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Are credit unions in Ecuador achieving economies of scale?

Nick A. Marchio
Macalester College, namarchio@gmail.com

MACALESTER COLLEGE

Are credit unions in Ecuador achieving economies of scale?
Testing the tradeoff between access and efficiency

Nick Marchio

Professor Gary Krueger

Economics Department

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Abstract: This study tests the assertion that membership growth in credit unions is constrained by their unique structural features, such as their non-profit mission and member-based ownership. Although these features enhance inclusiveness, existing theory suggest that they work against efficiency when membership grows too diffuse. To address this issue, this study uses a model that takes into account existing theory on constrained-optimization in credit unions and theory on the adverse effects of diffuse ownership. Using data on 36 public credit unions in Ecuador, the empirical analysis finds evidence that credit unions can achieve economies of scale despite their problematic structural features. One possible explanation for this result may stem from the level of formality in Ecuador's financial system including its level of prudential regulation, information technology, and capital market formation. Moreover, the optimal credit union size may be a function of institutional and technological development in addition to their unique structural features. This conclusion has important implications on policies aimed at expanding credit access in developing financial markets.

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1. Introduction:

When I arrived in Ecuador for my semester abroad, my goal was to better understand problems surrounding credit access. As it turned out, I was able to volunteer at a small private credit union in Quito. Unfortunately, this credit union was on the brink of insolvency, having over $80,000 in delinquent loans. To make matters worse, the accountant left earlier that year for a better paying position and the former manager quit after stealing $10,000 from the savings portfolio. Although this volunteer experience was a bit dispiriting, it highlighted some of the most critical problems facing credit providers in developing countries.

Specifically, these problems are known as agency problems, which include managerial expense-preference (demonstrated in the manager's rent-seeking behavior) and member delinquency (shown through the cascading failure of members to repay loans). Existing theory (Branch and Baker (1998), Labie and Perilleux (2008)) states that agency problems usually result from diffuse ownership, meaning that credit unions with more members are more susceptible. Paradoxically, in my case the credit union was small and private, which according to theory means it should exhibit fewer problems. To confound matters further, throughout the city large public credit unions were flourishing.

As a result, my attention turned to the question of formality, which was the variable differentiating my small private credit union from the larger credit unions in Ecuador. Formal institutions could be the confounding variable because they provide transparency and accountability, which in turn reduce the information asymmetries that lead to agency problems. Ecuador is known for its relatively well-developed institutions[1] (Branch and Baker, 1998: 24) including its system of prudential regulation, contract enforcement, and capital markets. This

[1] Institutional development as understood as the process of formalizing 'the rules of the game' that define relationships of trust.

explanation would reconcile theory and evidence because it explains why smaller private credit unions outside the formal financial system may have more agency problem than larger public credit unions within the formal financial system.

To address the possibility that formal institutions reduce agency problems, this paper examines 36 public credit unions[2] within Ecuador's formal financial system and uses a testable model that generates the optimal size in terms of members. If the optimal size is relatively large, then it suggests that a formal financial system enables credit unions to attain higher levels of access and efficiency despite their member-based ownership structure. What the empirical analysis finds is that the optimal credit union size is relatively large, resulting in three implications: (1) credit unions may not be as growth constrained as previously thought, (2) the optimal credit union size is most likely determined by the level of institutional development in addition to its organizational structure, and (3) credit unions can serve as an effective vehicle for expanding credit access despite existing perceptions.

This paper is organized as follows: Section 2 reviews the background and literature; Section 3 develops a conceptual model that determines the optimal membership level; Section 4 assembles the empirical model; Section 5 discusses the data and the specifications; Section 6 explains the methodology, analyzes the empirical finding, and provides anecdotal support; Section 7 concludes.

[2] According to the Cooperative Law of Ecuador No. 1031 of September 7, 1996, General Law on Institutions of the Financial System No. 72, and the Executive Decree No. 1227 of March 19, 1998, credit unions are defined as "private-sector societies, made up of individuals or entities which, without pursuing profit, take in savings and deposits, make discounts, grant loans to their members and make payments and collections on their account" (WOCCU, 2005: 318).

2. Literature Review:

Levine (1997) shows that credit is a central force in the process of development and more generally in the process of wealth creation. In developing countries the persistent lack of credit is a major obstacle to growth with an estimated three billion people lacking access to basic financial services (Helms, 2006: 1). The chief driver of credit scarcity is uncertainty faced by creditors when measuring borrower risk.[3]

Two popular strategies for expanding credit access under conditions of uncertainty stem from Yunus (1999) and de Soto (2000). Yunus (1999) promotes the microfinance model, which transfers risk from creditors to borrowers through group-based lending (Stiglitz, 1990: 351-353).[4] Developing a more system-wide approach, de Soto (2000) identifies the underlying causes of credit scarcity, namely the high costs of obtaining property rights, the lack of contract enforcement, and overly complex legal systems. Minimizing the costs of obtaining formal proof of creditworthiness enhances transparency and enables creditors to more formally ascertain borrower risk.

Although the above approaches have successfully increased credit access, one alternative overlooked in the literature is the credit union model. In 2007 credit unions numbered over 2,500 with more than $30 billion in assets in Latin America (WOCCU, 2008: 3). In terms of membership, credit unions in Latin America grew from 23 to 30 million members in 2007, an

[3] This uncertainty is due to the high costs of processing borrower information, which either (1) forces creditors to charge inflated interest rates to individuals with no credit history or (2) forces borrowers to enter the formal credit system which may have relatively high barriers to entry, especially in developing countries as argued in de Soto (2000). Individuals that cannot afford either of these options must self-finance, slowing their economic mobility and reinforcing intergenerational poverty. Therefore, findings ways to lower the costs of processing information on borrower risk is an important part in integrating more people into financial markets, increasing investment, and improving growth rates.

[4] In microfinance borrower risk is processed through peer-monitoring since additional financing is conditional upon the successful repayment each group member's loan. Another advantage of microfinance is that borrowers have access to decentralized information, making them better situated to process risk and select a group with a higher probability of loan repayment (reducing adverse selection).

annual growth rate of 25% (WOCCU, 2008:3; WOCCU, 2007:3). Credit unions merit further academic inquiry (especially in the context of expanding credit access) because they avoid the lending requirements of formal banks while offering credit at competitive interest rates due to member-based ownership. In addition, credit unions may be an appealing alternative for policymakers because they avoid the donor-based financing needed in microfinance (Grameen-style) and the challenge of raising bureaucratic efficiency in granting property rights as argued in de Soto (2000). The relatively greater market capture of credit unions compared to Microfinance Institutions (MFIs) (Figure 1) and the unchanging status of property rights reform (Figure 2) show the appeal of credit unions as a way to expand credit access.

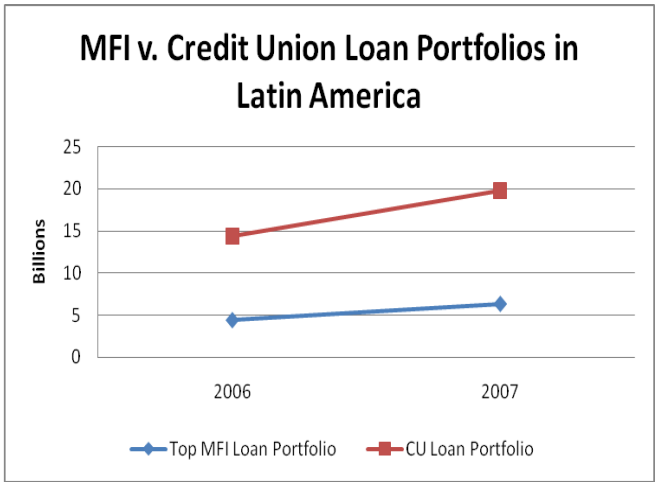

Figure 1: Source IDB (2008) and WOCCU (2007), (2008) **Figure 2:** Source World Bank Group (2008)

On the other hand, credit unions face several disadvantages related to their organizational structure such as their non-profit mission, unclear fiduciary responsibilities, non-tradeable shares, and a one-person one-vote governance structure (resulting in unclear property rights). While these features achieve a higher level of access and inclusiveness, they detract from efficiency and make credit unions susceptible to agency problems. Branch and Baker (1998) and Labie and Perilleux (2008) theorize that membership growth exacerbates these defects and deteriorates the ability of principal(s) to monitor agents' decisions and minimize information asymmetries.

Due to this relationship there is a tradeoff between access and efficiency in credit unions. Leggett and Strand (2002) lend empirical support to this view by showing that membership growth contributes to expense preference in management and worse performance. Additionally, Desrochers and Fischer (2002) find empirical evidence that diffuse ownership is a major cause of insolvency and institutional failure in credit unions. Frame et al. (2002) show that credit union membership expansion dilutes the information advantages associated with a tight common-bond of association, even though it reduces risk concentration and raises investment opportunities. Branch and Baker (1998) and Labie and Perilleux (2008) offer several ways to mitigate agency problems in credit unions in order to raise both accessibility and efficiency (see Table 1).

Authors	Structural Issue	Resulting Agency Problem	Solution
Branch and Baker (1998).	Members are clients as well as owners.	Can develop into borrower domination of board of directors.	Require that board is composed of savers, penalize mismanagement, and adopt rules to prevent conflicts of interest.
	One person one vote: all shares are given equal weight in voting.	Causes dilution of property rights and a free riding mentality. Less incentive to exercise fiduciary responsibilities.	Allow external supervision and offer competitive financial services to maintain member interest.
	Low income owners without high levels of business expertise.	Leads to a board of directors without necessary financial knowledge.	Require that the board is composed of professionals.
	Diffuse ownership.	Higher separation between ownership and control, makes monitoring costly.	Board that efficiently constrains managerial decision making. Maintain internal controls and oversight of the board.
	Non-profit objectives can obscure the need for high managerial compensation.	Low managerial compensation can lead to poor performance. Board may be unwilling to offer competitive wages.	Efficiency wages are needed to attract professionals with the necessary technical skills for running a large credit union.
Labie and Perilleux (2008).	Non-tradeable shares and no market for corporate control.	Leads to "expense preference" when managers do not act in the interests of owners.	Managerial compensation tied to performance, external and internal supervision.
	Managerial "entrenchment".	Managers exploit informational monopoly.	Avoid excessive concentration of managerial responsibilities.
	Information is not communicated between members and board.	Board may not promote interests of owners.	Board rotation and require regular contact with members.
	Professionals and volunteers define the mission of credit union differently.	Professionals favor economic efficiency over social objectives.	Established integration process to maintain credit union social mission.
	When membership expands the bonds of association deteriorate.	Leads to free riding attitudes, less scrutiny of governance, and less peer monitoring.	Maintain rigorous membership requirements.
	Increased complexity of services and products.	Leads to less member knowledge and thus less control.	To be eligible for board member must be a business professional.
	Credit union networking and the consolidation of different institutions.	Conflict between central and local governance levels, weakens internal control of credit union.	Adopting standardized rules and control mechanisms in networked credit unions.

Table 1

Table 1's solutions mainly focus on improving the institutions surrounding credit union governance to increase the monitoring of agents' decisions. The emergence of these institutions is closely associated with the formalization of a financial system. One developing country with many of these institutional features is Ecuador, which is specifically identified in Branch and Baker (1998). These institutional features include a relatively rigorous system of prudential regulation[5] and some capital market formation permitting corporate consolidation and economies of scale. Economies of scale improve monitoring in two ways: [6] (1) they enable credit unions to exploit information technologies to more accurately measure borrower risk, screen loans, and manage accounting information[7] and (2) they make it possible to hire full-time lawyers and collections officers to strengthen contract enforcement, to create stronger loan repayment incentives, and to lengthen members' time-horizons (as the risks of insolvency decline). Moreover, the benefits of economies of scale contribute to improved monitoring capabilities and fewer corporate governance issues. Figure 3 and 4 offer conceptual models that show the effect of institutional and technological improvements on the optimal size of credit unions.

[5] In terms of regulations, the Superintendency of Banks in Ecuador requires public credit unions to employ officials (including managers, directors, and members of supervisory committees) that meet a host of technical and experiential requirements (such as university degrees in economics or a finance related field), utilize internal and external auditors, hold managers liable for losses (with their own assets), and elect a supervisory committee in addition to the board of directors. If necessary the Superintendency can impose civil and penal sanctions, remove the board of directors and designate a controller in their place, and file an involuntary liquidation order (WOCCU, 2005: 318). Also credit unions must maintain high capital reserves, limit loan concentration, provision for losses, and write-off delinquent loans (Branch and Baker, 1998: 28-30). As a whole this system of prudential regulation is relatively rigorous and provides monitoring procedures to compensate for the lack of member monitoring that occurs under diluted ownership.

[6] Consolidation allows credit unions to have higher financial capabilities, improved liquidity management, and greater job specialization (Labie and Perilleux, 2008: 5). Wheelock and Wilson (2008) confirm these advantages by providing evidence of increasing returns to scale from consolidation in US credit unions.

[7] These improvements enhance managerial control by improving information management, leading to narrower information asymmetries and lower delinquency rates. Goddard et al. (2008) offer evidence of this relationship, showing a strong correlation between credit union consolidation and the use of information technology.

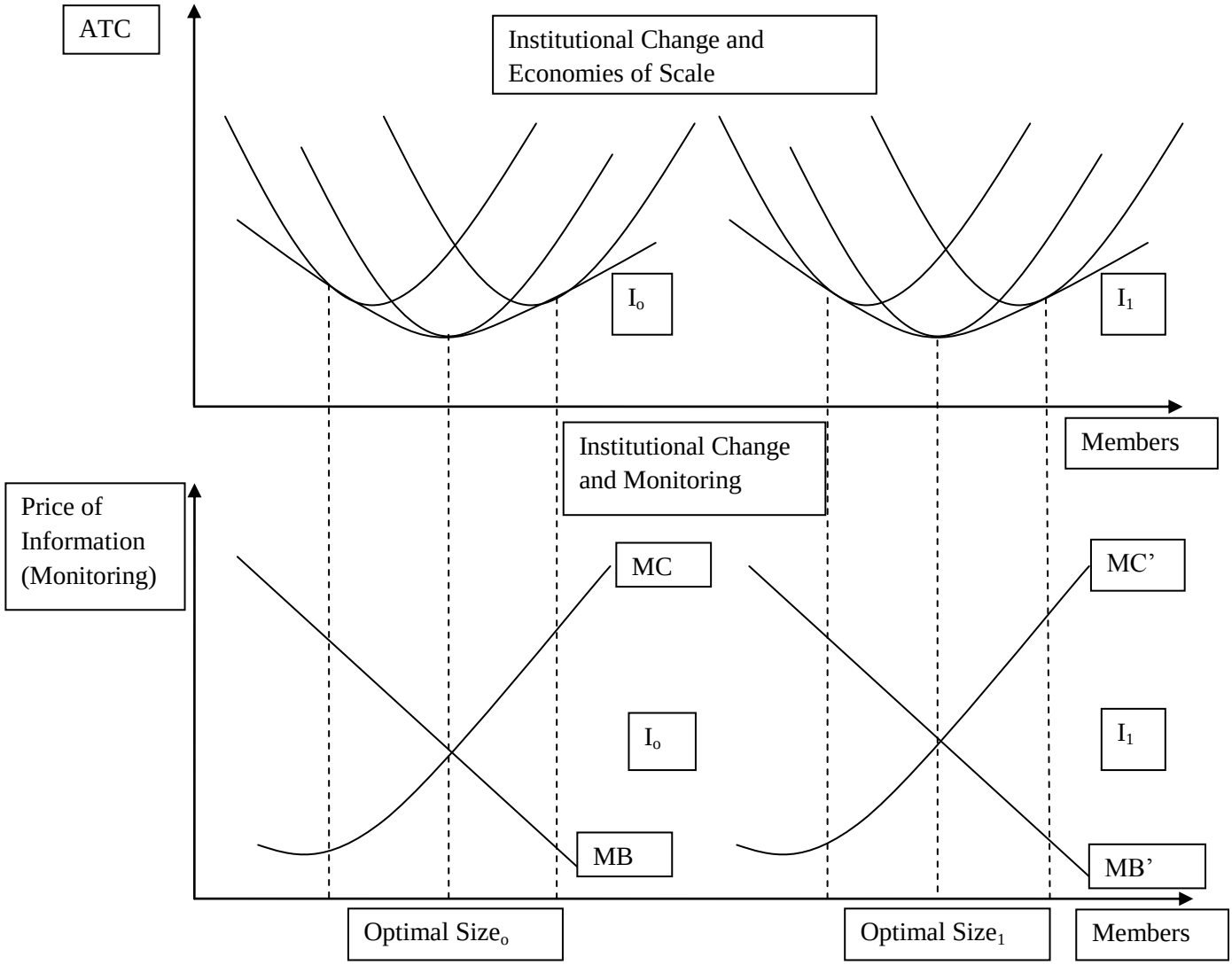

Figure 3: The shift from I_0 to I_1 represents an improvement in the level of institutional development causing a shift in the Long Run Average Total Cost Curve thereby permitting a higher optimal size. In the bottom figure, the change from I_0 and I_1 causes a shift in the Marginal Cost of Information curve (representing the cost of monitoring). As membership moves beyond the optimal point, the marginal cost of information exceeds the marginal benefit causing information asymmetries and agency problems (which is subsequently reflected in the increasing Average Total Cost curve above). In sum, the shift from I_0 and I_1 causes a change in the cost structure of information which enables credit unions to achieve a larger optimal size.

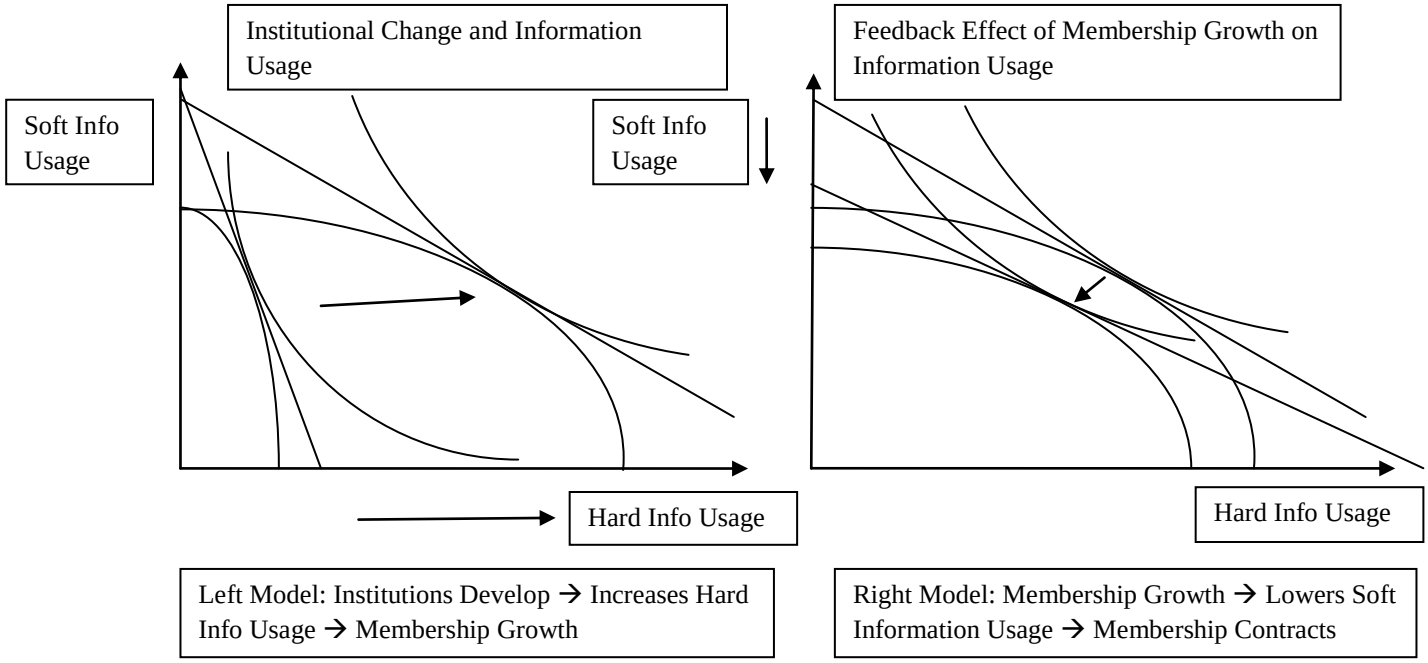

Figure 4: Information falls into two categories: soft (which is tacit and accumulated over time through repeated interactions) and hard (which is quantifiable and thus easily communicated with technology). Advances in information technology lower the price of hard information, allowing credit unions to grow (shown in the shift in the left model). However, one potential feedback effect of increased reliance on hard information is that soft information becomes more costly to gather due to diffuse ownership (shown in the shift in right model). This feedback effect forces credit union size to contract in order to restore the optimal balance between hard and soft information.

Given the relationship between institutional and technological development and the optimal size of credit union size, it appears that formalizing a financial system is an effective way to expand credit access. Although the explicit social and communal features fall to the wayside as credit unions enter the formal system and grow, the net effect is a more resilient, more efficient, and overall more inclusive financial system as asserted in Jones (2006). This paper builds from this perspective and tests if the credit unions within Ecuador's formal system can attain both efficiency and accessibility.

The lack of attention given to credit unions in development discourse suggests that theoretical misconceptions exist about their optimal size in developing countries. When attention is given it is often confined to the informal context, a setting well known for mixed

credit union performance (creating a bias against credit unions).[8] What this study does differently is it hones in on Ecuador and theorizes that its nascent formal financial system enables credit unions to grow larger than expected and achieve economies of scale (while minimizing agency problems).

3. Theory:

From a theoretical standpoint, to determine the optimal size of credit unions it is necessary to use theory on constrained-optimization in credit unions. The following section lays the foundation for this process by identifying: (1) the objective function of credit unions, (2) the budget constraint, and (3) the effects of growth (measured in terms of members).

First, one of the defining features of credit unions is their unique objective function due to member based ownership and control. Members exercise control in annual elections where they vote for a board of directors under a one-person one-vote system. As a result, to understand the utility-maximizing behavior of members it is necessary to define their voting objectives. Smith (1984) does this by dividing members into two groups: net borrowers (members that have more loans than savings) who maximize their Net Gain on Loans (NGL) and net savers (members that have more savings than loans) who maximize their Net Gain on Savings (NGS).[9] Smith (1984) provides the following:

$$U_{Members} = f\,(\text{Net Gain on Loans}^{j}, \text{Net Gain on Savings}^{j}) \qquad (1)$$

[8] The valuable development text Perkins et al. (2006) confines discussion of credit unions to the agrarian context, leaving out the more varied and complex history of credit unions in development. Also discussion of credit unions as a development model is missing in important Latin American development texts such as Franko (2006).

[9] Smith (1984) makes the following assumption: (1) credit unions offer uniform rates across members, (2) alternative rates always exist and all members face the same alternatives, (3) other aspects that increase member utility such as service and product quality are neglected, (4) the relative differences between credit union rates and competitor rates drives membership demand, (5) all savings and loans have a maturity of one period (Smith, 1984: 1156-1158).

$$\text{Net Gain on Loans}^j = (r^j_{LM} - r_L) \quad (2)$$

$$\text{Net Gain on Savings}^j = (r_S - r^j_{SM}) \quad (3)$$

Equation 2 shows Net Gain on Loans (NGL) as the difference between the market loan rate (r^j_{LM}) and credit union's specific loan rate (r_L), so net-borrowers seek to maximize NGL by electing directors that distribute profits through cheaper interest rates on loans. On the other hand, Equation 3 shows Net Gain on Savings (NGS) as the difference between credit union savings rate (r_S) and the market savings rate (r^j_{SM}), so net-savers seek to maximize NGS by electing directors that distribute profits through higher interest rates on savings (similar to the concept of a dividend). Due to data constraints this study utilizes NGL as the dependent variable, but excludes NGS.[10]

The second step in constrained optimization involves constructing a budget constraint. Building from Smith (1984), Bauer (2006) develops a workable budget constraint for credit unions.[11] Bauer (2006) provides the following:

$$B = r_L L - r_S S - r_{DM} D - C(L,S) - \Delta K \geq 0 \quad (4)$$

This budget constraint (B) shows net revenue generated from loans ($r_L L$), net dividends paid on savings accounts ($r_S S$), the interest rate on liabilities interacted with total liabilities ($r_{DM} D$), the costs associated with the level of loans and savings (C(L,S)), and change in capital reserves (ΔK). Furthermore, this study examines how well credit unions can maximize NGL subject to these constraints; accordingly the above variables are the basis for this study's explanatory variables. For visual benefit, Figure 5 illustrates this process of constrained-

[10] Recognizing the risk of omitted variable bias due to the exclusion of NGS, its worth saying that in general savings and loans rates are highly correlated and tend to diverge only in cases of extreme preferences towards net-savers or net-borrowers in the board of directors (Branch and Baker, 1998: 17). By using fixed effects it is possible to control for these cases and reduce the loss of information.

[11] Bauer (2006) makes the following assumptions: (1) loan and savings rates are homogenous for all members, (2) increases in NGL and NGS benefit all members holding all else equal, (3) the board of directors represent the preferences of the members, (4) the median director's preference is the preference of the institution, and (5) the preferences of the median director do not change (Bauer, 2006: 5-6).

optimization. It shows that as the budget constraint shifts outward the credit union moves to a higher indifference curve thereby optimizing the average member's utility. Moreover, rightward movements of the budget constraint signal improved performance in terms of NGL and NGS.

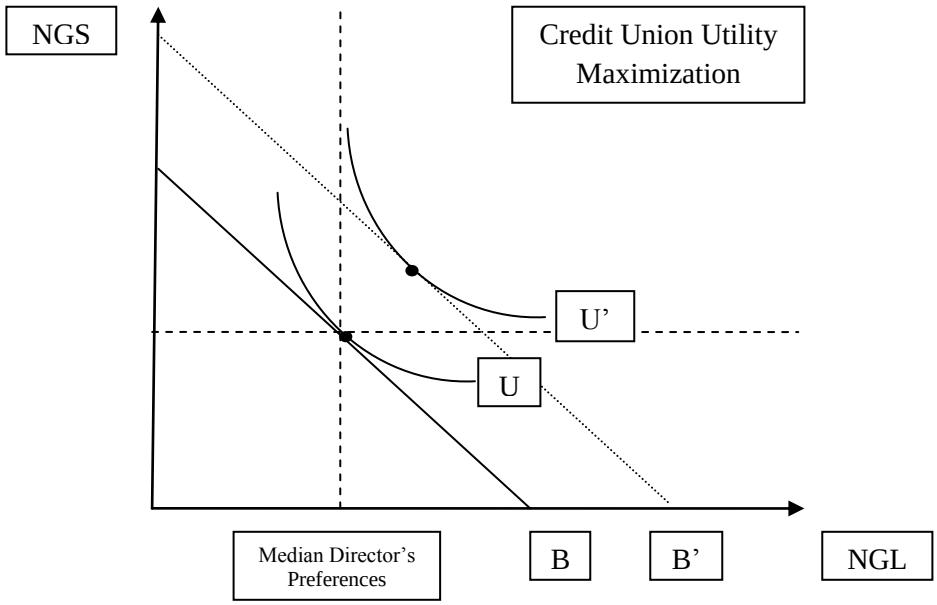

Figure 5 Borrowed from Bauer (2006).

Finally the third step is to add a variable accounting for the effects of growth (in terms of members) to the budget constraint.[12] The relationship between membership growth and NGL performance is expected to follow a non-linear, inverted U-shape path. As membership expands credit unions experience returns to scale due to greater specialization of job functions and an improved ability to finance the loan portfolio. Yet as membership exceeds a certain level, the increased separation of ownership and control leads to worse NGL performance. Moreover, this relationship implies an optimal size in terms of members (See Figure 3).

[12] Theoretical works on the subject of organizational growth date back to Coase (1937) with the theory of organizational hierarchies and transaction costs. More recently, Fama and Jensen (1983) describe how heightened organizational growth (and subsequent complexity) leads to increased separation between ownership and control. Although certain efficiencies are achieved in the separation of risk bearing and management functions, as a firm grows and information becomes more diffuse the cost of transferring information creates information asymmetries. To minimize these asymmetries and properly monitor agents' decisions, the management and control of decisions must be delegated throughout the organization.

The cause of the inverted U-shape path is the one-person one-vote system mentioned earlier which fixes ownership to the number of members rather the amount each has deposited. This voting system exacerbates separation between ownership and control because as membership grows the marginal voting power of each member decreases, leading to less control and unclear property rights. As the dilution of ownership worsens, members become more disassociated with credit union governance leading to less oversight, free riding, and more delinquency. To handle increased borrower risk, managers raise nominal interest rates, negatively affecting NGL performance. Equation 5 and 6 connect the concepts of membership growth, ownership dilution, and nominal interest rates:

$$i_t^j = r_{t+1} + \pi_{t+1} + \theta^j \qquad (5)$$

$$\theta^j = 1 / \left(\frac{s^j / s^J}{J} \right) + \varepsilon \qquad (6)$$

Equation 5 expresses the nominal interest rate on loans (i_t^j) to the j^{th} member in time t as a function of the expected real interest rate (r_{t+1}), the expected inflation rate (π_{t+1}), and borrower risk of the j^{th} member (θ^j). Equation 6 represents borrower risk as a function of ownership dilution (where S^j/S^J represents the share dilution of j^{th} member's deposit and J represents total members) and uncertainty (ε). Although Equation 6 is more heuristic than theoretical, it shows that increases in ownership dilution cause borrower risk to increase, thereby raising interest rates and adversely affecting NGL.

Having completed this constrained-optimization model taking into account the effects of growth, the next stage puts this theory into a testable form.

4. Methodology:

This study divides the econometric methodology into two stages. The first stage constructs a model using theory in section 3. The second stage addresses the central question of this paper by estimating the optimal size in terms of members. Combining Equation 2 (the credit union objective function), Equation 4 (the budget constraint), Equation 5 and 6 (the effects of membership growth), and a few control variables it is possible to obtain the following:

$$NGL = \beta_0 + \beta_1 R + \beta_2 E + \beta_3 G + \beta_4 DC + \beta_5 NC + \beta_6 KC + \beta_7 AD + \beta_8 r_{LM} + \beta_9 P + \beta_{10} M + \beta_{11} M^2 + \varepsilon \quad (7)$$

Revenue Variables Cost Variables Control Variables Membership Growth

Equation 7 shows the process of constrained optimization in credit unions. It shows net gain on loans (NGL) as a function of variables that represent revenue, cost, controls, and membership growth. The **revenue variables** are composed of profitability (R), managerial efficiency (E), and managerial expense (G) a proxy for the quality of managers or level of monitoring. The **cost variables** are composed of debt performance (DC), the cost of non-performing loans (NC), and the cost of setting aside capital reserves (KC). The additional **control variables** include asset diversification (AD) and differenced market interest rates (r_{LM}) which conveys information about real interest rates, competitiveness, and inflation. The variables (M and M^2) account for size in terms of **membership growth** and its polynomial functional form. Finally, fixed effects dummies (P) control for varying characteristics across credit unions and whether the credit union is biased towards net-savers or net-borrowers.

After estimating the coefficients, the calculation for finding the optimal membership level is expressed in Equation 8:

$$\frac{\partial NGL}{\partial M} = \beta_{10} + 2\beta_{11} M \quad (8)$$

It is possible to calculate the optimal membership level by setting Equation 7 equal to zero and solving for M. In the context of this study the optimal credit union size is considered a function of Ecuador's specific institutional features in addition to the specifications in Equation 7. This assumes that all credit unions are subject to the same institutional conditions, which is reasonable given that all credit unions are large, public (no common bond), and regulated by the same government agency.

5. Data:

The data set is from 36 credit unions in Ecuador at the monthly frequency from a period between the December 2005 and August 2008. The source of the data set is the Superintendency of Banks (*Superintendencia de Bancos y Seguros*) in Ecuador. In total there are 1110 observations and eight explanatory variables in each model. In Ecuador public credit unions are required to file monthly reports that include "balance sheets, operating statements, statements of financial position and equity using the formats, scope and regularity and accounting rules established for them" (WOCCU, 2005: 318). The data in this study are from these monthly financial reports and available through the Superintendency of Banks public database. Table 2 reports the measurements, expected signs, and summary statistics of the dependent and explanatory variables.[13] The data set is balanced.

Dependent Variable: Net Gain on Loans
NGL = Avg. Market Interest Rate – Credit Union Interest Rate (Mean 0.9, Standard Deviation 1.3)

Explanatory Variables	Measure	Expected Sign	Mean (Standard Dev.)
Primary Specifications			

[13] In literature that examines credit union performance, the preferred measure of variables are typically financial ratios (Richardson, 2002; Frame et. al, 2002; Leggett and Strand 2002; Braga et. al., 2006; Desrochers and Fischer, 2002). Financial ratios offer a reasonable approximation of the conceptual model by accounting for the major determinants of revenue, cost, and changes in business, in spite of being rough approximations.

Revenue Variables			
Return on Assets	Net Income / Average Assets	+	9.2 (7.3)
Efficiency	Operational Expense / Financial Margin	+	82.4 (51.8)
Monitoring	Managerial Expense / Average Assets	+/−	3.9 (1.6)
Cost Variables			
Debt Performance	Productive Assets / Expense on Liabilities	+/−	130.0 (33.1)
Delinquency Cost	Delinquency Rate	−	4.9 (2.7)
Capital Reserves	Capital Provisions / Delinquent Loans	+/−	305 (2,105)
Control Variables			
Alternative Interest Rate	Avg. Interest Rate (Not Differenced)	+	14.5 (2.4)
Asset Diversification	Assets (Not Natural Logged)	+	28.9m (25.3m)
Membership Variables			
Members	Number of Members	+	50,412 (63,747)
Members Squared	Number of Members^2	−	6.6E+09 (2.1E+10)
Member Preferences	Fixed Effects Dummies		
Alternative Specifications			
Alt. Revenue Variables			
Return on Equity	Net Income / Average Equity	+	1.8 (1.6)
Alt. Cost Variables			
Vulnerability	Delinquent Loans / (Net Income + Equity)	−	14.0 (14.7)
Liquidity	Available Funds / Short Term Deposits	+/−	18.9 (11.3)

Table 2 Source: Superintendency of Banks, Ecuador 2008

The dependent variable is net gain on loans (NGL) and is determined by the average interest rate on loans for a period longer than one year subtracted by the individual credit union's interest rate. The expected signs of the explanatory variables are straightforward. Return on assets, efficiency, and monitoring expense account for the **revenue side** of the budget constraint and should improve NGL performance. On the other hand, debt performance, [14] delinquency costs, and capital reserves account for the **cost side** and are expected to detract from NGL performance. For the sake of robustness, alternative specifications on the cost side include vulnerability (substituting for delinquency costs) and liquidity (substituting for capital reserves). One alternative specification for the revenue side is return on equity (substituting for return on

[14] Note that larger values of debt performance signify improvements.

assets).[15] **Control variables** include alternative market interest rates (differenced average of all credit union interest rates) and asset diversification as measured by the natural log of total assets, which should be positively related to NGL performance. The last explanatory variables account for **membership growth**, where positive effects dominate at lower levels of membership and negative effects at higher levels.[16]

6. Results and Analysis:

This section offers description and analysis of the regression results and the estimated optimal size. It concludes with some anecdotal support of the role of institutions on credit unions.

6.1 The Regression Results:

After running a series of diagnostics, the regressions in Table 2 appear to not suffer from severe multicollinearity or serial correlation, but have significant heteroskedasticity and require fixed effects.[17] Heteroskedasticity is corrected through the use of adjusted standard errors and generalized least squares estimation.

Dependent Variable: Net Gain on Loans Fixed Effects Model				
Explanatory Variables	**Model 1.1 (Within)**	**Model 1.2 (Within)**	**Model 2.1 (GLS)**	**Model 2.2 (GLS)**
Primary Specifications				

[15] Although the revenue and cost variables generally should increase or decrease NGL, respectively, theory does not provide a consensus on the sign for monitoring, debt performance, capital requirements, and liquidity. As a result, as shown in Table 2 the expected signs for these variables are both positive and negative.

[16] Due to a break in the data set, this study generated three rows of entries to fill in missing data on membership levels using a moving average over the missing dates.

[17] According to the Wooldridge test for serial correlation in panel data, the insignificant test statistic of 0.0746 accepts for now the null hypothesis of no autocorrelation. For more detail on the Wooldridge test see Wooldridge (2002) and Drukker (2003). Using a likelihood ratio test between two iterated GLS models with and without heteroskedasticity, the significant test statistic of 0.000 rejects the null hypothesis that there is no heteroskedasticity. Finally according to a random effects versus fixed effects Hausman test, the significant test statistic of 0.000 rejects the null hypothesis of no systematic difference in the coefficient estimates. Inefficiencies from multicollinearity are tolerated for two reasons: (1) dropping collinear variables does not severely alter coefficients and (2) it was not worth the risk of creating specification bias by omitting theoretically specified variables.

Revenue Variables				
Return on Assets	.2580 (5.92)*		.3055 (12.49)*	
Efficiency	.0005 (1.06)	.0003 (.570)	.0008 (1.24)	.0007 (1.03)
Monitoring	.1402 (1.67)	.1193 (1.43)	.0595 (0.98)	.0460 (0.76)
Cost Variables				
Debt Performance	-.0105 (-6.14)*		-.0115 (-6.58)*	
Delinquency Cost	.1119 (4.04)*	.1286 (4.00)*	.1116 (5.22)*	.1215 (5.60)*
Capital Reserves	4.2e-5 (80.56)*		4.2e-5 (3.40)*	
Control Variables				
Alternative Interest Rate	.2561 (26.69)*	.2578 (29.89)*	.2647 (12.91)*	.2570 (12.09)*
Asset Diversification	2.1082 (5.67)*	2.0249 (5.20)*	1.6486 (7.50)*	1.6896 (6.89)*
Membership Variables				
Members	9.96e-6 (2.06)*	9.07e-06 (1.58)	1.49e-5 (4.08)*	1.46e-5 (3.93)*
Members Squared	-1.93e-11 (-2.35)*	-1.54e-11 (-1.65)	-2.72e-11 (-3.83)*	-2.40e-11 (-3.38)*
Member Preferences	Fixed Effects	Fixed Effects	Dummies	Dummies
Alternative Specifications				
Alt. Revenue Variables				
Return on Equity		.04287 (4.18)*		.0544519 (10.48)*
Alt. Cost Variables				
Vulnerability		-.0036 (-.80)		.0016 (0.53)
Liquidity		-.0017 (-.32)		-.0012 (-0.23)
R^2	0.27	0.26		
Wald Chi^2			627.44	567.08

Table 3 *Denotes Significant at 5% Level

Again, the results are classified into four categories: revenue variables, cost variables, control variables, and membership growth variables. All variables had signs consistent with theory, except cost variables which were more ambiguous. A possible explanation for the ambiguous signage on costs could be that changes in cost do not necessarily factor into managers decisions to distribute profits through NGL (further research is necessary to substantiate this claim). In addition, all variables were significant at the 5% level except for efficiency and monitoring and the alternative cost variables. Although it is somewhat problematic that efficiency and monitoring (and to a lesser extent the alternative cost variables) are not significant, these measures may simply lack sufficient information to fully account for the specified concepts (especially since both are based upon measures of cost efficiency).

In terms of coefficients, changes in return on assets and asset diversification are shown to have a very strong positive effect on NGL performance. Further, it appears that the quality (return on assets) and quantity (asset diversification) of assets play a very important role in determining the amount of profits distributed through interest rates on loans (or, said differently, increases in NGL). Having briefly interpreted the regression results, it is time to estimate the optimal credit union size.

6.2 Estimated Optima:

Assuming that the conceptual model is theoretically valid and well specified, the next step is to use Equation 8 to calculate the optimal credit union size in terms of members. Table 4 shows the results according to the four separate models — each using the respective specifications and estimation techniques from the regressions' models. All four estimated optima are weighted towards the larger side of the sample, putting the optimal size over 250,000 members.

	Model 1.1 (Within)	**Model 1.2 (Within)**	**Model 2.1 (GLS)**	**Model 2.2 (GLS)**
Estimated Optima	258,031	294,480	273,897	304,166

Table 4

Given that Model 1.1 provides the most conservative estimate and is the closest to theory in terms of specifications and estimation technique, this model's stability can be tested with bootstrap replications. The bootstrap results (presented in Figure 6) show that the minimum and maximum estimates for each set of replications display signs of convergence, indicating some stability in the estimated optima.

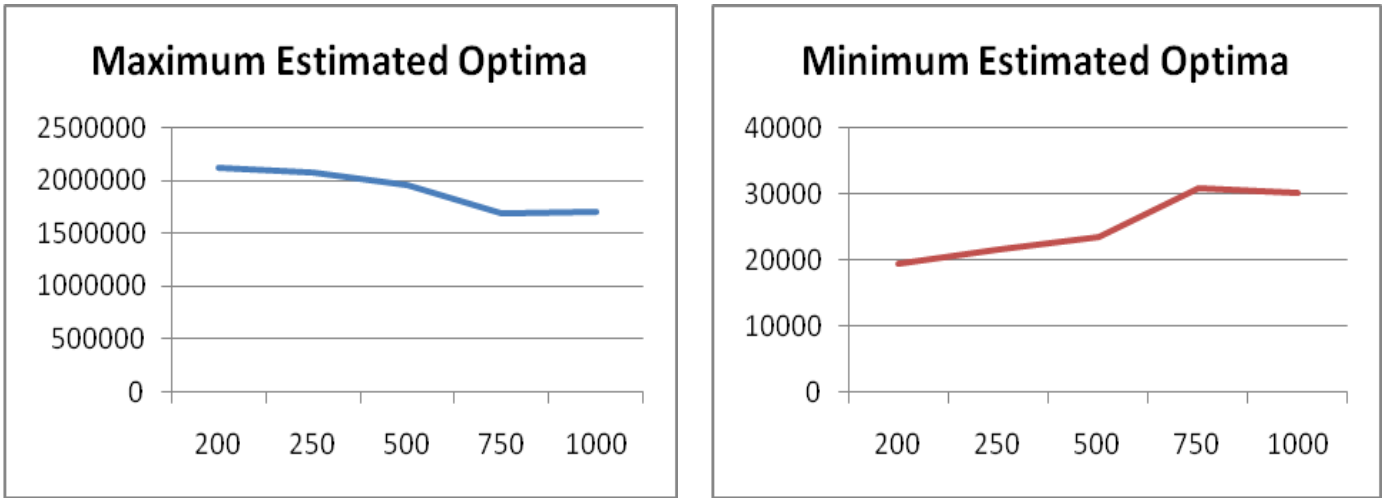

Figure 6: Note the x-axis represents the number of bootstrap replications and the y-axis represents the estimated optimal size in terms of members.

Although these results offer evidence that credit unions can achieve economies of scale while avoiding agency problems, the fact remains that the average size of credit unions is around 50,412 members. Although credit unions may eventually narrow the gap between the optimal and average size, the optimal size plot along with the distribution of membership (Figure 7 and 8, respectively) suggest that there may be barriers preventing credit unions growth.

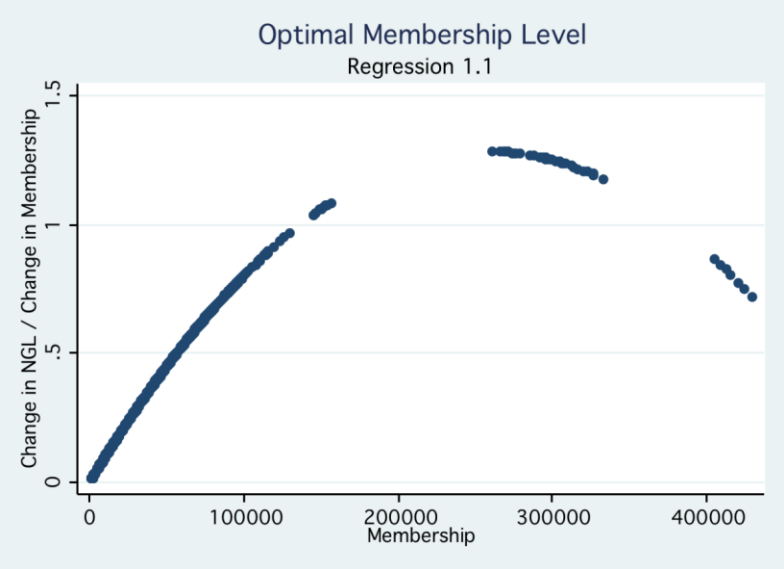

Figure 7

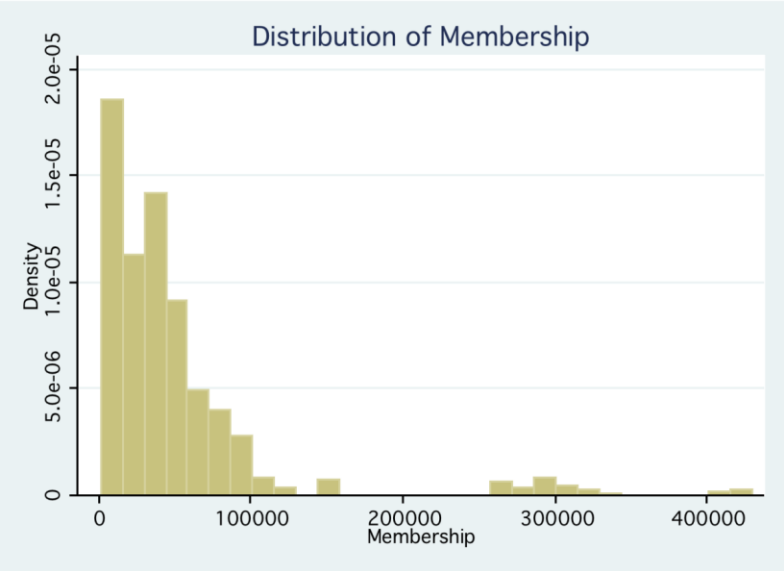

Figure 8

Three hypotheses may explain the gap between the average and the optimal size: (1) geography is a binding constraint on membership expansion, (2) lack of advertising is reducing the mobilization of members, and (3) incomplete capital markets or concerns in management over loss of credit union culture are hindering consolidation. Table 5 briefly addresses these hypotheses by presenting the regional breakdown of branches, the websites, and membership totals of each credit union in the sample.

Credit Unions	Members	Website	Amazon	Coast	Sierra
Small (7,500-30,000)					
SAN FRANCISCO DE ASIS	7843	http://www.csfasis.fin.ec			**1**
CALCETA	10385			**2**	
SANTA ANA	10413	http://www.coacsa.com/portal/		**2**	
JESUS DEL GRAN PODER	10740	http://coopjesusdelgranpoder.com/			
GUARANDA	12307	http://www.guarandaltda.fin.ec/			**3**
9 DE OCTUBRE	14213				**2**
LA DOLOROSA	15989	http://www.ladolorosa.fin.ec/		**1**	
11 DE JUNIO	17402	http://oncedejunio.fin.ec/		**3**	
CACPE BIBLIAN	17998	http://www.cacpebiblian.fin.ec			**3**
PADRE JULIAN LORENTE	22096	http://www.lorente.fin.ec/	**3**		**4**
COOPAD	22794	http://www.coopad.fin.ec		**2**	**1**
SANTA ROSA	24108	http://www.coopacs.fin.ec		**6**	
CHONE	25472			**3**	
Medium (30,000-50,000)					
EL SAGRARIO	30007	http://www.elsagrario.com/		**1**	**5**
COTOCOLLAO	30088	http://cooperativacotocollao.fin.ec/			**1**
COMERCIO	36008	http://www.coopcomer.fin.ec/		**1**	
CACPE PASTAZA	36556		**4**		**1**
SAN JOSE	37144	http://www.coopsanjose.fin.ec/		**1**	**4**
SAN FRANCISCO	40953	http://www.coac-sanfra.com/	**2**		**4**
23 DE JULIO	44259	http://www.coop23dejulio.fin.ec/			**3**
TULCAN	45101	http://www.cooptulcan.com/site/			**4**
PABLO MUÑOZ VEGA	48585	http://www.cpmv.fin.ec/			**5**
ATUNTAQUI	49049	http://www.atuntaqui.fin.ec/			**6**
Large (50,000-100,000)					
OSCUS	55814	http://www.oscus.fin.ec/			**7**
CACPECO	56767	http://www.cacpeco.com		**2**	**8**
CODESARROLLO	63253	http://www.codesarrollo.fin.ec	**2**	**1**	**9**
ALIANZA DEL VALLE	68638	http://www.alianzadelvalle.fin.ec			**3**
MEGO	73741	http://www.coopmego.com/	**2**	**1**	**8**
15DEABRIL	74163	http://coop15abril.fin.ec/		**3**	
RIOBAMBA	86040	http://www.cooprio.fin.ec/			**7**
PROGRESO	88367	http://www.cooprogreso.fin.ec/			**1**
Supersize (100,000-430,000)					
ANDALUCIA	101370	http://www.andalucia.fin.ec/			**2**
JUVENTUD ECUATORIANA	105526	http://www.coopjep.fin.ec/		**2**	**1**
CAMARA DE COMERCIO	129550	http://www.ccq.org.ec/			**2**
29 DE OCTUBRE	333290	http://www.29deoctubre.fin.ec	**6**	**8**	**13**
NACIONAL	429190	http://www.coopnacional.com/		**1**	

Table 5

For hypothesis 1 on the geographic constraint on membership expansion, there appears to be two prevailing strategies for branch expansion: (1) focus on geographic diffusion of regional branches or (2) focus on capturing a single large target population. These divergent strategies are demonstrated in the case of the two largest credit unions 29 de Octubre which has 27 branches and Nacional which has only one branch located in the largest and most populous city in Ecuador. Although both strategies appear to effectively expand membership, further research is necessary to elaborate on the relative roles of diffused vs. concentrated membership expansion strategies to help credit unions grow to the optimal size.

For hypothesis 2, since most of the credit unions have websites and are publicly-known, the evidence seems to lend itself against the idea that internet advertising is causing the gap between average and optimal size. Additionally the websites are surprisingly sophisticated across credit union sizes, implying that the level of information technology across the sample may be relatively constant.

For hypothesis 3, there seems to be a slight correlation between credit unions with a Catholic affiliation and small sizes. For instance, San Francisco de Asis, Santa Ana, Jesus del Gran Poder, Padre Julian Lorente, and Santa Rosa are all in the smallest bracket of credit unions. Although these credit unions are open to the public, this informal bond may be affecting the willingness of managers to expand or merge with other credit unions that lack this affiliation.

In sum, these three hypotheses present intriguing paths for further research on the gap between the average size and optimal size of Ecuador's public credit unions and offer an ongoing puzzle facing the ability of credit unions to expand credit access in Latin America.

6.3 Anecdotal Support:

The main limitation of this study is the absence of variables controlling for institutional development. Under ideal circumstances, cross-country panel data would account for the effect of different institutional features on the optimal size of credit unions. To compensate for the less than ideal data set, this next section uses anecdotal evidence to support the econometric findings. Although anecdotes are not a definitive empirical test, it places the regression results in the broader discussion of credit unions and shows a clearer relation between institutional development and optimal size. Using Figure 9, this section divides the supporting evidence into three phases: (1) informal institutions, (2) nascent formal institutions, and (3) developed formal institutions.

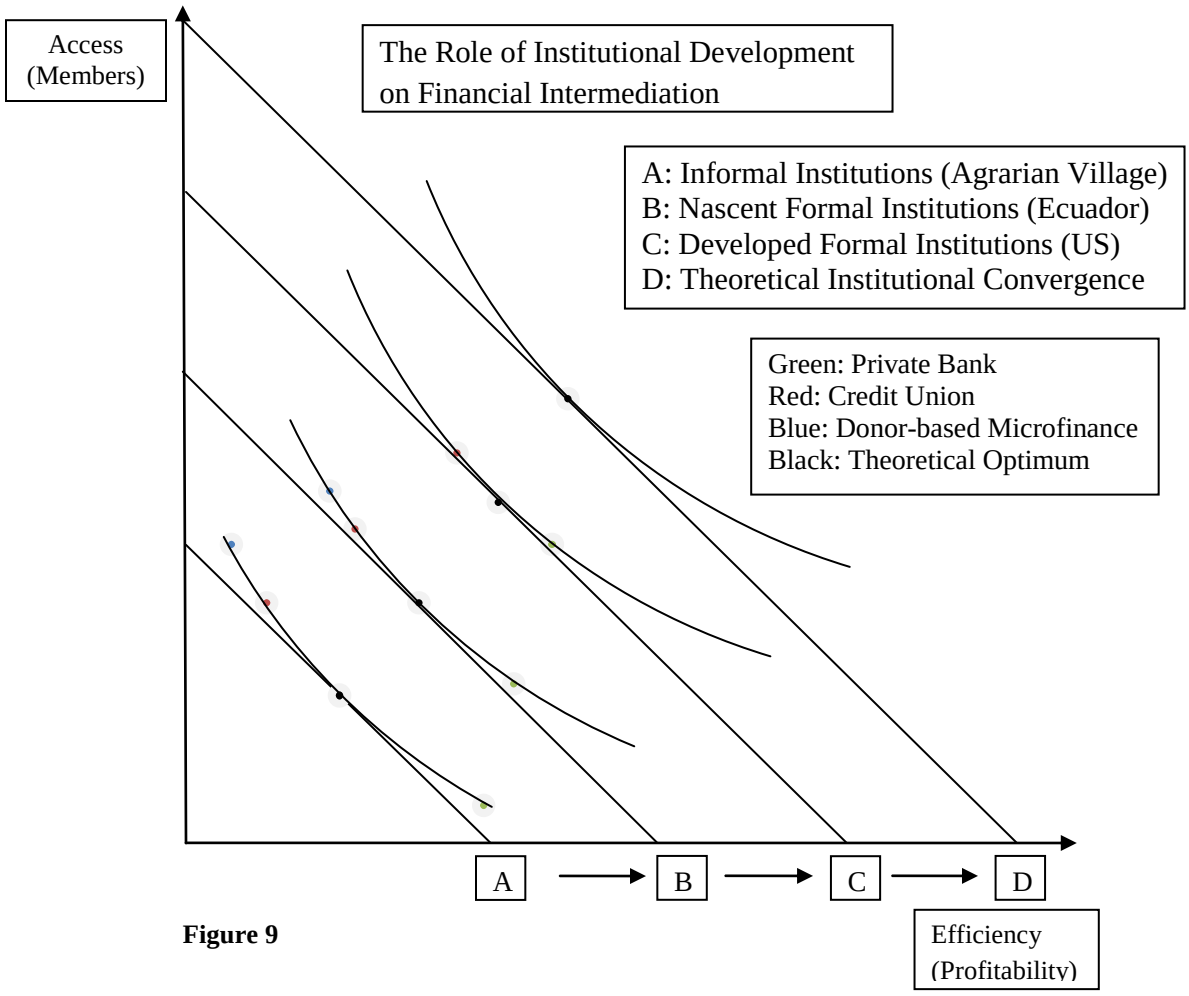

Figure 9

The first stage consists of informal institutions usually within the agrarian context. Under these conditions social networks with relatively informal rules determine access to credit unions. These credit unions often have a common bond of association, which enables them to process soft information (which is experience-driven and accumulated over time) on creditworthiness (Petersen and Rajan, 2002: 2533). At this stage credit unions rely upon relatively rudimentary means of conducting business using peer-monitoring to manage information and social sanctions to enforce contracts (Armendariz de Aghion and Morduch, 2005: 138-140).

Although growth is severely constrained and managers may lack financial acumen, credit unions are an appealing option at this stage due to their accessibility (Jones, 2006: 38). However, in some cases credit unions remain out of the reach of underserved social groups that lack enough human and social capital to organize a credit union (i.e. women in Bangladesh). For these groups, microfinance institutions like the Grameen Bank are a more feasible alternative. In reference to Figure 9, at this informal stage credit unions are much more accessible than private banks despite being less efficient and having to remain relatively small.

The second stage of institutional development usually occurs in large urban areas[18] with nascent formal institutions including a court system, formal property rights (however costly to obtain), prudential regulatory agencies, limited capital market formation (enough to permit consolidation and networking), and moderately-advanced data storage and loan-screening technologies (i.e. institutional features of Ecuador). To take advantage of these nascent formal institutions, credit unions must adapt by growing larger and achieve some semblance of scale economies.

[18] Moving from the previous informal stage, increases in population density may contribute to the ossification and emergence of a formal system. Specifically, as population grows the control of informal social networks may begin to deteriorate as rival social networks emerge. The need for an overarching formal system capable of linking unconnected individuals becomes necessary, thereby requiring a state sanctioned formal system. Clearly more research is needed with respect to this topic.

One way to increase size is to broaden the membership base by relaxing the common bond requirement (Emmons and Schmid, 1999: 62). The shift from a narrowly defined common-bond to a more public system requires the use of "hard information" which can be verified, recorded, and updated routinely (Petersen and Rajan, 2002: 2535). Hard information includes official identification cards, proof of employment, and up-to-date information on utility or rent payments. The advantage of hard information is that it allows for more impersonal economic relationships, making distance in both the social and geographic sense less important (Petersen and Rajan, 2002). By implication, soft information which is obtained through repeated interactions over time can be partially substituted with hard information.[19]

Moreover, the emergence of these nascent formal institutions strengthens trust between unconnected groups of individuals and shifts out the monitoring possibilities of managers thanks to hard information based technology (see Figure 3 and 4). In reference to Figure 9, at this intermediate stage microfinance (Grameen-style) begins to fall out of usage as the costs of obtaining soft information increase (relative to hard), while private banks become more accessible as formal property rights become more affordable. According to Figure 9, credit unions experience efficiency gains allowing them to grow larger and achieve scale economies. Presently Ecuador and most low-to-middle income countries are close to this stage of institutional development.

Finally the third stage of institutional development consists of advanced economies with developed formal institutions (e.g. the US and most of Western Europe). In this context, credit unions attain the highest level of access and efficiency and in the process become more formal, more professional, and more competitive with private banks. At this advanced stage the focus

[19] It is likely that soft and hard information are not perfect substitutes as it may be necessary to sustain some level of soft information in order to maintain healthy financial intermediation. See Figure 4 for more detail.

shifts away from social objectives towards commercial ones and in some cases credit unions choose to demutualize. Another characteristic is that credit unions further relax the bond of association or may open to the public, leaving managers to chiefly depend on hard information to ascertain creditworthiness and enforce contracts. Goddard et al. (2008) show that large formal credit unions in the US pursue complex financial products towards profitable-end while avoiding the problems that smaller credit unions encounter from growth. In reference to Figure 9, at this stage credit unions mirror private banks in nearly every respect ranging from their selection of financial products to business strategy to operational sophistication. In many ways at this advanced stage credit unions become substitutable with private banks.

In sum, these three examples offer a reasonable story explaining how developing formal institutions raises the optimal credit union size despite the member-based ownership structure.

7. Conclusion:

Although theory suggests that the non-profit mission and member-based ownership structure of credit unions works at the expense of efficiency, the results raise the possibility that formality and institutional development enable credit unions to achieve economies of scale while avoiding the agency problems brought on by membership growth. In spite of the fact that the regressions face some data constraints, the results should be interpreted seriously and should inform future research into the role of institutions on the optimal size of credit unions.

The next stage of research should adopt a more experimental approach and should survey credit union performance across different levels of institutional development. Such research could disaggregate institutional features along the lines of litigation services, costs of formal property rights, ratings of prudential regulatory agencies, level of capital market formation, and information technology investment (to account for the utilization of hard information). It could

also survey credit unions in both informal and formal financial sectors. In addition, further research is needed to explain the gap between the average size and optimal size of credit unions in Ecuador. This puzzle may be explained by one of the three hypotheses explaining the observed gap such as (hypothesis 1) the relationship between spatial distribution of regional branches and population capture, (hypothesis 2) the role of advertising and information technology on member mobilization, and (hypothesis 3) the effect of capital market formation and managerial attitudes on corporate consolidation.

In conclusion, credit unions should be considered in concert with other solutions for the problem of insufficient credit access in developing economies for three main reasons. First, adopting Ecuador's institutional features may require less bureaucratic reform than de Soto's innovative solution of increasing bureaucratic efficiency in granting property rights. Second, credit unions are able to remain competitive even in developed economies without the crutch of subsidization making them an attractive and enduring vehicle for pulling large amounts of individuals into the formal sector, which is a quality that donor-based microfinance lacks. Third, the distinct institutional recipe explaining large and efficient credit unions in Ecuador appears to be reproducible, raising the possibility that it could be applied (albeit cautiously) to other economies. More importantly, it appears that development discourse could benefit from a deeper consideration of credit unions as a leading vehicle for expanding credit access since the results suggest that they may be able to grow larger than expected, given the appropriate institutional controls.

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