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Bank Competition and Account Penetration: Evidence from Mexico*

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Abstract
This paper documents a positive relation between bank competition and the penetration of bank accounts at the municipal level in Mexico. To account for potential biases in our regressions due to the endogeneity of market structure, we employ a two-stage estimation approach based on an equilibrium structural model. Our preferred estimate implies that moving from a monopoly to a duopoly will lead to an increase of 1,016 accounts per 10,000 adults, a 42 % increase over the cross-municipality mean. This is comparable to the effect of large increases in per capita income and years of schooling, or the establishment of an additional branch by a bank who is already present in the local market. Our results suggest that competition policy should be given a prominent role in the financial inclusion agenda.
Keywords: Financial inclusion, banking, competition.
JEL Classification: O16, G21, L13, D43.

Resumen
Este artículo documenta una relación positiva entre la competencia bancaria y la penetración de cuentas bancarias a nivel municipal en México. Para corregir posibles sesgos en nuestras regresiones debidos a la endogeneidad de la estructura de mercado, implementamos un método de estimación en dos etapas basado en un modelo estructural de equilibrio. Nuestra estimación preferida implica que un cambio de monopolio a duopolio llevará a un aumento de 1,016 cuentas por cada 10,000 adultos, un crecimiento de 42 % sobre la media a través de municipios. Esto es comparable al efecto de grandes aumentos en el ingreso per cápita y años de educación, o al establecimiento de una sucursal adicional de un banco ya presente en el mercado local. Nuestros resultados sugieren que la política de competencia debe jugar un papel prominente en la agenda de inclusión financiera.
Palabras Clave: Inclusión financiera, banco, competencia.

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1. Introduction

A robust relationship between financial development and economic growth has been extensively documented (see Levine, 2005 for a review). An important element of financial development is broad access to and use of basic financial services such as deposit and savings accounts (World Bank, 2012). Evidence from both cross-country aggregate data and household surveys suggests that these services can decrease poverty, increase income, and help smooth consumption.[1] Accordingly, the goal of broadening access to and use of basic financial services has become an important element of the global development agenda with the International Monetary Fund (IMF), the World Bank, the International Finance Corporation (IFC), the G20, and other international bodies launching initiatives to better understand the problem and promote policies designed to broaden financial inclusion.[2]

In Mexico, there is an increased awareness of the importance of financial inclusion and the country's challenges in this area. The World Bank's 2012 Global Findex survey (Figure 1) found that only 27% of adults in Mexico have an account at a formal financial institution, lagging its peers Brasil (56%) and Chile (42%) as well as the average for developing countries (50%). Furthermore, as Figure 2 reveals, the penetration of accounts is low relative to Mexico's level of income. Regulators have responded with a variety of policy initiatives designed to bring Mexico up to speed including the introduction of bank correspondents and mobile banking, two programs which have had large impacts in other countries.

If policymakers are to succeed in increasing the penetration of basic financial services, it is important that the barriers to financial inclusion are documented and understood. Cross-country studies document that legal origin,[3] infrastructure, and heavy regulation or direct government participation in the banking sector are all important covariates of the penetration of financial services. Much less is known about the type of bank conduct that discourages participation in the formal financial sector. In an influential paper, Beck et al. (2008) use survey data of bank practices in 62 countries to help fill this gap. They find that minimum balances for checking accounts, annual fees, and document requirements are highly correlated with measures of access and use such as the number of bank branches and accounts per capita. Evidence from field experiments in Kenya and Nepal (Dupas et al., 2012 and Prina, 2012) shows that waiving the fixed cost of opening an account

[1] See Beck et al. (2007), Beck et al. (2009), Burgess and Pande (2005), Burgess et al. (2005), Dupas and Robinson (2011), Honohan (2004), Honohan and King (2009), and Prina (2012) among others. See Fulford (2011) for evidence of detrimental effects of credit in the long-term.

[2] Ardic et al. (2011) includes a more detailed discussion of recent initiatives.

[3] Legal origin refers to differences between countries' legal institutions, which generally correspond to those of one of the major colonial powers: English common law, French civil law, German civil law, etc.

can result in high take-up (63% and 84% respectively). While nearly all of those who opened an account in the Nepal study used it, only 18% of new accountholders in the Kenya study did so, citing a lack of trust, unreliable service and high withdrawal fees. These concerns keep even people who live in large metropolitan areas, who have easy physical access to bank branches, from using financial services, as is documented in Caskey et al. (2006) for Mexico City, New York City, and Los Angeles, and in Solo (2008) for Mexico City and Bogota.

Basic economic intuition suggests that prices (fees, minimum balances, etc.) and the quality of service should be responsive to competitive pressures. Therefore, it is natural to ask whether there is a robust relationship between bank competition and the penetration of financial services. This is the question upon which this paper is centered.

We use recently released municipality-level data on the number of bank accounts by institution to construct two measures of market structure: the Herfindahl-Hirschman concentration index and the number of banks with accounts registered in local markets. We then verify that these measures predict the penetration of bank accounts, measured by the number of accounts per 10,000 adults, at the local level. Controlling for other market characteristics such as income, population, education, and, critically, the number of bank branches, automatic teller machines (ATM) and points of sale (POS)[4] per adult, we find that account penetration is significantly lower in more concentrated markets. The relation we find is robust to the use of alternative measures of account penetration (e.g. the number of debit cards per 10,000 adults), physical access to banking services, and competition itself. It also persists when a battery of social and economic controls are included in the regressions. To address potential bias in our estimations due to correlation between unobservables affecting both market structure and our measures of financial inclusion, we employ a two-stage estimation procedure based on an equilibrium structural model. Our favored estimate implies that transitioning from monopoly to duopoly, keeping the number of bank branches, ATM's and POS's constant, leads to an increase of 1,016 accounts per 10,000 adults,[5] a 42% increase over the cross-municipality mean or 41% of the difference in the penetration of accounts between the first (376) and last quartiles (2,878). This is comparable to the effect of large increases in per capita income (428%) and years of schooling (6.5), or the establishment of an additional branch by a bank who is already present in the local market.

[4] ATM can be used to withdraw cash from an account, check balances and perform other common transaction. POS are locations where purchases can be made using a debit or credit card.
[5] The effect refers to Table 4, column 6.

While our analysis is limited by a lack of information on prices and quality at the local level, the connection which we identify between market structure and the use of basic financial services is of interest in itself as public policy can be designed to affect bank concentration. Moreover, our main results refer to the difference between monopoly and duopoly where the relation between market structure and competition is clearest – a focus dictated, in part, by the prevalence of highly concentrated markets in our dataset.

Our findings have considerable policy implications. The magnitudes of the estimated effects of improvements in competition and physical access are very large relative to the effects of income and education, the most relevant socio-economic factors. This suggests that Mexico's low level of financial inclusion is not a problem which will go away on its own as social and economic conditions improve. Rather, policies which directly address bank infrastructure and competition are needed. Furthermore, these policies tend to be cheaper and show payoffs sooner than those which aim to improve income and education levels.

Much attention has been paid to policies which encourage financial inclusion by lowering providers' costs of serving rural areas such as using mobile telephony to perform bank transactions (mobile banking) and enabling small retailers to take deposits and dispense withdrawals (bank correspondents). While these strategies have proven effective at increasing physical access, the fact remains that, in Mexico as in many countries, financial services are underused even in areas in which physical access is not an issue. This paper's findings suggest that competition policy can be a powerful tool with which to pursue financial deepening. Policies which lower barriers to, or costs of, entry and provide information to consumers may have as large an effect as those focused on physical access. In particular, we believe that the spread of mobile banking and bank correspondents can have an important effect if multiple providers are able to make inroads through them, but may have a more limited impact if these new channels are dominated by the largest players and do not foster competition.

The paper is organized as follows. Section 1.1 discusses related literature. Section 2 discusses market definition and competitive dynamics and describes our data. Section 3 presents our two-stage estimation procedure and Section 4 discusses its results. Section 5 concludes.

1.1 Related literature

A sizeable literature, driven in large part by researchers at the World Bank, has documented the extent and determinants of access to and use of financial services (see Beck et al., 2007; Claessens,

2006; or Honohan, 2008 for a discussion of both). The main focus of this paper is considerably narrower: the relationship between bank competition and account penetration. While the potential importance of this relationship has been recognized and discussed (Beck et al., 2008; Claessens, 2006), there is relatively little evidence documenting it.

A closely related strand of the literature attempts to determine whether bank competition affects firm's access to credit. Beck et al. (2004) use survey data of firm access to credit from 74 countries. They find that bank concentration increases obstacles to financing in countries with low levels of economic and institutional development. The negative effect of concentration is largest for small firms. Chong et al. (2012) make a similar point for small and medium enterprises in China. Using the Lerner index to measure competition, Love and Martínez Pería (2012) show that competition is positively related to firm's access to finance in their sample of 53 countries. Barth et al. (2009) document the importance of bank competition for corruption in lending, suggesting that competition makes banking practices fairer. While these papers focus on firm's access to credit, we are primarily concerned with individuals' access to deposit and savings accounts.

The most direct predecessors to this paper are three articles by World Bank economists exploring the determinants of the penetration of basic financial services. Beck et al. (2008) use information from banks in 62 countries to document barriers to banking such as minimum account balances, fees, and required documentation. They find that higher levels of these are associated with lower levels of banking outreach. They also find that these barriers are higher in more concentrated banking markets, providing the only available evidence on the mechanism by which concentration can lead to lower penetration. Using a combination of data on deposit account penetration and predicted values to cover 154 countries, Ardic et al. (2011) and Kendall et al. (2010) find a negative relation between the market share of the five largest banks (concentration ratio) and the penetration of deposit accounts, although the estimated coefficient in Kendall et al. (2010) is not statistically significant. Gimet and Lagoarde-Segot (2012) conduct GMM estimation on a panel of 138 countries showing that high deposit rates and low lending rates, and thus small margins, encourage access and use of banking services. They argue that the competitiveness of the banking sector is an important driver of financial inclusion.

Another paper which deserves special mention for its use of similar data to address questions of financial breadth and depth is Demirguc-Kunt et al. (2011). As we do, the authors use data on the penetration of basic financial services at the municipality level from Mexico's National Banking and Securities Commision (CNBV), together with socioeconomic data from other official sources, to study the impact of remittances on financial inclusion. They instrument for remittances using

municipalities' distance to the railroad network which carried migrants north to the United States during the first half of the twentieth century.

Our paper contributes to this literature in several ways beyond providing additional evidence for the link between bank concentration, income, education, population and other factors and the penetration of financial services. Because all of our data on account penetration is reported by the same banks to the same regulator, it is comparable across markets. Comparability, on the other hand, is a major concern with cross-country data (see Beck et al., 2007; Kendall et al., 2010; or Kneiding et al., 2009). By presenting within-country evidence, we are forfeiting the ability to document the importance of national institutions such as legal origin and financial regulation. However, the homogeneity of these factors across markets helps us to better identify the effect of other variables. Studying competition and account penetration at a local level allows us to document the effect of a wide range of market structures. While we use measures of market structure as proxies for competition, our main results contrast monopoly with duopoly, where this relationship is most clear-cut. Finally, we use a two-stage estimation procedure based on a simple structural model to correct for the endogeneity of market structure.

2. Description of data and context

We carry out our analysis at the local market level, which we define as municipalities or metropolitan areas. Municipalities are the smallest administrative division in Mexico, and the level at which much of the information gathered by government agencies is organized. We use municipality-level data from three separate sources on socio-demographic characteristics and access to and use of financial services. Socio-demographic variables are taken from the 2010 census conducted by INEGI, the National Institute of Geography and Statistics, and from CONEVAL's 2010 evaluation of poverty and inequality at the municipal level. The statistics used to calculate indicators of physical access to banking services and the penetration of financial services, as well as all of our measures of market structure, are published by the National Banking and Securities Commission (CNBV) and document market conditions as of April 2011. Our dataset is a cross-section of 2,167 local markets.

2.1 Local markets and competitive dynamics

Markets for basic banking services are local,[6] so that national aggregate data may mask significant heterogeneity. We adapt the geographic definition of a local market used by Berger et al. (2005) and related work to the Mexican context.[7] In the U.S. case, counties are used as proxies for local markets unless they are part of a metropolitan statistical area (MSA). We use municipalities, the rough Mexican equivalent to counties, and INEGI's definition of 56 metropolitan areas to aggregate the country's 2,456 municipalities[8] into 2,167 markets. To deal with cases in which municipalities may not correspond to local markets we exclude outliers from our analysis.[9] However, our results are robust to the inclusion of outliers or more aggressive trimming of the data.

Because banks do not generally have local pricing strategies[10] the channels through which competition may affect the use of financial services are limited to those at the discretion of branch managers such as the speed and quality of service and an emphasis on offering pricier products.[11] Giné et al. (2012) conducted an audit study in peri-urban areas in the state of Mexico and Morelos which confirms that these mechanisms are at play. Their auditors visited bank branches to solicit deposit or investment accounts. Although they were offered products which matched their maturity needs, they were seldom offered the most inexpensive product with the requisite characteristics. In particular, auditors were steered away from no-frills accounts[12] which offer basic features and cannot charge fees and commissions. Intriguingly, auditors who stated that they had shopped around for similar services were given more information about fees and commissions and the contractual terms of account usage.

The Giné et al. (2012) study aptly illustrates the competitive dynamics which we suspect lie behind our main results linking market structure to account penetration. In markets in which consumers have few alternatives, local bank managers push more expensive products, provide less information and provide a lower standard of service than they do in more disputed markets. This,

[6] Studies using data from the U.S. Federal Reserve's Survey of Consumer Finances and Survey of Small Business Finances have found that consumers and businesses tend to obtain their bank services from nearby providers. Additionally, numerous studies have found a relation between local market concentration and deposit interest rates. See Cohen and Mazzeo (2007) for a more detailed discussion.
[7] Alternative definitions such as labor market areas (LMA) are used by some other authors (Cohen and Mazzeo, 2007).
[8] Including the 16 delegations composing Mexico City's federal district.
[9] We exclude markets in which more than two accounts per adult are registered (8) and in which there are no accounts (5).
[10] For instance, commissions registered with the central bank are rarely location-specific, the one notable exception being for border areas and airports. Experts at the national banking commission (CNBV) confirm that product pricing is usually determined at the national level.
[11] Consultation with industry experts confirms that these channels are likely to be important.
[12] Cuentas básicas. See Negrín et al. (2009) for a description of the product and associated regulation.

naturally, drives customers away. Indeed, one recent national survey[13] shows that, while 62% of adults in Mexico save, only 35.5% do so in formal financial institutions. Indeed, 73% of those who do not have a bank account say that they cannot afford an account or their income is too low to warrant it and 16% say they do not need one. This lack of interest in bank accounts, in spite of a high proportion of savers and the availability of commission-free accounts, may be a reflection of poor service and information provision by banks.

2.2 Descriptive statistics

The remainder of this section contains tables and graphs which describe the variables of interest in our analysis. Unless specified, the figures presented are *not* nationally representative as they are not adjusted for population. For an in-depth assessment of financial inclusion in Mexico, we refer the reader to the CNBV's reports on financial inclusion.[14] Table 6 presents correlations between the variables used in the analysis. Data on physical access, account penetration, and competition refer to commercial banks only.

The country's 2,456 municipalities,[15] which we group together into 2,167 markets, present a diversity of circumstances comparable to a large cross-country sample. Panel A in Table 1 presents summary statistics for some socio-demographic characteristics at the market level. 128 markets have a population of less than a thousand, while there are 11 metropolitan areas with over a million inhabitants. 59% of markets are considered rural (population less than 15,000). There is also considerable variation in average monthly per capita income, which is less than 1,000 pesos in 32% of markets and roughly 4,500 pesos in the country's wealthiest markets. The eleven-to-one ratio between the income of the wealthiest and poorest markets in our sample is of the same order of magnitude as the difference in per capita GDP between the United States and the Philippines or Honduras.

Given the differences among markets in socio-demographic dimensions, it is not surprising that there are also great differences in terms of physical access to financial services, as documented in Table 1, Panel B. While the presence of ATM's and POS's[16] are good indicators of the usefulness of basic bank products such as debit cards, access to a branch is typically necessary in order to open

[13] National Survey for Financial Inclusion (2012) available at http://www.cnbv.gob.mx/Prensa/Paginas/Inclusion.aspx.
[14] Available online at http://www.cnbv.gob.mx/Prensa/Paginas/inclusionfinanciera.aspx .
[15] Including the 16 delegations composing Mexico City's federal district.
[16] Automatic teller machines (mainly used for withdrawing cash but also used to pay bills, etc.) and points of sale (locations where payment with a debit or credit card is accepted).

an account.[17] The pie charts in Figure 3 (a and b) describe physical access to commercial bank branches. It is noteworthy that 70% of markets do not have a bank branch. However, in only 5 municipalities were no accounts registered. While most markets do not have a bank branch, most Mexicans live in a municipality or metropolitan area in which a bank branch is located. As shown in Figure 1c, bank branches are more common in the wealthier central and northern parts of the country and less common in the poorer southern states and in Mexico's more isolated mountainous areas.

Our primary interest is in the penetration of bank accounts, measured by the number of accounts per 10,000 adults. A *bank account* is any account held at a bank which allows the accountholder to make deposits and withdrawals and to save, but which may or may not have an associated debit card or checkbook or facilitate payments and transfers. Panel C in Table 1 presents summary statistics on this variable. As expected, account density across markets is closely related to physical access, showing less penetration in poorer areas with rougher terrain and more in metropolitan areas and tourist destinations (Figure 3c). Nevertheless, as stated previously, most markets have registered accounts even when there are no bank branches.

While socio-demographic factors and physical access have received much attention as determinants of the penetration of financial services, our focus here is on the effect of competition. Although our measures of competition are limited by the lack of information on prices and costs at the local level, we are able to construct two variables which provide information on local market structure. Using market shares based on the number of accounts per institution, we calculate the Herfindahl-Hirschman index (HHI).[18] Additionally, we measure competition using the number of banks with accounts registered in a market.[19] In 70% of markets, the market for banking services is monopolistic. Most of these markets (78%) are rural; of 1,274 rural municipalities only 84 have bank accounts registered from more than one bank. Nevertheless, as Figure 4b shows, 65% of Mexicans live in a municipality or metropolitan area in which the banking market is only moderately concentrated (HHI below 2,000). This is clear in Figure 4c: the most populated zones of

[17] This is quickly changing, however, as the use of non-bank agents or correspondents becomes more widespread. While information on these is available, the coefficients on the associated variables were never significant in our regressions.

[18] One of the most commonly used measures of competition (Schmalensee, 1988). It is defined as the sum of squared market shares for all banks, multiplied by 10,000. An HHI of 10,000 corresponds to a pure monopoly. Markets with an HHI of over 2,000 are considered highly concentrated.

[19] We consider that the presence of accounts with a bank is evidence of that bank's participation in a local market. A bank's decision to enter a local market need not involve the installation of physical infrastructure. Instead, a bank may employ publicity or other outreach strategies. Using the number of banks with a branch leads to qualitatively similar results in the subsequent analysis.

the country present low levels of concentration and the most concentrated markets are in the poorest and most mountainous areas.

2.3 Descriptive regressions

In order to explore the correlations between the penetration of accounts and its possible determinants, including the HHI, we present OLS regressions with account penetration as dependent variable in Table 2. Analogous regressions using the number of banks in a market instead of the HHI are presented in Table 4, alongside results of our two-stage estimation procedure.

Regressions are presented with and without physical access controls. If competition affects banks' decisions to install branches, ATM's and POS terminals, the effect of these variables on account penetration can be attributed to market structure and should not be controlled for – we interpret the estimated effect of market structure in these regressions as an upper bound on the correlation of interest. On the other hand, we would like to know the effect of market structure on account penetration, taking infrastructure as given – Is there a difference between having two branches operated by the same bank, and having two banks each operating one branch? The γ coefficients from the regressions which control for access capture this relationship.

Columns 1-2 present the most parsimonious regressions. Column 3 controls only for those social explanatory variables which previous studies suggest have a large impact (Ardic et al., 2011; Beck et al., 2007; Djankov et al., 2008; Honohan, 2008): years of education, average monthly income, population, and population density. Column 4 adds controls for physical access. Column 5 adds a series of additional socio-demographic variables, along with a set of regional dummies.

The coefficient for HHI is highly significant and negatively related to use in all specifications, indicating a robust relationship between market concentration and account penetration. This relationship is maintained when the exercise is replicated with the number of debit cards per adult as the dependent variable (not shown). Interactions of HHI with population and population density were included in additional specifications (not shown), but their coefficients were not found to be significantly different from zero.

The coefficients for income are positive and significant in most cases, and have the expected sign. Also as expected, education is positively related to use (columns 3 and 4), but its standard errors are generally large. This is surprising given the strong relationship found between education

and use of financial services in previous studies.[20] The effect of bank concentration persists when a full set of controls is used (column 5), while other coefficients such as income and education become skewed because of colinearity. For instance, income is effectively proxied by the prevalence of telephones and computers. Coefficients on physical access variables have the expected sign (columns 2, 4 and 5) – more branches, ATM's, and point of sale terminals are associated with greater use of financial services. By far, the number of bank branches is the most important physical access factor.

3. Methodology

The regression coefficients presented in Table 2 cannot be given a causal interpretation as they may be biased due to the endogeneity of one or several regressors. In particular, our measures of market structure may be correlated with the error term in our specification due to omitted variable bias. For instance, consider the possibility that there is an unobserved variable, perhaps "financial sophistication," which is positively related to both market structure and account penetration. Sophisticated individuals are more informed about the availability of financial services, and have a better understanding of how to use them, than unsophisticated individuals. This leads them to use more financial services. It also attracts more competitors to the market since sophisticated customers are more likely to switch to a new bank offering superior alternatives or hire additional services from a new provider. If this is true, our estimates of the effect of market structure on the use of financial services are biased upward.

Endogeneity is a common problem in empirical work, most commonly addressed in cross-section data by the use of instrumental variables.[21] However, finding valid instruments in this context is very difficult.[22] Many related studies simply acknowledge the problem and present descriptive results. Some notable exceptions include Dermirguc-Kunt et al. (2011) who use distance to the railroad network as an instrument for remittances in a study of financial access and penetration, and Chong et al. (2012) who use concentration in neighboring markets as an instrument for local competition in a study of firms' access to credit.

[20] Most notably, Djankov et al. (2008) find a strong relationship between education and use of financial services using survey data from Mexico.

[21] The use of panel data techniques such as fixed effects regressions can also address endogeneity concerns when the necessary data is available, however see Manuzsak and Moul (2008) p. 97 for a discussion of some limitations of this approach.

[22] See Manuzsak and Moul (2008) for a discussion of the difficulty of finding instruments for market structure in particular. This is one of the classic problems faced by industrial organization scholars working within the structure-conduct-performance paradigm (Schmalensee, 1989).

Given the difficulty of finding valid instruments for market structure, other corrections for endogeneity are required. Mazzeo (2002) proposes a correction for the endogeneity of market structure based on the logic of the two-stage estimators used to address sample selection bias, such as the *heckit* (Heckman, 1979). In the first stage, following Bresnahan and Reiss (1991), an ordered probit is run to estimate a structural model of firm entry into local markets. The number of firms in a market is the dependent variable. Residuals from this estimation capture the effect of unobservables on market structure. Including first stage residuals as an explanatory variable in the OLS estimation of interest corrects for the omitted variable bias associated with market structure regressors.[23] While instrumental variables may be used to improve identification, the non-linearity of the first-stage equation enables identification of second-stage parameters even without instruments. We discuss our identification strategy in greater detail in Section 4.

Our regression of interest is:

$$Acct_m = \alpha + X_m\beta + \sum_{i=2}^{3} \gamma_i d_{i,m} + \varepsilon_m \quad (1)$$

where $Acct_m$ is our measure of account penetration, X_m is a vector of market characteristics and $d_{i,m}$ is a dummy variable taking the value of 1 when market *m* has at least *i* banks.[24]

In the first-stage, we estimate a latent payoff function for banks entering market m:

$$\bar{\pi}(Z_m, N_m, e_m; \theta) = \pi(Z_m, N_m; \theta) + e_m \quad (2)$$

Under the assumption that profits are declining in the number of entering banks:

$$\pi(Z, N; \theta) > \pi(Z, N+1; \theta) \quad (3)$$

Z_m is a vector of market characteristics, N_m is the number of banks which enter market *m*, and e_m is an error term capturing the effect of unobserved factors. $\bar{\pi}$ is interpreted as the expected value of discounted future profits. The strategic aspect of the entry decision is reflected in the inclusion of the number of banks as an explanatory variable; profits will decrease along with the number of banks in a market. The focus on the number of entering banks, rather than their specific identities, enables the researcher to account for multiple equilibria in a simple manner.[25]

[23] This procedure has been applied to a variety of markets including motels (Mazzeo, 2002), office supply stores (Manuzsak and Moul, 2008), and banks (Cohen and Mazzeo, 2010).
[24] We limit our attention to the cases in which there are 1, 2, or 3 or more banks in a market to guarantee that sample sizes in each category are large enough to ensure adequate power.
[25] For instance, if there are two identical banks (A and B) considering entry into a market that would only be profitable for one, there are two Nash equilibria in pure strategies: A enters and B does not, and B enters and A does not. The number of entering banks, though, is uniquely determined.

In a pure strategy Nash equilibrium, *N* banks will enter market *m* if they will be profitable and additional banks would not be:

$$\begin{aligned} N_m=0 \quad & \text{iff} \quad \pi(Z_m, 1;\theta) + e_m < 0 \\ N_m<N^{max} \quad & \text{iff} \quad \pi(Z_m, N_m;\theta) + e_m \geq 0 \text{ and } \pi(Z_m, N_m+1;\theta) + e_m < 0 \\ N_m=N^{max} \quad & \text{iff} \quad \pi(Z_m, N_m;\theta) + e_m \geq 0 \end{aligned} \tag{4}$$

Assuming that e_m and ε_m (the error term from the OLS estimation) are jointly normal and independent across *m* with Var($e_m|Z_m,X_m$)=1 and Corr($e_m,\varepsilon_m|Z_m,X_m$)=$\rho$, [26] we may estimate the entry game with an ordered probit. Furthermore, if the variables in *X* satisfy exogeneity and our model is correctly specified, we have that:

$$E[Acct_m|Z_m, X_m] = \alpha + X_m\beta + \sum_{i=2}^{3} \gamma_i d_{i,m} + \rho h(Z_m, N_m;\theta) \tag{5}$$

where *h* denotes the expected value of the first-stage residuals $E(e_m|d_m, Z_m)$. These are given by the inverse Mills ratios:

$$h(Z_m, N_m;\theta) = \begin{cases} \dfrac{\phi\left(\pi(Z_m, N_m;\theta)\right) - \phi\left(\pi(Z_m, N_m+1;\theta)\right)}{\Phi\left(\pi(Z_m, N_m;\theta)\right) - \Phi\left(\pi(Z_m, N_m+1;\theta)\right)} & for\ 0 \leq N_m < N^{max} \\ \dfrac{\phi\left(\pi(Z_m, N_m;\theta)\right)}{\Phi\left(\pi(Z_m, N_m;\theta)\right)} & for\ N_m = N^{max} \end{cases} \tag{6}$$

with Φ and ϕ representing the cdf and pdf of the standard normal distribution. We can then estimate the regression model:

$$Acct_m = \alpha + X_m\beta + \sum_{i=2}^{3} \gamma_i d_{i,m} + \rho h(Z_m, N_m;\theta) + u_m \tag{7}$$

The parameters of interest are γ_2 and γ_3. In particular, γ_2 measures the effect of going from a monopoly to a duopoly on the penetration of bank accounts in a given market. This counterfactual, relevant to a large proportion of the markets in our sample, is clearly associated with an increase in competition. The effect of going from a duopoly to an oligopoly, in which three or more banks participate, is measured by γ_3.

4. Identification, estimation and results

In this section we discuss our implementation of the Mazzeo (2002) estimation procedure and present our results. The identification of second stage parameters has two potential sources: the non-linearity of first stage estimates and exogenous variables included in the first stage but omitted from the second (i.e. variables in *Z* but not in *X*). We present two sets of results: specification A

[26] The scale of a discrete outcome model is not identified, so we normalize the variance of the latent payoff function to 1.

relies exclusively on first stage non-linearity, and specification B uses two plausible instruments in the first stage. Results are robust to using only one of these instruments.[27]

A particular advantage of the structural approach we pursue is that we may rely on functional form for the econometric identification of the model's parameters, eschewing the use of instrumental variables. The equilibrium conditions of the entry game introduce a fundamental non-linearity into the market structure equation, evident in the inequalities in (4), which is then exploited for the identification of second stage parameters. Thus, it is possible to identify the parameters of interest without relying on *ad hoc* exclusion restrictions (see Manuszak and Moul, 2008 for a discussion of this point). Note that this identification strategy rests on more solid ground in this case than it would in selection models (*heckit*) in which, one could argue, functional form assumptions are arbitrary (see Cohen and Mazzeo, 2010 and Mazzeo, 2002).

If instruments are used in the first stage, a good case must be made that they do not also belong in the second stage; that is, an exclusion restriction must be satisfied. Our first instrument is (log) population in 2000.[28] Entry decisions generally took place sometime in the past and were most likely based on local conditions at the time. The current penetration of financial services, however, is a function of current (2010) conditions. Thus, we maintain that lagged population is a determinant of bank entry but, *conditional on current population*, should have no effect on the penetration of financial services. Therefore, it is plausible that it should be included in the first-stage regression but not the second.

Our second instrument is a state-level legal order index published by IMCO, a Mexican think tank, which measures the objectivity and reliability of the local legal system. A bank's decision to enter a new market must take the local legal environment into account as it will likely rent property and enter into a variety of commercial contracts involving collateral on business loans, publicity, etc. Disputes involving bank accounts, however, are handled by federal agencies. Complaints about unrecognized charges or commissions are mediated by the National Commission for the Protection of Users of Financial Services (CONDUSEF) while bank failures and deposit insurance are the responsibility of the Institute for the Protection of Bank Savings (IPAB). Thus, the legal order index is a relevant factor in a bank's entry decision but should not otherwise affect the demand and supply of accounts.

[27] Regression results available from the authors upon request.
[28] Using the difference between log population in 2000 and 2010 is conceptually equivalent and leads to nearly identical results.

Regressions are presented with and without physical access controls. If competition affects banks' decisions to install branches, ATM's and POS terminals, the effect of these variables on account penetration can be attributed to market structure and should not be controlled for – we interpret the γ coefficients from these regressions as an upper bound on the correlation of interest. On the other hand, we would like to know the effect of market structure on account penetration, taking infrastructure as given – Is there a difference between having two branches operated by the same bank, and having two banks each operating one branch? The γ coefficients from the regressions which control for access capture this relationship.

Table 3 presents results of the first stage entry model without (Specification A) and with (Specification B) our instruments. As expected, income is critically important to banks' entry decisions. Population in 2000 is a better predictor of entry than current population, confirming that entry decisions were based primarily on past local conditions. The legal order index is also positively associated with entry, although standard errors are relatively large, perhaps reflecting the limited explanatory power that state-level controls have for market-level outcomes.

Table 4 presents results for both specifications of our two-stage estimation procedure alongside the analogous uncorrected regressions (Equation 1). Results for both specifications are quite similar.[29] For the regressions without controls for physical access (columns 2 and 3), the estimated coefficient on the endogeneity correction term is positive (as expected) and statistically and economically significant, suggesting that our uncorrected regressions overestimate the effect of market structure. However, including physical access controls reduces the magnitude of the endogeneity correction coefficient considerably. If unobserved factors which affect entry into a market also affect infrastructure in that market, this makes sense – physical access variables already reflect the influence of these unobservables.

Compared to the marginal changes in concentration studied in our descriptive regressions (Table 2), the changes in market structure identified by d_i are large. Correspondingly, the predicted effects on account penetration are large as well. Column 3 predicts that moving from monopoly to duopoly will increase the number of accounts per 10,000 adults by 1,522 (95% confidence interval 1,022-2,022). We obtain more conservative estimates of the effect of introducing competition from our specifications which control for physical access; account penetration increases by 1,016 accounts per 10,000 adults (95% confidence interval 540-1,492) when a market goes from monopoly to duopoly. This represents a 42% increase over the (admittedly low) cross-market

[29] Specifications including distance to the state capital or the nearest metropolitan area as additional control variables also yield very similar results. These are available from the authors upon request.

average. Similarly, the estimated effect of moving from monopoly to duopoly is equivalent to 41% of the difference in the penetration of accounts between the first (376) and last quartiles (2,878). In this first step – from monopoly to duopoly – the relation between market structure and competition is relatively uncontroversial, allowing us to claim that we have identified an effect of competition on account penetration. Estimated effects are larger for the second step – from duopoly to oligopoly – as markets with many banks are included in this category. This is consistent with the existence of competition effects from the entry of a third, fourth or fifth bank. Controlling for a polynomial of the endogeneity correction term (quadratic or cubic, not shown) in the regressions does not significantly alter the results.[30]

Our socioeconomic and physical access coefficients have the expected sign. Income and education are the most important socioeconomic factors explaining account penetration. Point estimates suggest that a 10% increase in average per capita income increases the number of accounts per 10,000 adults by about 67 (columns 5 and 6). An additional year of education for the average resident of a market leads to an increase of 161 accounts per 10,000 adults. As these numbers show, the effect of a change in market structure is comparable in magnitude to very large changes in income or education (428% increase in income or 6.5 additional years of education). Physical access to banking services, on the other hand, can also have large effects. An additional bank branch has an effect of comparable magnitude to entry by a second bank into a market (1,304 versus 1,016, column 6). Therefore, expanding physical access and improving service quality (through more competition) appear to be the most effective ways to increase the number of accountholders in Mexico.

5. Conclusions

We have provided evidence that bank competition is positively related with the penetration of basic financial services. Using municipality-level data on the penetration of bank accounts, and controlling for physical access to banking services, we have shown that, in markets in which the provision of bank services are more concentrated, people are less likely to use basic financial services. This relationship is robust to alternative measures of account penetration and market structure, as well as to the application of a two-step estimation procedure designed to correct for the endogeneity of market structure.

Improving access to and use of financial services has become a major public policy goal at the international level. Market-based policies pursued to this end have focused on favoring new

[30] These regression results are available from the authors upon request.

technologies which make access to the financial system easier and cheaper, for example mobile banking and non-bank agents or correspondents. “Basic accounts” which are designed to be easy to understand and inexpensive have been introduced with the explicit aim of improving financial inclusion (Kaiser et al., 2011 and Negrín et al., 2009). Governments in Mexico and India have also made a major effort to increase participation in the financial sector by channeling social welfare programs through the banking system. The evidence presented in this paper suggests that competition policy should be considered an important tool in the quest for financial inclusion and development. Conversely, the implications of inclusion-oriented policies for bank competition may be important. For instance, the spread of bank correspondents has decreased barriers to entry (Assunçao, 2013).

Several issues remain to be addressed by future research. Studies which address the identification issues discussed in this paper by taking advantage of natural experiments or randomized interventions would be very valuable. From a policy perspective, it is not clear what kind of pro-competition policy would have the greatest effect on the penetration of financial services. There is a need for careful evaluations of the effects of competition policy, including its effect on the use of financial services.

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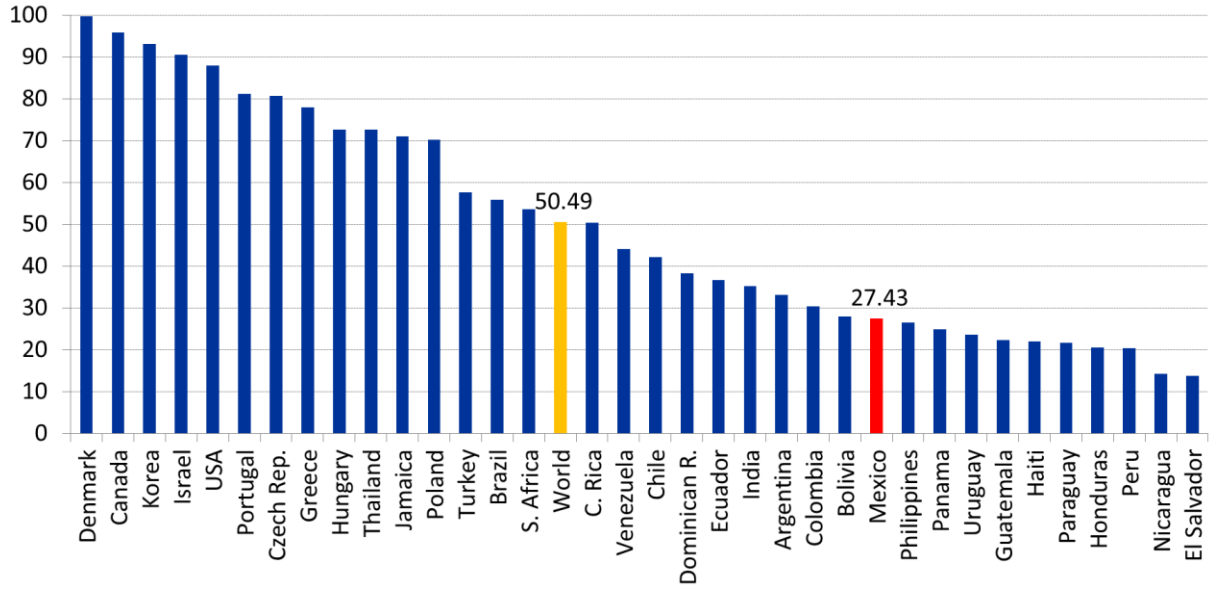
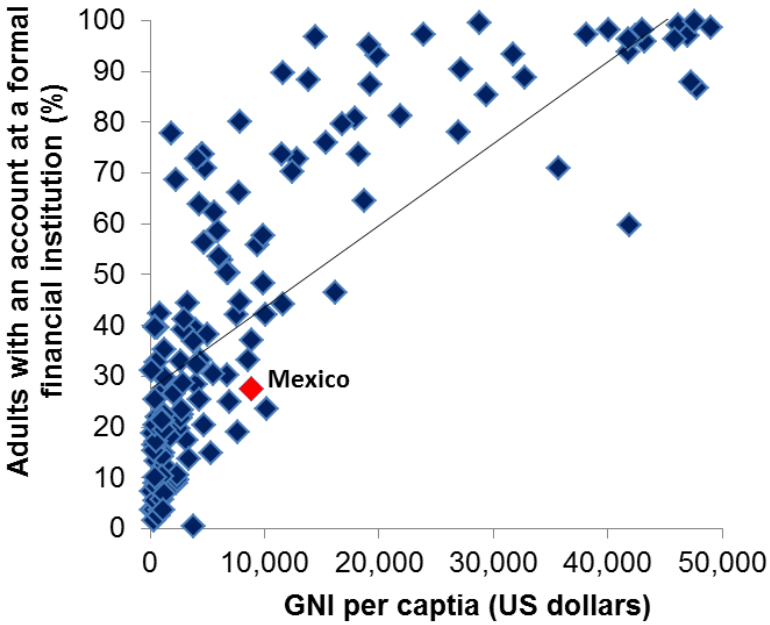
Figure 1: Percentage of adults with account at formal financial institution



Adults are considered 15 years and older.
World average only includes developing countries.
Source: World Bank - Global Findex Database, 2012.

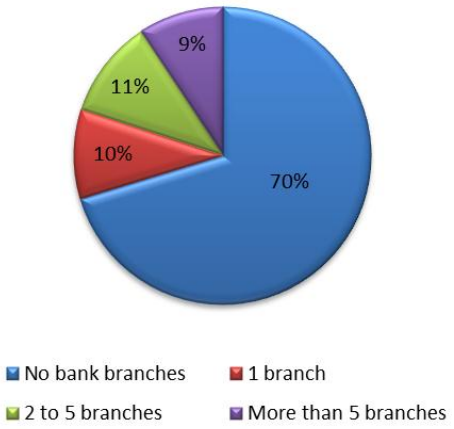
Figure 2: Relationship between financial inclusion and income across countries



Adults are considered 15 years and older.
Source: World Bank - Global Findex Database, 2012.

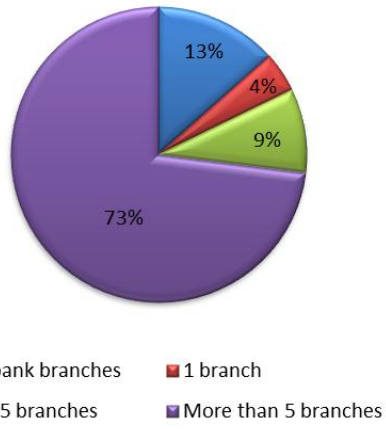
Figure 3: Physical Access – bank branches

a) Markets by number of bank branches



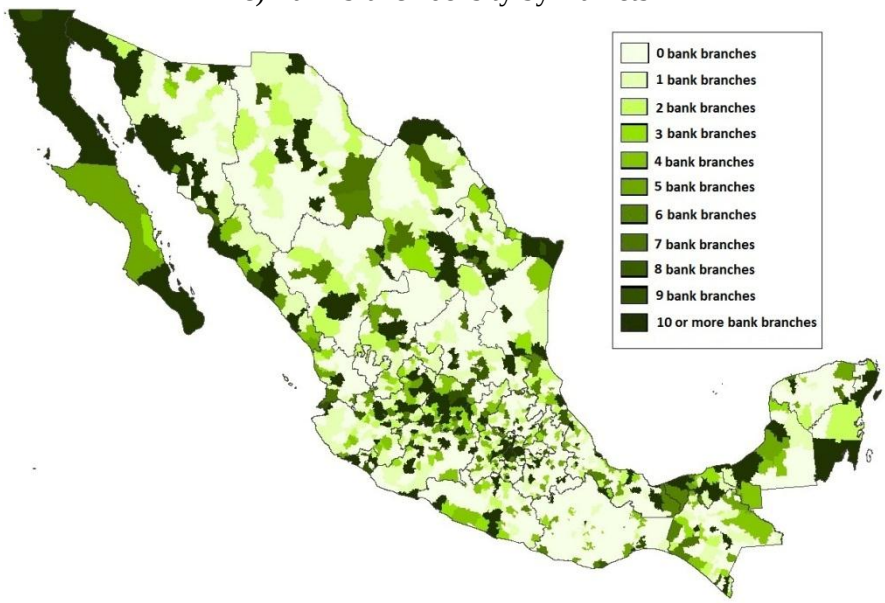
Source: Authors' calculation with CNBV and INEGI data.

b) Population by number of bank branches in their market



Source: Authors' calculation with CNBV and INEGI data.

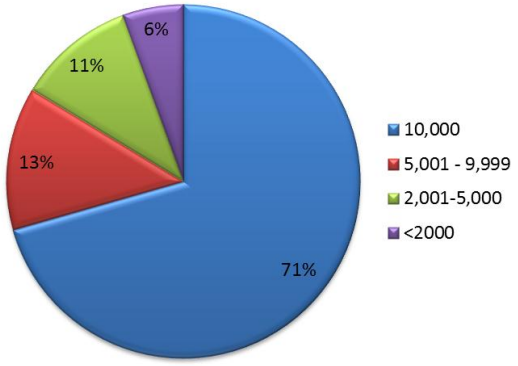
c) Bank branch density by markets



Source: Authors' calculation with CNBV and INEGI data.

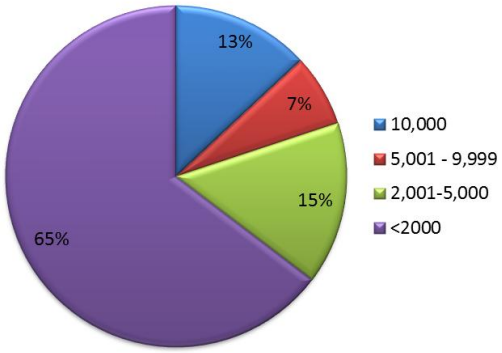
Figure 4: Concentration – Herfindahl-Hirschman index

a) Markets by concentration



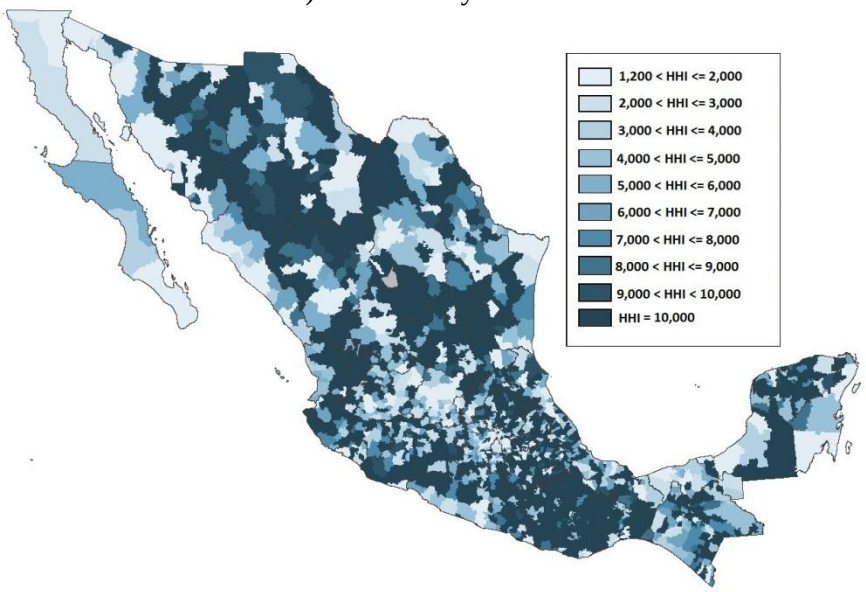
Source: Authors' calculation with CNBV and INEGI data.

b) Population by concentration in their market



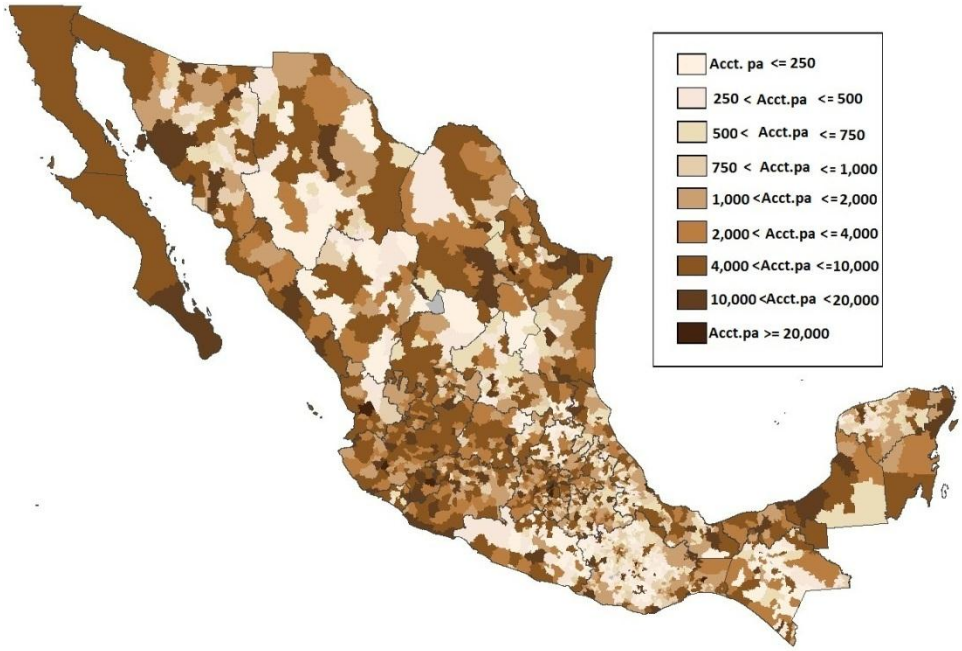
Source: Authors' calculation with CNBV and INEGI data.

c) HHI level by markets



Source: Authors' calculation with CNBV and INEGI data.

Figure 5: Accounts per 10,000 adults (Acct.pa)



Source: Authors' calculation with CNBV and INEGI data.

Table 1: Summary statistics

	Mean	Std Dev	Min	Max
Panel A: Sociodemographic				
Population	51,884	469,333	93	20,116,842
Density	82	145	0.21	2,558
Education	6.38	1.33	2.03	10.51
Income	$1,432	$693	$415	$4,622
Poverty	70%	17%	19%	97%
Gini	0.41	0.04	0.29	0.57
Social Security	62%	18%	2%	99%
Indigenous	27%	37%	0%	100%
Mobile Phone	36%	24%	0%	89%
Telephone	22%	14%	0%	64%
Computer	10%	9%	0%	49%
Panel B: Physical Access				
Branches (per 10,000 adults)	0.41	0.82	0	12.90
ATM (per 10,000 adults)	1.16	3.24	0	69.39
POS (per 10,000 adults)	10.43	26.18	0	487
Panel C: Accounts				
Accounts (per 10,000 adults)	2,445	3,403	3.46	34,977
Panel D: Competition				
Herfindahl Hirschman Index (HHI)	8,480	2,741	1,313	10,000
No. of banks with accts	2.10	2.64	0	32

Notes: Statistics are for local markets (i.e. municipalities or metropolitan areas). Number of observations is 2,167. Physical Access and Use variables are in per 10,000 adults units. HHI not calculated for markets with zero accounts. See Table 6 for definitions.

Table 2: Descriptive regressions

	Accounts	Accounts	Accounts	Accounts	Accounts
	(1)	(2)	(3)	(4)	(5)
HHI	-0.914***	-0.444***	-0.743***	-0.405***	-0.412***
	(0.0186)	(0.0681)	(0.0258)	(0.0626)	(0.0601)
Education			90.25	124.8**	-14.64
			(65.33)	(53.11)	(52.34)
Income (log)		1,161***	1,431***	728.5***	-285.1
		(149.5)	(189.0)	(186.0)	(226.4)
Branches (per 10,000 adults)		1,561***		1,504***	1,402***
		(355.1)		(355.1)	(353.1)
ATM (per 10,000 adults)				8.605	16.04
				(17.16)	(14.10)
POS (per 10,000 adults)				10.53***	7.422***
				(2.988)	(2.700)
Full set of Controls	No	No	No	No	Yes
Observations	2,154	2,154	2,154	2,154	2,152
R-squared	0.620	0.741	0.658	0.746	0.773

Notes: Coefficients are from ordinary least squares regressions with robust standard errors in parenthesis. Markets reporting more than 2 accounts per adult were dropped from the sample. ***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Controls for log population and population density included in specifications 3-5. Additional controls in specification 5 are: poverty, Gini, social security, legal order index, indigenous, telephone, computer, mobile phone and regional dummies. Adults are inhabitants 15 and over. See Table 6 for variable definitions and sources.

Table 3: Determinants of bank entry

	Number of banks (Specification A)	**Number of banks** (Specification B)
Income (log)	2.330***	2.177***
	(0.272)	(0.281)
Education	-0.0353	0.0380
	(0.0754)	(0.0738)
Population (log)	1.418***	0.219
	(0.0897)	(0.231)
Density	-0.000469	-3.45e-05
	(0.000369)	(0.000391)
Population in 2000 (log)		1.262***
		(0.230)
Legal Index		0.00798*
		(0.00412)
Cut 1	30.91***	31.23***
	(2.298)	(2.413)
Cut 2	31.89***	32.24***
	(2.321)	(2.438)
Observations	2,160	2,148
Pseudo R-squared	0.5548	0.5649
LR test $\chi^2(2)$		20.91
P-value of LR test		0.000

Notes: Estimation results from an ordered probit with robust standard errors in parenthesis. ***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Cut 1 and Cut 2 are the threshold values of the latent variable (profit) which determine the observed number of banks in the market. These cut points are statistically different at a 1% confidence level. See Table 6 for variable definitions and sources. The LR test verifies the joint significance of the instruments, Population in 2000 (log) and Legal Index. See Table 6 for variable definitions and sources.

Table 4: Determinants of account penetration

	Accounts	Accounts (corrected A)	Accounts (corrected B)	Accounts	Accounts (corrected A)	Accounts (corrected B)
	(1)	(2)	(3)	(4)	(5)	(6)
2 or more banks with accts	2,249***	1,434***	1,522***	1,216***	990.6***	1,016***
	(224.8)	(247.6)	(255.3)	(305.4)	(229.2)	(243.1)
3 or more banks with accts	3,181***	2,883***	2,902***	2,142***	2,065***	2,072***
	(255.7)	(276.2)	(268.1)	(264.3)	(264.6)	(253.6)
Population (log)	-10.81	155.5***	137.2***	18.79	67.99*	61.26
	(36.97)	(47.33)	(48.68)	(30.47)	(38.90)	(39.48)
Density	0.414	0.303	0.316	0.363	0.329	0.336
	(0.388)	(0.381)	(0.369)	(0.291)	(0.295)	(0.297)
Education	170.8***	201.8***	209.1***	144.2***	152.9***	160.8***
	(61.50)	(65.95)	(64.55)	(50.53)	(51.12)	(52.70)
Income (log)	1,251***	1,481***	1,441***	639.7***	720.7***	698.7***
	(174.2)	(184.1)	(183.0)	(160.6)	(186.8)	(186.8)
Branches (per 10,000 adults)				1,338***	1,303***	1,304***
				(334.1)	(375.0)	(370.5)
ATM (per 10,000 adults)				11.74	10.29	10.89
				(18.00)	(21.46)	(22.30)
POS (per 10,000 adults)				13.66***	13.99***	13.90***
				(3.519)	(4.028)	(3.974)
Endogeneity correction term		768.6***	721.4***		238.5	226.2
		(220.1)	(229.0)		(190.6)	(196.2)
Observations	2,154	2,154	2,142	2,154	2,154	2,142
R-squared	0.688	0.694	0.694	0.766	0.766	0.767

Notes: Odd columns report coefficients from an ordinary least squares regression with robust standard errors in parenthesis. Even columns report coefficients from a second step ordinary least squares regression with bootstrapped standard errors in parenthesis. Markets reporting more than 2 accounts per adult were dropped from the sample. ***, **, and * indicate significance levels of 1%, 5%, and 10% respectively. Controls for log population and population density included in all specifications. Adults are inhabitants 15 and over. See Table 6 for precise definitions and sources.

Table 5: Correlation matrix for variables used in market level regressions

	Accounts (per 10,000 adults)	**Number of banks in mkt**	**Herfindahl-Hirschman Index** (IHH)	**Population** (log)	**Population in 2000** (log)	**Population density**	**Education**	**Income**	**Branches** (per 10,000 adults)	**ATM** (per 10,000 adults)	**POS** (per 10,000 adults)	**Legal Rights Index**	**Poverty Rate**	**Gini**	**Social Security** (% of households)	**Indigenous** (% of population)	**Telephone** (% of households)	**Computer** (% of households)
Number of banks in mkt	0.69	1.00																
Herfindahl-Hirschman Index (IHH)	-0.75	-0.84	1.00															
Population (log)	0.54	0.70	-0.71	1.00														
Population in 2000 (log)	0.55	0.70	-0.71	1.00	1.00													
Population density	0.27	0.48	-0.33	0.44	0.42	1.00												
Education	0.57	0.57	-0.58	0.47	0.46	0.28	1.00											
Income	0.62	0.65	-0.61	0.49	0.49	0.28	0.86	1.00										
Branches (per 10,000 adults)	0.74	0.60	-0.68	0.44	0.45	0.19	0.47	0.54	1.00									
ATM (per 10,000 adults)	0.40	0.39	-0.36	0.28	0.28	0.20	0.33	0.40	0.37	1.00								
POS (per 10,000 adults)	0.58	0.69	-0.61	0.48	0.47	0.24	0.51	0.61	0.53	0.41	1.00							
Legal Rights Index	0.07	0.13	-0.14	0.04	0.04	-0.18	0.14	0.23	0.14	0.15	0.14	1.00						
Poverty Rate	-0.51	-0.49	0.47	-0.31	-0.31	-0.14	-0.81	-0.91	-0.44	-0.35	-0.48	-0.27	1.00					
Gini	0.21	0.22	-0.27	0.44	0.44	0.13	0.19	0.17	0.17	0.11	0.14	0.05	-0.05	1.00				
Social Security (% of homes)	0.13	0.12	-0.13	0.13	0.13	-0.06	0.30	0.30	0.12	0.12	0.13	0.28	-0.34	0.01	1.00			
Indigenous (% of inhabitants)	-0.32	-0.22	0.27	-0.23	-0.25	-0.03	-0.48	-0.45	-0.28	-0.17	-0.20	-0.12	0.50	0.01	-0.20	1.00		
Telephone (% of homes)	0.50	0.44	-0.43	0.31	0.33	0.17	0.58	0.66	0.42	0.27	0.38	0.10	-0.66	0.06	0.17	-0.52	1.00	
Computer (% of homes)	0.68	0.69	-0.66	0.54	0.53	0.30	0.86	0.92	0.58	0.40	0.64	0.22	-0.83	0.21	0.27	-0.44	0.72	1.00
Mobile Phone (% of homes)	0.54	0.49	-0.54	0.49	0.48	0.19	0.77	0.83	0.48	0.32	0.48	0.21	-0.80	0.15	0.31	-0.53	0.54	0.80

Table 6: Variable definitions

Variable	Definition	Source
Population	Total number of inhabitants	INEGI - 2010 Population Census
Population in 2000	Total number of inhabitants	INEGI - 2000 Population Census
Density	Number of inhabitants per square kilometer	INEGI - 2010 Population Census
Education	Average years of schooling	INEGI - 2010 Population Census
Income	Average monthly income per capita	CONEVAL - 2010 Report on Poverty
Poverty	Percentage of population below the poverty line	CONEVAL - 2010 Report on Poverty
Gini	Municipal Gini coefficient	CONEVAL - 2010 Report on Poverty
Social Security	Percentage of population registered with social security	INEGI - 2010 Population Census
Legal Order Index	State-level index indicating reliability and objectiveness of the legal system.	IMCO - 2006
Indigenous	Percentage of inhabitants self-identified as indigenous	INEGI - 2010 Population Census
Mobile Phone	Percentage of homes with at least one mobile phone	INEGI - 2010 Population Census
Telephone	Percentage of homes with a fixed telephone line	INEGI - 2010 Population Census
Computer	Percentage of homes with a computer	INEGI - 2010 Population Census
Branches (per 10,000 adults)	Number of commercial bank branches per 10,000 adults	CNBV - Financial Inclusion, April 2011
ATM (per 10,000 adults)	Number of automatic teller machines per 10,000 adults	CNBV - Financial Inclusion, April 2011
POS (per 10,000 adults)	Number of points of sale per 10,000 adults	CNBV - Financial Inclusion, April 2011
Accounts (per 10,000 adults)	Number of deposit accounts per 10,000 adults	CNBV - Financial Inclusion, April 2011
HHI	Herfindahl-Hirschman Index calculated using banks' share of the number of accounts in each market	CNBV - Financial Inclusion, April 2011
No. of banks with accts	Number of banks registering at least one account in the municipality	CNBV - Financial Inclusion, April 2011