Evaluating the Impact of Financial Services in Mexico: A Proposal using a Structural Equilibrium Approach [3]

Robert M. Townsend[⊕]

El objetivo del documento es proponer una metodología para evaluar el impacto de distintas características institucionales de los intermediarios financieros, y en general del acceso a los servicios financieros, en el bienestar de las familias mexicanas. Para lo anterior, propone 2 modelos econométricos; el primero de ellos es una adaptación del modelo utilizado para el caso Tailandés, mientras que el segundo es una propuesta para el caso mexicano. La aplicación de la metodología permitirá entender los mecanismos detrás de una serie de variables económicas y de bienestar (crecimiento de la oferta de servicios financieros, crecimiento económico, distribución de la riqueza) y su impacto en la pobreza.

1. Introduction and General Objective

The general purpose of this study is to evaluate the impact of financial services over the Mexican household's welfare. In this document, a series of complementary structural models are proposed for assessing these impacts on both the micro effects on household decisions, and the macro implications on the economic development. In particular, this structural framework allows us to understand the mechanisms behind a series of economic and welfare variables such as: financial services growth (financial deepening), economic growth, the distribution of wealth, and their impact on poverty alleviation.

2. Particular Objectives

The structural models proposed for estimating the impacts of financial services identify a set of structural parameters inherent to the Mexican economy. The basis of these models is

---

[3] This document presents the preliminary design of the impact study of the financial sector for Mexico.

[⊕] rtownsen@uchicago.edu.

the analysis of household's decisions which allows us to analyze the trends and impact of financial services on the following particular indicators over time:

i) Income Growth;

ii) Savings Rate;

iii) Labor Share of Output;

iv) Occupational Choice;

v) Households Entrepreneurship;

vi) Income and Wealth Inequality; and

vii) Financial Deepening (access).

The equilibrium implications of the parameters estimated by maximum likelihood (MLE) are used to build the indicators which ultimately are compared to those observed in the Mexican economy behavior in order to: 1) find those parameters which are not identified in the MLE procedure by the way of calibration to mimic the real trends in the macro indicators; 2) test the implications of exogenous changes in financial policies; and 3) identify time trends associated to each of the above indicators.

The rest of this document is organized as follows. Section 3 presents the different structural models proposed for studying the particular objectives. Section 4 presents a guide to estimate and calibrate the structural and econometric models for the case of Mexico including a briefing of those sources of information that better fits the needs of these models. Section 5 presents some results of these models applied for studying the case of Thailand economy. Section 6 concludes the document.

3. Theoretical Framework: Structural Models and the Financial System

Though the relationship between financial structure and economic growth has long been studied both empirically and theoretically, empirical studies have been mainly focused on statistical relationships without a serious study of underlying mechanisms that generate the observations. For this reason and in order of pursuing the objectives of a broader evaluation of the financial system for Mexico, this proposal considers a series of structural models where the basic unit of analysis is the household.

Along these structural models, households are simultaneously consumers and face entrepreneur and work choices. In particular, four models are explored to build different complementary settings. From the theoretical implications of each of these models, we then compare their implied conditions for the Mexican economy and how each additional relaxation of an assumptions permits to add new explications on the empirical content of the data.

The fist benchmark model uses a general equilibrium approach without a financial system, to then analyze a second model which permits the existence of a financial system without constraints on credit as in a traditional neoclassical environment. Then, from these settings, the analysis continues to propose a third and fourth frameworks where the financial system exists and grows due to: 1) exogenous rates in the financial deepening; and 2) endogenous forces in the economy.

This structural approach has been implemented successfully in an analysis of the nature and implications of the expansion in the financial system for the Thailand economy[1] and some of these results will be presented in further detail in the section 4 of this document for illustrating the scope of these models.

3.1. A Model of Self-Financing Capital

The basic building block of all of the models proposed at the household level is the choice of occupation. Let us assume that a household has income γ in subsistence agriculture, wage w in the (unskilled) employment option, and profits π in non-farm enterprise. The latter is determined by choice of hired unskilled labor l and utilized capital k[2]*:*

[1] See for instance: Giné and Townsend (2004), Kaboski and Townsend (2005), or Townsend and Ueda (2006.)

[2] From now, a symbol *f(x,y,z)* will represent a function "*f*" of the variables "*x,y*, and *z*" while a symbol *a[b+c]* represents the multiplication of variable a times the sum of b and c.

$$\pi = max_{k,l}\ \ F(k,l) - w\ l - k \qquad (1)$$
$$s.t.\ k \in [o, b\text{-}x]\ ,\ l \geq 0$$

The Lloyd-Ellis and Bernhard model (LEB from now) begins with a standard production function $F(\bullet)$ mapping a capital input k and a labor input l at the beginning of the period into output $q = F(k,l)$ at the end of the period.

In the original LEB model, and in the numerical simulations this document plan to explore, this function is taken to be quadratic. This quadratic function can be viewed as an approximation to virtually any production function and has been used in several applied works. This function also facilitates the derivation of closed form solutions and allows labor share to vary over time. Specifically, let:

$$F(k,l) = \alpha k - [\beta/2]\ k^2 + \zeta\ l - [\rho/2]\ l^{\,2} + \sigma\ l\ k \qquad (2)$$

Using this specification, then previous analyses[3] shown the solution of the model has the following specifications:

$$l(b,x,w) = \quad [\ \sigma\ \ k(b,x,w) + [\ \zeta - \omega]\ ] \quad [1/\rho] \qquad (3)$$

and

$$k(b,x,w) = \quad b\text{-}x \qquad \text{if constrained} \qquad (4)$$
$$[\ C\ [\alpha\text{-}r] + \sigma[\ \zeta\text{-}w]\ \ ] \ \ / \ \ [\beta\, C + \sigma^2\ ]$$

where C is a constant which is a function of several parameters of this structural model.

Let us note that in the previous model there is no access to credit so capital must be self-financed, that is, $k \leq b - x$ where b is initial, beginning-of-period, predetermined wealth and x is a fixed set up cost for going into business. The latter variable is imagined to be

[3] For instance: Townsend & Giné (2004) or Townsend and Urzúa (2006.)

unobserved to the econometrician/analyst, but known to be distributed in the population according to density *h(x,m)*. Each household has to know its own x before choosing, so x along with wealth b is the key pair of state variables. Wage w is vital for purposes of this choice analysis and at this stage it is also exogenous. The cumulative distribution of initial wealth x in the population is given by:

$$x \sim H(x,m) = [1-m]\,x + m\,x^2 \qquad (5)$$

When $m = 0$, this distribution is uniform, when m<0 it is tilted to the left, and if $m > 0$, tilted to the right. End-of-period resources consist of earnings from a chosen occupation, plus what is left of initial wealth, so that:

$$W(b,x,w) = \begin{cases} \gamma + b & \text{; if is a subsistence worker} \\ w - n + b & \text{; if a wage earner} \\ \pi(b,x,w) - x - \eta + b & \text{; if a firm} \end{cases} \qquad (6)$$

is the array of choices. Here η is an additional disutility cost of leaving subsistence agriculture.

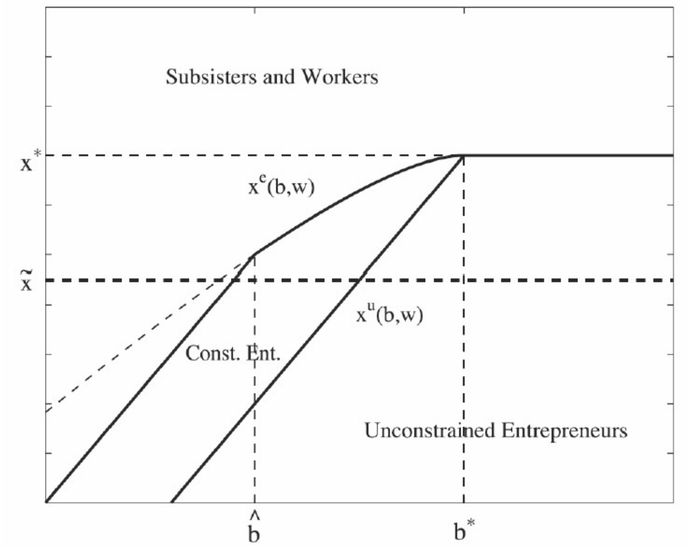
The end of period utility for the household is given over consumption and savings for the next period as follows:

$$U(C,B) = C^{1-\omega} B^{\omega} \qquad (7)$$

U(•) is maximized by choice of consumption C and savings B for next period. That way, ω is the saving rate out of end-of-period wealth.

The key beginning-of-period state variables capturing heterogeneity for the household are initial wealth b and set up cost x. The occupational choice mapping the parameters of wealth of the households can be summarized in Figure 3.1 below.

Figure 3.1. Occupational choices with wealth and talent-cost parameters



Source: Giné and Townsend (2004)

Intuitively, there is a region of high cost and low wealth households who choose to be subsistence wage earners.

Note that in equilibrium, with some population left in subsistence agriculture, $w - \eta = \gamma$, and thus we can collapse the wage and subsistence sectors into one: households will either be indifferent or the entire subsistence agricultural sector will be depleted.

On the other extreme, there is a region of low cost, $x < x^*$, high wealth, $b > b^*$, households who will be running firms at the scale l^* and k^* as if they can hire labor and utilize capital at wage w and implicit zero net interest rate, $1 + r = 1$, the rate at which resources at the beginning of the period can be carried over in the back yard to resources at the end of the period. There is also a region of constrained firms with wealth and setup costs such that $k = b - x < k^*$.

These firms hire a limited number of workers, if any, and have limited capitalization. They would also appear to have high rates of return as measured by the average yield y/k, or ROA. The "curve of indifference" $x^e(b, w)$ marks the combinations of wealth and cost pairs under which a household is indifferent between subsistence/wage work and profits from enterprise, and $x^u(b, w)$ marks the margin at operating at unrestricted scale k^*. It is important to note that most firms will not be indifferent, that is, will have profits π over and above the opportunity cost of foregone earning w.

3.2. Perfect Market for Capital and Household Decisions

The second stage of the structural model considers the existence of a perfect market for capital. In this new setting there is a market clearing interest rate r at which households and firms could borrow and save at much as they wanted. In this case, occupation choice would not depend at all on initial wealth b. This is the typical, neoclassical result, which in our case provides us of a useful second benchmark framework.

Perfect capital market condition also implies there would be complete separation between the production and consumption activities.

Firms operated by households maximize profits, as would any firm. Here, without other sources of heterogeneity in production by type or sector, all firms operate at a common scale of capital:

$$k^*(w,r) = \tau[\alpha-r] + \sigma[\zeta-w] \;/\; [\beta\rho - \sigma^2] \qquad (8)$$

and hire identical labor:

$$l^*(w,r) = [\,\sigma k^* + [\zeta-w]\,] \;/\; [\rho] \qquad (9)$$

All firms also have marginal returns on assets (marginal ROA) equal to r, that is, rates of internal and external returns are equated, at a common market clearing interest rate. There would be a critical level of cost given by:

$$x^{-}(w,r) = [\,F(k^*,l^*) - wl^* - rk^* - w\,] \;/\; [r] \qquad (10)$$

below which all households would be entrepreneurs. Thus, in the perfect market benchmark, only talent matters in occupation choice, not initial wealth, and only talented households are running firms. In comparison to the non-intermediated sector, low wealth households are more likely to be firms, but high wealth low talent households are more likely to be savers, to put their money in the bank rather than operate an inefficient enterprise.

Formally, let us formally define $y_i = \{1,0\}$ denote the binary choice of household i for setting up an enterprise, or not. The probability that $y_i = 1$ *is* $Pr\{ y_i=1\} = Pr\{ x_i \leq x^e(b_i, w)\}$.

The log likelihood for a sample of size *n of* households is then written as:

$$logL = \Sigma_n \{ y_i \, ln[Pr\{ x_i \leq x^e(b_i, w)\} \, ln[1- Pr\{ x_i \leq x^e(b_i, w)\}]]\} \qquad (11)$$

where:

$$Pr\{ x_i \leq x^e(b_i, w)\} = (1-m)\, x^e(b_i,w) + m\, x^e(b_i,w)^2 \qquad (12)$$

From this setting, and using MLE, we are able to recover the following set of parameters: $\{\gamma, \mu, \alpha, \beta, \rho, \sigma, \zeta\}$ while the parameters $\{\eta, \omega, \gamma_{gr}\}$ can be calibrated from the observed behavior of the economy.

3.3. Endogenous and Exogenous Financial Intermediation Growth Models

The benchmark models discussed above permit us to complement and extend their implications on the aggregate behavior with a new type of analysis that include new dimensions on our investigation, particularly for modeling the intermediation sector growth and the impact of different set of policies.

Two alternative points of view can be tested and modeled regarding the growth in financial deepening: first the analysis may include an exogenous growth model which facilitates the access to credit to the households at a given rate; and as a second approach, the study may also consider a more complex environment where the financial system growth is endogenously determined by the dynamics of the economy.

For measuring the financial sector exogenous growth and develop the first extension of the models, we can use the observed historical growth rate of financial services and implement the methodology above described allowing for this new case permitting the expansion of financial sector at exactly that observed rate. This permits us to re-calibrate the parameters and study impacts on the primary indicators of wealth, distribution and choice and compare this to our previous benchmark models.

The second extension is to model the growth in the financial system from inside the Mexican economy. In this new type of model, the structural model modifies to follow the canonical model of Greenwood and Jovanovich (1990), GJ from now, which extension developed by Townsend and Ueda (2005) was successfully applied for understanding the behavior of the Thailand economy from the late 70s toward the 90s. This widen framework provides indeed the natural continuation for studying the case of Mexico.

Townsend and Ueda (1990) extend the GJ model to include a wider class of constant relative risk aversion (CRRA) utility functions and with this alternative approach, they characterize much of the transitional dynamics analytically and, in doing so, provide new results.

The seemingly non-convex technology of financial participation is under some conditions "convexified" by the optimal choice of portfolio shares between risky and safe assets. Consequently, savings and portfolio choice are uniquely determined depending on the household wealth level. In particular, ironically, those risk-averse households and businesses without access are not condemned to low-yield (though safe) technologies but rather shift towards risky enterprises, especially as their wealth approaches a critical value. These make clear the rich and potentially complicated dynamics not obvious in the original GJ formulation. Indeed, the single-valuedness of savings and portfolio choice facilitates further research into transitional dynamics using numerical methods and we find, for example, overall inequality movement is not necessarily monotonic on the growth path—it can increase, then decrease, and increase again as it moves slowly towards its asymptotic steady state. Financial deepening and growth are not monotonic either.

Hence, the different settings of structural models ranging from the extreme benchmarks to a more "realistic" exogenous and endogenous financial system growth provide us a vast set of tools to analyze the Mexican Economy impacts of different policies and phenomena related to the financial system.

3.4. Financial Institutions and Policies Effects

The last purpose of this study for Mexico is to identify relative successful institutional policies for inducing financial use on the households. This higher use of the financial system is, from our previous setting , related to positive trajectories on economic growth and wealth formation though the effects on household's outcomes.

For this part of analysis, this proposal considers the approach proposed by Kaboski and Townsend (2005). Moreover, the results these authors provide in their analysis for Thailand provide a good reference for the range of policies that may encourage financial use on the households, and the impact on some of the main outcomes: asset growth, consumption smoothing, occupational mobility, and moneylender reliance.

Following this framework for the case of Mexico, we can start with a simple model where the presence of a financial institution, of a given type, in a community (municipality or village for instance) influences whether a household n is a member of such as institution. In this setting membership m_n is a proxy for the access to financial intermediation F_n that influences outcomes.

Let us define two different sets of regression equations to try and model this behavior. The first is a two-stage least squares approach that assumes linear membership and outcome equations. The second is a simultaneous equation, maximum likelihood approach that accounts for the binary nature of the membership variable and each of the outcome variables except asset growth. It also uses the possible correlation of error terms between the membership and outcome equations in the estimation.

First, for assets, business ownership, occupation, and moneylender reliance, the equations in the primary variables of household n would take the form:

$$\tilde{y}_{n,t} = \sum_{j=1}^{\infty} \beta F_{n,t-j} + \theta_n + \tilde{\varepsilon}_{y,n,t} \tag{13}$$

Here, $\tilde{y}_{n,t}$ represents the "level" variable of household n at time t, β, the effect of intermediation, θ_n a household-specific fixed effect, and $\tilde{\varepsilon}_{y,n,t}$, the error term. Time differencing eliminates θ_n and yields:

$$y_n = \beta F_{n,t-1} + \varepsilon_{y,n} \tag{14}$$

where we have defined new notation $y_{n,t} = \tilde{y}_{n,t} - \tilde{y}_{n,t-1}$ and $\varepsilon_{n,t} = \tilde{\varepsilon}_{n,t} - \tilde{\varepsilon}_{n,t-1}$. For Mexican datasets, t is considered to be 2005, while $t - 1$ is 2004.

The equation for consumption/input use assumes no change in access to financial intermediation between the years of interest ($F_{n,t-1} = F_{n,t-2} \equiv F_n$) and postulates an interaction effect between current income ($Y_{n,t}$) and membership:

$$\tilde{y}_{n,t} = \alpha \tilde{Y}_{n,t} + \beta \tilde{Y}_{n,t} F_{n,t-1} + \theta_n + \tilde{\varepsilon}_{y,n,t} \tag{15}$$

Again, time differencing yields:

$$y_n = \alpha Y_n + \beta F_n Y_n + \varepsilon_{y,n} \qquad (16)$$

using the additional notation, $Y_{n,t} \equiv \widetilde{Y}_{n,t} - \widetilde{Y}_{n,t-1}$. Thus, with $\beta < 0$, past financial intermediation lowers the coefficient on (idiosyncratic) income variation. Below, the proposal model considers household and community control variables, X_n and Z_n, respectively, and interpret each of the outcome regressions in light of the preceding equations.

Impact estimation by type of institution involves several different regressions, each of which is explicitly discussed below[4].

This proposal starts with a simple model where the presence of an institution (of a given type) in a village influences whether a household is a member of such as institution, and membership m_n is a proxy for the access to financial intermediation F_n that influences outcomes. Again, we can consider two different sets of regression equations to try and model this. The first is a two-stage least squares approach that assumes linear membership and outcome equations. The second is a simultaneous equation, maximum likelihood approach that accounts for the binary nature of the membership variable and each of the outcome variables except asset growth. It also uses the possible correlation of error terms between the membership and outcome equations in the estimation

3.4.1. Two-stage least squares

Let y_n be the outcome variable and M_n the membership variable for household n:

[4] In section 4 of this proposal we present some of the impact estimation using specific policies.

$$y_n = \sum_{i=1}^{I} \alpha_i X_{i,n} + \sum_{j=1}^{J} \tau_j Z_{j,n} + \beta M_n + u_{y,n} \tag{17}$$

and

$$M_n = \sum_{i=1}^{I} \gamma_i X_{i,n} + \sum_{j=1}^{J} \phi_j Z_{j,n} + \delta I_n + u_{m,n}. \tag{18}$$

Membership M_n affects outcomes y_n additively and the presence of the institution in the village I_n affects membership additively. The $X_{i,n}$ are sets of household-specific variables and $Z_{j,n}$ are sets of village specific-variables for household n. We assume that $u_{y,n}$ and $u_{m,n}$ are independent of $X_{i,n}$ for all i. We are interested in the parameter β in equation (17) as our measure of membership impact. Since membership M_n may be potentially endogenous (i.e., correlated with $u_{y,n}$), we use the presence of an institution as an instrument for membership via the membership equation. Although, institutions may also be present in a based set of villages, we assume that our observable village characteristics $Z_{j,n}$ control for this village selection bias. That is, given the village-level observables, we assume I_n is uncorrelated with $u_{y,n}$ and is therefore a valid instrument for two-stage least squares estimation.

3.4.2. Simultaneous equation MLE

One problem with two-stage least squares is that it assumes linearity of relationships that are clearly nonlinear. For example, the membership variable M_n is binary, but first stage estimation will give us not only intermediate values, but also values less than zero and greater than one.

Similarly, for all but asset growth, the outcome variables are binary as well. Given this, we use a second model specification that allows us to account for these nonlinearities, though it requires us to assume a (normal) distribution for the errors terms.

Let the binary variables $D_{y,n}$ and $D_{M,n}$ be determined by continuous latent indexes y^*_n and M^*_n , respectively:

$$y_n = 1, \text{ for } y_n^* > 0$$
$$y_n = 0, \text{ for } y_n^* \leq 0 \qquad (19)$$

and

$$M_n = 1, \text{ for } M_n^* > 0$$
$$M_n = 0, \text{ for } M_n^* \leq 0. \qquad (20)$$

Now, we assume linear empirical relationships for these two latent unobserved indexes, and avoid imposing linear relationships for the binary outcome variable and membership variable themselves:

$$y_n^* = \sum_{i=1}^{I} \alpha_i X_{i,n} + \sum_{j=1}^{J} \tau_j Z_{j,n} + \beta M_n + u_{y,n} \qquad (21)$$

and

$$M_n^* = \sum_{i=1}^{I} \gamma_i X_{i,n} + \sum_{j=1}^{J} \phi_j Z_{j,n} + \delta I_n + u_{m,n}. \qquad (22)$$

We again assume that both $u_{y,n}$ and $u_{m,n}$ are independent of the $X_{i,n}$ and $Z_{j,n}$. However, we explicitly model the dependence of membership M_n and $u_{y,n}$ through the correlation between $u_{m,n}$ and $u_{y,n}$. That is, we assume a joint normal distribution of $u_{m,n}$ and $u_{y,n}$ with a correlation of ρ:

$$(u_{m,n}, u_{y,n}) \sim \text{Bivariate Standard Normal}(0, 0; \rho). \qquad (23)$$

The normalization of variances to unity is possible since y^*_n and M^*_n are unobserved indexes, with zero being the only critical value.

Equations (19)–(22) can be estimated as a system of simultaneous equations with the village presence variable I_n playing the role of an exclusion restriction, instead of an instrument as in the 2SLS. Given the assumption of normality, we write down the joint likelihood equations and estimate the parameters by maximizing the likelihood. The actual likelihood equation is given by equation (24) below, where $\phi(\bullet)$ and $\Phi(\bullet)$ represents the normal probability density function and normal cumulative density function respectively.

Again, the advantage of the simultaneous MLE approach is that we account explicitly for the bounded, non-linear conditional expectation of the binary outcome and membership variables.

The weakness of the approach is its reliance on the assumed joint normality that cannot be justified a priori. The strength of the 2SLS approach is that we avoid making distributional assumptions. Its weakness is that we propose a linear fit to a conditional expectation function that is clearly nonlinear. In any case, both approaches should be used since neither approach clearly dominates and we want to make sure our assessment of impact is not peculiar to a particular technique.

$$\ln \mathcal{L} = \sum_{n=1}^{N} \ln \phi \left(y_n^* - \left[\sum_i \alpha_i X_{i,n} + \sum_j \tau_j Z_{j,n} + \beta M_n \right]; \sigma_y \right) \tag{24}$$

$$+ \sum_{n=1}^{N} M_n \ln \Phi \left(\frac{\sum_j \gamma_n X_{j,n} + \sum_j \phi_j Z_{j,n} + \delta I_n + \frac{\rho}{\sigma_y} \left(y_n^* - \left(\sum_i \alpha_i X_{i,n} + \sum_j \tau_j Z_{j,n} + \beta M_n \right) \right)}{1 - \rho^2} \right)$$

$$+ \sum_{n=1}^{N} (1 - M_n) \ln \Phi \left(\frac{\sum_j \gamma_n X_{j,n} + \sum_j \phi_j Z_{j,n} + \delta I_n + \frac{\rho}{\sigma_y} \left(y_n^* - \sum_i \alpha_i X_{i,n} - \sum_j \tau_j Z_{j,n} - \beta M_n \right)}{-(1 - \rho^2)} \right)$$

3.4.3. Direct impact of institution

A third approach is to introduce the presence of the institution I_n directly into the outcome equation. That is, instead of measuring the effect of intermediation on members only, we estimate its average effect on all sampled households in the village, or more succinctly on an average villager as discussed earlier.

This approach would in theory capture any external effect that the institution might have on nonmembers. The equation used is in this case:

$$y_n = \sum_{i=1}^{I} \alpha_i X_{i,n} + \sum_{j=1}^{J} \tau_j Z_{j,n} + \beta I_n + u_{y,n}. \tag{25}$$

Again, β here represents the direct impact of institutional presence on the outcomes of households in the village, not the impact of membership.

These regressions for the case of Thailand produced results that are generally smaller, less significant or insignificant, but not strikingly different than the membership impacts using the above methods. Since the linear probability model produces heteroskedastic error terms, it is needed to report White–Huber robust standard errors.

4. Structural Parameters, Estimation, and Calibration Procedures for Mexico

This section presents the procedures to get the estimation for the relevant parameters of the models proposed. This is done by pointing out the relevant source of information, and in some particular cases, the relevant questions may be used to gather that variables on which the estimation is based.

Two are the main set of parameters the econometrician is interested in recovering from the Mexican data: 1) those associated to the canonical LEB model and its proposed extensions; and 2) the institutional policy-impact from the linear and 2SL2 models. In the following two subsections, this proposal shows in detail how to pursue each of these estimation procedures.

4.1. LEB Structural Model and Extensions

In the family of LEB models and extensions, two econometric complementary techniques are the main procedures to recover the relevant parameters: 1) a structural maximum likelihood estimation; and 2) a calibration of the non-identified parameters. In the following subsections, each of these procedures and the way to recover the variables from Mexican datasets are shown in more detail.

4.1.1. LEB structural maximum likelihood

Although the original LEB model is designed to explain growth and inequality in transition to a steady state, there are recurrent or repetitive features to be considered. Specifically, the decision problem of every household at every date depends only on the individual beginning-of-period wealth b and cost x and on the economy-wide wage w.

Further, if the initial wealth b and the wage w are observable, while x is not, then the likelihood that an individual will be an entrepreneur can be determined entirely as in the occupation partition diagram, from the curve $x^e(b, w)$ and the exogenous distribution of talent $H(x, m)$[5]. That is, the probability that an individual household with initial wealth b will be an entrepreneur is given by $H\ (x^e(b, w), m)$, the likelihood that cost x is less than or equal to $x^e(b, w)$. The residual probability $1 - H\ (x\ ^e(b, w), m)$ dictates the likelihood that the individual household will be a wage earner.

The fixed cost x takes on values in the unit interval and yet enters additively into the entrepreneur's problem defined at wealth b which can be measured in Mexican real pesos. Thus setup costs can be large or small relative to wealth depending on how we convert from Mexican Real Pesos into LEB units. In this case, different scaling factors "*s*" are needed to be tested in order to map wealth in Mexican pesos into the LEB-model units.

Related, it is possible to pin down the subsistence level c in the model by using the estimated scale s to convert to LEB model units the counterpart of subsistence measured in Mexican Pesos in the data, corresponding to the earnings of those in subsistence agriculture.

Let θ denote the vector of parameters of the model related to the production function and scaling factor, that is, $\theta = (\beta, \alpha, \rho, \sigma, \zeta, s)$. Suppose we had a sample of n households, and let y_i be a zero one indicator variable for the observed entrepreneurship choice of household i. Then with the notation $x^e(b_i \mid \theta, w)$ for the point on the $x^e(b, w)$ curve for household i with wealth b_i, at parameter vector θ with wage w, we can write the explicit log likelihood of the entrepreneurship choice for the n households as:

$$L_n(\theta, m) = \frac{1}{n}\sum_{i=1}^{n} y_i \ ln\ H[x^e(b_i \mid \theta, w), m] + (1 - y_i) ln\{1 - H[x^e(b_i \mid \theta, w), m]\} \qquad (26)$$

[5] For having a close-form solution, this distribution was assumed to be as in equation (5) of this document.

The parameters over which to search are again the production parameters *(β, α, ρ, σ, ζ, s)*, the scaling factor *s* and the skewness *m* of $H(\theta, m)$.

Intuitively, however, the production parameters in vector θ cannot be identified from a pure cross-section of data at a point in time. For if we return to the decision problem of an entrepreneur facing wage w, we recall that the labor hire decision given by equation (7) is a linear function of capital k. Then substituting $l(k,w)$ back into the production function we obtain a relationship between output and capital with a constant term, a linear term in *k*, and a quadratic term in *k*. Essentially, then, only three parameters are determined, not five.

If data on capital and labor demand at the firm level were available, we could solve the identification problem by directly estimating the additional linear relation $l(k)$. This would give us two more parameters thus obtaining full identification. Unfortunately, these data are not available. However, the model suggests that we can fully identify the production parameters by exploiting the variation in the wages over time observed in the data. Townsend and Giné (2004) shows in detail the coefficients estimated and how the production parameters are recovered from the above information.

Up to this point, the econometrician then would be able to recover the following set of parameters:

Scaling factor: $\{s\}$

Subsistency income level: $\{\gamma\}$

Fixed Cost distribution: $\{m\}$

Technology parameters: $\{\beta, \alpha, \rho, \sigma, \zeta\}$

For the household level information the previous maximum likelihood algorithm may require, the econometrician can consider several sources of general information: i) the Encuestas Nacionales de Ingreso y Gasto de los Hogares (ENIGH) implemented by INEGI, in several of their waves; 2) the Encuesta Basal Sobre Ahorro, Credito Popular y Microfinanzas Rurales, collected by BANSEFI for studying the impact of financial system on household decisions; 3) the Encuesta Nacional de los Niveles de Vida de los Hogares (ENNVIH) carried out jointly by the Centro de Investigacion y Docencia Economica (CIDE) and the Universidad Iberoamericana (UIA), and 4) the Encuesta Nacional de los Hogares Rurales de México (ENRUHM) collected by The Programa de Estudios del Cambio Económico y la Sustentabilidad del Campo Mexicano (PRECESAM) at El Colegio de México (COLMEX). This section will focus on the fist two datasets, as the construction of variables is similar to any dataset selected by the econometrician[6].

The first and primary data base could be the widely used Encuesta Nacional de Ingreso y Gasto de los Hogares (ENIGH). The ENIGH surveys collect, periodically and systematically, socio-economic information of the households. This information is representative at the national, rural-urban, and marginality stratum (for 2002 only, according to CONAPO's classification) levels. The main objective of this survey is to generate information on current income and expenditure structure, financial income and expenditure structure, the value of the goods and services for self-consumption, the socio-economic characteristics of the household members, their labor conditions, and the household characteristics. For each year, the sampling process was stratified, multi-staged and by conglomerates. The final sampling unit is the household and all its members. In every stage, the selection probability is proportional to the size of the sampling unit, so the use of weighting factors is necessary to obtain the appropriate aggregate estimates.

ENIGH contains information on the key variables such as: entrepreneurship and occupational choice of the households, and asset variables which are the basis to build a wealth index which will be discussed in further detail below. ENIGH sample is nationally representative, and it includes several cross-sections collected between 1984 and 2004.

[6]The Appendix to the document presents some general characteristics of these datasets which can also be consider for the estimation procedures.

Unfortunately, this data does not constitute a panel. In any case, as in Townsend and Giné (2004) the sample can be stratified by age of the household head, and even with this limitation the econometrician would be left with a substantial sample given the large sample of each wave of data. Jeong and Townsend (2000) restrict their attention to relatively young households, aged 20–29, whose current assets might be regarded somewhat exogenous to their recent choice of occupation. They also restrict attention to households who had no recorded transaction with a financial institution in the month prior to the interview, a crude estimate of lack financial access, as assumed in the LEB model. This need to be done by checking the questionnaire section regarding financial access inside the ENIGH asset section which includes information regarding: credit cards, credit payments, mortgage, and bank transactions. This construction may be different from wave to wave as the questionnaire changes, so is recommended to build a unique definition which may be consistent across surveys. ENIGH does not record directly measures of wealth, but from the ownership of various household assets, the value of the house, and other rental assets, it is possible to follow the procedure proposed by Jeong (1999) to build this measure[7].

The second dataset to consider is the specialized panel survey conducted in Mexico by BANSEFI which uses a series of questionnaires developed by Christopher Woodruff among others The Encuesta Basal Sobre Ahorro, Credito Popular y Microfinanzas Rurales (BANSEFI household surveys from now) contains information for Mexican households having (and not) BANSEFI financial services for two rounds between 2004 and 2005. The sample is special in that it includes panel information for both users and not users of the BANSEFI financial institutions, and also, contains a complementary survey at community level and information from the financial institutions themselves. BANSEFI household surveys contain specific information on: income, consumption, labor and entrepreneurship

[7] This author propose to estimate a measure of wealth based on Principal Components Analysis which essentially estimates a latent variable that can best explain the overall variation in the ownership of the house and other household assets.

choice, agricultural production information, formal and informal financial assets and liabilities. The advantage of this survey is that the household questionnaire elicits an enumeration of all potential assets (household, agricultural and business), finds out what is currently owned, and if it was acquired from one wave of the panel data to the other. In this way, it is possible to create a measure of wealth following Paulson and Townsend (2001) or as in Jeong (1999). As in the Townend-Thai dataset, a business owner can be defined as being: a store owner, a farmer, a trader, or, a mechanic. Yet, this definition is not exclusively reduced to this set of occupations given the broad context of small entrepreneurship of Mexico. Among other variables, the survey also records the current education level of household members; the history of use of the various possible financial institutions: formal (commercial banks, Procampo, Oportunidades, and Cajas de Ahorro) and informal (friends and relatives, landowners, shopkeepers, moneylenders, and "tandas [8]".)

Table 4.1 below shows the questionnaire sections and variables which helps to identify the relevant LEB variables from BANSEFI surveys we may consider,

Table 4.1. LEB Variables identification from BANSEFI's Households Study

General Variable	Particular Variable	Section	Questions
Household Wealth and Assets	Household Services	I	1.13-1.20
	House ownership	II	2.08
	Financial investments	IV	4.01-4.11
	Agricultural land ownership	VIII	Q.8.01-Q.8.12
	Agricultural capital Ownership	IX	Q.9.16-Q.9.23
	Basic assets	X	Q.10.06-10.09
	Other properties ownership	XII	12.01-12.06
Financial Liabilities:		III	Q.3.01-Q.3.07
Credit Access		III	Q.3.08
Occupation Choice	Employed	I	Q.1.10-Q.1.11
	Farmer Ownership	IX	Q.9.01-Q.9.15

[8] "Tandas" is a common type of savings in Mexico. Is a sort of pool of equal resources among a certain number of households with the commitment of giving this pool to one household per period.

Risk	Social security access	II	Q.2.15-Q.2.18
	Type of shock and perception of household on its effects	XI	Q.11.01-Q.11.02
Money Lender	As a source of financing	III	Q.3.01-Q.3.07 R6
	Household as lender	V	Q.5.18-Q.5-24

Source: BANSEFI, Encuesta Basal Sobre Ahorro, Credito Popular y Microfinanzas Rurales, 2004.

Finally, the econometrician may also estimate the parameters using complementary sources of information, this for purpose of robustness checks. The two datasets this proposal suggests are the ENNVIH and the ENHRUM, which basic characteristics are presented below.

The ENNVIH is a broad-purpose multi-topic, nationally representative survey of individuals, households and communities. The baseline covers over 8,400 households in 150 communities across the whole Mexico. The ENNVIH interviewed every household member at age 15 and above and collected extremely detailed information on a wide array of social, economic, demographic and health behaviors of individuals and their families. All household members participated in an in-home physical health assessment which measured anthropometry, hemoglobin levels and blood pressure. A Raven's (cognitive) test was applied to all members of the household in specific age categories, and a short mental health instrument was administered to all adults.

ENNVIH also includes two crime and victimization modules, at the household and individual levels. In addition to collecting traditional measures of resources, such as income and expenditures, the ENNVIH baseline also asks about the wealth of individuals in order to depict accumulation decisions over the life course and provide a better measure of lifetime resources. The survey also includes comprehensive information at the community and facility levels. ENNVIH is carried out by institutional collaboration between: The Centro de Investigacion y Docencia Economicas, A.C. (CIDE) and the

Universidad Iberoamericana (UIA), with additional support from the Departments of Economics and Sociology at the University of California Los Angeles (UCLA) and the California Center for Population Research (CCPR).

Finally, a second option to check the robstness of the parameters is the Encuesta Nacional de los Hogares Rurales de México (ENRUHM) is collected by The Programa de Estudios del Cambio Económico y la Sustentabilidad del Campo Mexicano (PRECESAM) at El Colegio de México (COLMEX), and the Rural Economies of the Americas and Pacific Rim (REAP) of University of California at Davis. This research is prior to the ENVIH and focuses on production and consumption decisions of the rural households in Mexico. It also collects information on assets, consumption, and production, and provides a complementary set of information for contrasting the parameter consistency across different sources of information.

4.1.2. LEB calibration and metrics of assets

At this point, the model is not complete as the analyst still needs to pin down the cost of living v and the ''dynamic'' parameters, namely, the savings rate ω and the subsistence income growth rate γ_{gr}. One way to determine these parameters is calibration: look for the best ω, and γ_{gr} combination according to some metric relating the dynamic data to be matched with the simulated data.

This macro analysis calibration may use as benchmark those indicators reported by the Banco de Mexico (BANXICO), the Comisión Nacional Bancaria y de Valores (CNBV), and the Instituto Nacional de Estadística, Geografía, e Informática (INEGI.) These macro indexes also must be compared to the micro index eventually will be develop from micro unit surveys simulations from the models.

Any calibration exercise requires a metric to assess how well the model matches the data. As an example, the business cycles literature has focused on models that are able to generate plausible co-movements of certain aggregate variables with output. Almost by definition, the metric requires that the economy displayed by these models be in a steady state. Even though the economy we consider here eventually reaches a steady state, we are interested in the (deterministic) transition to it, thus the metric put forth as our objective function suffers from being somewhat ad hoc. In particular, the econometrician can consider the normalized sum of the period-by-period squared deviations of the predictions of the model from the actual Mexican data. For instance, Giné and Townsend normalize the deviations in the five variables by dividing them by their corresponding means from the Thai aggregate data as follows,

$$C = \sum_{s=1}^{5} \sum_{t=1976}^{1996} w_{st} \left[\frac{z_{st}^{\text{sim}} - z_{st}^{\text{ec}}}{\mu_{z_s}} \right] \tag{27}$$

where z_s denotes the variable s, t denotes time, and w_{st} is the weight given to the variable s in year t. In order to focus on a particular period, more weight may be given to those years. Analogously, all the weight may be set to one variable to assess how well the model is able to replicate it alone. All weights are re-normalized so that they add up to unity.

All the statistics, but the savings rate, have a natural counterpart in the model. As an approximation, the econometrician can consider ''savings'' the fraction of end-of-period wealth bequested to the next generation so the savings rate then is computed by dividing this measure of savings by net income.

4.2. Institutional Policy-Impact Models

Finally, the keystone source of information for testing the impact of different financial policies, and analyze the instruments for valuating the effects of policy expansion or contraction of the financial system, is given by the joint parallel studies carried by

BANSEFI and previously studied in its household section: 1) the Encuesta Institucional de Servicios Financieros (BANSEFI institutional surveys from now); and 2) the Encuesta Basal Sobre Ahorro, Credito Popular y Microfinanzas Rurales (BANSEFI household surveys).

BANSEFI surveys are unique in their statistical design. Based on the Thailand field experience, Townsend, Woodruff, and Kaboski focused the design of institutional surveys, when there also a household survey, in providing information regarding the two sides of the financial system: the financial institutions and their policies for several communities across Mexico; and also present information on the household decision side, and evolution of wealth and occupational choice of the households. As each BANSEFI financial institution may follow different policies (analyzed in more detail below) in each of the communities they operate, the survey contains valuable information on the nature of the policies and the potential impacts at community and household level of these policies, as these databases in principle may be linked to the households they serve.

Townsend and Kaboski (2005) consider an additional way for accounting the unobserved heterogeneity on households. In this case, the authors propose to focus on changes over time on the most representative outcome variables, all of which can be interpreted as allowing for household fixed effects.

Hence, for the Mexican evaluation of the financial system, this proposal considers to study the change in five outcome variables for measuring impact of policies, using the panel property of the sample and information in Table 4.1:

(1) Growth in assets;
(2) Probability of reducing consumption or input in a year if a bad income shock occurs;
(3) Probability of starting a business;
(4) Probability of switching primary occupation; and
(5) Probability of becoming a moneylender (informal financial) customer.

Each of these can be thought of as allowing for underlying unobserved heterogeneity on a primary "level" variable (i.e., level of assets, level of consumption/input use, probability of being a business owner, probability of being a rice-farmer, and probability of borrowing from a moneylender), whose value depends on past access to financial intermediation F.

For studying impact by policy, in principle, BANSEFI household databases do not have direct evidence of membership of households in institutions with different policies because policy information is taken form the BANSEFI institutional survey and the household survey only records membership in an institution, and not its policy. So, instead of using the presence of an institution as an instrument for membership, the proposal considers to use the direct impact equation (25) by clustering by community and financial institutions.

In this case, the proxy for intermediation, I_n, is now a dummy variable for whether all the institutions in a community had a particular policy or whether no institution in the community had a particular policy. The coefficient β represents the parameter of impact and is an estimate of the average impact of the intermediation on members and non-members. In this context X_i and Z_j are again the household- and community level controls, respectively. Households in communities that had multiple institutions that differed in the relevant policy or had an institution for which the relevant policy was unclear were not used in the regression.

Since membership is no longer used, at this stage the models considered do not have the issue of household level selection in these policy impact regressions. As long as I_n is independent of $u_{y,n}$ in (25), after controlling for village observables Zn, the model do not have a problem with community-selection either[9].

[9] There are many reasons for believing this is a justified assumption and that policy variation is primarily exogenous, as discussed earlier in the section 3.

Regarding the nature of policies that financial institutions may have followed, BANSEFI institutional questionnaire provides useful information at institution level regarding: 1) personnel structure and size; 2) accounting statements; 3) lending structure; 4) default policies; 5) additional services offered; 6) training of personnel; 7) members basic socioeconomic composition; 8) institutional organization and size; and 9) household remittances.

There are a vast potential of policies that can be analyzed from this survey, as it includes retrospective information on some variables inherent to the financial organization inside the financial institution. Hence, the combination of exogenous community policies and the characteristics of the financial institution provide the analyst a toolset of variables to model the impact on household's outcomes.
By way of example of what type of policies may induce financial deepening and/or other impacts on household's outcomes Table 4.2 below shows some of those policies this proposal considers, by section of the institutional questionnaire, the following policy indicators as important question to address:

Table 4.2. Institutional Policy Identification from BANSEFI's Institutional Survey

Section	Institutional Financial Policy
Section II.	1) Savings facilities to members. 2) Minimum requirements on accounts opening, fees, and minimum balance.
Section III.	3) Lending facilities to members. 4) Number of loans, amount, and maturation, given in the institution by collateral and or guarantee requirement. 5) Eligibility criteria changes over the last 5 years. 6) Minimum requirements on loans, fees, and minimum balance.

Section IV.	7) Different settings of default policies constraints.
Section V.	8) Additional services offered to clients currently, and changes on these services over the last 5 years;
Section VI.	9) Training of the financial institution given by BANSEFI.
Section VII.	10) Membership geographical requirements;

Source: BANSEFI, Encuesta Institucional de Servicios Financieros, 2004.

To sum up, this section shows there is econometric feasibility of applying the structural econometric approach. Estimation and calibration of LEB models can be achieved from several sources of information and the robustness of the results may be tested by using these general databases. Policy impact estimation, on the other hand, can be performed in further detail by linking the results from BANSEFI surveys at both institution and household levels.

5. Some Results of the Structural Framework: the Thailand Experience

The methodology proposed in the previous section presents a general equilibrium perspective which has been successfully implemented for analyzing the case of Thailand. This country experienced an outstanding economic performance during the 80s and 90s. With the model settings above several authors were able to understand the mechanisms behind Thailand economic growth, and also identify the role of financial systems on that performance.

For starting the analysis of the benchmark structural models, Table 5.1 below displays the set of parameters estimated by Giné and Townsend (2004) using the Townsend's set of Thailand Study Surveys (Townsend Thai data from now) and the Thailand Socio Economical Survey (SES) data.

Table 5.1. Estimation of Structural Parameters for Thailand Economy

	SES		Townsend-Thai	
	Coefficient	S.E.	Coefficient	S.E.
Scaling factor				
s^a	1.4236	0.00881	1.4338	0.03978
Subsistence level				
γ	0.02744	0.00119	0.01538	0.00408
Fixed cost distribution				
m	− 0.5933	0.05801	0.00559	0.17056
Technology				
α	0.54561	0.06711	0.97545	0.00191
β	0.39064	0.09028	0.0033	0.00013
ρ	0.03384	0.00364	0.00966	0.00692
σ	0.1021	0.02484	0.00432	0.00157
ξ	0.2582	0.03523	0.12905	0.04146
Number of observations	24,433		1272	
log-likelihood	− 8233.92		− 616.92	

[a] The parameter value and standard error reported are multiplied by a factor of 10^6.

The standard error bands in parenthesis indicate the potential range of parameter values at a 95% confidence interval, obtained from bootstrap estimation, drawing the sample repeatedly from an urn with replacement.

The basic structural model was simulated using the computer programs developed by Giné and Townsend (2004). At every date there is a distribution of beginning-of-period wealth, presumed to lie on some a priori grid. Guessing a wage, along with using the estimated parameters of technology, the regions of the occupation partition are recovered.

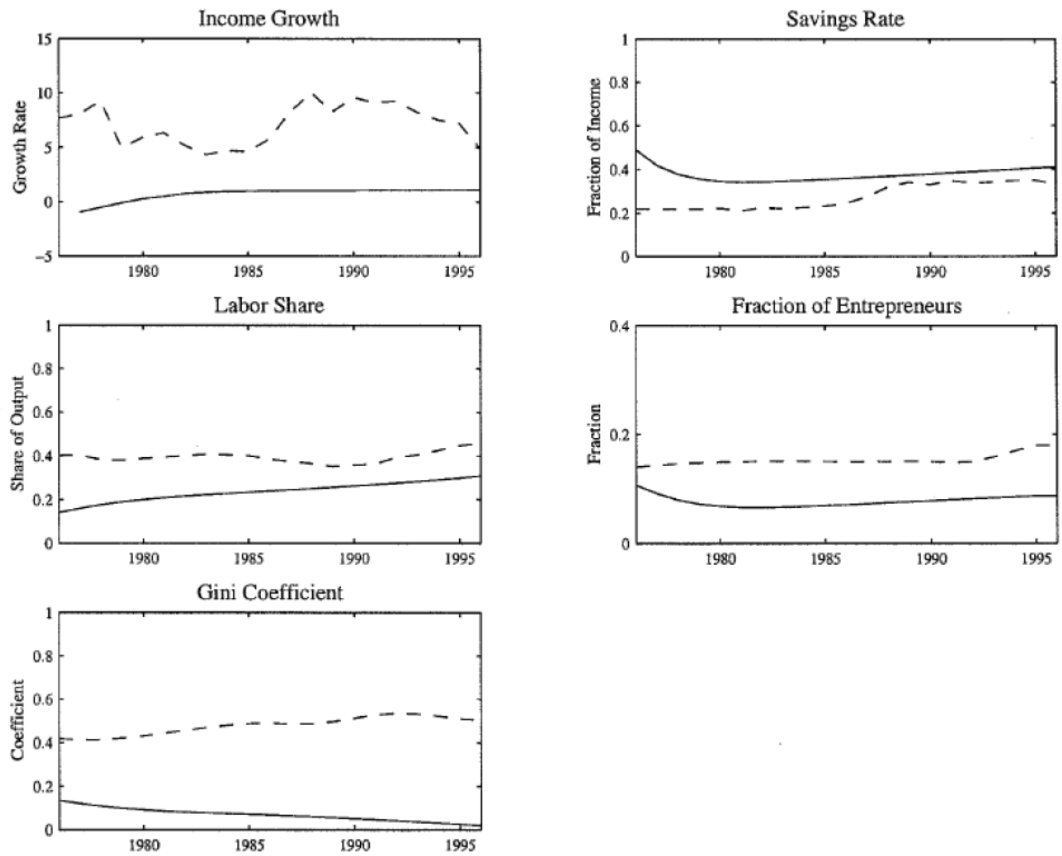
The distribution of talent then determines the fractions of the population choosing to be workers, subsisters, or entrepreneurs at each level of wealth. Adding up over all wealth levels, these population fractions should sum up to one, otherwise the labor market does not clear.

This procedure is repeated to find an equilibrium wage in a bisection algorithm and also the end-of-period wealth is determined. A fraction ϖ of this wealth is saved, and this determines next period's distribution of beginning-of-period wealth.

The distribution of setup cost for entrepreneurs adds additional diversity. The lower endpoint of the wealth distribution is the wealth of the household in the previous period who had least beginning-of-period wealth and the lowest talent (highest setup cost), and the upper endpoint is associated with the household in the previous period who had the highest beginning-of-period wealth and the highest talent (lowest setup cost). The initial condition of the model is the estimated initial distribution of wealth.

For Thailand, the basic model without financial liberalization fails to explain the levels and changes in roughly all variables. In the simulation of this model, using the parameters estimated for this economy, the growth rate of income is flat at roughly 2% as growth is driven mainly by the exogenous growth of the subsistence level.

Figure 5.1. Estimation of Structural Base Model
Thailand Economy: Best Fit



Source: Gine and Townsend, 2004.

Overall, the economy shrinks in the early periods, and then by 1983 it grows at the exogenous rate of growth of the subsistence level. Then, the authors tried to match the growth rate alone and they are able to replicate the low growth-high growth phases seen in the data. However, the improvement in the growth rate comes at the expense of increasing the model's savings rate above one from 1985 onwards, far above the actual one. Labor share increases sharply in the model, but not in the data. The income Gini coefficient and the fraction of entrepreneurs are very poorly matched as both drops to zero.

The fraction of entrepreneurs and the Gini measure of inequality are both low as well, and the latter decreases in the model simulation, unlike the data. The reason for such drastic macroeconomic aggregates is the choice of model parameters which try to match the growth rate of income.

Behind the scenes, the model is converging to one with many people in subsistence agriculture with common earnings. The subsistence sector is so profitable relative to setting up a business that by 1988 all entrepreneurial activity disappears and everyone in the subsistence sector earns the same amount. It is clear that focusing on the growth rate alone has perverse effects on the rest of statistics.

After this benchmark exercise, Townsend and Giné expanded the model to consider one model that mimics what is apparently a key part of the Thai reality: allowing an exogenous increase in the intermediated sector from 6% to 26% from 1976 to 1996. The intermediated model's explanation of events differs sharply from that of the non-financial benchmark without an intermediated sector.

Under this new setting, the second model is able to generate simulated time series which track the Thai economy more accurately. The implied growth rate of income is again lower than that of the Thai economy. The model still starts with negative growth until 1984. The initial phase of negative growth comes from an initial overly high aggregate wealth in the economy. But growth jumps to 5.4% by 1987. This high growth phase comes from the rapid expansion of the intermediated sector during those years. Finally, the growth rate declines after 1987 monotonically, driven by the imposed diminishing returns in the production function. The model matches remarkably well the labor share levels and changes, especially after 1990 where they both show a steady rise. The savings rate is only closely matched for the period 1987–1996.

Figure 5.2. Estimation of Structural Model with Intermediation Thailand Economy

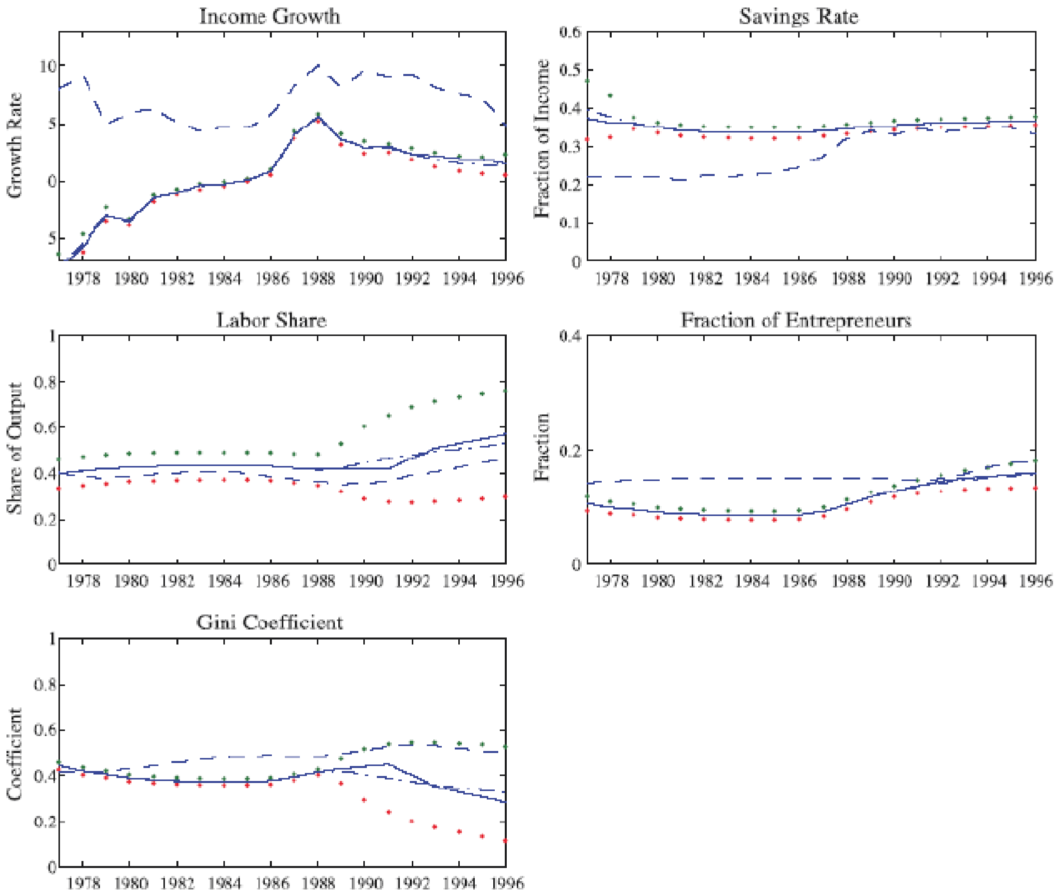


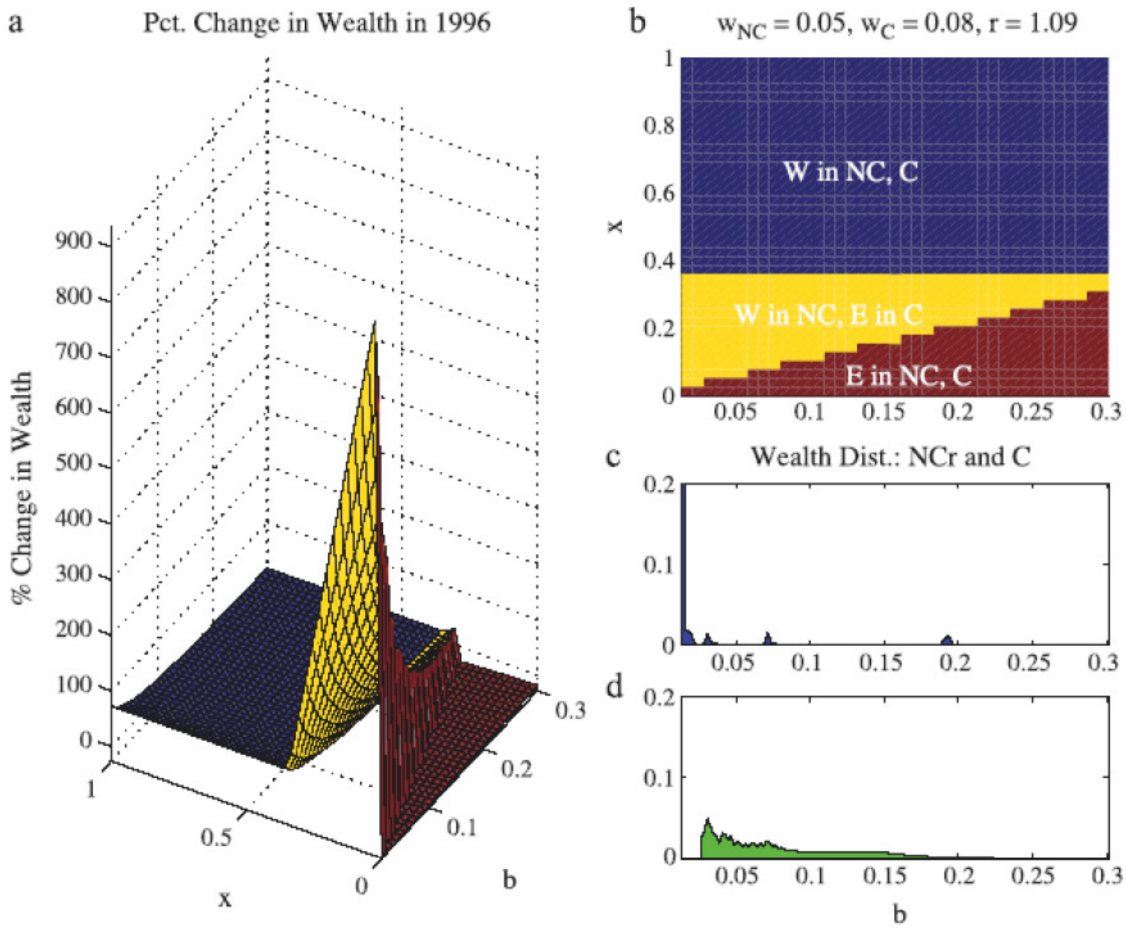
Fig. 3. Intermediated model (SES Data). Legend: – – (dash–dash) Thai economy, — (solid) simulation at estimated parameters, –· (dash–dot). Mean simulation,··(dot–dot) confidence intervals.

Source: Gine and Townsend, 2004.

Here, the authors take the 1976 SES wealth distribution, scaled by the chosen wealth scale for converting Thai baht into model units, *s*, determined also in the estimation, as the initial wealth distribution for simulation. One period in the simulation corresponds to one year in the data.

The distinct paths of the Thai economy with and without intermediation allow then to estimate the distribution of gains (and potential losses) at the household level from the observed expansion/liberalization of the financial sector. Essentially, one can overlap the occupation choice diagrams of the non-intermediated and intermediated sectors. Figure 5.3 below shows estimated distribution of gains for the simulated year 1979 with both sectors. Of great interest is the region of those who establish enterprise in the economy with some intermediation and would not do so in the economy without intermediation. As the wage w is the same in both economies in 1979, this is simply a comparison across sectors in 1979 of otherwise identical households with and without access to banks.

Figure 5.3. Distribution of Gains and Loses
Thailand Economy, 1996



Source: Gine and Townsend, 2004.

Of interest also are those who would set up firms in the non-intermediated sector but who save their money in the bank in the intermediated sector. The associated differences in end-of period wealth, that is, the "static" welfare gains, are depicted in Figure 4.3. These in turn can be weighted by the fractions of the population imagined to be at various wealth=b, cost=x combinations, according to the estimated distribution of costs x and various assumptions about what the distribution of wealth b would look like in the non-intermediated and intermediated economies.

Apparent are the extraordinary gains for talented, poor households. There are other interesting features of the graph, such as the gain for high cost, high wealth households who abandon the inefficient enterprises they would have been running. Related is financial income; wealth increases savings that can be put into the bank. Note, however, that those who would be wage earners in either sector do not experience any welfare gain. Again, in 1979 the wage is the same in the two economies. Likewise, no one can experience a welfare loss. As prices have not moved, the choice of every household is the same or less restricted than what it would have been without intermediation.

By 1996, however, the wage in the Thai economy is higher than it would have been without intermediation. That means that a (b,x) household running a firm in the actual, intermediated economy has lower profits than they would have had if running a firm in the associated nonintermediated economy at a lower wage. One can no longer compare across intermediated and nonintermediated sectors in the actual Thai economy. Difference in earnings due to differences in access does not pick up the general equilibrium wage effect. We can still calculate, however, from the structure of the model, the differences in earnings of those wage earners at (b, x) points who would be wage earners in the non-intermediated economy but set up firms by borrowing from banks in the intermediated economy.

These gains are still quite large. But now those who would be wage earners in the economy without intermediation and remain wage earners in the economy with intermediation also experience the gain of an increased wage. As mentioned, those who would be firms in the non-intermediated economy and in the intermediated economy if given access may well experience losses due to the increase in the wage (though excess savings can be put in the bank at interest). For previously constrained firms, in the economy without intermediation, enhanced access allows them to operate at a more efficient scale. Higher wage effects and increased efficiency compete with one another.

Table 5.2 summarizes the distribution of gains and losses to expansion of the financial sector. As anticipated average, median, and modal gains can be substantial in the various years, from 17% to 201% of average Thai household income. The skewness of gains is what makes the three measures so different from one another. Welfare losses are also substantial, at approximately 104-109% of average income (the overall average, not the income of entrepreneurs). The fraction of losers varies from 5% to 14 % of the population.

Table 5.2. Estimation of Gains for Thailand Economy

	Intermediated ec.		Wealth Dist	Non-intermediated ec.		Wealth Dist
	1997 Baht	Dollar	Pct. of Inc.	1997 Baht	Dollar	Pct. of Inc.
Townsend-Thai Data, 1979						
Welfare gains						
Mean	82,376	3295	200.93	61,582	2463	150.21
Median	22,839	914	55.71	3676	147	8.97
Mode	7779	311	18.97	6961	278	16.98
Pct. of population		100			100	
SES Data, 1996						
Welfare gains						
Mean	76,840	3074	100.54	83,444	3338	109.18
Median	25,408	1016	33.24	20,645	826	27.01
Mode	25,655	1026	33.57	18,591	744	24.32
Pct. of population		86			95	
Welfare losses						
Mean	117,051	4682	107.59	115,861	4634	106.50
Median	113,705	4548	104.51	112,097	4484	103.04
Mode	117,486	4699	107.99	118,119	4725	108.57
Pct. of population		14			5	

Both the structural theories with and without financial services growth discussed in Section 3 and estimated for Thailand by Giné and Townsend predict that increased financial intermediation leads to higher asset growth rates. In support of these theories, there is some evidence that institutions, especially those institutions with stability or expansion of services, promote asset growth among members.

In this spirit, Townsend and Kaboski (2006) used a framework for analyzing relative success of different type of financial services and their policies similar as the proposed in the previous section for studying the case of Thailand villages. The results of their analysis, highlighted below, are predominantly consistent with theory.

First, the authors find evidence in support of theory for positive impacts of village financial institutions on asset growth, especially among those institutions and policies that were associated with successful provision of intermediation services. That is, institutions that seem to succeed in membership, savings mobilization, and lending are institutions that have higher positive impact on households. In particular, cash loans are associated with the stability or expansion of services, while rice lending institutions and buffalo banks are associated with contraction or failure. PCGs and women's groups, institutions that typically lend cash, had positive impacts on asset growth, while buffalo banks and to a lesser extent rice banks appear to have had, if any, negative impacts. The results are significant only for the maximum likelihood estimation, and not for two-stage least squares regressions, however. Also, three specific policies associated with institutional success (offering training services, savings services, and pledged savings accounts) were each individually associated with faster asset growth rates. Institutions with these policies yielded 5–6% higher annual growth in assets to their villagers.

Second, institutions with certain policies can help to smooth responses to income shocks. These policies include offering emergency services, training services, and various savings-related policies. While both standard (i.e., flexible) and pledged (i.e., restrictive) savings accounts help with smoothing, flexible accounts appear more helpful. Households in villages with these beneficial policies were 10–29 percentage points less likely to reduce consumption/input use in a year with a bad income shock. Nevertheless, the average institution does not appear to alleviate risk and may increase the probability of having had to reduce consumption, buffalo banks and perhaps rice banks in particular. Though the overall lack of a positive impact on alleviating risk is troubling, the fact that institutions associated with diminishing services had perverse (if any) impacts, and the polices correlated with successful intermediation had positive impacts is in line with what theory suggests.

Third, in their study, Townsend and Kaboski find some evidence in support of the theories of constrained occupational choice, but more so for job mobility per se than entering into business. Women's groups do seem to increase job mobility. Pledged savings accounts (associated with successful intermediation) appear to increase the probability of switching jobs, and possibly starting a business, while traditional savings accounts (associated with diminishing intermediation) seem to have the opposite impact. Nevertheless, the evidence is not fully in harmony with the theory, since PCGs decrease the probability of switching jobs and also perhaps the probability of starting a business, and emergency services also lower the probability of starting a business.

Fourth, the most robust result is that institutions overall help reduce reliance on moneylenders, our indirect measure of the prevalence of formal credit constraints. The effect on the average villager is to reduce the probability of becoming a moneylender customer by 8 percentage points. Our interpretation is that village institutions loosen households' constraints on formal credit, at least to credit that could be acquired alternatively from moneylenders. Other than women's groups, there is no strong evidence of any particular institution or policy associated with this impact, however. We emphasize that the results overall show that institutions and policies correlated with the success and stability of services are also significantly associated with positive impacts on households.

Complementing the above results, the authors test the following policies and institutions finding that "Buffalo banks" tended to have negative growth in lending services. In this same spirit, institutions that made rice loans were more likely to have negative growth in lending. In contrast, cash loans were positively correlated with lending growth.

The provision of agricultural training was positively correlated with lending growth and the provision of non-agricultural advice/consultation was positively correlated with growth in savings.

In general, more stringent policies such as requiring minimum initial deposits and having pledged savings accounts were positively related to growth of membership and saving, while more flexible policies such as savings being optional for membership and having standard (save and withdraw as desired) accounts were negatively related to growth. One exception is that institutions with time deposit savings accounts—an inflexible account - were more likely to have negative savings growth.

These policies were specifically analyzed using the econometric models proposed in the previous section to test if institutions with successful (unsuccessful) policies had larger (negative) impacts on household/business outcomes. The econometric results of such models are presented below.

In general, the 2SLS and MLE results are consistent in sign, but only the MLE results are significant. For institutions overall, we focus on the first two rows of Table 4.3. Both the 2SLS and MLE estimate positive impacts of membership on asset growth, but only the MLE is significant. Only those institutions that did not tend to diminish services have positive impacts; the institutions associated with declining services have negative impacts on asset growth. Specifically, Table 4.3 shows that in Thailand rice banks and buffalo banks tend to have negative impacts on asset growth, while PCGs and women's groups have positive impacts. Again, the results are only significant using the MLE, however.

Table 5.3. Membership impact estimates using Townsend Thai key informant data (by type of institution)

Membership by institution type	Number of members	Outcome variable: Asset growth	Reducing consumption or input use in bad year	Starting a business	Changing jobs	Becoming moneylender customer
Any village institution 2SLS	367	0.2175 (0.3998)	0.1693 (0.1993)	0.1238 (0.1187)	0.0408 (0.1529)	−0.6338 (0.1335)
Any village institution Simultaneous MLE	367	1.7037 (0.0678)	0.7098 (0.3493)	−0.0302 (0.3725)	0.0183 (0.4216)	−1.3903 (0.1161)
Rice bank 2SLS	107	−0.3157 (0.3398)	0.2815 (0.1516)	0.1112 (0.1020)	0.0608 (0.1233)	−0.0517 (0.1192)
Rice bank Simultaneous MLE	107	−0.7212 (0.2051)	0.7917 (0.3117)	0.3430 (0.4231)	0.5320 (0.6036)	1.3191 (0.6506)
Buffalo bank 2SLS	13	−1.3584 (1.8823)	2.2932 (1.3029)	0.3474 (0.6836)	1.0805 (0.8022)	1.4900 (1.1835)
Buffalo bank Simultaneous MLE	13	−2.0419 (0.4190)	1.4777 (0.4332)	1.8044‡ (0.5217)	−1.0918‡ (0.2281)	−1.1848‡ (0.2194)
PCG 2SLS	68	0.7178 (0.6119)	0.0058 (0.3099)	0.0236 (0.1866)	−0.2944 (0.2140)	−0.0903 (0.1607)
PCG Simultaneous MLE	68	1.7798 (0.1183)	0.1671 (0.5641)	0.4082 (0.6244)	−0.4873 (0.8814)	−0.6680 (0.5120)
Women's group 2SLS	54	4.9670 (6.0915)	−18.1780 (59.5241)	1.5768 (2.4794)	1.4076 (4.2478)	−4.2552 (3.0400)
Women's group Simultaneous MLE	54	1.8805 (0.1132)	2.0672‡ (0.1057)	−0.0142 (1.2957)	2.1976 (0.7468)	−1.5887 (0.1285)

Notes: Shading indicates significance at 5% level. ‡ Estimate is significant, but MLE yielded an insignificant error correlation that approached perfect positive or negative correlation. The impact estimate is the coefficient on the membership variable in 1990. "Outcome variables" are the dependent variables in the outcome equation. Impacts are measured from 1991 to 1997. Other independent variables used as controls are head of household characteristics (age; age squared; years of education, sex); household characteristics (numbers of adult males, adult females, and children; total assets, total assets squared; membership/customer of commercial bank, agricultural bank, money lender) and village characteristics (average wealth; average wealth squared; average years education of household heads; fraction of households in rice farming as primary occupation, in multiple occupations, and in agriculture only; presence of a hall for village assembly; economic status relative to other villages in the *tambon*/subdistrict; and the relative level of government assistance that the village receives). In addition, the "asset growth" and reducing consumption" equations contain occupation dummies for the household head. The "becoming moneylender customer" excludes customer of moneylender as a right-hand side regressor. The wealth controls for "starting a business" use non-business wealth. The membership equation contains all of the control variables in the outcome equation as well as a dummy variable for the presence of the institution in the village in 1990 from the Townsend data.

The divergence between the 2SLS and MLE estimates is a bit troubling; especially since the linear model should be consistent despite the fact that membership is binary. It could be that these results would indeed turn significant given more data, however, and the MLE incorporates more information (i.e., the correlation of error terms in the membership and outcome equations) into its estimation.

For the results in Table 5.4 and Table 5.5, these estimated correlations are both sizable and significant). Nevertheless, these MLE results also rely on the distributional assumption of normality.

Table 5.4. Impact estimates by policies of institution (growth/failure-related policies)

Outcome variable							
Presence of institution with policy	Number of observations	Asset growth	Reducing consumption or input use in bad year	Starting a business	Changing jobs	Becoming money-lender customer
Baseline	2858	0.0296 (0.0521)	0.0914 (0.0227)	0.0161 (0.0153)	0.0050 (0.0186)	−0.0821 (0.0151)
Offer lending services	716	−0.1332 (0.1186)	−0.0041 (0.0550)	−0.0477 (0.0367)	0.0145 (0.0457)	0.0333 (0.0305)
Savings used to evaluate loan applicants	731	−0.0979 (0.0960)	−0.1792 (0.0468)	−0.0209 (0.0322)	−0.0351 (0.0359)	−0.0381 (0.0283)
Offer emergency services	672	−0.0604 (0.1690)	−0.2005 (0.0826)	−0.0996 (0.0447)	−0.0693 (0.0623)	0.0118 (0.0451)
Provide training or advice	674	0.2605 (0.1125)	−0.0993 (0.0555)	−0.0175 (0.0327)	−0.0094 (0.0459)	−0.0087 (0.0319)
Offer saving services	731	0.2546 (0.0996)	−0.1344 (0.0464)	0.0068 (0.0273)	−0.0063 (0.0371)	−0.0268 (0.0289)
Offer pledged savings accounts	688	0.3183 (0.1274)	−0.1155 (0.0672)	0.0670 (0.0427)	0.1305 (0.0539)	−0.0671 (0.0339)
Offer traditional savings accounts	731	−0.1433 (0.2533)	−0.2946 (0.1149)	−0.1058 (0.0890)	−0.2644 (0.1009)	0.0663 (0.0749)
Savings is optional to members	716	−0.0735 (0.1079)	−0.1201 (0.0515)	−0.0450 (0.0316)	−0.0373 (0.0412)	−0.0291 (0.0284)
Savings requires minimum deposit	688	0.1057 (0.1015)	−0.1496 (0.0499)	−0.0286 (0.0307)	−0.0424 (0.0389)	0.0162 (0.0296)

Notes: Light shading indicates significance at 5% level. Dark shading Indicates significance at the 10% level. Impact estimates are the OLS estimate of the coefficient on the dummy variable for all institutions in the village in 1990 having/not having the relevant policy. "Outcome variables" are the dependent variables. The other independent variables are the list of controls variables contained in the notes to Table 8.

Tables 5.4 and 5.5 show that the policies correlated with growth have positive impacts on asset growth, but the policies traditionally mentioned in the literature as important to successful microfinance intermediation do not. Providing training or advice, offering savings services, and offering pledged savings accounts in particular are associated with significant positive impacts on households.

Table 5.5. Impact estimates by policies of institution (traditional microfinance policies)

Impact variable						
Presence of institution with policy	Number of observations	Asset growth	Reducing consumption or input use in bad year	Starting a business	Changing jobs	Becoming moneylender customer
Baseline	2858	0.0296 (0.0521)	0.0194 (0.0227)	0.0161 (0.0153)	0.0050 (0.0186)	−0.0821 (0.0151)
Collateral required	552	0.1230 (0.1728)	0.0776 (0.0744)	−0.0182 (0.0496)	−0.0266 (0.0690)	−0.0348 (0.0487)
Guarantor required	582	0.0318 (0.1176)	0.0268 (0.0533)	0.0044 (0.0352)	0.0464 (0.0458)	−0.0054 (0.0367)
Frequent payments	537	−0.0279 (0.1909)	0.0233 (0.0834)	−0.0237 (0.0629)	0.0105 (0.0738)	0.0150 (0.0548)
Frequent monitoring	375	0.2253 (0.1850)	0.0018 (0.0758)	−0.0071 (0.0510)	−0.0149 (0.0613)	−0.0077 (0.0563)
Everyone monitored	360	−0.1971 (0.1643)	−0.1256 (0.0762)	−0.0024 (0.0465)	0.0103 (0.0570)	−0.0215 (0.0400)

Notes: Light shading indicates significance at 5% level. Dark shading indicates significance at the 10% level. Impact estimates are the OLS estimate of the coefficient on the dummy variable for all institutions in the village in 1990 having/not having the relevant policy. "Outcome variables" are the dependent variables. The other independent variables are the list of controls variables contained in the notes to Table 8.

Quantitatively, these impacts are sizable. Ceteris paribus, households in villages with institutions that offered savings services had 26% higher growth in assets over six years (about 4% per year) than households in villages that did not (see Table 4.5). Institutions that offered savings services yielded 25% higher growth (again, about 4% per year), and institutions offering pledged savings accounts in particular yielded 32% higher growth (5% per year).

With the set of previous results we conclude for purposes of this proposal document that the set structural models, their theoretical connection, and complementary nature to assess the effects of financial system on the economy, have a feasible econometric counterpart for being estimated and calibrated. Both viability and validness rely on using data that gathers the most important variables from micro household decision, and the macro results and environment. The next section of this document presents the sources of information that may be used to particularly develop those methods and estimate them for the case of Mexico.

6. Conclusion

This document proposed a coherent unified approach for evaluating the impact of the financial system over the Mexican household welfare. This structural framework permits to study the linkages among economic growth, financial structure, and inequality, bringing together disparate theoretical and empirical literature.

The implications of these models provide a helpful and coherent framework for identifying the mechanisms behind the relationship between economic growth and financial deepening expansion.

The structural and consistent construction of the models proposed are complemented with the feasibility of their estimation for the Mexican case given the nature of the particular surveys of information collected by BANSEFI for this study. Furthermore, the test of robustness of the results can be achieved by testing the parameters and implications of these sets against some alternative household datasets such as ENIGH, ENNVIH, and ENHRUM.

References

Banerjee, Abhijit, and Esther Duflo (2003), "Inequality and growth: What can the data say?" Journal of Economic Growth, 8(3): 267-299.

Banerjee, A. and A. Newman (1993) "Occupational Choice and the Process of Development" Journal of Political Economy, 101(2):274-298.

Deaton, Angus. (1997). The Analysis of Household Surveys. John Hopkins

Galor, O. and J. Zeira (1993) "Income Distribution and Macroeconomics", Review of Economic Studies, 60(1):35-52.

Evans, David S. and Jovanovic, Boyan (1989) "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints," Journal of Political Economy, 97(4): 808-27

Gine, Xavier and Townsend, Robert M. (2004) "Evaluation of Financial Liberalization: A General Equilibrium Model with Constrained Occupation Choice," Journal of Development Economics, 74(2):269-307

Greenwood, Jeremy and Jovanovic, Boyan (1990) "Financial Development, Growth, and the Distribution of Income," Journal of Political Economy, Part 1, 98(5):1076-1107

Jeong, H. (1999) "Education and Credit: Sources of Growth with Increasing Inequality in Thailand. PhD Thesis, University of Chicago, Chicago IL.

Kaboski, Joseph and Townend, Robert M. (2005). "Policies and Impact: An Analysis of Village Level Microfinance Institutions". Journal of European Economic Association, 3(1):1-50.

Lloyd-Ellis, Huw and Bernhardt, Dan (2000) "Enterprise, Inequality and Economic Development,"Review of Economic Studies, 67)1:147-68

Paulson, Anna and Townsend Robert M. (2002) "Entrepreneurship and Liquidity Constraints in Rural Thailand." Working Paper, University of Chicago.

Piketty, Thomas (1997) "The Dynamics of the Wealth Distribution and the Interest Rate with Credit Rationing," Review of Economic Studies, 64(2):173-89

Townsend, Robert M. and Ueda, Kenichi (2006) "Financial Deepening, Inequality, and Growth: A Model-Based Quantitative Evaluation," Review of Economic Studies, 73(4):251-293.

Appendix: Databases Characteristics, by Type of Survey

Table 1. National Survey of Income and Expenditure of the Households

Name:	Encuesta Nacional de Ingreso y Gasto
Acronym Code:	ENIGH
Collected by:	INEGI
Sampling Design	
Observation Unit:	House
Sampling Unit:	House
Analysis Unit:	Households
Survey Frame:	Cross Section
Time Coverage:	1984, 1989, 1992, 1994, 1996, 1998, 2000, 2002 & 2004
Time Decomposition:	Quarterly and Annual
Geographic Coverage:	National and some States
Geographic Decomposition:	National and, 2 Levels of Population Size: 1) 2500 or less inhabs; and 2) 2500 or more inhabs.
Sampling Size:	20,000 households (approximately)
Survey Instruments:	1. Cuestionario Básico de Ingreso y Gasto de los Hogares;
Objective	
ENIGH covers the main aspects regarding: i) Socio demographic basic data; ii) Occupation characteristics for older than 12 years old members; iii) Household income (total, monetary, current); iv) Household consumption and expenditure (total, monetary, current); v) Financial and Capital Perceptions (total, monetary, current); vi) Financial and Capital Payments (total, monetary, current); vii) Total Income; viii) Total Expenditure.	

Table 2. The Mexican Life Household Survey

Name:	Encuesta Nacional sobre los Niveles de Vida de los Hogares
Acronym Code:	ENNVIH
Collected by:	CIDE and UIA
Sampling Design	
Observation Unit:	House
Sampling Unit:	House
Analysis Unit:	Households
Survey Frame:	Cross Section (with several rounds to complete a Panel)
Time Coverage:	
Time Decomposition:	Quarterly and Annual
Geographic Coverage:	National
Geographic Decomposition:	National
Sampling Size:	8,440 households (approximately)
Survey Instruments:	Several Questionnaires regarding topics as: Household Consumption, Migration, and Financial Decisions;
Objective	
ENNVIH covers the main aspects regarding multi-dimiensional wellbeing levels of the households among wich: i) Socio demographic basic data; ii) Health Data of the Family; iii) Occupation characteristics for older than 12 years old members; iv) Education choice of the members; v) Household income (total, monetary, current); vi) Household consumption and expenditure (total, monetary, current); vii) Financial and Capital Perceptions (total, monetary, current); viii) Financial and Capital Payments (total, monetary, current); ix) Total Income; x) Total Expenditure.	

Table 3. The Mexican Rural Household Survey

Name:	Encuesta Nacional de los Hogares Rurales de México
Acronym Code:	ENHRUM
Collected by:	Programa de Estudios del Cambio Económico y la Sustentabilidad del Campo Mexicano (PRECESAM) at El Colegio de México (COLMEX), Rural Economies of the Americas and Pacific Rim (REAP) of University of California at Davis
Sampling Design	
Observation Unit:	House
Sampling Unit:	House
Analysis Unit:	Community, House, and Household
Survey Frame:	Cross Section and expansion to Panel (2007)
Time Coverage:	2000
Time Decomposition:	Annual
Geographic Coverage:	National for Rural Areas (from 500 to 2,499 inhabs.)
Geographic Decomposition:	National, State, Municipalities, and Households.
Sampling Size:	80 communities in 16 states
Survey Instruments:	1. Set of ENHRUM questionnaires
Objective	
ENHRUM is an effort for having a National representative study for analyzing both rural economy and society and the impacts of agricultural reforms. ENHRUM permits to perform empirical analysis on the effects of that reforms on: i) production, ii) income, iii) consumption, and iv) migration.	

Table 4. Survey of Savings, Popular Credit and Rural Microfinance

Name:	Encuesta Basal sobre Ahorro, Credito Popular, y Microfinanzas Rurales
Acronym Code:	BANSEFI household surveys
Collected by:	BANSEFI
Sampling Design	
Observation Unit:	House
Sampling Unit:	House
Analysis Unit:	Households
Survey Frame:	Panel Section (2 Rounds)
Time Coverage:	2002 and 2005
Time Decomposition:	Quarterly and Annual, with Retrospective Information
Geographic Coverage:	National and some States
Geographic Decomposition:	National
Sampling Size:	5,000 households (approximately)
Survey Instruments:	1. Cuestionario Básico, Socios 2. Cuestionario Básico, No Socios
Objective BANSEFI household surveys covers the main aspects regarding: i) Socio demographic basic data; ii) Occupation characteristics for older than 12 years old members; iii) Household income (total, monetary, current); iv) Household consumption and expenditure (total, monetary, current); v) Financial and Capital Perceptions (total, monetary, current); vi) Financial and Capital Payments (total, monetary, current); vii) Total Income; viii) Asset composition and use.	

Table 5. The Financial Institutions Survey

Name:	Encuesta Institucional de Servicios Financieros de BANSEFI
Acronym Code:	BANSEFI institutional surveys
Collected by:	BANSEFI
Sampling Design	
Observation Unit:	Financial Institutions
Sampling Unit:	Financial Institutions
Analysis Unit:	Financial Institutions
Survey Frame:	Cross Section
Time Coverage:	2004
Time Decomposition:	Quarterly and Annual
Geographic Coverage:	National
Geographic Decomposition:	National
Sampling Size:	?
Survey Instruments:	Questionnaire regarding topics as: Assets, Balances, Financial Policies, and time trends on some financial variables;
Objective	
BANSEFI institutional survey covers the main aspects regarding multi-dimensional financial elements of financial services providers (*instituciones financieras*) including: i) Assets Structure; ii) Credit Evolution; iii) Financial Policies; iv) Client (members) evolution; v) Retrospective information on credit and savings for members in the community.	