channels to send remittances to Mexico, with survey evidence indicating a higher rate of use of informal channels.<sup>19</sup>

Because Pew survey microdata is publicly available, it is possible to construct estimates of the average annual number of transactions for individuals who send by different channels.<sup>20</sup> Table 5 shows that the smallest number of annual transactions is consistently done through informal delivery channels, which is perhaps not surprising given that the convenience of sending through this channel might be less than for formal channels. The survey evidence also suggests that the use of informal channels to send remittances declined somewhat over the course of the 2000s, which is consistent with the fact that the cost of sending through formal channels has fallen significantly since the late 1990s, a development that has led analysts to postulate that there has been substitution from informal to formal channels.<sup>21</sup>

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<sup>19</sup> An underestimate of informal transactions by the CBM may be due a lack of capture of remittances sent by courier by the survey they use to measure informal transactions: see footnote 4.

<sup>20</sup> These estimates take into account the frequency that remitters using particular channels report.

<sup>21</sup> See Freund and Spatafora (2008), Hernández-Coss (2005), and Roache and Gradzka (2007), pp.5-6.

**Table 5**  
**Remittance Channels**

	Question	Mexican Origin only							
		International money transfer company <sup>A</sup>	Bank	Credit union	Electronic cashier	Cash card	Mail	People traveling	No response/ don't know
<b>Pew Surveys</b>									
2004(03) National Latino Survey	In general, how do you send the money?	67%	11%	1%			9%	10%	1%
2004 Mexican Migrants survey	In general, what method do you use to send money to Mexico?	71%	11%	1%	2%	2%	2%	8%	3%
2006 National Latino Survey	In general, what method do you use to send money?	64%	13%	1%	3%	2%	5%	8%	4%
	-Foreign-born only	66%	13%	1%	3%	2%	4%	6%	4%
	-U.S.-born only	51%	10%	0	0%	3%	10%	21%	5%
<i>Average number of transactions per year</i>									
2004(03) National Latino Survey		14.2	13.1	9.0			12.6	8.5	
2004 Mexican Migrants survey		17.4	17.1	21.5	14.3	19.1	16.7	13.3	
2006 National Latino Survey									
	-Foreign-born	13.5	14.0	11.0	11.7	11.0	14.9	9.1	
	-U.S.-born	18.2	13.5				22.5	12.4	
<b>Bendixen Surveys</b>	NA <sup>B</sup>								

A : Western Union and MoneyGram, for example.

B : Data on channels used by Mexican-origin respondents only are not reported for any survey.

**Table 5**  
**(continued)**

(continued)

	Question	All Latino Groups							
		International money transfer company	Bank	Credit union	Electronic cashier	Cash card	Mail	People traveling	No response/don't know
Pew Surveys									
2004(03) National Latino Survey		70%	11%	2%			7%	10%	0%
2006 National Latino Survey		65%	12%	1%	3%	1%	5%	7%	5%
Bendixen Surveys									
2001 survey	How do you usually send money to your family?	41%	14%	6%			14%	15%	10%
2004 survey		78%	7%	1%			2%	11%	
2006 survey		63%	19%				10%	8%	
2007 survey <sup>A</sup>									
2008 survey		58%	26%			2%	12%		

A : Data on remittance channels not reported in publication for that year.

#### IV. Remittance-Based Estimate of the Mexican Foreign Born Population Resident in the U.S.

Values or ranges of values for all variables in equation (2) have been established except for P, the population of non-Mexican-foreign-born that could potentially send remittances to Mexico. Table 6 below summarizes estimates of the Mexican-origin and Mexican foreign-born populations resident in the U.S. in 2006 and 2007. The difference between these populations is assumed to consist of U.S.-born residents who identify themselves as being of Mexican origin. This population is consistent in definitional terms with the group who identify themselves as being born in the U.S. and of Mexican ancestry in the 2006 Pew National Latino Survey. We assume that the population of non-Mexican-foreign-born that could potentially send remittances to Mexico corresponds to this group.<sup>22</sup> The number of U.S.-born residents of Mexican ancestry 18 years and over is estimated at roughly 8 million in 2007.

**Table 6**

	Mexican-Origin Population		Mexican Foreign-Born Population		Residual: U.S.-Born of Mexican Origin	
	2006	2007	2006	2007	2006	2007
<b>Total</b>	28,323,000	29,145,000	11,541,404	11,738,537	16,781,596	17,406,463
<b>By age group:</b>						
< 5 years	3,324,000	3,451,000	103,873	93,908	3,220,127	3,357,092
5 to 24 years	Na	10,434,000	2,562,192	2,476,831	na	7,957,169
5 – 9 years	Na	2,908,000	na	na	na	na
5 – 17 years	Na	na	1,061,809	1,021,253	na	na
10 - 14 years	Na	2,732,000	na	na	na	na
15 - 19 years	Na	2,384,000	na	na	na	na
18 - 24 years	Na	na	1,500,383	1,455,579	na	na
20 - 24 years	Na	2,410,000	na	na	na	na
25 to 44 years	Na	9,672,000	6,024,613	6,104,039	na	3,567,961
45 to 54 years	Na	2,821,000	1,511,924	1,655,134	na	1,165,866
55 to 64 years	Na	1,474,000	761,733	798,221	na	675,779
> 64 years	1,216,000	1,293,000	577,070	610,404	638,930	682,596
<b>Memo:</b>						
18 years and over	na	18,623,600 <sup>A</sup>	10,375,722	10,623,376	na	8,000,224

Sources: Mexican-origin population estimated by the U.S. Bureau of the Census Current Population Survey; Mexican foreign-born population estimated by the U.S. Bureau of the Census American Community Survey.

A : population in age group 18-19 years estimated as two-fifths of the 15-19 year age group.

<sup>22</sup> It is possible that there are people not of Mexican origin who are resident in the U.S. and who send remittances to Mexico. Our assumption is that the size of this group is so small as to be negligible for purposes of the calculations made here.

Before developing remittance-based estimates of the Mexican foreign-born population, three important issues remain to be addressed. First, CBM transactions must be corrected for informal-transaction undercount. Second, two issues that introduce significant uncertainty into remittance-based estimates must be confronted: individual versus household responses to survey remittance questions, and remittance bundling.

### **Undercount of Informal Remittance Transactions**

As discussed earlier, the CBM estimate of the percentage of remittances going through informal channels of 1% is significantly less than what the Pew and Bendixen surveys suggest. Given the consistency of the survey evidence on the degree to which remitters use informal channels, we assume that the CBM undercounts informal remittance transfers and correct CBM remittance transactions accordingly using data from the Pew 2006 National Latino survey. Table 5 gives average annual remittance transactions for different channels. Multiplying the number of remitters in the 2006 survey using a particular channel by the annual average number of remittances for that channel gives the total number of remittances made through that channel. The share of remittances going through informal channels (“people traveling”) in all remittances is estimated at 6.2%. This is slightly less than the 8% of remitters who reported using informal channels in the 2006 Pew National Latino survey, because informal-channel remitters send somewhat fewer transactions per year than other remitters.

The total number of CBM remittance transactions in 2007 is 75.7 million, of which 1% (771,000) was recorded as going through the personal delivery channel. Increasing the number of personal-delivery transactions to 4.95 million, so that total remittance transactions were 79.9 million, results in a share of personal-delivery transactions of 6.2%.

### **Individual versus Household Interpretation of Remittance Questions**

In Table 3, the typical question posed by the survey asked the individual “Did you send money to your home/ancestral country (in the last year, regularly, etc)?” Respondents who are members of multi-person households could interpret this question as being about their behavior as an individual, but they could also interpret the question as asking whether anyone in their household made remittance transactions. Answering on behalf of the household must be taken into account when developing a remittance-based population estimate, because household-based responses should be converted into individual-based equivalents in order to estimate population accurately.

Consider a simple example of a population of 100 households that are each 2-person married-couple households in which the wife sends 12 remittances per year to her family in Mexico, and the husband does not send remittances, so that total remittance transactions are 1200. If a husband is interviewed and responds as an individual, he will report no remitting activity, and if a wife is interviewed and responds as an individual, she will report 12 remittances. If the survey properly samples this population, its sample should contain equal numbers of interviews with women and men, and the survey would show a propensity to remit equal to 0.5. In this case, a remittance-based population



estimate would equal  $1200/(0.5*12)$ , or 200, which is the actual size of the underlying population. However, if both husbands and wives respond on behalf of their household, then husbands will report that “they” remitted, and the survey would show a propensity to remit equal to 1. In this case, the population estimate would equal  $1200/(1*12)$ , or 100, which is half the size of the true population. *Ceteris paribus*, a remittance-based population estimate understates the true size of the underlying population to the degree that individuals in multi-adult households respond on behalf of their household rather than as an individual.

No information exists in currently-available surveys to correct for this potential bias. Such information could come from a more detailed set of questions that asked respondents about the remitting behavior of each member of their household, but no survey to date has administered such questions. Given the absence of such information, we will consider two extreme possibilities: all respondents in multi-adult households responded about their remittance behavior based on their individual activity only, and all individuals responded on behalf of their households. Appendix B develops an adjustment to the 2006 Pew survey propensity to remit under the latter assumption. For the Mexican foreign born, the adjusted propensity to remit is 36.5% as compared to an unadjusted 54%, and for the U.S. born of Mexican origin, the adjusted propensity is 10.9% as compared to an unadjusted 20.5%.

### **Transactions Bundling**

It is possible that individuals sending money to Mexico combine their funds into one transaction so as to economize on transactions cost. If bundling is significant, then neglecting to correct for it will lead to an underestimate in a remittance-based population estimate, because more individuals are remitting than is indicated by the number of remittance transactions. One way to determine the degree of bundling present in remittance activity is to compare the average value of a recorded CBM remittance with the average value of a remittance as captured in the Latino surveys. If bundling is significant, then the CBM value should be higher than the survey value. Appendix C considers this issue in depth and develops an estimate of the ratio of these two values and a correction factor that can be used to adjust the frequency of remitting ( $Q$ ) if bundling is present. Evidence from most surveys suggests that there may have been some transactions bundling going on in the remitting population, but evidence from the 2006 Pew survey suggests that no significant transactions bundling was taking place. Given the mixed evidence on this issue, we will consider three scenarios regarding transactions bundling: no significant bundling was present, some bundling was present in the Mexican foreign born remitting population but not the U.S. born Mexican origin population, and some bundling was present in both of these populations.

### Remittance-Based Mexican Foreign Born Population Estimates for 2007

We are now in a position to estimate the Mexican foreign born population resident in the U.S. in 2007 who were 18 years or older based on remittance transactions recorded by the CBM and remittance behavioral parameters based on survey estimates and the issues discussed above. Table 7 below summarizes empirical values for these variables, and table 8 provides population estimates given these values.

**Table 7**  
**Empirical Values for Equation (2) Variables**

Variable	Value				Source
	Low		High		
T	79,882,530 <sup>A</sup>				CBM
P	8,000,224				Table 6
R <sub>P</sub>	10.9%		20.5%		Pew 2006 survey
Q <sub>P</sub>	16.8				Pew 2006 survey
Q <sub>P</sub>	14.6 <sup>B</sup>		16.8		
R <sub>F</sub>	36.5% <sup>C</sup>	43.2% <sup>C</sup>	54%	64%	Pew 2006 and Bendixen 2007 surveys
Q <sub>F</sub>	11.4 <sup>B</sup>		13.1		
Q <sub>F</sub>	13.1				Pew 2006 survey

A : adjusted for informal-transaction undercount.

B : if significant transactions bundling present in this remitting population.

C : lower bound based on assumption that all respondents answer on behalf of their household.

**Table 8**  
**Remittance-Based Estimates of Adult Mexican Foreign Born Population in 2007**

	No bundling present	Bundling among:	
		Mexican foreign born only	Mexican foreign born and U.S. born of Mexican origin
Mexican foreign born propensity to remit = 54%			
Responses as:			
Individuals	7,370,762	8,472,140	9,052,252
Households	13,596,169	15,627,781	16,084,399
Mexican foreign born propensity to remit = 64%			
Responses as:			
Individuals	6,219,080	7,148,368	7,637,838
Households	11,473,561	13,188,001	13,573,332

These estimates can be compared to the equivalent population estimate as developed by the U.S. Census. The Census estimate based on the 2007 American Communities Survey of the Mexican foreign born population 18 years and over is 10,623,376. This should be adjusted to exclude individuals in this group who are living in institutionalized group quarters.<sup>23</sup> We estimate the number of these individuals at 88,044, so that the relevant comparison ACS value is 10,535,332.<sup>24</sup>

A comparison of the estimate values in table 8 with this comparator value shows that in some scenarios, the remittance-based estimate exceeds the ACS population value, and in other scenarios, the remittance-based estimate is less than the ACS value. Table 9 below gives values for the difference between the remittance-based estimate and the ACS value as a percentage of the remittance-based estimate. There is substantial variation in these percentages across scenarios. If the average of all remittance-based estimate values in table 8 is calculated and compared to the ACS value, the former exceeds the latter by 2.3%. Table 9 also presents percentage differences for the average of purely-individual and purely-household response scenarios. If significant transactions bundling is present and the propensity to remit is 54%, then the remittance-based estimate is 13-16% higher than the ACS value. However, if the propensity to remit is 64%, then there is little difference between the remittance-based and ACS values if bundling is present.

Remittance-based estimates are clearly characterized by a high degree of uncertainty, and this uncertainty is driven mainly by the way that questions on remitting behavior have been asked in the surveys. If the surveys were to ask questions that clarify whether respondents are speaking on behalf of themselves or their household, and the degree to which bundling of transactions is taking place, it should be possible to substantially reduce uncertainty in the estimates.

It is nonetheless striking that even given this significant uncertainty, the results of table 9 are not particularly supportive of the hypothesis that there is a high degree of undercount in the Mexican foreign-born in the ACS. A high degree of undercount would require significant bundling, a relatively low propensity to remit, and a tendency for respondents to speak on behalf of their household. If we consider the four shaded cells in table 9, only one out of four suggests that there is a significant undercount. Clearly more information is needed to reduce uncertainty in the estimate, but it is more likely than not that a small degree of undercount will emerge if such information is obtained.

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<sup>23</sup> Institutionalized group quarters comprise prisons and nursing homes. Individuals in both situations are unlikely to engage in remitting activity and are not covered by the Pew and Bendixen surveys.

<sup>24</sup> Details of how this population is estimated are available upon request.

**Table 9**  
**Percentage Difference Between Remittance-Based and ACS Population Values**

	No bundling present	Bundling among:	
		Mexican foreign born only	Mexican foreign born and U.S. born of Mexican origin
Mexican foreign born propensity to remit = 54%			
Responses as:			
Individuals	-43%	-24%	-16%
Households	23%	33%	34%
Mexican foreign born propensity to remit = 64%			
Responses as:			
Individuals	-69%	-47%	-38%
Households	8%	20%	22%
Average of purely-individual and purely-household response values			
Propensity to remit = 54%	-0.5%	12.6%	16.2%
Propensity to remit = 64%	-19.1%	-3.6%	0.7%

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## Appendix A: Structural Breaks in Remittance Transactions Growth

Table 1 and Figure 1 reveal that remittance transactions grew unusually rapidly in 2001 and 2003. The rapid growth in 2001 is due to an unusual transient decrease in recorded transactions in 2000 that is apparent in Figure 1 and which disappeared in 2001<sup>25</sup>. In contrast, the rapid growth in 2003 was not transient. Figure A1 below shows that remittance transactions grew unusually rapidly in the first quarter of 2003, soon after the CBM changed its remittance data collection methodology. As a result of this growth and the much lower but still strong growth rates that prevailed through the first quarter of 2006, CBM remittance transactions grew by 167% during 2001-2006.

This rapid growth is not consistent with change in underlying fundamental factors that presumably determine the level of remittances. Table A1 below develops an estimate of implied remittance transactions based on the estimated Mexican foreign-born population resident in the U.S. and estimates of the propensity to remit and average number of transaction per year that are derived from surveys and are discussed in depth in the main body of the paper. These estimates are crude and should not be taken as an alternative to the CBM measure; they are developed only to permit comparison of growth in CBM transactions versus a fundamentals-based proxy. Comparison of these growth rates shows that CBM transactions growth far exceeded growth in the fundamentals-based proxy during 2001-2004, by a factor of 2 to 5. However, during 2004-2006, the growth rates were equal to each other.

Taken together, the evidence suggests that a structural break in remittance transactions growth began in late 2002 or early 2003 that was due to the changes in data collection methodology that the CBM implemented in 2002. These changes may have also impacted growth in 2004 and 2005, but their impacts had largely or completely dissipated by early 2006. Because the structural break was positive, changes in data collection methodology caused coverage of remittance transactions to increase such that flows that previously would not have been measured began to be reported by payment intermediaries.

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<sup>25</sup> This temporary negative shock resulted in negative growth in transactions in 2000. Negative growth in 2000 and positive growth in 2001 resulted in an average annual transactions growth rate during 1999-2001 of 15%, which is much closer to the growth rate norm of the 1990s. Also, as Figure 1 shows, the transient decrease in transactions in 2000 was accompanied by a transient increase in the average remittance value in the same year. Considered together, this evidence suggests that the high growth rate in 2001 was due to a transient negative shock impacting recorded transactions in 2000. The 2000 shock was possibly related to methodology in data collection and/or processing, but no explanation or discussion of the shock is available publicly.

Figure A1  
Growth Rate of Quarterly Seasonally-Adjusted CBM Total Remittance Transactions

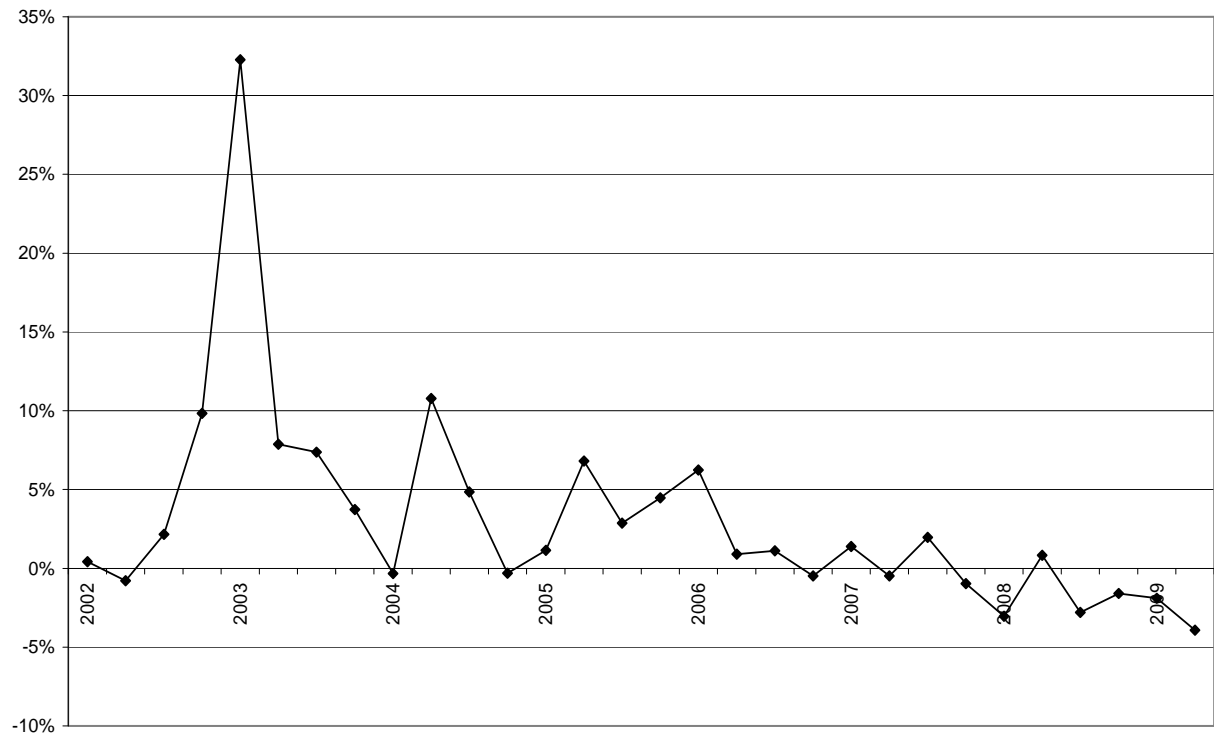


Table A1

	Mexican foreign-born population (1000s)	Propensity to remit				Frequency: average remittance transactions per year				Implied remittance transactions (1000s)		CBM remittance transactions (1000s)
		Mexican foreign born only		All Latino foreign born		Mexican foreign born only		All Latino foreign born		Bend.	Pew	
		Pew	Bend.	Pew	Bend.	Pew	Bend.	Pew	Bend.			
2001	9,234		65%		59%				9.8	58,925		27,744
2002	9,856	47%		49%							63,180	29,954
2003	10,011	39%		40%		13.6	23.3	13.8				47,651
2004	10,268				61%				13.0	81,125		57,011
2005	10,970											64,923
2006	11,541	54%	76%	54%	73%	13.1		13.6	12.0	105,438	82,594	74,184
Growth during:												
2001-06	25%									79%		167%
2002-06	17%										31%	148%
2001-04	11%									38%		105%
2004-06	12%									30%		30%

Sources: Mexican foreign-born population is estimate based on the American Community Survey. Propensities to remit and average remittances per year obtained from Pew and Bendixen surveys and are described in main text.



## **Appendix B: Individual-Based versus Household-Based Responses**

The propensity to remit will be biased upwards to the extent that individuals in a multi-adult household answer remittance questions on behalf of their households as opposed to describing their individual behavior. No information is available to determine on what basis a survey respondent is replying to these questions. We therefore consider two extreme cases: all survey respondents in multi-adult households answer as individuals, and all answer on behalf of their household. In the former case, there is no need to adjust the propensity to remit as given in Table 3. In the latter case, it is necessary to adjust downwards the number of individuals responding “yes” to whether they remitted to reflect the assumption that they are speaking on behalf of their household.

The Pew 2002 and 2004(03) National Latino surveys asked respondents about the number of adults 18 years or older in their household, although the 2006 Pew survey did not. The distribution of Mexican foreign-born and U.S.-born of Mexican origin respondents across households according to number of adult members is given in table B1 below. The 2002 and 2004(03) distributions are very close for both groups, indicating that a similar distribution can be expected to pertain in 2006. The 2004(03) distribution is applied to the number of Pew 2006 survey respondents who answered “yes” to the question on whether or not they had remitted in the past year to obtain an estimated number of respondents by household size.

To develop the adjustment for the case in which every respondent answers on behalf of their household, we must make an assumption on the number of adults in a household of a given size that make remittance transfers. We assume that only one member in a household makes remittance transfers, which ensures that the adjusted propensity to remit is a true lower bound case. We thus divide the number of “yes” respondents in households with  $n$  adult members by  $n$  to obtain the actual number of remitters under the assumption of only one remitter per household. Adjusted “yes” respondent numbers are summed across household size groups to get an adjusted total number of “yes” responses, and an adjusted propensity to remit is then calculated. For the Mexican foreign born, the adjusted propensity to remit is 36.5% as compared to 54%, and for the U.S. born of Mexican origin, the adjusted propensity is 10.9% as compared to 20.5%. Finally, the Bendixen 2007 propensity to remit value of 64% is adjusted downward to reflect the household-based response scenario by multiplying 64% by the ratio (36.5/54), producing a value of 43.2%.

**Table B1**  
**Adjustment to Propensity to Remit if All Respondents Answer on Behalf of Household**

	Number of Adults in Household								
	1	2	3	4	5	6	7	8	Total
<b>Mexican Foreign Born</b>									
2002 Pew survey	38	349	117	72	20	14	3	1	614
(% distribution)	6%	57%	19%	12%	3%	2%	0%	0%	
2004(03) Pew survey	40	286	88	54	15	5	2	1	491
(% distribution)	8%	58%	18%	11%	3%	1%	0%	0%	
2006 Pew survey respondents answering "yes" to whether they sent money home in past year:									271
Distribution across household size using 2004(03) weights	22	158	49	30	8	3	1	1	
Number of "yes" respondents divided by household size	22	79	16	7	2	0	0	0	127
2006 Pew survey respondents answering "no" to whether they sent money home in past year:									221
Adjusted propensity to remit:									36.5%
<b>U.S. Born of Mexican Origin</b>									
2002 Pew survey	35	212	83	49	7	2	1	1	390
(% distribution)	9%	54%	21%	13%	2%	1%	0%	0%	
2004(03) Pew survey	42	219	86	39	13	3	0	0	402
(% distribution)	10%	54%	21%	10%	3%	1%	0%	0%	
2006 Pew survey respondents answering "yes" to whether they sent money home in past year:									39
Distribution across household size using 2004(03) weights	4	21	8	4	1	0	0	0	
Number of "yes" respondents divided by household size	4	11	3	1	0	0	0	0	19
2006 Pew survey respondents answering "no" to whether they sent money home in past year:									153
Adjusted propensity to remit:									10.9%

## Appendix C : Remittance Transactions Bundling

Two or more remittance senders might combine their individual remittances into a single bundled transaction in order to minimize the cost of sending the remittance to Mexico. Remittance bundling does not lead to an undercount of remittance transactions, but it does break the one-to-one link between remittance senders and remittance transactions in the case of those who bundle. There are *a priori* reasons to expect that the degree of bundling among those sending remittance from the U.S. to Mexico is low. First, organizing bundling activity requires time and seemingly requires a high level of trust among those sending the remittance and those receiving it, because the actual transaction will be in one name only.<sup>26</sup> Second, the cost of sending remittances to Mexico has fallen substantially since the late 1990s, so that the transactions cost savings incentive to bundle is not very strong. Nonetheless, an attempt to control for bundling must be made if possible.

No direct evidence on the degree of bundling by U.S.-Mexico remittance senders is available, as surveys have not asked questions about this practice. However, it is possible to infer the degree to which bundling is present in the remitting population by comparing the average remittance value as reported by the CBM and as reported to surveys. Define the following variables as:

$N$  : number of remitters who do not bundle;

$B$  : number of remitters who bundle;

$P$  : total number of remitters ( $P = N+B$ );

$b$  : percentage of remitter population that bundles ( $bP = B$ );

$Q_{NB}$  : average frequency with which non-bundlers remit (transactions per year);

$cQ_{NB}$  : average frequency with which bundlers remit, where  $c$  is a parameter;

$R_{NB}$  : average value of a remittance sent by a non-bundler;

$aR_{NB}$  : average value of a remittance sent by a bundler, where  $a$  is a parameter;

$n$  : average number of individual remittances included in a bundle.

Then the total value of remittance transactions recorded by the CBM is:

$$(C1) \quad V = Q_{NB}NR_{NB} + cQ_{NB}BaR_{NB},$$

the total number of remittance transactions recorded by the CBM is:

$$(C2) \quad T = Q_{NB}N + cQ_{NB}\left(\frac{B}{n}\right),$$

and the average remittance value as recorded by the CBM,  $R_{CBM}$ , is:

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<sup>26</sup> Clustering of immigrants from the same hometown in Mexico in U.S. cities might facilitate the organization and ease of bundling.

$$(C3) \quad R_{CBM} = \frac{V}{T} = \frac{Q_{NB}NR_{NB} + cQ_{NB}BaR_{NB}}{Q_{NB}N + cQ_{NB}\left(\frac{B}{n}\right)},$$

which after substitution and algebraic manipulation becomes:

$$(C4) \quad R_{CBM} = \frac{(1-b)R_{NB} + cbaR_{NB}}{(1-b) + \left(\frac{c}{n}\right)b}.$$

The average remittance value that is reported to surveys equals a weighted average of average remittance values sent by non-bundlers and bundlers:

$$(C5) \quad R_s = (1-b)R_{NB} + baR_{NB}.$$

In order to simplify algebraic expressions, we now assume that c equals 1, so that non-bundlers and bundlers remit at the same frequency. In this case, the ratio  $R_{CBM}/R_s$  is:

$$(C6) \quad K = \frac{R_{CBM}}{R_s} = \frac{(1-b)R_{NB} + baR_{NB}}{(1-b) + \left(\frac{1}{n}\right)b} * \frac{1}{(1-b)R_{NB} + baR_{NB}},$$

which can be simplified to:

$$(C7) \quad K = \frac{1}{1 + \left(\frac{1}{n} - 1\right)b},$$

so that:

$$(C8) \quad b = \frac{\left(\frac{1-K}{K}\right)}{\left(\frac{1}{n} - 1\right)}.$$

If values for K and n can be established, then a value for b can be determined. Manipulation of equation (C2) produces an expression that permits correcting an estimate of the remitting population P for bundling:

$$(C9) \quad T = Q_{NB}N + cQ_{NB}\left(\frac{B}{n}\right) = Q_{NB}(1-b)P + cQ_{NB}\left(\frac{bP}{n}\right),$$

so that

$$(C10) \quad P = \frac{T}{\left[ (1-b) + c \left( \frac{b}{n} \right) \right] Q_{NB}},$$

which, if  $c$  is assumed equal to 1, becomes:

$$(C11) \quad P = \frac{T}{\left[ (1-b) + \left( \frac{b}{n} \right) \right] Q},$$

where  $Q$  is the remitting frequency that is equal for non-bundlers and bundlers. The term  $[(1-b)+(b/n)]$  that multiplies  $Q$  in equation (C11) is a bundling-associated correction factor.

### **Evidence on Empirical Values For the Ratio $R_{CBM}/R_S$**

We first consider determining a value for  $R_S$ . Table C1 below summarizes data on the average remittance value across all Latinos questioned by the survey, and across Mexican foreign born only. All of the surveys posed a question similar to “On average, how much money do you send (to ancestral country)?” The 2004(03) and 2004 Mexican Migrant Pew surveys let respondents choose among a range of amount bin values (eg “less than \$100”, “\$100-199”, etc), and the Bendixen surveys apparently also used bin values as response categories. A very important exception to this is the 2006 Pew survey, which asked respondents to give a specific number that they chose themselves as an average amount. In table C1, responses for this survey were summed into bins corresponding to those used by the other surveys to enable comparison. A key result apparent in table C1 is that the weight of responses in the highest-value bin ( $> \$500$ ) is significantly higher for the 2006 Pew survey than for the other Pew surveys.

In order to estimate an average remittance value for the Pew surveys, average remittance values for each value bin must be assumed. The mid-point of the value range for each bin is assumed except for the category “ $> \$500$ ”, which is an open-ended tail: a value of \$600 is set for this bin (see memo line in table C1). Weighted averages were then constructed. It is not known how average remittance values were constructed for the Bendixen surveys (values in table C1 were taken from presentations that did not explain methodology used), but it is likely that a similar approach was taken in these cases. For Mexican foreign born, the average remittance value is between \$236-295 except for the 2006 Pew survey value of \$348. This result is not surprising given that the 2006 Pew survey has a higher percentage reporting average remittance value greater than \$500.

The \$348 average value for the 2006 Pew survey is constructed by arbitrarily setting average values for the value bins, and in particular setting the value for the “ $> \$500$ ” bin at \$600. However, because the 2006 survey data is publicly available, it is possible to calculate the actual average value for each bin for that particular survey, which are given in the memo section of table C1 for relevant population groups. Average remittance

values constructed using these actual 2006 bin average values are given in the last column of table C1, which shows that average remittance estimates increase, particularly in the case of estimates for the 2006 Pew survey.<sup>27</sup>

Inspection of reported average remittance values for the 2006 Pew survey shows that 17% of Mexican foreign born respondents reported an average remittance value of \$1,000 or more, 3% reported a value \$5,000 or greater, and one person reported a maximal value of \$8,000. Very high values of reported average remittances raises the question of whether these answers suffer from reporting error on the part of the respondent. It is possible to check the plausibility of a reported average remittance value by determining the frequency of remitting that a person reported and estimating an implied annual amount of remittances sent to Mexico, and then comparing that amount with the person's reported household income.<sup>28</sup> Observations for which implied annual remittances seem implausibly high given household income can then be scrubbed from the sample. We scrub observations using the criterion that reported income minus implied annual remittances is less than \$5,000. All observations for which implied annual remittances was \$5,000 or greater were checked this way, and 18 of 223 observations were scrubbed from the sample under this approach and criterion.<sup>29</sup> Table C2 reports average remittance values for relevant Mexican-origin populations after scrubbing observations.<sup>30</sup> These values are significantly less than corresponding values in table C1.

Table 1 in the main text shows that the value of  $R_{CBM}$  in 2007 was \$344. We must thus determine a value for the ratio  $R_{CBM}/R_S$ . Estimates for 2004 Pew surveys using assumed bin values suggest that the average remittance value for Mexican foreign born was less than \$300. The 2008 Bendixen survey suggests that it was roughly \$300 in that year. The estimate for the 2006 Pew survey using assumed bin values and not scrubbing for implausible observations is \$348 for the Mexican origin population (foreign born and U.S. born). The estimate for the 2006 Pew survey using actual values and scrubbing for implausible observations is \$401 for the Mexican origin population. Taken together, the evidence suggests that plausible lower and upper bounds for the relevant average remittance value in 2007 is \$300 and \$400 respectively. In the case of the lower bound, the ratio  $R_{CBM}/R_S$  equals  $\$344/\$300$ , or 1.147. In the case of the upper bound, there is no evidence of bundling, and no need to correct for bundling in the population estimate.

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<sup>27</sup> This is not surprising, given that the 2006 Pew survey has a much higher weight of observations for the "> \$500" bin.

<sup>28</sup> Household income is reported in \$5,000 bins up to \$50,000, and in wider bins above \$50,000.

<sup>29</sup> Details are available from the authors.

<sup>30</sup> These values were constructed taking into account the frequency that each respondent reported making remittances.

**Table C1**  
**Average Remittance Values from Survey**

	Value Bins						Estimated average remittance value using:	
	< \$100	\$101-200	\$201-300	\$301-400	\$401-500	> \$501	Assumed bin values	Pew 2006 actuals
<b>All Latino groups</b>								
<i>Pew Surveys</i>								
2004(03) survey	14%	41%	20%	7%	8%	10%	\$238 <sup>A</sup>	\$272 <sup>B</sup>
2006 survey	9%	30%	19%	11%	5%	27%	\$316 <sup>A</sup>	\$464 <sup>B</sup>
<i>Bendixen Surveys</i>								
2001 survey	30%	28%	15%	17%			\$200	
2004 survey							\$240	
2006 survey							\$300	
2008 survey	30%	35%	15%	7%	5%	8%	\$325	
<b>Mexican foreign born</b>								
<i>Pew Surveys</i>								
2004(03) survey	10%	41%	22%	7%	9%	11%	\$253 <sup>A</sup>	\$314 <sup>B</sup>
2004 Mex.Migr. survey	18%	35%	20%	10%	6%	10%	\$236 <sup>A</sup>	\$292 <sup>B</sup>
2006 survey	6%	27%	18%	12%	3%	34%	\$348 <sup>A</sup>	\$611 <sup>B</sup>
<i>Bendixen Surveys</i>								
2001 survey <sup>C</sup>	29%	45%		14%			NA	
2008 survey							\$295	
<b>All Mexican origin</b>								
2006 Pew survey	6%	27%	19%	12%	3%	33%	\$342 <sup>A</sup>	\$617 <sup>B</sup>
Memo:								
Assumed bin average value	\$50	\$150	\$250	\$350	\$450	\$600		
2006 Pew survey actuals:								
Mexican foreign born	\$54	\$112	\$207	\$302	\$400	\$1,438		
All Mexican origin	\$46	\$111	\$206	\$302	\$400	\$1,517		
All Latino groups	\$53	\$113	\$205	\$303	\$400	\$1,256		

A : calculated using assumed bin average value assumptions;

B : calculated using Pew 2006 survey actual bin average values;

C : for Central American group.

**Table C2**  
**Pew 2006 Survey Average Remittance Values After Scrubbing Observations**

All Mexican origin	\$401
Mexican foreign born	\$390
U.S. born of Mexican origin	\$467

### Bundling Correction Factor

Using equation (C8) and a value of the ratio  $K$  of 1.147, the value of  $b$ , the percentage of the remitting population that bundles transactions, and the correction factor in equation (C11) associated with different values for  $n$  (average number of transactions per bundle) can be calculated. Table C3 gives these values for  $n = 2$  to 4. For a fixed ratio  $K$ , the correction factor  $(1-b)+(b/n)$  does not vary with  $n$ . We will thus set the correction factor equal to 0.87 when correcting for the possibility of bundling in the remitting population.

**Table C3**  
**Estimates of  $b$  and the Bundling Correction Factor**

	<b>n</b>			
	<b>2</b>	<b>2.5</b>	<b>3</b>	<b>4</b>
$b$	26%	21%	19%	17%
$(1-b)+(b/n)$	0.87	0.87	0.87	0.87

A final consideration is whether the degree of bundling differs systematically across the Mexican foreign born and U.S. born of Mexican origin populations. We have no data that would permit evaluating this question. We will thus take the approach in the paper of presenting two scenarios: one in which only the Mexican foreign born population engages in bundling, and one in which both populations engage in bundling. A correction factor of 0.87 will be applied in both scenarios.