Banking Efficiency and Remittances: The Mexican Case

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Abstract

This study examines the efficiency of the Mexican banking industry from 2000 to 2009. Using Data Envelopment Analysis and the production approach (where the number of loans and deposit accounts are considered outputs) I estimate efficiency scores for every state in Mexico. Results show that efficiency scores are on average 0.83 for the whole sample, with a minimum average efficiency score of 0.49. Central states, Mexico, Hidalgo and Michoacán specifically, are on average more efficient than some northeastern and southwestern states. There is high variation in efficiency scores implying high heterogeneity in financial access across Mexico. Furthermore, by identifying two subsamples, high remittance-recipient states and low remittance-recipient states, I find statistically significant differences between efficiency scores. High remittance-recipient states are statistically more efficient than low remittance-recipient states for every year in the sample.

JEL classification: F34, G2

Keywords: Banking efficiency, remittances, DEA, financial development

1. Introduction

This study investigates the efficiency on Mexico's banking sector by utilizing commonly used indicators of banking sector outreach (Beck et al., 2007). This analysis will address, among other factors, the breadth of outreach of the Mexican banking sector by estimating efficiency measures for each state in Mexico. Also, the effect of remittances on banking efficiency is investigated by identifying states as high remittance-recipients and low remittance-recipients and comparing their efficiency levels.

Low-income regions experience high levels of migration and a high percentage of the population residing in those regions receive remittances from family members working in the U.S. Lately, there has been an increasing interest not only by the U.S. and Mexican governments but also by Mexican and U.S. financial institutions to bank remittances. This has helped bring more clients to use services by formal financial institutions (i.e. commercial banks) to open accounts and to use ATMs and debit cards.

Developed and developing countries need efficient institutions to promote and support economic growth. Starting with King and Levine (1993), research on the link between finance and economic growth reveals that countries with "better" financial systems tend to grow faster. The existence of financial institutions per se is not enough, the quality and efficiency of these institutions are crucial for the transmission of funds in the economy. The study of banking efficiency is fundamental to improve and understand a nation's financial institutions. Banks, as any other firm, face numerous sources of competition from both other banks and other firms inside and outside their industry. Presumably, the more efficient units, not only in this industry but in general, are the ones that survive (Wheelock and Wilson, 1995). An open and flexible

banking environment not only provides more credit, but also better allocation of credit, leading to the funding of more positive net present value projects that contribute to economic growth.

Studies on banking efficiency are relevant in constantly changing economies. Countries that undergo significant transformations in their financial institutions will face different challenges from one year to another, and only efficient institutions will be able to face them successfully. Mexico's banking sector, as in many other developing countries, experienced periods of expropriation by the Federal government, privatization of banks without foreign intervention, and liberalization of foreign participation in bank ownership. These changes surely impacted its development and its performance.

However, literature on Mexican banking efficiency is very limited. Taylor, Thompson, Trall and Dharmapala (1997) first utilized Mexican data to study banking efficiency in the country. Using the non-parametric methodology Data Envelopment Analysis (DEA), they estimate a production frontier for each year between 1989 and1991 to classify banks according to their efficiency levels. Guerrero and Negrin (2005) investigate the Mexican banking system estimating static and dynamic parametric models of banking efficiency. Monthly data on commercial banks from 1997 to 2004 is employed for the estimation of cost and profit functions using Stochastic Frontier Analysis (SFA). Using confidential data obtained from a census performed by Banco de Ahorro Nacional y Servicios Financieros (BANSEFI), Paxton (2006, 2007) examines the efficiency of Popular Savings and Credit Institutions (PSCI) in Mexico. Using DEA, she finds that even the most efficient institutions were far from the efficient frontier (Paxton, 2006). Finally, Solis and Maudos (2008) analyze the relationship between cost efficiency and market power in the Mexican banking system from 1993 to 2005. They find that

market power has a negative effect on cost efficiency and no significant effect on profit efficiency.

Research studies of workers' remittances in developing countries uncovered important implications for the economies of remittance-recipient countries. Some of these implications are: economic growth and development (Mundaca, 2008; Giuliano and Ruiz-Arranz, 2009), school retention (Hanson and Woodruff, 2003), reduction in poverty levels (Adams and Page, 2005; Taylor et al., 2005), and impact on microenterprises (Woodruff and Zenteno, 2007; Woodruff, 2007). However, there is one important implication usually ignored by remittance studies, the link between remittances and the banking sector. Only two recent studies (Aggarwal et al., 2010; Demirgüç-Kunt, 2010) address the causal relationship between remittances and banking sector development.

The contribution of this study is threefold. First, it adds to the extant literature on banking efficiency in developing nations; second, empirically studies the relationship between banking efficiency and remittances; and third, provides empirical evidence on the evolution of regional banking efficiency in Mexico. Empirical evidence on banking efficiency in Mexico is obtained by using the number of employees, number of branches, and number of accounts by state. Results show that the average efficiency score for the whole sample is 0.83. The minimum efficiency score is 0.25 for the year 2001 and the maximum average efficiency score of 0.89 occurs during the years of 2004 and 2005. To analyze the relationship between remittances and banking efficiency states are identified as high remittance-recipients or low remittance-recipients. Results show that there are statistically significant differences between these two groups for every year. Nevertheless, these changes are recent and the effect of remittances on banking efficiency will probably be stronger in the future.

The remainder of the paper is organized as follows. Section 2 describes the Mexican the banking sector and its relationship with remittances. Section 3 describes the DEA methodology. Section 4 describes the data and the process of dividing states as high remittance-recipients and low remittance-recipients. Section 5 presents the results and section 6 concludes.

2. The Mexican banking sector

During the beginning of the liberalization period and NAFTA (1989 to 1993), Mexico's economy was booming. However, the financial liberalization and lack of monitoring of banks led to reckless lending behavior and excessive risk taking. By December 1993, 16 percent of loan portfolios of Mexico's banks were non-performing. Thus, the Mexican banking sector was heading straight to collapse even before the devaluation of the peso in December 1994. The precarious situation of the banking sector together with the unstable political environment[1] and high levels of capital leaving the country contributed to a dramatic fall in foreign reserves. Mexico's "crawling peg" exchange rate was at risk without sufficient foreign reserves to maintain the exchange rate level. Finally, the peso was devalued in December 1994. The banking sector endured the collapse of the peso but by February 1995, banks in Mexico were practically bankrupt (Torre, 2006).

Mexican Bailout and Foreign entry

The debacle of the Mexican peso created two problems for the banking sector. First, it increased the percentage of non-performing loans and second, gave foreign investors strong incentives to take their funds out of the country. This reaction by investors forced the Mexican government to increase interest rates. By March 1995, the inter-bank loan reached 114 percent

[1] In 1994, a revolutionary group appeared in Chiapas and one of the strongest presidential candidates was murdered.

and mortgage rates jumped to 74 percent (Haber, 2005). This situation pushed performing loans into default and as a consequence, the stock of non-performing loans mounted.

Saving the Mexican banking sector required an array of support programs for financial institutions and their borrowers. The National Commission of Banking and Securities of Mexico (Comisión Nacional Bancaria y de Valores, CNBV) implemented a series of reforms to improve monitoring and recapitalize banks. Among others, the CNBV implemented the following: first, banks are required to published consolidated financial statements, making insider lending more difficult to carry out; second, banks are required to diversify risk, as of June 1998, bank loans to any individual cannot exceed 10 percent of a bank's net capital; and third, as of January 1997, banks are required to adopt new accounting standards, which more closely approximate generally accepted standards.

With the initiation of NAFTA in 1994, restrictions on foreign bank ownership were gradually released. However, in 1995, the government removed some restrictions on foreign bank acquisitions of Mexican banks beyond the schedules originally negotiated under NAFTA. In March of 1995, the Mexican Congress passed legislation allowing foreign banks a major stake in Mexican banks. However, foreign interest in the three largest banks was limited to 30 percent. With the removal of some restrictions, from 1994 to 1996 a total of seventeen foreign banks, mainly from the U.S., entered the Mexican market. In December 1996, seven percent of total bank assets were controlled by foreign banks.

In 1998, all remaining restrictions on foreign ownership of Mexican banks were removed by the government. These changes in the banking sector modified the nature of the financial sector as foreign ownership increased from 1997-1998 with foreign acquisitions of the largest commercial banks. Table 1 provides a list of foreign acquisitions that occurred between 1995 and

2005. Between 1995 and 2004, foreign banks invested more than $30 billion in the Mexican banking sector.

[Insert Table 1 here]

By the end of 2004, large institutional banks such as BBVA (Spain), Banco Santander (Spain), Citibank (U.S.), HSBC (UK) and Scotiabank (Canada) had acquired most of the largest domestic banks in Mexico. As a result, the share of assets held by foreign banks increased from 20 percent in 1999 to 82 percent in 2004. Another interesting implication from the liberalization of the banking sector is its high concentration. In 2009, 77% of total assets were concentrated in only five banks and four of these are under foreign control, Banamex, BBVA Bancomer, Santander, and HSBC. At this time, Banorte is the only "big" bank still controlled by domestic investors.

Financial access and remittances

Foreign bank entry in Mexico helped to improve bank health, but according to Beck and Martinez Peria (2010) it also caused a decline in outreach of banking services. Their results show a consistent decline in the number of deposit and loan accounts following foreign acquisitions of domestic banks. Furthermore, this decline is stronger in rural and poorer regions of Mexico. The research on the impact of foreign bank participation on competition and efficiency concludes that foreign entry can bring potential gains in this area except in banking sectors with high concentration or with barriers to bank entry and exit, two existing characteristics of the Mexican banking sector.

Financial access in Mexico is still developing and improving as indicated by some outreach indicators (i.e. number of branches and number of ATMs). According to recent

statistics from the "Access to Finance" project by the International Monetary Fund[2], the number of commercial bank branches per 100,000 adults in 2004 was 11.1 compared to 14.7 in 2009. Mexico ranks higher than Brazil, Chile and Argentina but lower than India, Philippines, Guatemala, and the U.S. in the number of bank branches per 1,000 km^2. However, deposits as a percentage of GDP changed very little from 19.1% in 2004 to 20.9% in 2009. Figure 1, shows the amount of private credit as a percentage of GDP granted by financial institutions across comparable countries in 2008. Argentina is ranked last granting only 14% of private credit as a percentage of GDP, Mexico is ranked one place before last granting 22% of private credit. Spain on the other side of Figure 1 is ranked first with a percentage of 201% of private credit as a percentage of GDP.

Mexico is a very interesting case to study the link between banking services and remittances because is consistently ranked among the top recipients of remittances worldwide. In 2008, the amount of Mexican remittances reached $26.3 billion. This amount is the second largest source of external finance just below oil exports and considerable higher than FDI flows. Remittances also flow with a dramatically higher persistence to rural or semi-urban communities in Mexico. Also, remittance flows are geographically concentrated within the Mexican territory. Over 40% of households receiving remittances are located in only five states of a total of thirty one states in Mexico. According to the 2008 ENIGH (Encuesta Nacional de Ingresos y Gastos de los Hogares), a household survey representative at the national level that asks about receipt of remittances by household, in those high remittance-recipient states 12.4% of all households receive remittances.

[2] http://fas.imf.org

In recent years, remittance transmission channels have changed dramatically in Mexico. Figure 2 shows the amount of Mexican remittances sent through different instruments from 2000 to 2009. The most dramatic change is the higher number of electronic transmissions compared to the number of money orders, particularly in the last five years. Orozco (2004) reports that 55% of remittances received in Mexico are channeled through the banking system. Technological changes have increased not only the speed of transactions but also the role banks play in the remittance sender game. Finally, while the cost of sending money through informal channels has decreased considerably in the last five years, the World Bank reports that fees remain close to 6 percent of transfers.[3] This percentage is still an incentive for Mexican banks to increase their efforts to attract those that do not have access to financial services and systematically receive remittances from relatives living in the U.S.

3. Methodology

The estimation of a technological or economic efficiency level allows the relative comparison among economic units sharing the same characteristics. These efficiency levels are calculated comparing the estimated efficiency for each institution or firm with the best practice frontier from the sample. Banking efficiency studies are clearly divided between parametric and non- parametric estimation methods to measure the "best practice frontier".

Berger and Humphrey (1997) report an almost equal split between studies using non-parametric estimation and parametric estimation of banking efficiency. Earlier studies focused on Mexican banking efficiency relied on non-parametric techniques (Taylor et al., 1997; Paxton,

[3] Payment Systems Group of the World Bank http://www.remittances.prices.org

2006) while more recent studies on Mexican financial institutions utilize parametric estimation (Paxton, 2007; Solis and Maudos, 2008).

Parametric and non-parametric methods differ in the way in which the frontier is obtained. The efficiency frontier using non-parametric techniques, such as Data Envelopment Analysis (DEA) or Free Disposable Hull Analysis, is calculated using linear programming methods. Parametric techniques include Stochastic Frontier Analysis (SFA), the Distribution Free Approach (DFA), and Thick Frontier Analysis (TFA). These techniques introduce a random error into the estimation of the efficient frontier and specify a functional form for the cost, profit or production relationship among inputs, outputs and environmental factors.

Berger and Mester (1997) reveal that studies of U.S. banks using non-parametric techniques report lower efficiency levels and more variation between them. This could reflect some random or measurement error not accounted for in the sample. However, there are several advantages of using DEA or other non-parametric techniques over stochastic estimation. These techniques do not require a functional form specification for the frontier estimation. Also, the non-stochastic nature of the estimation does not require assumptions on probabilistic distributions of the efficiency or measurement errors. Therefore, any deviations from the efficient frontier are considered technical inefficiencies.

To measure the efficiency of Mexican banks from 2000 to 2009 I employ Data Envelopment Analysis (DEA), which was developed by Charnes et al. (1978). DEA is typically used to measure technical efficiency (the ability to produce maximum output from a given set of inputs) of a set of peer Decision Making Units (DMUs) by evaluating their performance. These DMUs can be of various forms to evaluate the performance of entities, such as hospitals, banks,

firms, schools, and others, including the performance of countries, cities, regions, states, etc. In their original study, Charnes et al. (1978) described DEA as a mathematical linear programming method that can be applied to real observational data providing new estimates of relations that are cornerstones of modern economics. Examples of these basic economic relationships are production possibility frontiers or production functions. Formally, DEA's objective is to estimate a frontier rather than central tendencies. Instead of trying to fit a regression line through the center of data points, one estimates a linear surface to "float" on top of the observations. Because of this approach, DEA is successful at unveiling relationships that are frequently ignored by other methodologies.

In the Constant Returns Scale Model (CRS), it is assumed that there is data on *K* inputs (*x*) and *M* outputs (*y*) for each of *N* states. For the *i*th state these are represented by the vectors x_i and y_i, respectively. The model can be expressed as

$$\max h_i(u,v) = \frac{\sum_j u_j y_{ji}}{\sum_s v_s x_{si}} \qquad (1)$$

where u is an M×1 vector of output weights and v is a K×1 vector of input weights, and the *y*'s and *x*'s are the observed output and input values, respectively, of state *i*. To select optimal weights we specify the following mathematical programming problem:

$$\max h_i(u,v) = \frac{\sum_j u_j y_{ji}}{\sum_s v_s x_{si}}$$

s.t.

$$\frac{\sum_j u_j y_{ji}}{\sum_s v_s x_{si}} \leq 1 \text{ for } i = 1, 2, \ldots N,$$

$$u_j \geq 0 \text{ for j} = 1,2, \ldots \text{M}$$

$$v_s \geq 0 \text{ for s} = 1,2, \ldots \text{K} \qquad (2)$$

The efficiency score is bounded by one and weights must be positive and are determined so that the efficiency ratio of the individual DMU is maximized. However, the above ratio yields an infinite number of solutions; if (u^*, v^*) is optimal, then (αu^*, αv^*) is also optimal for $\alpha > 0$. Therefore, the additional constraint of $\sum \rho_s x_{si}=1$ is added to transform the equations into an ordinary linear programming model, which leads to:

$$\max z = \sum \mu_j y_{ji}$$
s.t.
$$\sum_j \mu_j y_{ji} - \sum_s \rho_s x_{si} \leq 0$$
$$\sum \rho_s x_{si} = 1$$
$$\mu_j, \rho_s \geq 0 \qquad (3)$$

where we change notation from u and v to μ and ρ, respectively, to represent transformation. The dual problem can be expressed with a real variable θ denoting the ith DMU's efficiency score and λ is a N×1 vector of constraints. The efficiency scores will range from 0 to 1 with a value of 1 indicating that the DMU_i is located on the frontier:

$$\min \theta,$$
s.t.
$$-y_{ji} + Y\lambda \geq 0,$$
$$\theta x_{si} - X\lambda \geq 0,$$
$$\lambda \geq 0. \qquad (4)$$

The previous specification is called input–oriented model whose objective is to minimize inputs while producing at least the given output levels. However, the objective of this study is to analyze the outreach of banking activity in Mexico by estimating efficiency levels by state. The output-oriented model is perfectly suited for this task. The objective of the output-oriented model

is to maximize outputs (e.g. number of credit accounts) while using no more than the observed amount of any input. Similar to (4), the output-oriented model can be formulated as:

$$\begin{aligned} &\max \eta, \\ &\text{s.t.} \\ &\quad x_{si} - X\mu \geq 0, \\ &\quad \eta y_{ji} - Y\mu \leq 0, \\ &\quad \mu \geq 0. \end{aligned} \tag{5}$$

The CRS model is only appropriate for measuring technical efficiency among firms that are operating at their optimal scale. This assumption is empirically unrealistic in Mexico's monopolistic environment. Therefore, the Variable Returns to Scale Model (VRS) is used to analyze efficiency measures. The VRS model adds a convexity constraint $\sum \mu = 1$ to (5).

4. Data

The sample is a balanced panel of annual operational data on all active commercial banks by state from 2000 to 2009. The data source is the National Banking and Securities Commission (known by its Spanish acronym CNBV). CNBV gathers quarterly financial statements and information on the number of branches, employees, number of accounts and loan portfolios of Mexican banks since the reform period after the financial crisis of 1995. Banks are required to submit their financial information to the CNBV to make their information available to the public. Operational activity by location and by bank on a quarterly basis is published in the CNBV's Statistical Bulletin of Commercial Banking every three months. These reports are publicly available from the CNBV's website.[4]

[4] www.cnbv.gob.mx

Table 2 shows the number of banks in Mexico from 2000 to 2009. The number of banks decreased from 35 in 2000 to 29 in 2005. In the last three years, a number of retail chains (i.e. Walmart) received approval to operate banks in Mexico. Their objective is to provide banking services to Mexico's low-income individuals (Hernández-Murillo, 2007).This change increased the number of active banks to 41 by December of 2009. Globalization and foreign bank participation also affected the structure of the banking industry in Mexico. The number of foreign banks increased dramatically during the 2000-2005 period.

[Insert Table 2 here]

There are two different approaches to estimate efficient frontiers, the intermediation and the production approach. The first approach defines a bank as an intermediary between savers and borrowers. The second approach looks at a bank as a producer of savings and loan accounts. This state-level analysis utilizes the production approach. This approach is well suited to analyze the breadth of outreach of financial institutions (Paxton, 2006). Also, the specification of variables as inputs or outputs is usually determined by the selected approach. The production approach uses the number of accounts as output while inputs are restricted to only physical variables such as capital and labor. In this study, credit card accounts (y1) and deposit accounts (y2) represent outputs in the model, while number of employees (x1) and number of branches in the state (x2) represent inputs in the computation of efficiency measures. Table 3 shows descriptive statistics of inputs and Table 4 shows descriptive statistics of outputs.

[Insert Table 3 here]

[Insert Table 4 here]

As can be seen in Table 3, the number of bank branches increased on average from 2000 to 2009. However, its standard deviation also increased, implying higher heterogeneity in financial access in Mexico. From 2000 to 2009 the number of employees working at commercial banks increased by 24.42%. Table 4 shows that the number of deposit accounts decreased by 33.4% while the number of credit card accounts increased by 211%.

For the analysis of the effect of remittances on banking efficiency by state, every year 31 states are ranked according to the amount of state remittance flows. The top ten states will then become the high remittance-recipients in that year. The states ranked in the bottom ten become the low remittance-recipients for that year. The amount of remittances by state is gathered from Banxico (Mexico's central bank) in million U.S. $. The states categorized as high recipients are the same from 2003 to 2008. San Luis Potosi replaces Chiapas as a high remittance-recipient state in 2009. Some states categorized as low recipients do not change much from year to year. Nuevo Leon is the only state that is categorized as low recipient only twice, in 2005 and 2008. Table 5 shows the categorization of high and low remittance-recipient states and the yearly amount of remittances per state.

[Insert Table 5 here]

5. Results

The technical efficiency scores for each state in Mexico are summarized in Table 6. Since DEA estimation is very sensitive to outliers, these results do not include Distrito Federal (Mexico City) in the estimation. The average technical efficiency for the Mexican banking sector from 2000-2009 is 0.83. Only two states have the highest technical efficiency score possible: Mexico (1.000) and Tlaxcala (1.000), followed by Hidalgo (0.991), Michoacán (0.989)

and Zacatecas (0.986). Higher efficiency scores are associated with efficient use of resources while low efficiency scores are associated with inefficient use of resources. States with efficiency scores of one are located on the production frontier.

Mexico and Tlaxcala are both located in the central region of the country and are located side by side. However, Mexico is a state with a considerable higher population than Tlaxcala. In 2009, over 10 million adults were living in Mexico while less than one million adults resided in Tlaxcala. Hidalgo, Michoacán and Zacatecas are also located in the central region of the country and are traditionally among the top receivers of remittances. The states with the lowest average technical efficiency scores are: Sonora (0.580), Baja California (0.579), and Quintana Roo (0.492). Baja California and Sonora are located in the Northwest and both are border states with the U.S. On the other hand, Quintana Roo is located in the Southeast and has no rural population.

Table 6 shows the average efficiency scores as well as the minimum efficiency score by year. The average lowest efficiency score of 0.72 occurs in 2001, followed by the 2008 with an average efficiency score of 0.78. Additionally, these years have the highest standard deviation of the sample. This is a possible effect of the non-parametric estimation method (Berger and Mester, 1997). Efficiency scores consistently increase from 2001 to 2005, a period of high foreign acquisition activity in the banking sector (see table 1). These results shed some light into the controversial relationship between efficiency and foreign participation in the banking sector. It is important to point out that efficiency scores are calculated using an output oriented model where the objective of economic units is to maximize outputs with a specific number of inputs. At the same time, we are assuming having variable returns to scale. Efficiency measures assuming constant returns to scale are not reported but are available upon request.

Table 7 shows efficiency scores of the subsamples of states with high remittance levels (HIGH) and low remittance levels (LOW) by year and tests for group differences using the rank-sum test developed by Wilcoxon-Mann-Whitney. Since the theoretical distribution of the efficiency score in DEA is usually unknown, we are forced to deal with nonparametric statistics (Cooper et al., 2000). The main idea of the test is to compare the DEA scores of two groups of DMUs, in this particular case high remittance-recipients and low remittance-recipients.

Results show that statistically significant differences exist between groups. It is important to point out that overall states are located on the efficient frontier in both groups. One possible explanation for these results is that there are other factors affecting technical efficiency besides the amount of remittances received by the state. A more formal statistical analysis is needed to control for other factors that may affect efficiency such as foreign ownership of banks, state GDP, rural or urban population, and migration indicators.

6. Conclusions

The objective of this study is to analyze the efficiency of the Mexican banking industry from 2000 to 2009. The Mexican banking sector is unique in its composition, not only it is highly concentrated but the top five banks in the industry own almost 80% of total assets. Also, Mexico is a very interesting case to study the link between banking services and remittances because is consistently ranked among the top recipients of remittances worldwide. Therefore, I investigate the effect of remittances on banking efficiency by identifying states as high remittance-recipients and low remittance-recipients and compare their efficiency levels.

Following the banking literature and using the production approach (where the number of loans and deposit accounts are considered outputs) I estimate an efficient production frontier for

each year. Results show that efficiency scores are on average 0.83 for the whole sample, and with a minimum efficiency score of 0.49. These measures are consistent with previous literature and much higher than efficiency scores of Mexican semi-formal financial institutions (Paxton, 2006). Central states, Mexico, Hidalgo and Michoacán specifically, are consistently more efficient than some northeastern and southwestern states. There is high variation in efficiency scores implying high heterogeneity in financial access across Mexico.

Furthermore, by identifying two subsamples, high remittance-recipients and low remittance-recipients, I find empirical evidence of statistically significant differences between efficiency scores. High remittance-recipient states are statistically more efficient than low remittance-recipient states. One implication derived from this study may be that remittance-recipient states are increasing their utilization of banking services. Banks located in those states receiving large amounts of remittances provide a higher number of deposit and credit accounts than states receiving small amount of remittances. Therefore, banks should increase their presence particularly in those states with rural populations that lack financial services and receive remittances from the U.S.

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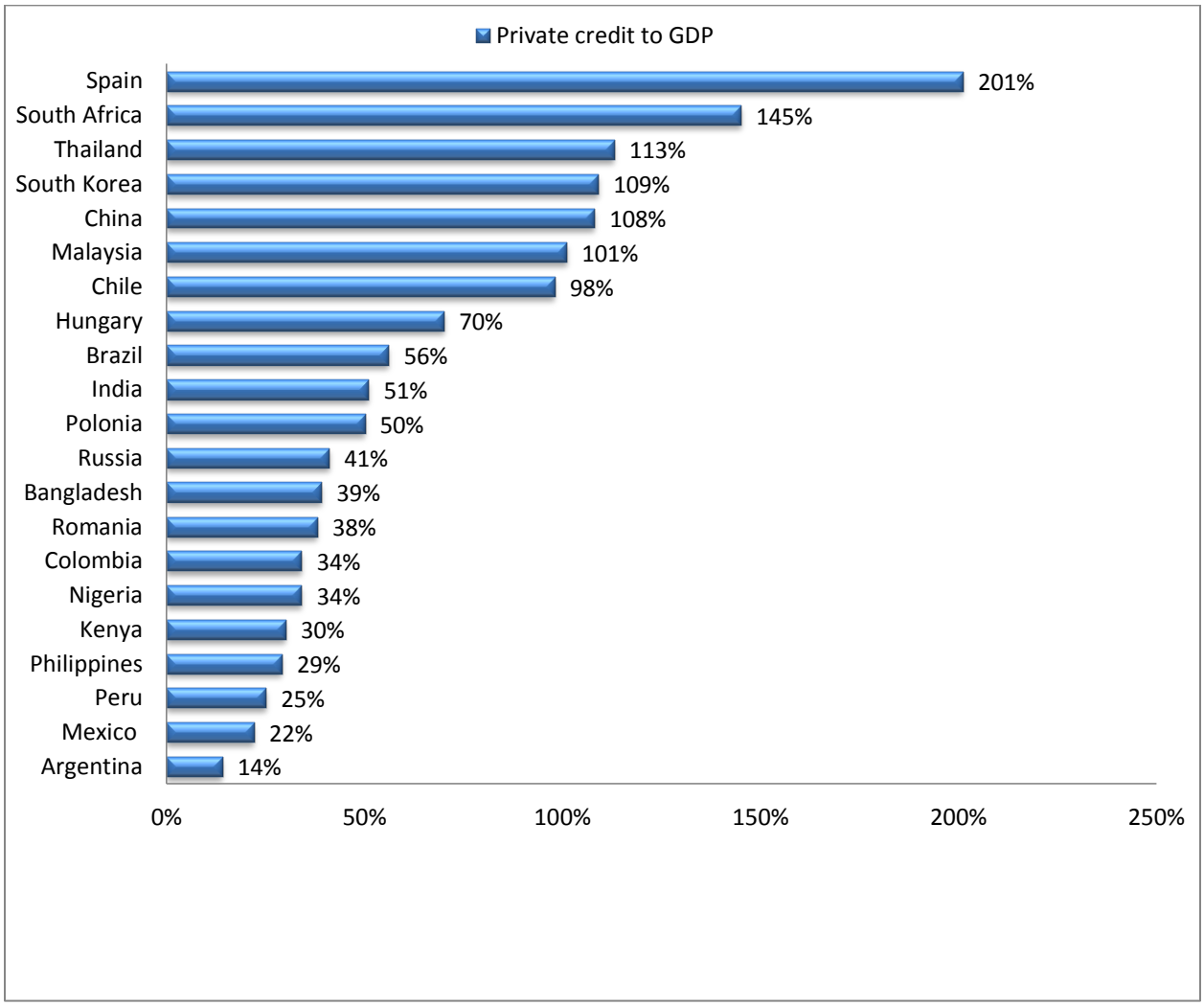
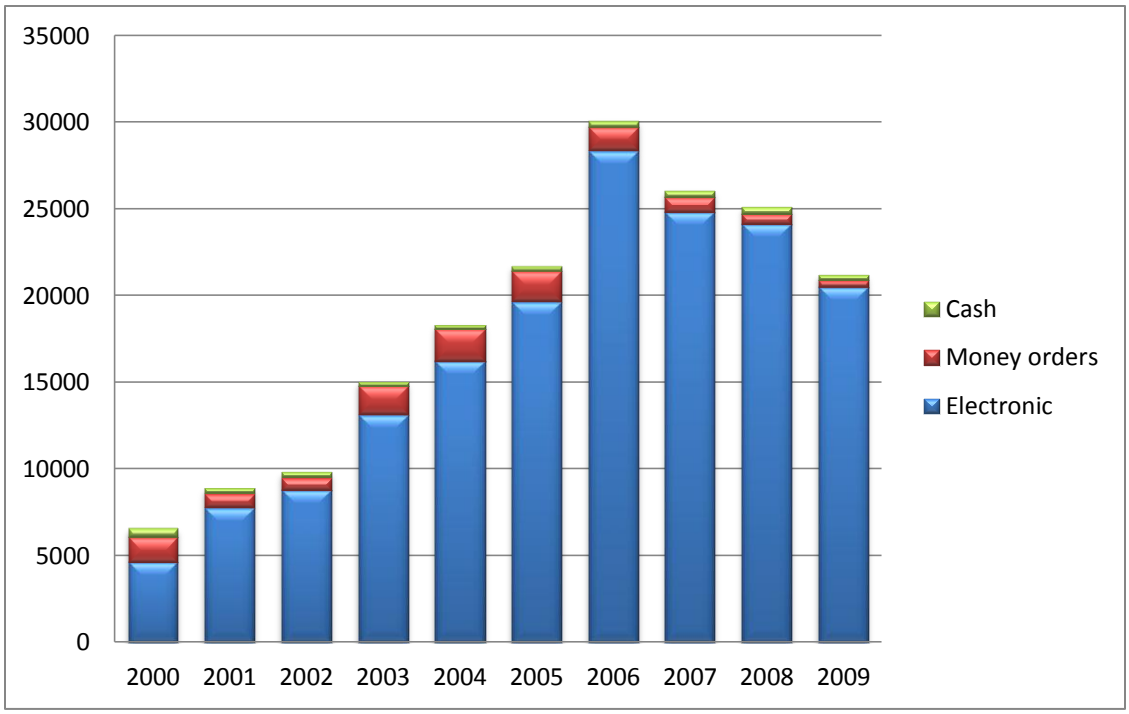
Figure 1. Amount of private credit to GDP granted by financial institutions in 2008



Source: World Development Indicators and CNBV for Mexican data

Figure 2. Remittances in U.S. million by transmission channel



Source: Mexico's Central Bank (Banxico)

Table 1. Foreign acquisitions of Mexican banks from 1995-2005

Date	Target	Acquirer	Country	Nominal value of the transaction[a]	Share of total bank assets held by foreign banks
1995:2	Probursa	BBVA	Spain	350	6.11[b]
1997:2	Mexicano	Santander	Spain	379	14.63[c]
1998:2	Confia	Citibank	U.S.	195	25.52[d]
2000:2	Serfin	Santander	Spain	1,540	31.34[e]
2000:3	Bancomer	BBVA	Spain	1,400	48.04[f]
2000:4	Inverlat	Scotiabank	Canada	40	55.36[g]
2001:4	Banamex	Citibank	U.S.	12,480	75.5[h]
2002:4	Bital	HSBC	UK	1,135	81.86[i]

Source: Schulz (2006);Beck and Martinez Peria (2010) and own elaboration based on data from CNBV

[a]In US $ million

[b]BBVA increases its stake in Probursa from 20% to 70%

[c]Santander acquires 75% stake in Banco Mexicano

[d]Citibank acquires 100% of Banca Confia

[e]Santander acquires 100% of Serfin

[f]BBVA takes 32.2% stake in and control of Bancomer*

[g]Scotiabank acquires a majority of the shares of Inverlat

[h]Citibank acquires 99.9% of Banamex

[i]HSBC acquires 99.5% of Bital

[*]BBVA increases its stake in BBVA Bancomer to 97.8% in 2004

Table 2. Active banks in Mexico per year

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Domestic Banks	15	13	13	13	13	13	15	23	22	22
Foreign Banks	20	18	20	19	17	16	16	17	19	19
Total	35	31	33	32	30	29	31	40	41	41

Source: Own elaboration based on data from CNBV

Table 3. Descriptive statistics of inputs per year

	Branches				Employees			
Year	Mean	SD	Min	Max	Mean	SD	Min	Max
2000	200.81	167.48	42	737	2505.26	2784.2	292	11191
2001	188.84	155.26	39	667	1982.23	2073.86	292	9209
2002	202.68	157.35	45	624	2040.84	1998.87	299	8998
2003	201.52	160.46	46	658	2108.87	2076.39	311	9437
2004	201.77	162.12	46	671	2413.74	2394.57	361	10344
2005	213.10	176.80	48	724	2413.13	2412.79	372	10120
2006	224.16	189.17	49	781	2597.03	2642.73	431	11318
2007	250.74	217.46	53	925	2839.45	2929.07	468	13029
2008	292.58	258.04	64	1170	3043.81	2927.57	509	13870
2009	293.03	265.29	60	1220	3117.16	2987.52	552	13937

Source: own calculation based on data from CNBV

Table.4. Descriptive statistics of outputs per year

	Deposit accounts				Credit accounts			
Year	Mean	SD	Min	Max	Mean	SD	Min	Max
2000	113889.0	105737.0	15979	479666	106114.0	111581.0	12198	498536
2001	103154.0	96220.6	11671	453461	113621.0	97737.5	17216	412364
2002	100713.0	95736.4	11634	450429	152496.0	154861.0	15461	698997
2003	95677.2	89287.8	10914	421329	244472.0	240739.0	23854	1077920
2004	84398.0	77995.4	9843	362950	244557.0	237184.0	26117	1046620
2005	82363.7	75602.7	8238	354923	320091.0	313172.0	36386	1351930
2006	80204.3	72655.7	8422	340600	582571	676300.0	83061	3213200
2007	77630.2	68659.2	8906	321683	716370.0	820934.0	107037	3919860
2008	83938.7	73562.3	12009	344664	465775.0	412386.0	63187	1500520
2009	75868.3	69046.4	10670	332055	330113.0	298193.0	51314	1241130

Source: Own calculation based on data from CNBV

Table 5. Categorization of states based on the amount of workers' remittances by year

	2003		2004		2005		2006
HIGH							
Michoacán	1778.9	Michoacán	2299	Michoacán	2461.8	Michoacán	2520.4
Guanajuato	1403.2	Guanajuato	1734	Guanajuato	1904.8	Guanajuato	2319.4
Jalisco	1345.4	Jalisco	1486	Mexico	1791.6	Mexico	2110.8
Mexico	1112.1	Mexico	1466	Jalisco	1723.1	Jalisco	2009.0
Veracruz	989.6	Veracruz	1163	Veracruz	1364.4	Veracruz	1672.4
Guerrero	845.5	Guerrero	982.7	Puebla	1133.3	Puebla	1425.9
Puebla	804.9	Puebla	963.0	Guerrero	1117.3	Guerrero	1378.0
Oaxaca	770.8	Oaxaca	929.6	Oaxaca	1053.6	Oaxaca	1321.0
Hidalgo	589.1	Hidalgo	698.1	Hidalgo	782.1	Hidalgo	945.5
Chiapas	439.3	Chiapas	595.6	Chiapas	772.1	Chiapas	943.6
	2003		2004		2005		2006
LOW							
Baja California	144.4	Coahuila	184.3	Nuevo León	291.4	Sonora	334.4
Tlaxcala	143.1	Tlaxcala	181.3	Baja California	263.2	Baja California	309.6
Coahuila	142.2	Sonora	174.6	Coahuila	247.0	Coahuila	282.3
Sonora	130.5	Baja California	168.8	Tlaxcala	218.0	Tlaxcala	268.0
Colima	105.2	Chihuahua	137.6	Colima	169.1	Tabasco	192.5
Tabasco	87.3	Tabasco	107.8	Tabasco	160.3	Colima	187.5
Yucatán	59.5	Yucatán	73.0	Yucatán	88.8	Yucatán	119.0
Quintana Roo	53.7	Quintana Roo	68.9	Quintana Roo	86.9	Quintana Roo	102.0
Campeche	52.5	Campeche	54.6	Campeche	67.4	Campeche	84.0
Baja California Sur	19.4	Baja California Sur	18.3	Baja California Sur	25.1	Baja California Sur	29.2

Remittances are in U.S. million. High is the category for states with high level of remittances per year. Low is the category for states with low level of remittances per year. States are rank each year based on the amount of remittances received by the state.

Table 5. Categorization of states based on the amount of workers' remittances by year cont.

	2007		2008		2009
HIGH					
Michoacán	2392.0	Michoacán	2457.2	Michoacán	2125.3
Guanajuato	2353.6	Guanajuato	2324.5	Guanajuato	1900.3
Mexico	2171.4	Mexico	2095.6	Mexico	1706.6
Jalisco	2008.7	Jalisco	1942.4	Jalisco	1487.1
Veracruz	1736.2	Veracruz	1620.4	Puebla	1341.0
Puebla	1555.4	Puebla	1567.5	Guerrero	1311.0
Oaxaca	1420.3	Oaxaca	1456.5	Veracruz	1291.6
Guerrero	1418.2	Guerrero	1401.6	Oaxaca	1227.4
Hidalgo	1085.6	Hidalgo	939.5	Hidalgo	851.5
Chiapas	906.3	Chiapas	799.9	San Luis Potosí	627.3
	2007		2008		2009
LOW					
Baja California	336.1	Nuevo León	331.1	Sonora	282.1
Sonora	335.7	Sonora	318.3	Aguascalientes	280.2
Coahuila	294.2	Coahuila	299.6	Tlaxcala	256.3
Tlaxcala	293.5	Tlaxcala	299.3	Coahuila	243.9
Colima	196.3	Colima	197.9	Colima	171.8
Tabasco	185.2	Tabasco	159.4	Tabasco	115.8
Yucatán	133.4	Yucatán	129.0	Yucatán	106.8
Quintana Roo	99.4	Quintana Roo	99.5	Quintana Roo	86.6
Campeche	81.0	Campeche	74.4	Campeche	56.5
Baja California Sur	32.4	Baja California Sur	35.5	Baja California Sur	32.3

Remittances are in U.S. million. High is the category for states with high level of remittances per year. Low is the category for states with low level of remittances per year. States are rank each year based on the amount of remittances received by the state.

Table 6. Technical efficiency over time

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	All years	Rank
Aguascalientes	1.00	0.79	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.977	4
Baja California	0.62	0.57	0.56	0.67	0.66	0.59	0.45	0.49	0.60	0.58	0.579	27
Baja California Sur	0.91	0.45	0.68	0.67	0.73	0.63	0.49	0.47	0.30	0.58	0.592	25
Campeche	1.00	0.48	1.00	1.00	1.00	0.92	1.00	1.00	1.00	1.00	0.939	7
Chiapas	0.91	0.51	0.63	0.76	0.82	0.92	0.63	0.64	1.00	1.00	0.781	19
Chihuahua	0.74	0.54	0.74	0.79	0.71	0.81	0.93	0.87	0.78	1.00	0.790	18
Coahuila	0.52	0.45	0.59	0.74	0.70	0.67	0.61	0.65	0.72	0.75	0.640	24
Colima	0.78	0.59	0.66	0.75	0.65	0.87	0.54	0.58	0.62	0.64	0.669	22
Durango	0.95	1.00	0.67	0.82	0.88	1.00	1.00	1.00	0.79	0.84	0.896	9
Guanajuato	0.82	0.83	0.85	0.87	0.88	0.88	0.77	0.76	1.00	1.00	0.865	13
Guerrero	0.88	0.77	0.81	0.76	0.78	0.77	0.79	0.83	0.75	0.76	0.791	17
Hidalgo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.92	0.991	2
Jalisco	1.00	1.00	1.00	1.00	1.00	1.00	0.74	0.81	1.00	1.00	0.955	6
Mexico	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1
Michoacán	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.989	2
Morelos	0.99	0.68	0.94	0.93	0.91	0.85	0.79	0.79	0.65	0.67	0.819	15
Nayarit	0.87	0.67	0.92	1.00	1.00	0.99	0.99	0.97	0.71	0.81	0.893	10
Nuevo León	1.00	1.00	0.88	0.93	0.95	0.95	0.67	0.65	1.00	0.89	0.892	11
Oaxaca	0.93	1.00	0.97	1.00	1.00	0.97	1.00	1.00	1.00	0.99	0.985	3
Puebla	1.00	0.84	0.97	1.00	1.00	1.00	0.90	1.00	0.98	0.87	0.957	5
Querétaro	1.00	0.60	1.00	1.00	1.00	1.00	0.85	0.74	0.54	0.66	0.839	14
Quintana Roo	0.51	0.25	0.50	0.53	0.47	0.47	0.63	0.68	0.37	0.50	0.492	28
San Luis Potosí	0.76	0.80	0.92	0.91	1.00	0.95	0.86	0.94	0.83	0.92	0.889	12
Sinaloa	0.70	0.60	0.73	0.74	0.81	0.84	0.52	0.52	0.56	0.62	0.664	23
Sonora	0.58	0.57	0.61	0.62	0.65	0.69	0.45	0.48	0.53	0.62	0.580	26
Tabasco	0.92	0.38	0.83	0.87	0.80	0.84	0.71	0.73	0.43	0.58	0.709	21
Tamaulipas	0.79	0.65	0.74	0.73	0.85	0.85	0.57	0.60	0.62	0.74	0.714	20
Tlaxcala	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.000	1
Veracruz	1.00	0.83	0.91	1.00	1.00	1.00	0.76	0.83	0.85	0.91	0.909	8
Yucatán	0.80	0.49	0.88	0.91	0.88	0.91	0.85	0.91	0.68	0.82	0.815	16
Zacatecas	1.00	0.92	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	0.986	2
Mean	0.87	0.72	0.84	0.87	0.88	0.88	0.79	0.80	0.78	0.83	0.83	
SD	0.15	0.22	0.16	0.14	0.15	0.14	0.19	0.19	0.22	0.17	0.15	
Min	0.51	0.25	0.50	0.53	0.47	0.47	0.45	0.47	0.30	0.50	0.49	
Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

Technical Efficiency scores are calculated using DEA each year. Input variables included in the estimation are number of bank branches and bank employees per state. Output variables included in the estimation are number of deposit accounts and number of credit card accounts per state. Ranking of states is based on the sample average per state where the top ranked states have an efficiency level of 1. Efficiency scores range from 0 to 1, being 1 the highest efficiency score.

Table 7. Comparison of DEA scores of high remittance-states and low remittance-states

high03	low03	high04	low04	high05	low05	high06	low06	high07	low07	high08	low08	high09	low09
0.87	0.74	1.00	0.70	1.00	0.95	1.00	0.45	1.00	0.49	1.00	1.00	1.00	0.62
1.00	0.67	0.88	1.00	0.88	0.63	0.77	0.45	0.76	0.48	1.00	0.53	1.00	0.99
1.00	0.62	1.00	0.65	1.00	0.67	1.00	0.61	1.00	0.65	1.00	0.72	1.00	1.00
1.00	1.00	1.00	0.66	1.00	1.00	0.74	1.00	0.81	1.00	1.00	1.00	1.00	0.75
1.00	0.67	1.00	0.65	1.00	0.87	0.76	0.71	0.83	0.58	0.85	0.62	0.87	0.64
0.76	1.00	0.78	0.80	1.00	0.84	0.90	0.54	1.00	0.73	0.98	0.43	0.76	0.58
0.76	0.75	1.00	0.88	0.77	0.91	0.79	0.85	1.00	0.91	1.00	0.68	0.91	0.82
1.00	0.53	0.97	0.47	0.97	0.47	1.00	0.63	0.83	0.68	0.75	0.37	0.99	0.50
1.00	0.87	1.00	1.00	1.00	0.92	1.00	1.00	1.00	1.00	0.99	1.00	0.92	1.00
1.00	0.91	0.82	0.73	0.92	0.63	0.63	0.49	0.64	0.47	1.00	0.30	0.92	0.58
Rank-sum test	2.077 **		2.136 **		2.192 **		1.955 *		2.192 **		2.380 **		2.429 **
p-value	(0.038)		(0.033)		(0.028)		(0.051)		(0.028)		(0.017)		(0.015)

Technical Efficiency scores are calculated using DEA each year. Input variables included in the estimation are number of bank branches and bank employees per state. Output variables included in the estimation are number of deposit accounts and number of credit card accounts per state. Efficiency scores range from 0 to 1, being 1 the highest efficiency score. States are rank each year based on the amount of remittances received by the state. See table 5 for complete ranking and amount of remittances. Rank-sum test is a non-parametric test comparing DEA scores from two different groups. The null hypothesis of the test is that both groups have the same population of efficiency scores. P-values are in parenthesis below the rank-sum test. *, **, *** indicate rejection of the null hypothesis at a 10, 5 and 1 percent respectively.