Expansion of the Middle Class, Consumer Credit Markets and Volatility in Emerging Countries:

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Boston College Electronic Thesis or Dissertation, 2017

Boston College

Morrissey College of Arts and Sciences

Graduate School

Department of Economics

Expansion of the Middle Class, Consumer Credit Markets and Volatility in Emerging Countries

A dissertation

by

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submitted in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

April 2017

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Advised by Professor Peter Ireland

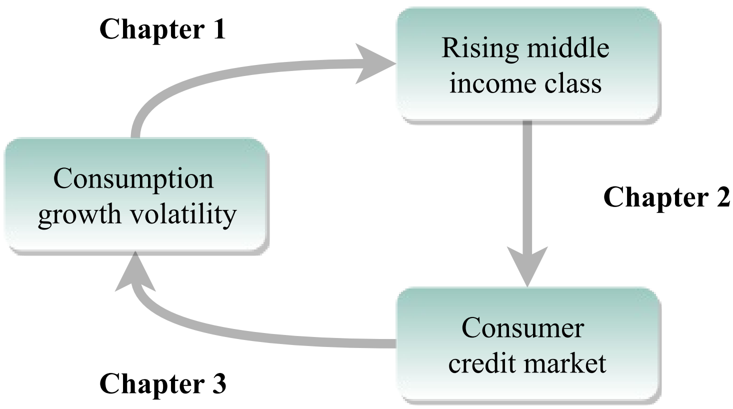
Abstract

The literature on real business cycles finds that one reason why emerging economies are more volatile than developed small open economies is that they face greater financial frictions. Indeed, according to several measures of financial depth and access, financial systems in emerging countries are on average less developed than those in developed small open economies. Despite the lag in financial development, private credit, particularly unsecured credit to households, has been steadily increasing during the last two decades in emerging countries in Latin America.

During this period of rising credit, various countries in the region observed an increase in the size of their middle income class population and the emergence of the vendor financing channel in their consumption credit market. Estimates by the World Bank suggest that the share of middle class households increased from 20.9 % in 1995 to 40.7 % in 2010. In addition, the share of poor households was approximately halved and reached 23.4 % at the end of this 15 year period. This phenomenon not only increased credit demand but also motivated the entry of new suppliers in the consumer credit market in countries like Mexico, Colombia, Chile and Brazil. In spite of a significant decline in unemployment in recent years, the lack of formal employment and poor credit history were still impeding many individuals from gaining access to consumer finance from traditional financial

institutions. In order to enable *new middle class shoppers* access items typically offered by large retail stores, the retailers themselves started offering credit.

In this dissertation, I study the relationship between middle class size, unsecured credit markets and aggregate consumption volatility in emerging countries. In the first chapter of this thesis, we examine the link between middle class size and consumption growth volatility using a sample of middle income countries. In the second chapter, we study the effect of an expansion of the middle class on vendor financing incentives and unsecured credit supply on its extensive margin. In the third chapter, I study business cycle implications of a reduction in the share of financially excluded households in an emerging economy.



In the first chapter, I empirically examine the effect of middle income class size on consumption growth volatility in emerging countries. Using a panel data of middle income countries, I find that a larger middle class size tends to increase aggregate consumption growth volatility, particularly at lower levels of financial system depth. Financial development plays a significant role in determining the sign of the marginal effect of middle class size on aggregate volatility. Unlike emerging countries, the effect of the size of the middle class and the role of financial development on consumption volatility in developed countries is ambiguous. The key message of this analysis is that as more households escape poverty thresholds and reach the middle income class status in developing and emerging economies, it becomes more important to deepen financial systems from the perspective of aggregate consumption volatility.

In the second chapter, I explore through the lens of a theoretical model, potential reasons triggering an increase in credit supplied by the non traditional financial sector, i.e vendors, at the extensive margin. I find that a reduction in the average risk of default and an increase in the market size of credit customers raise vendor financing incentives. This model rationalizes the observation that the improvement of economic conditions of the low-income and financially constrained households potentially led to increased credit supply by vendors in several countries of Latin America.

In the third chapter, I study business cycle implications of a decline in household financial exclusion in a dynamic general equilibrium model suitable for emerging economies. Using Mexico as a case study, I estimate the model with Bayesian methods for the period 1995 to 2014. Standard measures of predictive accuracy suggest that the extended business cycle model with limited credit market participation outperforms a model with zero financial exclusion. The results of the estimation suggest that a rise in credit market participation in an emerging economy increases aggregate volatility of key macroeconomic aggregates, and that financial frictions play a key role in this relationship. I confirm this prediction by re-estimating the model for Mexico after splitting the sample into two non-overlapping decades. A key implication derived in this chapter is that a reduction of financial exclusion within an emerging country may lead to higher consumption growth volatility and trade balance volatility, and that fewer financial frictions dampen the marginal effect. As household financial access increases in these countries, a greater need for improving broad financial development measures arises.

A Juan Carlos, Blanca y mis abuelos

Acknowledgements

I am forever grateful to Prof. Peter Ireland for putting every bit of his academic brilliance into every discussion we had. Without his persistent help, guidance and encouragement, this thesis would not have been possible. I sincerely thank Prof. Dongho Song and Prof. Pablo Guerron for the useful comments and for tirelessly answering all my questions. I'm grateful for the financial and institutional support from Boston College and the Central Bank of Paraguay.

I thank all my friends in Boston; in particular, Francesca, Ana and Deeksha. Thank you for the exchange of ideas, helping me improve my presentation skills and most importantly, the unconditional friendship. Special thanks to Deeksha for proof reading a large part of this thesis and for the great hindu stories. The story of Arjuna, the archer aiming his arrow at the fish's eye, remains my favorite.

I would like to express my deepest gratitude to Matteo, who has been by my side for the last three years of this journey and the path since then has been so much easier and fun. Thank you for showing me how to enjoy life while maintaining perspective. I thank my parents for their incessant moral support throughout my graduate education and for so much more. My sisters and I grew up knowing there is nothing us girls couldn't dream of being or accomplishing. Thank you for teaching us the value of hard work and perseverance. I thank my sisters Eli, Jaz and Paci for listening and comforting me when I needed. Grazie, Gracias!

Last but not least, I wish to express my most sincere gratitude to Prof. Emilio Ortiz Trepowski, who motivated me to pursue a Ph.D. and to Prof. Charles Becker, for his guidance and increasing my interest in economics. They were both highly influential in my path towards earning a doctorate degree.

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Chapter 1

Inequality and volatility in developing countries

1.1 Introduction

According to a recent publication by the World Bank (Ferreira et al., 2013), Latin America -historically recognized as one of the regions with the highest income inequality- has recently begun an upward social mobility process. Estimates for the region suggest that within the 15 year period from 1995 to 2010, the percentage of poor and vulnerable households decreased from 79.1% to 59.3%, and the middle class population approximately doubled from 20.9% to 40.7%. This upward trend in the middle class is not restricted to Latin America, other developing countries have been experiencing it as well. See Dang and Lanjouw (2015a), Dang and Lanjouw (2015b), Kharas (2010), Kharas (2017) and Kochhar (2015).

This paper is an empirical study that examines the link between a rising middle income class within a developing country and macroeconomic implications in the short run. In particular, I focus on the effect of a larger middle class on aggregate (consumption growth) volatility in emerging/developing countries. Since developing countries have less developed financial systems than their high-income counterparts, I examine the role of financial development in the relationship of interest.

Previous theoretical literature using closed economy models has explored the relationship between inequality and volatility and suggests some answers. However, an unambiguous answer can only be pinned down by unobserved structural parameters like the degree of capital market imperfections or those related to households preferences.

The paper by Aghion et al. (1999) introduces a closed economy model with separation between savers and physical capital investors and an imperfect capital market. They show that the degree of separation (inequality measure implied by the model) may lead the economy to fluctuate around its steady state growth path and that the degree of capital market imperfection (constraints on amount investors can borrow from savers) plays a key role. In particular, the combination of both a relatively high degree of physical separation and poor functioning capital markets may yield higher aggregate volatility in the long run.

Ghiglino and Venditti (2007) derive conditions related to technology and consumer's preferences that lead to either a negative or positive impact of wealth inequality on macroeconomic volatility. In their deterministic model with complete markets and no borrowing constraints, wealth inequality (modeled through heterogeneity in share of initial stock of capital and labor endowments) may affect the economy through the stability properties of the steady state and generate periodical solutions. The authors find that if absolute risk tolerance is a strictly concave function, sufficiently low levels of wealth inequality may lead to higher macroeconomic volatility.

Even though there exists a very large empirical literature studying the effect of inequality on growth and development[1], the empirical literature focusing on the

[1] The majority of empirical papers within the inequality-growth literature support the thesis that inequality hinders growth. Several mechanisms have been explored and supported; for example, inequality can undermine progress in health and education which are important growth determinants (Easterly, 2001). See Easterly (2007) for a more extended survey.

relationship between income distribution and growth volatility is meagre.

Breen and García-Peñalosa (2005) studied the effect of (long run) volatility on inequality for a set of both developed and developing countries. Using a sample of 80 countries, the authors run OLS of the GINI coefficient in 1990 on the standard deviation of annual rate of growth real per capita GDP over the period 1960 to 1990. The authors find a significant positive effect of volatility on inequality. This result, however, is unsurprising since developing and emerging countries have the highest income inequality indices and at the same time output growth in these countries is much more volatile than in their developed counterparts. It is a challenging task to disentangle the causal effect of volatility on inequality (or vice versa) without using panel data methods to control for unobserved heterogeneity and endogeneity.

Iyigun and Owen (2004) use a panel data of 27 countries to assess the impact of income inequality on volatility of real consumption or output growth. Their estimation strategy is a two and three period fixed effect model. They find supporting evidence that a decline in inequality increases consumption growth volatility in a sample that includes both developed and developing countries. Their limited sample size prevents any analysis by income level classification and the question of whether a particular set of countries may be driving their findings remains unanswered.

A couple of seminal papers from the political economy literature study the effect of inequality on long run growth. They suggest some mechanisms through which inequality changes may affect aggregate volatility. Alesina and Perotti (1996) argue that a lower middle class fuels social discontent increasing socio-political instability, and ultimately reduces investment. Their cross sectional regressions based on a sample of 71 countries for the period 1960-1985 provide empirical support for this hypothesis. Rodrik (1999) argues that when there is an external shock, the policy response (e.g. devaluation and fiscal retrenchment) would be much more difficult to implement in a country with potential for social conflict because of the distributional implications of the policies. The author provides evidence on the negative effect of inequality on long run growth, through its effect on potential social conflict. The validity of income inequality as an instrument of socio-political instability in both papers, suggests that a decline in inequality is associated with a reduction in the number of potential social conflicts and political instability. The question that is left unanswered in both papers, is the effect of decreasing socio-political instability on aggregate volatility. Assuming this type of instability is among the most important sources of growth volatility in developing countries, it would predict a reduction on aggregate volatility.

Since the upward trend in income mobility in developing countries is still relatively recent, there is not enough evidence that a rising middle class may bring unambiguously lower social conflict and political instability within countries still facing relatively high levels of inequality. Hirschman and Rothschild (1973) suggest that the movement of others, when unaccompanied by one's own, might be welcomed at first but subsequently resented. This may indeed be the case with developing countries, where even though the middle class has been increasing, they still observe the highest income inequality levels. The political economy mechanism is left for future research to explore.

This paper contributes to the empirical literature on the effect of inequality and middle class size on consumption volatility by focusing on developing countries. Relative to Iyigun and Owen (2004), we improve the estimation strategy, increase the sample size and divide the sample by income level classification. In addition, we examine the role of financial development.

We find that the size of the middle class tends to have a positive effect on consumption growth volatility in developing countries, particularly at low levels of financial development. For this sample of countries, financial development has a significant role. Finally, we find that the effect of the size of the middle class and the role of financial development on consumption volatility in developed countries is ambiguous and not significantly different from zero.

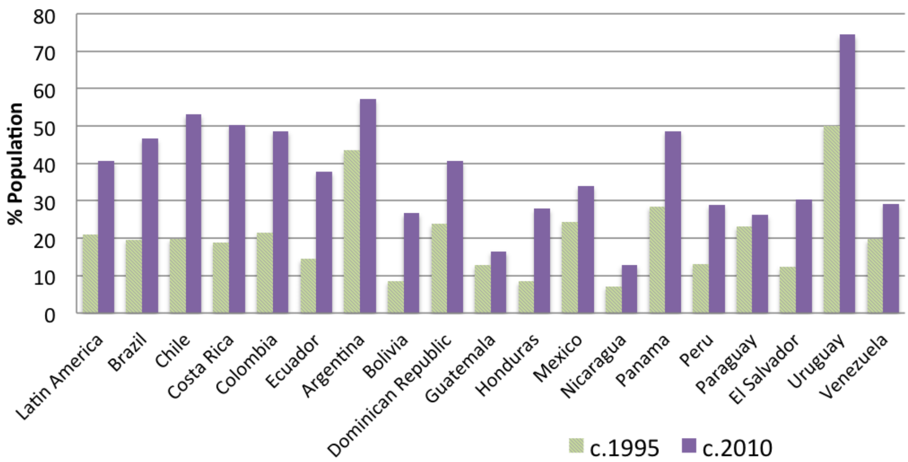
The rest of the paper is organized as follows. Section 2 describes the rising middle class in developing countries as documented by previous papers. Section 3 explains the econometric methodology and describes the sample, middle class and financial development measures. Section 4 presents estimation results and answer our research question. Furthermore, we examine the role of financial depth. Section 5 presents robustness checks and Section 6 concludes.

1.2 The rising middle income class in the developing world

A report by the World Bank (Ferreira et al., 2013) found that Latin America has been experiencing a dramatic increase in the middle class population in the last 15 years. The Report uses household surveys from 18 Latin American countries for the period 1995-2010 and defines a middle class household as one with per capita income between US$10 and US $50 a day- expressed in 2005 US$ PPP (purchasing power parity). This is a region specific measure derived by Lopez-Calva and Ortiz-Juarez (2011) which echoes the concept of economic security, that is a "low probability" (10 percent) of falling back into poverty, when setting the lower bound of income threshold. It has also been validated by self perception surveys and respects a standard moderate poverty line in the region.

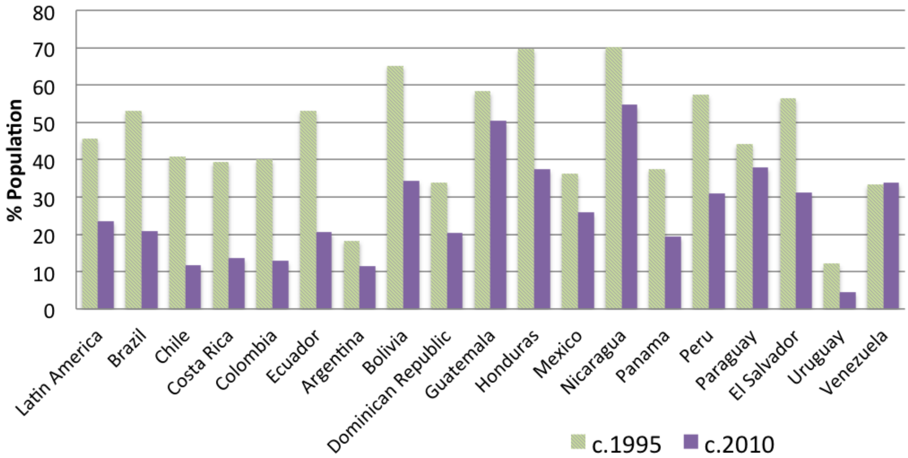
The derivation of transition matrices based on synthetic panels yielded interesting findings across countries and allowed the construction of regional measures. Out of every 100 latin americans, 43 changed their economic status during the period and out of these 43 "movers", only 2 experienced a worsening of their status. Their estimates for the region suggest that the percentage of middle class households increased from 20.9% in 1995 to 40.7% in 2010 (Figure 1.1). In addition, the percentage of poor households was approximately halved and reached 23.4% by the end of the same 15 year period (Figure 1.2). Out of 18 latin american countries included in the analysis, five countries emerge as the main protagonists of this social progress: Brazil, Chile, Costa Rica, Colombia and Ecuador. Within a 15 year period, these countries at least halved the poor population and around 50 to 60 % of the population moved upwards in the defined social scale.

Figure 1.1: The emerging middle class in Latin America



Source: World Bank (2013)
Notes: "Middle class": individuals with a per capita income higher than US$10 per day expressed in 2005 US$ PPP (purchasing power parity). Report based on household surveys from Socio-Economic Database for Latin America and the Caribbean (SEDLAC). Middle class measure for the entire Latin America region use as weights country-specific population estimates of the last available period. Years vary across countries. Years used are: Argentina 1994 and 2009; Bolivia 1992 and 2007; Brazil 1990 and 2009; Chile 1992 and 2009; Colombia 1992 and 2008; Costa Rica 1989 and 2009; Dominican Republic 1996 and 2009; Ecuador 1995 and 2009; Guatemala 2000 and 2006; Honduras 1994 and 2009; Mexico 2000 and 2008; Nicaragua 1998 and 2005; Panama 1994 and 2009; Peru 1999 and 2009; Paraguay 1999 and 2009; El Salvador 1991 and 2008; Uruguay 1989 and 2009; and Republica Bolivariana de Venezuela 1992 and 2006.

Figure 1.2: Declining poverty headcount ratios at 4 US$ a day



Source: World Bank (2013)
Notes: Poverty lines and incomes are expressed in 2005 US$ PPP per day. Report based on household surveys from Socio-Economic Database for Latin America and the Caribbean (SEDLAC).

This upward trend in the percentage of middle class households is not restricted to Latin America. Dang and Lanjouw (2015a) use the same methodology to construct synthetic panels from cross sectional surveys and a similar vulnerability-based definition for the middle class to document the rising middle class in India. They find that the population share of the poor category decreased by 14% and that of the middle class increased by 24% over the period 2004-2009. They also find that during the subsequent period of 2009-2011, there was a faster shrinkage of poor households (22%) and a faster growth of the middle class (28%). Repeating the analysis for Vietnam, Dang and Lanjouw (2015b) find that the population share of the poor category decreased by 29 % and that of the middle class increased by 22% over the period 2004-2008.

Kharas (2010) aims to quantify and project the evolution of the global middle class, by defining it as the percentage of households with per capita incomes between \$10 and \$100 per person per day in 2005 PPP terms. The author projects the size of the global middle class until 2020 and finds that *"several asian countries, in particular China and India, have reached a tipping point where large numbers* *of people will enter the middle class and drive (global) consumption*".

Since then, two developments have shaped global middle-class calculations. First, a survey of purchasing power parity (PPP) prices conducted in 2011 has replaced the previous 2005 PPP survey World Bank (2014) as the basis for comparing real income levels across countries. Second, the addition of new household surveys that allow, in some cases, direct measurement of the middle class.

Kochhar (2015) takes into account these two developments and redefines middle class households as those with per capita income within the range of $10 and $20 USD (PPP 2011). After compiling survey data from 111 countries for the years 2001 and 2011, the author documents that the global middle class doubled (+ 385 million people) within the decade examined but the rise was mostly concentrated in few regions within the developing world. The increase in the global middle class was mostly coming from China (53%), Latin America (16%) and Eastern europe (10 %). Table 1.1 shows the estimated percentage of middle class households in 2001 and 2011 for selected countries.

Table 1.1: Middle class households as % total households in selected countries.

	2001	2011
China	3%	18%
Belarus	21%	53%
Romania	6 %	25%
Ukraine	8%	49%
Bulgaria	28%	48%

Source: Kochhar (2015)

A more recent paper by Kharas (2017), calculates the size of the global middle class in order to contrast it with his earlier forecast (Kharas, 2010). His new calculations suggest that there were approximately 3.2 billion people in the middle class at the end of 2016; that is around 500 million more than his previous estimates. Furthermore, the updated data is able to distinguish two groups. In the developed countries of North America and Europe, the middle class is large but growing slower than overall population growth. In fact, some households are falling below the middle class threshold, while others are escaping and reaching the so called rich status. The other group is the one corresponding to developing countries where there is a dynamic and fast growing middle class. Even though the middle class is growing everywhere in the developing world, Asia observes the greatest numbers.

The rest of this paper examines whether a larger middle income class within a developing country may bring some negative macroeconomic implications, in particular higher aggregate volatility in consumption. In addition, we explore the role of financial development. We begin by describing the empirical approach and the data in the next section.

1.3 Empirical model and data description

1.3.1 A simple econometric model

Denote $M_{i,t}$ to be a measure of the middle class size and $FINDEV_{i,t}$ a measure of financial development for country i at time t. Consumption growth variability, $V_{i,t}$, is defined as the standard deviation of quarterly growth rate of real consumption per capita estimated for a 5 year period and starting at time t.

The model assumed for the data generating process is as follows:

$$\begin{aligned} V_{i,t} =& \beta_1 Q_{i,t} + \beta_2 M_{i,t} + \beta_3 M_{i,t} \times FINDEV_{i,t} + \epsilon_{i,t} \\ \epsilon_{i,t} =& \mu_i + v_{i,t} \\ E(\mu_i) =& E(v_{i,t}) = E(\mu_i v_{i,t}) = 0 \end{aligned} \tag{1.1}$$

Following previous literature on determinants of growth or growth volatility (see Beck et al. (2000) and Bekaert et al. (2006) for a survey), variables included in $Q_{i,t}$ control for different levels of consumption growth variability across countries. These controls include initial income per capita, population growth rate, openness to trade, the ratio of government spending and financial development. The coefficients of interest are the effect of middle class size on consumption growth volatility (β_2) and the interaction effect between financial development and middle class size (β_3).

One immediate problem in applying pooled OLS to this empirical model is that regressors are very likely to be correlated with fixed effects in the error term and this violates an assumption needed for consistency. One way to purge fixed effects is to use the LSDV estimator and draw them out of the error term by entering dummies for each country but there is still the need to address potential endogenity of regressors. 2SLS is not convenient since according to Roodman (2014), even though consistent, is efficient under homoskedasticity. This assumption is rarely valid when using panel data.

In fact, existing empirical research with similar models of average consumption growth over non-overlapping periods, often rely on a dynamic panel estimation strategy. This is due to several reasons. First, the data generating process assumed in equation (1) assumes fixed individual effects which favors a panel setup where the time dimension can prove to be useful to identify parameters. Second, regressors are most likely endogenous or at least predetermined but not strictly exogenous. Third, idiosyncratic disturbances $v_{i,t}$ may have individual specific patterns of heteroskedasticity and serial correlation. Fourth, after including time effects and perhaps region dummies, the idiosyncratic disturbances are uncorrelated across countries. Fifth, the panel is small T and relative large N. All these reasons favor the use of difference and/or system GMM estimators.

The difference GMM estimator of Arellano and Bond (1991) allows to purge fixed effects by transforming the regression model by first differencing.

$$\Delta V_{i,t} = \beta_1 \Delta Q_{i,t} + \beta_2 \Delta M_{i,t} + \beta_3 \Delta \left(M_{i,t} \times FINDEV_{i,t} \right) + \Delta v_{i,t} \tag{1.2}$$

After transformation, the endogeneity issue still remains. Moreover, any predetermined variable becomes potentially endogenous. To see this, assume $M_{i,t}$ is a predetermined but not strictly exogenous variable [2]. The term $M_{i,t}$ in $\Delta M_{i,t}$ is correlated with the term $v_{i,t-1}$ in $\Delta v_{i,t}$.

To address this endogeneity problem, Arellano and Bond (1991) suggest to instrument the lagged values of explanatory variables with their levels. Assuming that there is no serial correlation in the error term v, valid instruments for the first difference of predetermined variables $(X_{i,t})$ are the first and further lags of their levels while for endogenous variables are the second and further lags of their levels. The corresponding GMM estimator exploits the following moment conditions:

$$E\left[X_{i,t-s} \cdot (\Delta v_{i,t})\right] = 0 \quad \forall s \geq 1 \quad t = 2, \ldots, T \tag{1.3}$$

As Beck et al. (2000) and the references therein pointed out, there are several conceptual and econometric problems with the difference GMM that lead their empirical work on the relationship between growth and financial development be

[2] $E(M_{i,t} v_{i,s}) = 0 \quad \forall t \leq s$ is a reasonable assumption to make since one could argue that even though future volatility may be related to current social indicators of inequality, unanticipated changes (idiosyncratic disturbances) are unrelated.

based on the system GMM approach. First, by first-differencing the researcher neglects the pure cross country dimension of the data. This is a potential concern in this study since ratios of between variation over within variation for different measures of inequality range from $2.9 - 4.4$ (see Descriptive statistics in Table A.1 in Appendix). Second, differencing may decrease the signal-to noise ratio and exacerbate measurement error biases. Finally, lagged levels are often rather poor instruments for first differenced variables, especially if the variables are close to a random walk.

Taking into account these conceptual and econometric shortcomings and following Beck et al. (2000), the estimator chosen to answer the empirical question is system GMM developed by Blundell and Bond (1998) and outlined in Arellano and Bover (1995). This approach instead of transforming regressors to deal with fixed effects, transform instruments to make them exogenous to fixed effects. Valid instruments for predetermined variables are their first difference at all lags (including contemporaneous) while for endogenous variables are the first and further lags of their first difference. For example, let regressors X be predetermined but not strictly exogenous, in addition to the moment conditions specified in equation (3) this estimator uses the following moment conditions:

$$E\left[\Delta X_{i,t-s} \cdot (\mu_i + v_{i,t})\right] = 0 \quad \forall s \geq 0 \quad t = 2, \ldots, T \tag{1.4}$$

Validity relies on the assumption that changes in instrumenting variables X are uncorrelated with fixed effects, equivalently $E\left[X_{i,t} \cdot \mu_i\right]$ is time invariant. Moreover and as in difference GMM, validity also depends on the assumption that v is not serially correlated.

1.3.2 Sample description

Since the focus of our research question is on emerging and developing countries, the sample is restricted to low middle income and upper middle income countries according to the World Bank's income group classification[3]. In addition, we add five countries typically considered emerging markets[4] that on june 2015 (date of data download) were classified as high income: Russian Federation, Chile, Poland, Trinidad y Tobago and Uruguay.

The panel considered for this study spans the years 1985 to 2014 and includes an initial set of 67 developing and emerging countries: Azerbaijan, Bahamas, The, Belarus, Belize, Bolivia, Botswana, Brazil, Brunei Darussalam, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Dominican Republic, Ecuador, Egypt Arab Rep., El Salvador, Equatorial Guinea, Estonia, Gabon, Guatemala, Honduras, Hungary, India, Indonesia, Iran Islamic Rep., Israel, Jordan, Kazakhstan, Kyrgyz Republic, Lebanon, Macedonia, Malaysia, Malta, Mauritius, Mexico, Morocco, Namibia, Nicaragua, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Puerto Rico, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, South Africa, Thailand, Trinidad and Tobago, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Vietnam, West Bank and Gaza.

This set will be restricted by the availability of data on middle class size indicators.

[3]Country selection is based on data from the World Bank's World Development Indicators database accessed on june 2015

[4]Both Morgan Stanley Capital International (MSCI) and J.P. Morgan Securities Inc. consider these countries in their corresponding emerging markets indexes widely used by financial investors. In particular and as example, the Emerging Markets Research group from J.P. Morgan Securities Inc. includes them in their emerging markets debt benchmark known as EMBI Global (Emerging Markets Bond Index Global). The criteria to establish the universe of eligible countries to be included in the EMBI Global are two and are described in Cavanagh and Long (1999)

1.3.3 Measuring the middle class

Ferreira et al. (2013) argue that defining the middle class is not a trivial matter and the choices depend on the perspective of the researcher. In sociology and political science, the middle class is often defined in terms of education, occupation or asset ownership. In economics, by contrast, the definition is often focused on income levels. Within this field, the authors distinguish two common types of definitions: the relative income based and the absolute income based. The former classifies the middle class as households with income falling in between a pre-specified range of ranks or positions in the income distribution. The latter identifies the middle class as those households with income in a specific range of standardized international dollars (that is, at purchasing power parity [PPP] exchange rates).

As pointed out in their paper, there is currently no dataset that reports absolute measures of the middle class and that also has large enough cross-sections and long-enough time series. Moreover, the absolute measure faces the fundamental question on how to define such absolute level.

This study will use the relative income based definition following Barro (2000) and Easterly (2001). According to their definition, a middle class household has income falling within the three middle quintiles of income distribution. Due to the lack of immediate data on the percentage of total households classified as middle class under this criteria, middle class size is approximated by the share of income held by the middle quintiles of income distribution. Two measures of inequality will also be considered. In total, four variables are used to proxy for middle class size within country i at time t ($M_{i,t}$ in equation 1):

1. The share of income held by the second, third and fourth quintiles of income distribution (SH234)

2. The share of income held by second and third quintiles of income distribution (SH23)

3. The Gini index (GINI): This index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus, a Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

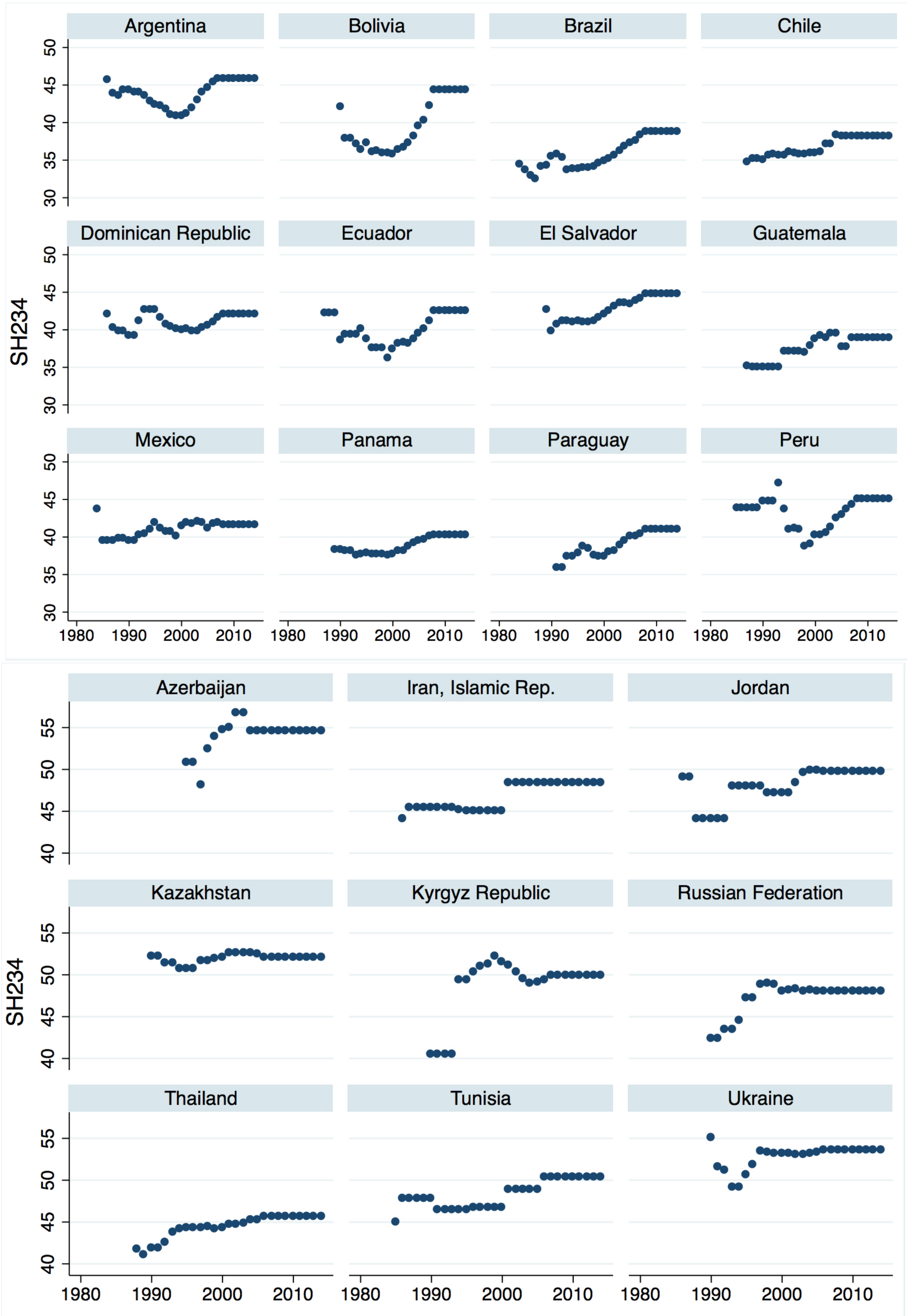
4. The share of income held by the fifth quintile over the share held by the third quintile (SH5TO3).

In the following figures, the time evolution of these indicators are displayed for 21 selected countries during the sample period. The figures plot the rolling five-year averages of SH234, SH23, GINI and SH5TO3. In general, and in particular for latin american countries, there is an apparent downward trend of the Gini index and SH5TO3 and an upward trend of SH23 and SH234.

Tables A.5 and A.6 in the Appendix show the mean of all middle class size indicators during the period 2000-2009 and their change relative to the previous decade, by country. Twenty one countries experienced a change in GINI, SH23 and SH5TO3 consistent with an "emerging middle". Eight out of the 21 countries are from Latin America (Brazil, Chile, El Salvador, Guatemala, Mexico, Nicaragua, Panama and Paraguay). Kyrgyz Republic, Russian Federation, Namibia, Malaysia, Iran and Azerbaijan also stand out as countries in which inequality indicators declined substantially.

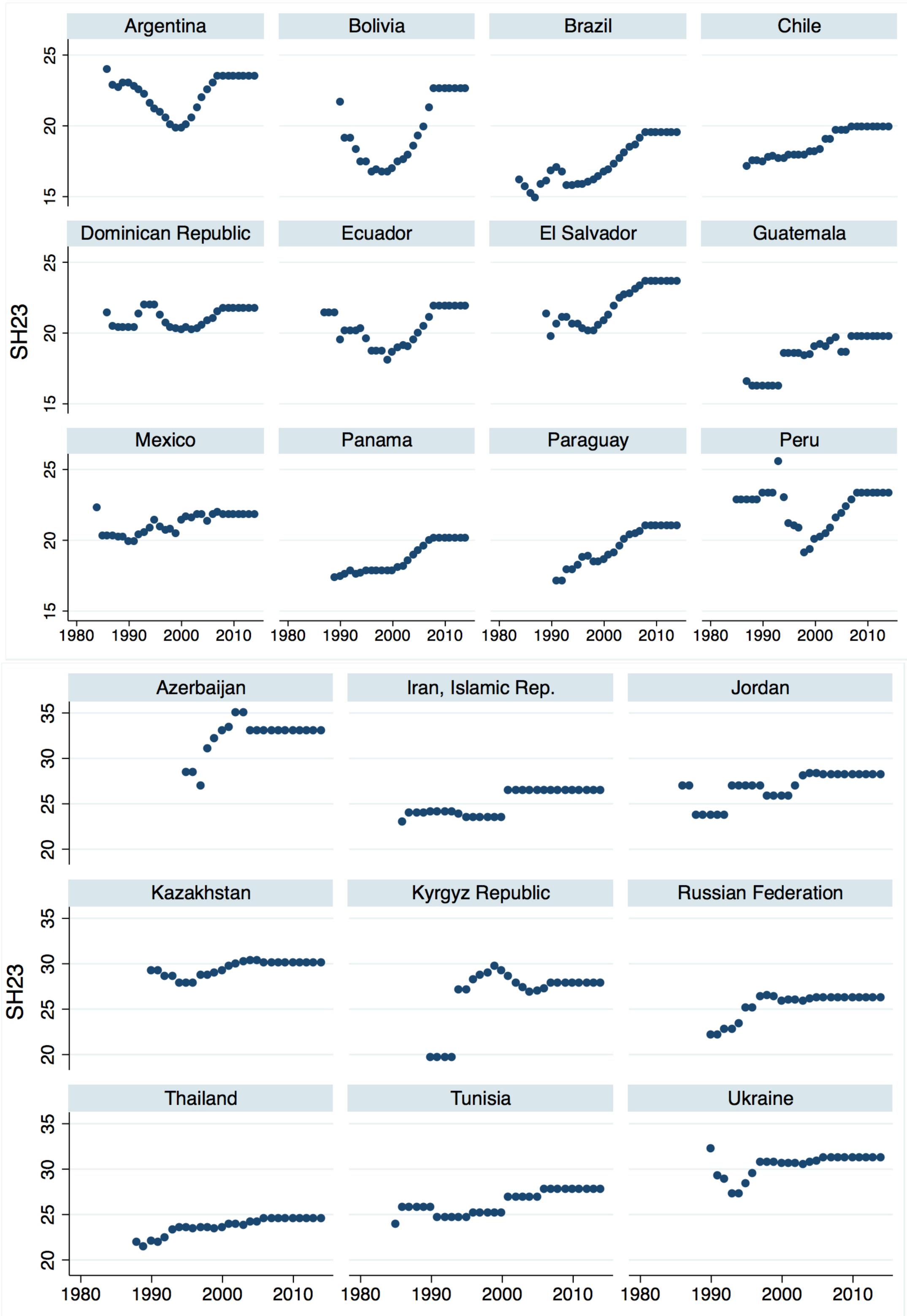
Middle class size measures and all variables considered as controls in our regression are downloaded from World Bank World Development Indicators (WDI) database.

Figure 1.3: Evolution of share of income held by the 2nd, 3rd and 4th quintiles of income distribution (SH234) in selected countries (rolling 5 year mean)



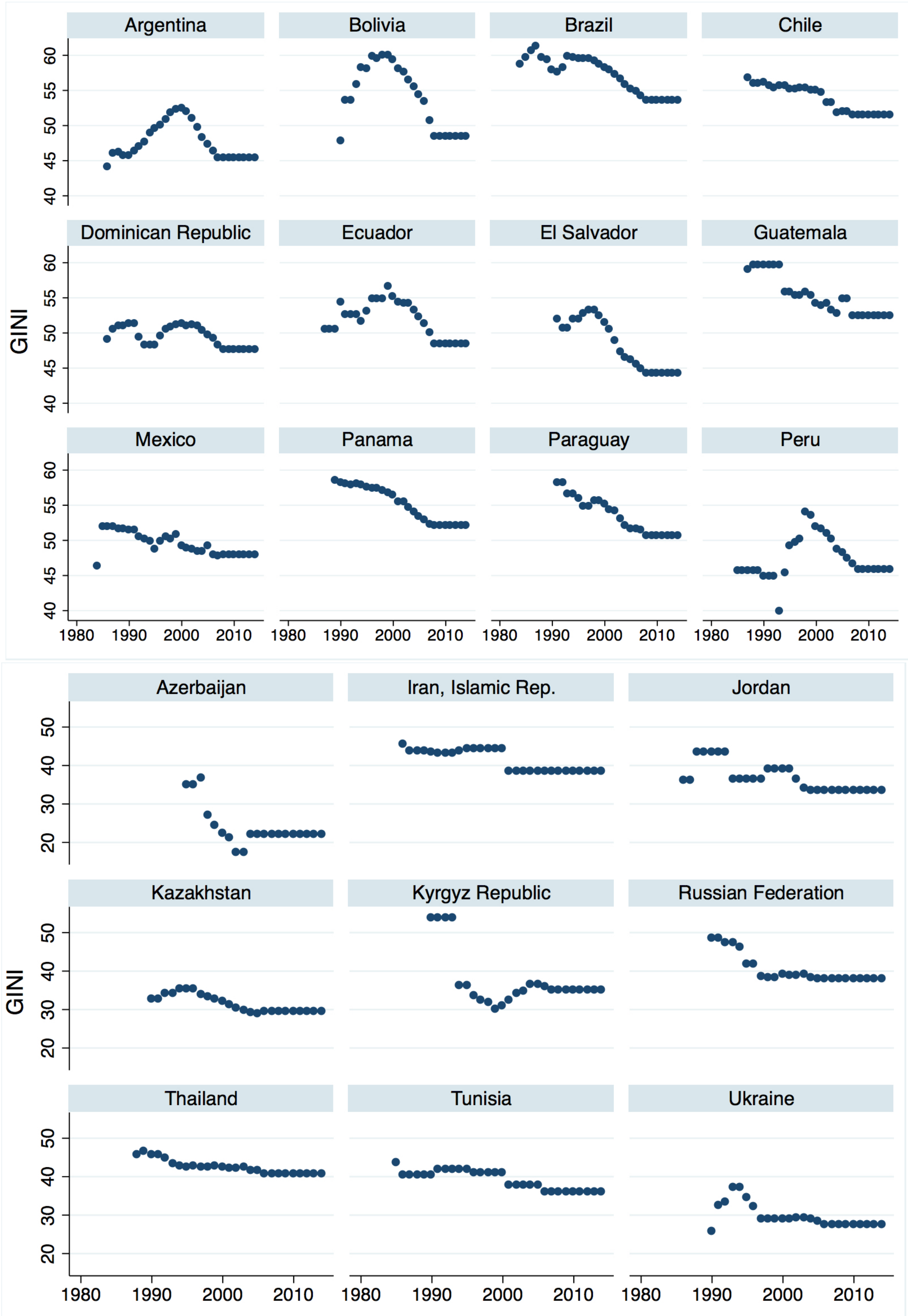
Source: World Bank Global Financial Development (GFD) database.

Figure 1.4: Evolution of share of income held by the 2nd and 3rd quintiles of income distribution (SH23) in selected countries (rolling 5 year mean)



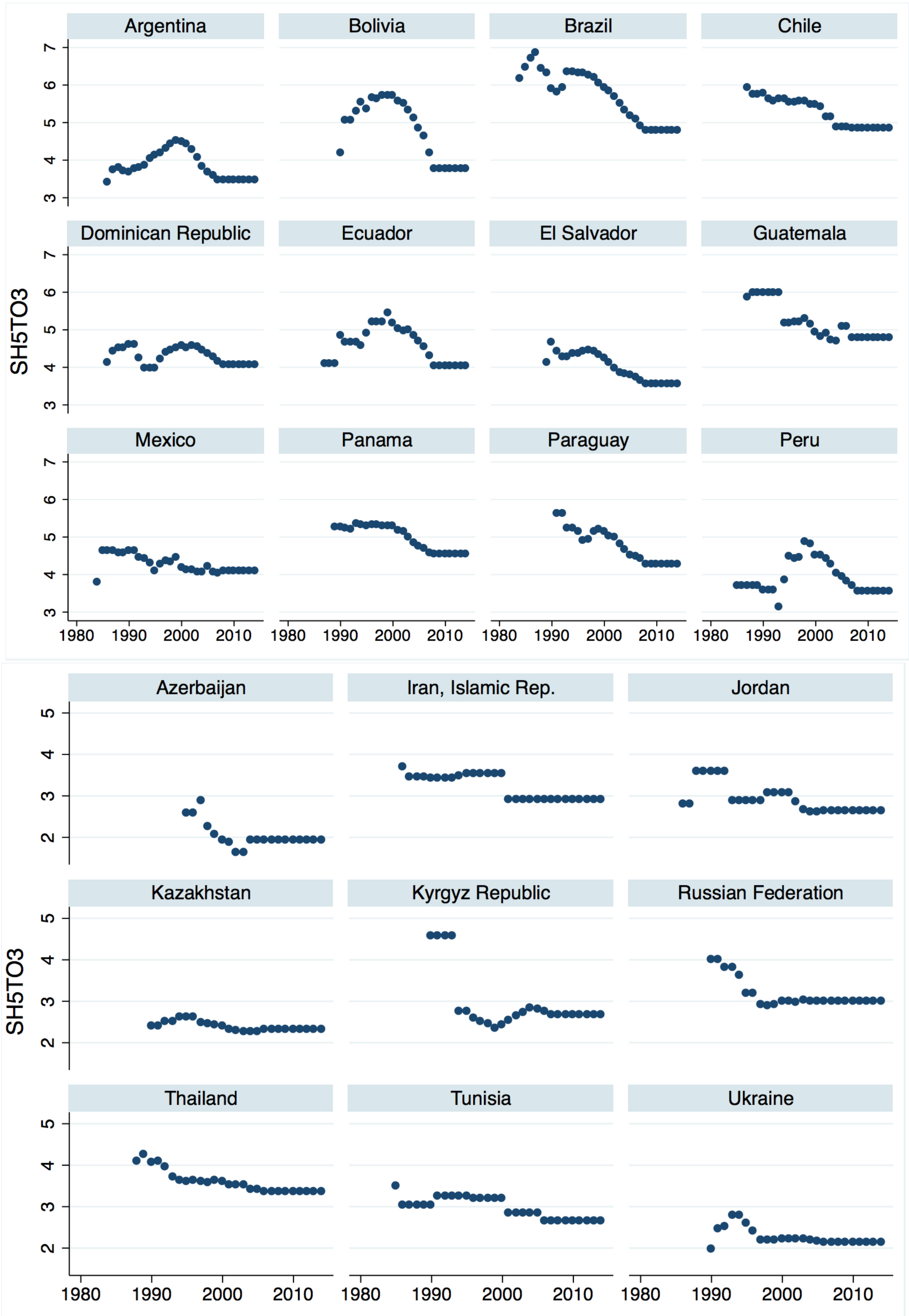
Source: World Bank Global Financial Development (GFD) database.

Figure 1.5: Evolution of the GINI index in selected countries (rolling 5 year mean)



Source: World Bank Global Financial Development (GFD) database.

Figure 1.6: Evolution of share of income held by 5th quintile relative to 3rd quintile (SH5TO3) in selected countries (rolling 5 year mean)



Source: World Bank Global Financial Development (GFD) database.

1.3.4 Measuring financial development

According to Levine (2005), *"financial development occurs when financial instruments, markets, and intermediaries ameliorate - though do not necessarily eliminate - the effects of information, enforcement, and transactions costs and therefore do a correspondingly better job at providing the five financial functions"*. These five functions are: (i) production of ex-ante information about possible investments, (ii) monitoring of investments and implementation of corporate governance, (iii) trading, diversification, and management of risk, (iv) mobilization and pooling of savings, and (v) exchange of goods and services.

Since obtaining such direct measures of these financial functions is a major challenge, Cihak et al. (2012) describe indicators that could be used to measure four important characteristics of financial systems. These characteristics are proxies of the services provided by the financial system:

1. Size of financial institutions and markets (depth).
2. Degree to which individuals and firms can and do use financial institutions and markets (access).
3. The efficiency of financial institutions and markets in providing financial services (efficiency).
4. Stability of financial institutions and markets (stability).

After clustering countries by income level, the authors provide summary statistics of winsorized and rescaled variables (0-100) for each characteristic. The authors find that the largest difference between the financial system of middle income countries (both lower and upper) and high income is on its depth. While financial systems in developing countries tend to be much less deep and also somewhat less efficient and providing less access, their stability has been comparable to developed.

Due to this finding and also to the lack of long enough series for the suggested variables that approximate access or efficiency, this study will focus on measures of depth, a proxy of the overall extent of services provided by the financial system. Therefore, following Cihak et al. (2012), the variables considered will be: domestic credit to private sector as % of GDP (PRIVY), liquid liabilities to GDP (LIQY), bank deposits to GDP (BANKDY), financial system deposits to GDP (FINDY) and money and quasi money (M2) as % of GDP. M2 is a measure of the money supply that includes cash, checking, and saving accounts.

Data is downloaded from World Bank's Global Financial Development. database launched in 2012.

1.4 Estimation results

This section presents the results of estimating the model with predetermined regressors using system GMM and up to two lags when building internal instruments. Joint validity of instruments is tested using the Hansen J test of over identifying restrictions. Validity of instruments depends on error terms not serially correlated, so we perform the Arellano-Bond test for autocorrelation.

The model includes time effects to remove universal time related shocks from errors. After controlling for time effects, standard errors are assumed to be uncorrelated across countries and heteroskedastic within countries. Two step results are presented with the Windmeijer small sample correction which according to Roodman (2014) reduces the problem of downward bias and removes the need to present first step estimates. All regressions include the typical controls used in growth and volatility regressions mentioned earlier.

Table 1.2 presents results when middle class size is measured by share of income held by second, third and fourth of income distribution (SH234) and considering all five proxies of financial development (more precisely, depth of the financial system). All coefficients of SH234 -our first main interest- are positive and four out of five are significant at the 5% level. The interaction term between SH234 and financial development -our second main interest- is negative across all proxies of financial development and four out of five are significant. Interestingly, the sign of financial development is positive across all proxies and three out of five are significant at least at the 10% level.

Same findings, yet even more significant, appear when middle class size is measured by share of income held by second and third of income distribution (SH23). These estimates are presented in Table 1.3.

Table 1.4 presents results when the middle class size is proxied by the Gini index. In all five cases, the Gini index is negatively associated with consumption growth volatility. That is, an increase in the middle class size (a decrease in the Gini index) increases consumption growth volatility. While the sign of financial development proxy is consistently negative in all cases, it is significant in four out of five. The interaction term is positive across all proxies of financial development and three out of five are significant at least at the 10% level.

Table 1.5 displays similar results when measuring middle class size by share of income held by fifth quintile over the share of income held by third quintile of income distribution (SH5TO3). All coefficients of SH5TO3 are negative and three out of five are significant at the 5% level. The sign of financial development is again negative across all proxies and three out of five are significant at least at the 5% level. Finally, and similar to the GINI specification, the interaction term is positive across all proxies of financial development and three out of five are significant.

Overall, regardless of the middle class size measure, our findings suggest that the marginal effect of middle class size on consumption growth volatility is positive for low levels of financial development and turns negative at higher levels of financial development. Figure 1.7 illustrates the conditional marginal effect of each middle class size indicator using FINDY as proxy of financial development and taking all controls at their means. This proxy is chosen for illustration since it is significant through both its level and interaction term regardless the middle class size measure considered. See Appendix (figures A.1 - A.4) for conditional marginal effects based on other proxies.

Regarding the concern about validity of instruments, we can't reject the null hypothesis of validity of over-identifying restrictions. The p-values of the Hansen J-test range from 0.301 to 0.910 and sixteen out of a total of twenty models[5] report p-values between 0.4 and 0.9. There is also no evidence for significant second order autocorrelation. The p-values of the test of second order autocorrelation range from 0.197 to 0.831. To sum up, these test statistics hint at a proper specification.

Regarding the significance of growth regression type of controls, only six out of twenty models could report 10 % statistical significance for initial GDP per capita (lgdppc). Also, only in two cases we find the coefficient of annual population growth rate significant and positive. This is consistent with the findings of Bekaert et al. (2006).

[5]Four middle class size measures and five financial depth proxies make a total of twenty specifications or "models"

Table 1.2: SH234 and consumption growth volatility

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	2.506	2.891	3.869*	3.752*	1.888
	[2.807]	[3.457]	[2.240]	[2.196]	[2.636]
pop	3.571*	2.069	0.304	0.345	-0.0697
	[1.796]	[1.986]	[2.147]	[2.117]	[1.890]
trade	1.567	2.780	2.078	2.030	2.065
	[2.034]	[2.071]	[1.860]	[1.879]	[1.966]
gov	-0.175	-2.109	-1.369	-1.609	-0.543
	[2.364]	[2.796]	[2.808]	[2.851]	[2.269]
SH234	0.900***	1.012***	0.863**	0.879**	0.741
	[0.294]	[0.365]	[0.380]	[0.363]	[0.450]
FINDEV	0.321**	0.660**	0.664	0.677*	0.476
	[0.131]	[0.324]	[0.398]	[0.397]	[0.491]
SH234xFINDEV	-0.00735**	-0.0144**	-0.0153*	-0.0155*	-0.0111
	[0.00282]	[0.00670]	[0.00839]	[0.00832]	[0.0101]
Hansen statistic	9.150	11.77	8.507	8.241	10.06
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.821	0.625	0.861	0.876	0.758
AR(2) test statistic	0.691	-0.939	-0.628	-0.720	-0.573
p-value of AR(2)	0.489	0.348	0.530	0.472	0.567
Number of instruments	26	26	26	26	26
Countries	51	52	51	51	51
N	190	193	187	187	187

Standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: World Bank World Development Indicators (WDI) and Global Financial Development (GFD) databases.

Notes: The table displays two step system GMM results with the Windmeijer small sample correction and including time effects. Base sample is an unbalanced panel of middle income countries spanning from 1985-2010 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable is the real per capita consumption growth volatility. SH234 is the 5-year arithmetic mean of share of income held by second, third and fourth quintile of income distribution. FINDEV relates to the 5 year mean of the proxy chosen for financial development and displayed in each column. PRIVY is domestic credit to private sector as % of GDP, M2 is money and quasi money as % of GDP, BANKDY is bank deposits to GDP, FINDY is financial system deposits to GDP and LIQY is liquid liabilities to GDP (broad money). Controls are also expressed as 5 year mean and include: log of GDP per capita at constant 2005 US$ (lgdppc), population annual growth rate in percentage points (pop), sum of exports and imports of goods and services to GDP in logs (trade) and general government final consumption expenditure to GDP in logs (gov). Regressions use robust standard errors and treat all regressors as predetermined but not strictly exogenous variables. Instrument matrix considers up to two lags and is collapsed by the estimation. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for AR(2) are the p-values for second order autocorrelated disturbances in the first differences equations.

Table 1.3: SH23 and consumption growth volatility

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	1.734	2.271	3.996*	3.977*	2.251
	[2.646]	[3.072]	[2.011]	[1.991]	[2.132]
pop	3.338*	2.176	0.675	0.702	0.262
	[1.973]	[2.333]	[2.138]	[2.094]	[1.891]
trade	0.796	1.996	2.011	2.014	1.949
	[1.895]	[1.815]	[1.677]	[1.698]	[1.949]
gov	0.145	-1.491	-1.181	-1.394	0.0623
	[2.428]	[2.684]	[2.430]	[2.434]	[2.189]
SH23	1.108***	1.239**	1.058**	1.077***	0.961*
	[0.392]	[0.485]	[0.417]	[0.399]	[0.516]
FINDEV	0.226**	0.422*	0.434*	0.442*	0.355
	[0.0993]	[0.219]	[0.231]	[0.229]	[0.307]
SH23xFINDEV	-0.0101**	-0.0175**	-0.0189**	-0.0192**	-0.0155
	[0.00392]	[0.00834]	[0.00869]	[0.00851]	[0.0114]
Hansen statistic	10.66	12.41	7.858	7.578	10.83
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.713	0.573	0.897	0.910	0.699
AR(2) test statistic	0.550	-0.734	-0.534	-0.607	-0.571
p-value of AR(2)	0.582	0.463	0.593	0.544	0.568
Number of instruments	26	26	26	26	26
Countries	51	52	51	51	51
N	190	193	187	187	187

Standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: World Bank World Development Indicators (WDI) and Global Financial Development (GFD) databases.

Notes: The table displays two step system GMM results with the Windmeijer small sample correction and including time effects. Base sample is an unbalanced panel of middle income countries spanning from 1985-2010 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable is the real per capita consumption growth volatility. SH23 is the 5-year arithmetic mean of share of income held by second and third quintile of income distribution. FINDEV relates to the 5 year mean of the proxy chosen for financial development and displayed in each column. PRIVY is domestic credit to private sector as % of GDP, M2 is money and quasi money as % of GDP, BANKDY is bank deposits to GDP, FINDY is financial system deposits to GDP and LIQY is liquid liabilities to GDP (broad money). Controls are also expressed as 5 year mean and include: log of GDP per capita at constant 2005 US$ (lgdppc), population annual growth rate in percentage points (pop), sum of exports and imports of goods and services to GDP in logs (trade) and general government final consumption expenditure to GDP in logs (gov). Regressions use robust standard errors and treat all regressors as predetermined but not strictly exogenous variables. Instrument matrix considers up to two lags and is collapsed by the estimation. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for AR(2) are the p-values for second order autocorrelated disturbances in the first differences equations.

Table 1.4: GINI and consumption growth volatility

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	2.930	1.424	4.882*	5.151*	-0.804
	[3.015]	[4.524]	[2.668]	[2.669]	[4.759]
pop	1.279	0.579	0.736	0.860	-0.676
	[1.440]	[2.141]	[2.186]	[2.088]	[1.667]
trade	0.0927	0.978	3.274	3.296	0.733
	[2.269]	[2.350]	[2.882]	[2.885]	[3.117]
gov	1.284	-0.649	-2.347	-2.225	-1.647
	[3.823]	[2.955]	[1.997]	[1.952]	[2.741]
GINI	-0.344*	-0.375**	-0.398***	-0.399***	-0.387***
	[0.171]	[0.174]	[0.134]	[0.129]	[0.134]
FINDEV	-0.121	-0.215*	-0.389***	-0.383***	-0.324**
	[0.171]	[0.121]	[0.122]	[0.116]	[0.131]
GINIxFINDEV	0.00251	0.00457	0.00899***	0.00881***	0.00641*
	[0.00388]	[0.00285]	[0.00300]	[0.00292]	[0.00359]
Hansen statistic	14.39	16.21	10.07	9.975	12.52
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.421	0.301	0.757	0.764	0.565
AR(2) test statistic	1.074	0.214	-0.562	-0.497	-1.290
p-value of AR(2)	0.283	0.831	0.574	0.619	0.197
Number of instruments	26	26	26	26	26
Countries	51	52	51	51	51
N	189	192	186	186	186

Standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: World Bank World Development Indicators (WDI) and Global Financial Development (GFD) databases.
Notes: The table displays two step system GMM results with the Windmeijer small sample correction and including time effects. Base sample is an unbalanced panel of middle income countries spanning from 1985-2010 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable is the real per capita consumption growth volatility. GINI is the arithmetic mean of the Gini index over a 5 year period. FINDEV relates to the 5 year mean of the proxy chosen for financial development and displayed in each column. PRIVY is domestic credit to private sector as % of GDP, M2 is money and quasi money as % of GDP, BANKDY is bank deposits to GDP, FINDY is financial system deposits to GDP and LIQY is liquid liabilities to GDP (broad money). Controls are also expressed as 5 year mean and include: log of GDP per capita at constant 2005 US$ (lgdppc), population annual growth rate in percentage points (pop), sum of exports and imports of goods and services to GDP in logs (trade) and general government final consumption expenditure to GDP in logs (gov). Regressions use robust standard errors and treat all regressors as predetermined but not strictly exogenous variables. Instrument matrix considers up to two lags and is collapsed by the estimation. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for AR(2) are the p-values for second order autocorrelated disturbances in the first differences equations.

Table 1.5: SH5TO3 and consumption growth volatility

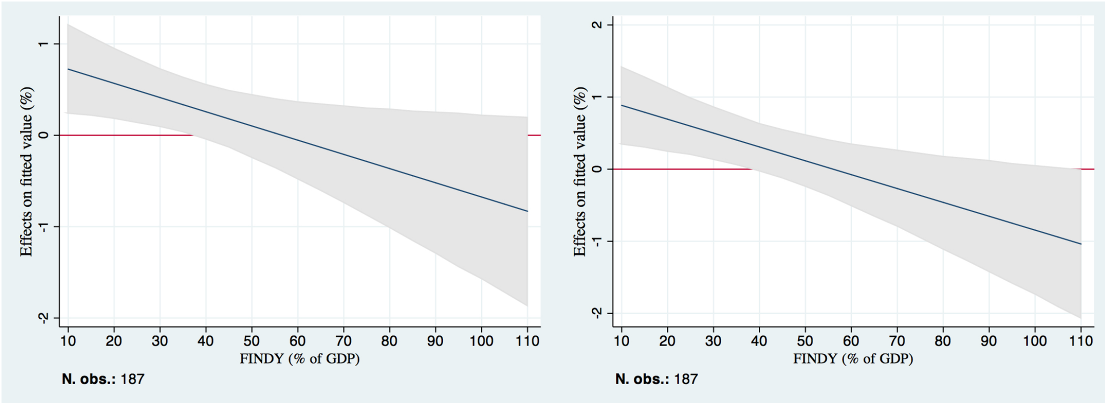
	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	1.815	-0.212	5.218	5.651	-0.835
	[4.574]	[5.255]	[3.354]	[3.411]	[4.757]
pop	1.647	1.315	0.607	0.739	0.0114
	[1.781]	[2.528]	[3.145]	[3.057]	[2.136]
trade	3.863	2.257	3.971	4.033	1.823
	[3.451]	[3.757]	[3.338]	[3.382]	[3.537]
gov	-1.396	-2.260	-3.039	-2.911	-3.271
	[2.616]	[2.863]	[2.603]	[2.622]	[3.034]
SH5TO3	-1.682	-1.352	-3.424**	-3.484**	-3.256**
	[1.215]	[1.273]	[1.704]	[1.694]	[1.513]
FINDEV	-0.0832	-0.0751	-0.258**	-0.257***	-0.265***
	[0.0730]	[0.0713]	[0.0973]	[0.0925]	[0.0844]
SH5TO3xFINDEV	0.0139	0.00925	0.0703**	0.0695**	0.0630*
	[0.0161]	[0.0194]	[0.0278]	[0.0270]	[0.0320]
Hansen statistic	15.26	16.07	12.61	12.34	13.84
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.360	0.309	0.557	0.579	0.462
AR(2) test statistic	1.066	0.908	-0.542	-0.463	-1.541
p-value of AR(2)	0.286	0.364	0.588	0.643	0.123
Number of instruments	26	26	26	26	26
Countries	51	52	51	51	51
N	190	193	187	187	187

Standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

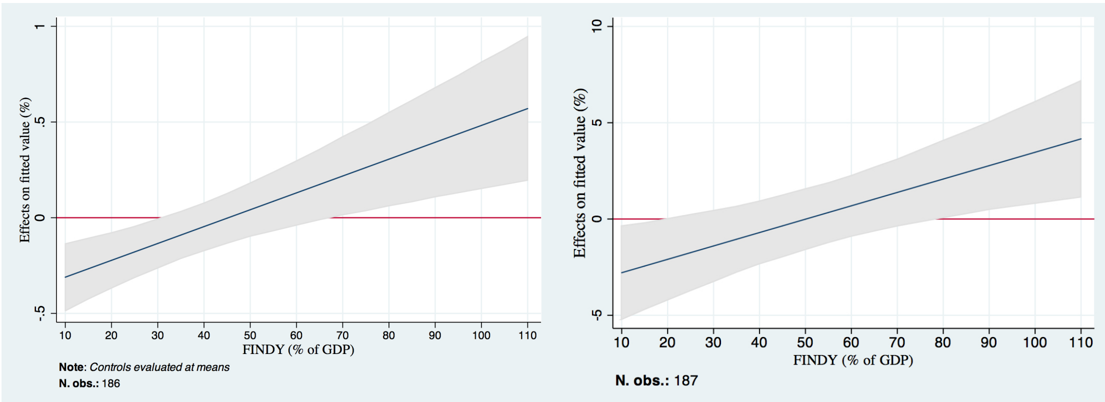
Source: World Bank World Development Indicators (WDI) and Global Financial Development (GFD) databases.
Notes: The table displays two step system GMM results with the Windmeijer small sample correction and including time effects. Base sample is an unbalanced panel of middle income countries spanning from 1985-2010 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable is the real per capita consumption growth volatility. SH5TO3 is the 5-year arithmetic mean of share of income held by fifth over share of income held by third quintile of income distribution. FINDEV relates to the 5 year mean of the proxy chosen for financial development and displayed in each column. PRIVY is domestic credit to private sector as % of GDP, M2 is money and quasi money as % of GDP, BANKDY is bank deposits to GDP, FINDY is financial system deposits to GDP and LIQY is liquid liabilities to GDP (broad money). Controls are also expressed as 5 year mean and include: log of GDP per capita at constant 2005 US$ (lgdppc), population annual growth rate in percentage points (pop), sum of exports and imports of goods and services to GDP in logs (trade) and general government final consumption expenditure to GDP in logs (gov). Regressions use robust standard errors and treat all regressors as predetermined but not strictly exogenous variables. Instrument matrix considers up to two lags and is collapsed by the estimation. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for AR(2) are the p-values for second order autocorrelated disturbances in the first differences equations.

Figure 1.7: Marginal effects of inequality indicators conditional to FINDY as proxy for financial development

(a) SH234 (b) SH23



(c) GINI (d) SH5TO3



Source: World Bank World Development Indicators (WDI) and Global Financial Development (GFD) databases.

Notes: The proxy for financial development in this graph is Financial system deposits over GDP (FINDY). GINI is the World Bank estimate of the Gini index in the scale of 0 to 100. SH5TO3 is income share held by fifth quintile over income share held by third quintile of income distribution. SH234 is income share held by second,third and fourth quintile of income distribution. SH23 is income share held by second and third quintile of income distribution. Controls included in the regression model are evaluated at means and shaded area is 90 % confidence interval. Each subfigure represents the effect of an unit increase on the correspondent inequality indicator on the standard deviation of real consumption per capita annual growth over a 5 year period. For example: an increase of one point in the GINI index (say from 50 to 51) is associated with a larger decline in volatility at lower levels of FINDY. As FINDY increases this marginal effect becomes less negative. At levels above the 50% a marginal increase in the GINI index is associated with an increase in volatility.

1.4.1 Taking the estimation to a sample of developed countries

For the purpose of comparing whether results hold for high income countries, we perform the same analysis with a sample of developed countries and consider an initial list of 31 high-income countries according to data from the World Bank in 2015: Australia, Austria, Belgium, Canada, Chile, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Lithuania, Netherlands, Norway, Poland, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad y Tobago, United Kingdom, United States and Uruguay.

The model is first estimated following the benchmark specification, that is with predetermined regressors using system GMM and up to two lags when building internal instruments. It also includes time effects, and two step results are presented with Windmeijer small sample correction. The p-values of the Hansen J-test and those of the second order autocorrelation have values ranging as in the benchmark specification so we can't reject the null hypothesis of validity of over-identifying restrictions and there is no evidence for significant second order autocorrelation.

Estimation results indicate that when switching the analysis to a high-income sample of countries, there is no evidence that middle class size affects volatility since all the twenty models display insignificant estimates and mixed signs. Table 1.6 displays results using SH234 as middle class size measure[6].

[6]Regression results using other middle class size indicators are available upon request.

Table 1.6: SH234 and consumption growth volatility in high-income countries

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	-2.886**	-2.428*	-2.522**	-3.110*	-3.154
	[1.350]	[1.276]	[1.200]	[1.818]	[2.616]
pop	0.689	0.733	0.534	0.621	1.215
	[1.648]	[1.596]	[1.450]	[2.106]	[1.485]
trade	0.558	-0.566	1.868	-0.468	1.113
	[3.060]	[2.745]	[2.816]	[5.413]	[4.762]
gov	-4.108	-5.848	-0.307	-6.593	2.532
	[6.934]	[5.493]	[7.587]	[12.77]	[13.11]
SH234	0.115	0.108	0.314	-0.00862	0.143
	[0.327]	[0.305]	[0.435]	[0.716]	[0.568]
FINDEV	0.242	0.130	0.137	-0.487	0.101
	[0.314]	[0.463]	[0.745]	[0.969]	[0.826]
SH234xFINDEV	-0.00402	-0.00208	-0.00293	0.00879	-0.00254
	[0.00570]	[0.00898]	[0.0139]	[0.0181]	[0.0163]
Hansen statistic	8.011	10.49	11.31	9.539	11.39
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.889	0.725	0.661	0.795	0.655
AR(2) test statistic	0.961	0.911	0.691	0.952	0.826
p-value of AR(2)	0.336	0.362	0.490	0.341	0.409
Number of instruments	26	26	26	26	26
Countries	31	31	29	29	28
N	113	98	105	107	104

Standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: World Bank World Development Indicators (WDI) and Global Financial Development (GFD) databases.

Notes: The table displays two step system GMM results with the Windmeijer small sample correction and including time effects. Base sample is an unbalanced panel of high income countries spanning from 1985-2010 with data at five-year intervals, where the start date of the panel refers to the dependent variable. The dependent variable is the real per capita consumption growth volatility. SH234 is the 5-year arithmetic mean of share of income held by second, third and fourth quintile of income distribution. FINDEV relates to the 5 year mean of the proxy chosen for financial development and displayed in each column. PRIVY is domestic credit to private sector as % of GDP, M2 is money and quasi money as % of GDP, BANKDY is bank deposits to GDP, FINDY is financial system deposits to GDP and LIQY is liquid liabilities to GDP (broad money). Controls are also expressed as 5 year mean and include: log of GDP per capita at constant 2005 US$ (lgdppc), population annual growth rate in percentage points (pop), sum of exports and imports of goods and services to GDP in logs (trade) and general government final consumption expenditure to GDP in logs (gov). Regressions use robust standard errors and treat all regressors as predetermined but not strictly exogenous variables. Instrument matrix considers up to two lags and is collapsed by the estimation. The row for the Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for AR(2) are the p-values for second order autocorrelated disturbances in the first differences equations.

1.5 Some robustness checks

1.5.1 Controlling for region dummies

Since business cycles are likely to be correlated across geographical regions, this section checks robustness of previous findings when in addition to time effects and country fixed effects, region fixed affects are also considered. Countries of the sample are distributed across six regions: East Asia and Pacific (7) , Europe and Central Asia (15), Latin America and Caribbean (23), Middle East and North Africa (9), South Asia (2) and Sub-Saharan Africa (6).

Adding either a latin american dummy or the full set of regional dummies in the regression, does not change the results significantly. In the model using SH234 as the middle class size indicator, all coefficients of SH234 are significantly positive. Regressions with the latin american dummy are presented in Appendix (tables A.8 - A.11). This robustness check shows that results are not driven by Latin American countries or other regions.

1.5.2 Using non-overlapping 4 year and 6 year periods

When estimating the model using non-overlapping 6 year periods, the instrument matrix is extended to include 3 lags due to the result that for many of the twenty models, the 2 lags specification no longer pass the hansen test (p-values are less or around 0.1). When 3 lags are used to instrument predetermined variables in the model, models that use GINI and SH5TO3 not only prove to be robust and consistent with earlier findings but also PRIVY and M2 are now significant through both their levels and the interaction terms at least at the 10%. In the cases of SH234 and SH23, coefficients of the inequality proxy remain positive and overall significant at least at the 10% level. While signs of all interaction terms remain consistent with earlier findings, only the one including M2 remains significant at the 10%.

When estimating the model using non overlapping 4 year periods and using two lags as instrument, results overall are consistent with earlier findings; especially when middle class size is proxied by GINI or SH5TO3. In the cases of SH234 and SH23, results prove to be a bit weaker since only a few coefficients of the middle class size proxy or its interaction with financial development retain their significance at 10%[7]

1.5.3 Restricting the sample to latin american countries

While the original dataset includes 23 latin american countries, data limitation of social indicators sets the maximum sample size of the restricted sample to 20 countries (dropping The Bahamas, Cuba and Puerto Rico). The remaining list of latin american countries includes: Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay and Venezuela.

When restricting the sample, descriptive statistics (see table A.2 in Appendix) suggest an important loss of overall variation on both middle class size and financial depth measures. Losses of overall variation for the list of financial development proxies when restricting the sample are much greater than those observed for measures of middle class size measures[8]. Much of the loss of overall variation comes through between variation. One way to see this is by calculating the new ratios of between variation over within. Regarding social indicators, while ratios

[7]Regression results are available upon request.

[8]Overall standard deviation of GINI, SH5to3, SH234 and SH23 are 0.7 to 5.25 lower relative to those observed for the unrestricted sample. Overall standard deviation of financial depth measures are 7.5 to 12 lower relative to those observed for the unrestricted sample.

range from 2.9 to 4.4 in the unrestricted sample, ratios are now in the 2.3 -2.7 range. Regarding financial development proxies, while ratios were in between 2.3 - 2.6 for the unrestricted sample, now the range is 1.9-2.

Table A.2 in appendix presents a snapshot of the distribution of means for each variable proxying inequality during the entire period 1985-2010 and for the unrestricted sample. This table shows that latin american countries have the lowest levels of middle class size (or highest inequality levels), regardless of the measure chosen. More than half of the latin american sample have Gini index or SH5to3 above the 75th percentile of its corresponding sample distribution. Ten out of 23 countries have SH234 and SH23 below the 25th percentile of its corresponding sample distribution (while 19 countries have it below the 50th percentile). Similar analyses for financial development measures also suggest that on average, latin american countries also have lower financial development regardless of the proxy selected.

Not only will the total number of observations be more than halved when restricting the sample to the latin american region, identification is expected to be much more challenging since a large fraction of between variation is lost. Despite this prediction, I describe estimation results[9].

The model is first estimated following the benchmark specification; i.e with predetermined regressors and using system GMM and up to two lags when building internal instruments. As the benchmark specification, it includes time effects and two step results are presented with Windmeijer small sample correction. In addition, variables are averaged over 5 year periods (non-overlapping) and the analysis is fixed to the period 1985-2010. As before, twenty models are considered since we use 4 different measures of middle class size and 5 measures of financial development.

[9] Regression results are available upon request.

Three out of twenty models contradict previous findings. Specifications GINI-M2, GINI-PRIVY and SH234-M2 seem to support the opposite hypothesis that *a larger middle class is associated with subsequent lower consumption growth volatility and an increase in financial development attenuates this relationship and potentially reverses it.* The remaining seventeen models have mixed signs and no significant estimates.

One thing that all these twenty specifications have in common is that joint validity of instruments arises as potential concern and results should be taken carefully since the p-value of hansen is high. Therefore, the model is re-estimated by restricting the instrument set to one lag and this reduces p-value of Hansen test to the range found in the benchmark specifications. This second round of estimations find that two out of twenty models still challenge our earlier finding for the unrestricted sample (i.e Sh5to3-M2 and SH234-M2).

Having described estimation results for the latin american case that deliver contradicting results, it is worth noting that only M2 - although not robustly across measures of income inequality - supports the alternate hypothesis that a larger middle class amid higher financial development may increase subsequent consumption growth volatility. Since no other financial development proxy supports this - perhaps due to a bigger identification problem after a significant loss in overall variation when restricting the sample -, results are only suggestive. According to Cihak et al. (2012), the ratio of M2 to GDP captures the degree of monetization in the system (proxy for financial depth), but does not capture the degree of bank intermediation. Also, it doesn't capture the broad access to bank finance by individuals and firms, the quality of bank services and the efficiency of providing banking services. The M2 variable could be well capturing other effects so results should be taken carefully.

1.6 Conclusion

This paper examines empirically the link between a rising middle income class within a developing country and macroeconomic implications in the short run. In particular, I focus on the effect of a larger middle class on aggregate (consumption growth) volatility in emerging/developing countries. Since developing countries have less developed financial systems than their high-income counterparts, I examine the role of financial development in the relationship of interest.

Using a sample of middle income countries, this paper provides empirical evidence that a larger middle class size tends to increase aggregate consumption growth volatility, particularly at low levels of financial system depth. Financial development plays a significant role on determining the sign of the marginal effect of middle class size on aggregate volatility. As more households escape poverty thresholds and reach the middle income class status, the need to deepen financial systems in developing and emerging countries becomes more important from the perspective of aggregate consumption volatility.

Chapter 2

Rising middle class and vendor financing incentives in unsecured credit markets in Latin America

2.1 Introduction

The period of rise in the middle class population in Latin America, described in Chapter 1, was also a period of increasing consumer credit. In particular, in countries such as Mexico, Colombia, Chile and Brazil, international and national-level retail chains emerged as the main credit suppliers of the lower-middle income population (Obermann (2006), Ruiz-Tagle et al. (2013) and Montero and Tarzijan (2010)).

According to Casanova and Renck (2015), in spite of a significant decline in unemployment in recent years, the lack of formal employment and poor credit history were still impeding many individuals from gaining access to consumer finance from traditional financial institutions. In order to allow "new middle class shoppers" access non-essential items typically offered by large retail stores, the retailers themselves started offering credit.

Motivated by the emergence of vendors as consumption credit suppliers in these Latin American countries, I set up a theoretical model of vendor financing in the unsecured credit market. The model illustrates the fundamentals affecting vendor financing incentives that could increase credit supply on its extensive margin.

There are two strands of literature which we build on and contribute to.

The first strand is the study of consumption credit and default. Much of this literature focuses on explaining stylized facts of the US credit market related to the evolution of bankruptcy filing and consumption credit. There is indeed active research trying to explain why the personal bankruptcy rate in the US has increased more than threefold in the last two decades. Since there is an increasing consensus that the rise in bankruptcies is primarily driven by consumer debt market developments particularly related to IT progress, most of this literature is gravitating towards the study of this link. Another theme in this literature is what Livshits et al. (2016) call *democratization of credit* and what Drozd and Serrano-Padial (2016) call *revolving revolution*, i.e., the extension of credit to new and seemingly riskier borrowers in the recent decades. This rise in credit on the extensive margin is driven by financial innovations in the former work and IT adoption by the debt collection industry in the latter work. It may also arise naturally in different models[1]. We extend the literature on unsecured credit by including an alternative type of lender -vendors- whose business model differs from that of banks. This exercise is highly relevant given that vendors are an important source of consumption credit in developing countries[2].

The second strand is the research related to trade finance. One of the earliest papers with a stylized model of vendor financing incentives is by Brennan et al. (1988). Their model suggests that one reason why retailers find profitable to extend credit is that customers differ in their price elasticity and vendor financing is a channel enabling them to price discriminate and increase overall sales. However,

[1]See Livshits (2015) for a review of papers in this literature.

[2]Livshits (2015) argued that one key challenge that he doesn't think has been successfully addressed yet is modelling a consumer credit market where borrowers may deal with multiple lenders

the type of credit is secured - the good purchased using credit is also used as the collateral. Not surprisingly, subsequent papers both on the empirical and theoretical front, evolved towards studying inter-firm credit. To my knowledge, there is no theoretical work studying manufacturer incentives to provide unsecured credit to the final good consumer. This research aims to be a first step to fill that gap.

In this paper, we present a stylized model of vendor financing in an unsecured credit market, following the intuition by Brennan et al. (1988). Vendors face two types of customers - those who have unlimited access to credit and are able to buy their good using cash or bank credit (cash customers), and those financially constrained with low cash in hand that need credit to purchase the good (credit customers). We study potential reasons triggering an increase in the credit supplied by the non traditional financial sector, i.e vendors, at the extensive margin. We particularly focus on the effect of a reduction in the average risk of default and the market size of credit customers on vendor financing incentives. In addition, we also examine the effect of certain structural parameters in the model - one reflecting financial development and the other capturing bankruptcy costs.

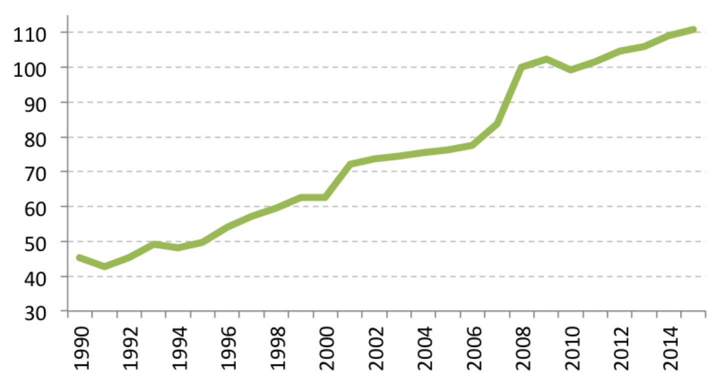
This paper is structured as follows. Section 2 describes the development of commercial stores as non traditional consumption credit suppliers in Chile. Section 3 outlines the theoretical model of vendor financing in the unsecured credit market. Section 4 presents the analytical results of the vendor's optimization problem with and without vendor financing. Section 5 enumerates cases depending on structural parameters of the model and the corresponding vendor financing gains function. Section 6 derives the core results of the paper through comparative statics exercises. Section 7 provides empirical evidence supporting the model's main mechanism and an important model implication. We conclude by summarizing our findings.

2.2 Understanding the rise of vendor financing using Chile as case study

Using the Chilean case as a research motivation is sensible given that it was Chile where the vendor financing business model flourished, and later expanded regionally. Even though Brazilian retailers pioneered the offer of installment payment plans, Chilean retailers provide the earliest and most successful stories of offering store cards (Calderón Hoffmann, 2006). Once the Chilean market came close to saturation, Chilean retail conglomerates expanded to other Latin American countries through acquisitions of local chains or local operations of multinational retailers[3].

We start by looking at aggregate measures of credit market depth in Chile. According to a report by the SBIF (2015), debt to income ratio (DIR) experienced a significant increase in the last two decades, jumping from 35% in 2001 to 61% in 2015. Similarly, domestic credit to private sector as % of GDP increased from 45.3% in 1990 to 110.9% in 2015 and observed a clear upward trend during the selected period as seen in figure 2.1.

Figure 2.1: Domestic credit to private sector in Chile (% GDP)

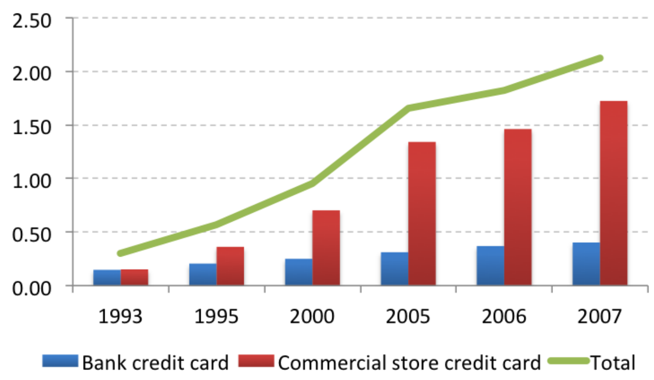


Source: World Bank - World Development Indicators (WDI)

[3]The second big surge of investment abroad from Chile occurred in 2003 and it was lead by retail companies (i.e Cencosud , Falabella, Ripley). See Calderón Hoffmann (2006).

The greatest change that occurred in the Chilean consumption credit market during the period 2000-2008 is the significant increase in non-bank debt (Central Bank of Chile (2009)). Figure 2.2 illustrates the evolution of credit cards per adult in Chile and shows that commercial stores were the most dynamic participant in this market during the period 1993-2007. The number of active credit cards per adult provided by commercial stores increased significantly after 1995 and stayed well above those provided by banks throughout the period 1995-2007.

Figure 2.2: Bank and non bank credit cards (active) per adult in Chile



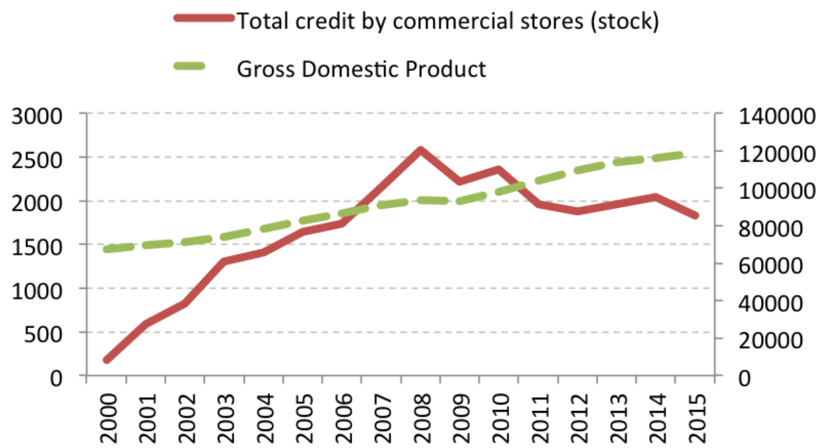
Source: Superintendencia de Bancos e Instituciones Financieras de Chile

Figure 2.3 illustrates the evolution of total credit supplied by commercial stores in Chile, expressed in constant prices. We can infer from the figure that consumers' outstanding debt with commercial stores grew faster than real GDP during the period 2000-2008.

There is a lack of precise information regarding when exactly these new participants in the credit market became more apparent. Marshall (2004) points out that while in the early 90s, consumption credit in Chile was mainly supplied by the traditional banking sector, new suppliers of financial services to households emerged in the late 90s.

According to Aparici and Yáñez (2004), as banks were decreasing their participation in total consumption debt during the period 1999-2003, commercial stores were placing themselves as second most important source of consumption credit.

Figure 2.3: The evolution of total credit by commercial stores and GDP in Chile (thousand millions of 2011 chilean pesos)

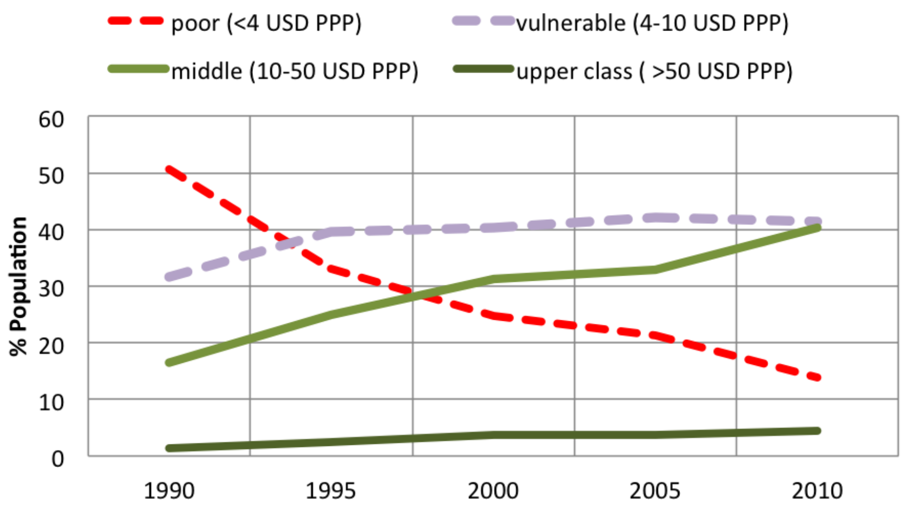


Source: Superintendencia Valores y Seguros Chile (SVS) and World Bank - World Development Indicators (WDI)
Notes: Total credit by commercial stores reflects stock of outstanding consumption debt with vendors, including refinanced loans. Nominal values were converted to constant prices by diving the series with the implicit GDP deflator- extracted from the OECD database.

In addition to the emergence of these new credit suppliers, the significant rise in consumption credit was also a consequence of the increase in credit demand by new sections of the population (SBIF, 2015). Indeed, Chile was the country with the highest middle class population growth within the Latin American region during the period 1995-2010 (Ferreira et al., 2013). About 20% of the population was considered middle class in 1995 and this percentage jumped to 53% by 2010. In figure 2.4, I plot the shifting composition of the population in Chile across income class. While the upper and vulnerable classes remained relatively stable, there is a clear downward trend for the poor households, and a significant rise in the middle class.

Casanova and Renck (2015) explain how an increase in the consumer market size driven by the rising middle class and a *delayed response by banks* led retailers to offer credit themselves, in order to boost sales and increase profits.

Figure 2.4: Percentage of total households by income class in Chile (5 year mean)



Source: Author calculations based on database by Ferreira et al. (2013)
Notes: The classification of income class has been determined for Latin America by the World Bank and is expressed in 2005 US$ PPP (purchasing power parity)

There are other proposed explanations of the rise of vendors as a non-traditional source of credit. One is related to marketing strategies. In particular, the provision and use of store credit cards, which mainly serve purchasing within the stores of its affiliates, improves customer retention rates (Samsing, 2011).

Another explanation is a change in the regulatory framework implemented in 1999 by the SBIF, the authority responsible for monitoring and regulating the financial market in Chile. The new regulation led to the *segmentation* of the interest rate ceiling. This regulation increased the maximum rate of interest that financial and non-financial lenders (including commercial stores) could charge borrowers, particularly when provided credit in small amounts. Many specialists claimed that this significantly stimulated the supply of credit cards (Rojas (2011), Benado (2011)).

Finally, a scandal involving a particular Chilean commercial store in 2011[4] led policy makers to start questioning this sector's lending practices, and their

[4] A recount of the accounting scandal involving the retailer La Polar can be found in McMillan (2012)

increasing role in the consumer credit market. There was widespread public attention to the matter - see Barrionuevo (2011), Knowledge@Wharton (2011) and Evans (2014) - and studies of vendor financing incentives from a theoretical perspective were called upon. In the next section, we present a first attempt to model vendor financing incentives in the market for unsecured credit.

2.3 Introducing vendor financing in the unsecured credit market

The model presented in this paper adapts the stylized model of Brennan et al. (1988) and uses it to shed light on the plausible factors behind the rise of vendor financing in Latin America. We modify their model on the credit demand and credit supply setup. We substitute farmers demanding credit with households maximizing utility from consumption, and accumulating durable good services through purchases of vendor's goods. In our model, both banks and vendors' captive financial intermediary offer unsecured credit contracts.

There are five agents in the model- a competitive bank sector, a profit maximizing vendor, the vendor's captive financial intermediary and two types of households.

2.3.1 Households

Constrained households

Constrained households derive utility from their consumption in non-durables (c_t) and services from durables (d_t). However, since they don't have enough cash in hand to purchase durable goods, they need access to a source of finance to do so. A **key assumption** in this model is that if constrained households receive a credit offer from banks, they use it solely to finance the purchase of one unit of the durable good, commercialized at price z_1 set by the vendor.

There are two periods. The household's labor income in the two periods is denoted by y_1 and y_2. The first period income is pre-determined and consists of household's cash in hand, i.e his labor income net of debt repayment. The second period income, y_2, is stochastic taking one of two possible values $y_2 \in \{y_L, y_H\}$. A simplifying assumption is that $y_1 < y_L$, so households don't have incentives to transfer resources from period 1 to period 2 through savings. In other words, constrained households spend all their period income in non durable spending[5].

Households differ in the probability ρ of receiving the high income y_H. We identify households with type ρ where $\rho \sim Beta(\alpha, \beta)$. Borrowing households know their type.

In the two period optimization problem, we assume each household chooses non-durable consumption for two periods (c_1, c_2) and if received a credit offer, whether to accept or reject the offer that will allow them to purchase one unit of durable good in the first period.

We assume CRRA preferences over a CES aggregator of non-durable consumption and services from durable goods. Consistent with empirical findings[6], we assume that period utility takes the Cobb-Douglas form:

$$U(c_t, d_t) = \frac{\left(c_t^{\gamma} d_t^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} \tag{2.1}$$

where σ measures the degree of risk aversion and γ captures the weight of each

[5]The rule of thumb behavior not only simplifies derivations but is also aligned with the purpose of this paper. We are particularly interested in examining the effect of a larger middle income class on vendor financing incentives. The improvement of economic conditions of the low income can be interpreted as an increase in permanent income of constrained households.

[6]Fernández-Villaverde and Krueger (2011) reviews previous empirical literature estimating CRRA utility functions with a CES aggregator and using US consumption data. Findings suggest that the intratemporal elasticity of substitution -between services flows from durables and nondurables- is not significantly different from one.

type of consumption in household preferences ($0 < \gamma < 1$).

If the household hasn't received a credit offer, then they won't purchase any durable goods and they face the following two period optimization problem:

$$\begin{aligned}
\max_{\{c_1^i, c_2^i, \textit{Purchase or No Purchase}\}} \quad & U(c_1^i, d_1^i) + \beta U(c_2^i, d_2^i) \\
& \textit{subject to:} \\
& c_1^i \leq y_1^i \\
& c_2^i \leq y_2^i \\
& d_1^i = (1-\delta) d_0^i \\
& d_2^i = (1-\delta)^2 d_0^i
\end{aligned}$$

If the household receives a credit offer, they must choose whether to accept or reject it. If rejected, then the solution of the previous problem applies. If accepted, then household proceeds to purchase one unit of durable good. In this case, $d_1^i = 1 + (1-\delta)d_0^i$ and $d_2^i = (1-\delta) + (1-\delta)^2 d_0^i$.

The value of accepting a loan will factor in the possibility of default. With probability ρ, the household receives high income y_H in period 2 and pays back the loan repayment value z_2. Conversely, with probability $1-\rho$ they receive low income y_L and default. Following the literature of unsecured credit, if they default, they suffer a utility cost which is equivalent to losing share ϕ of second period income. Regardless of paying back or not, they still hold the durable good purchased in period 1.

The value of autarky (i.e not buying durable goods) for the household is:

$$V^{nb}(d_0, \rho) = U(y_1, (1-\delta)d_0) + \beta\rho U(y_H, (1-\delta)^2 d_0) + \beta(1-\rho)U(y_L, (1-\delta)^2 d_0) \quad (2.2)$$

The value of accepting the credit offer (or equivalently the value of buying one unit of durable good) is:

$$V^b(d_0,\rho,z_2) = U(y_1, 1+(1-\delta)d_0) + \beta\rho U(y_H - z_2, (1-\delta)+(1-\delta)^2 d_0) + \dots$$
$$\beta(1-\rho)U((1-\phi)y_L, (1-\delta)+(1-\delta)^2 d_0)$$

Then a household will accept the credit offer and purchase one unit of durable good as long as

$$V^b(d_0,\rho,z_2) \geq V^{nb}(d_0,\rho)$$

For simplicity, we **assume** that constrained households have such low durable good stock (d_0^c) that for any $z_2 \leq \phi y_H$, the value of accepting the credit offer and purchase the good is always larger than the value of autarky.

That is, given the share of income lost if default (ϕ), preference parameters (γ,β) and depreciation rate δ, their durable good stock satisfies:

$$\frac{(1-\phi)^{\frac{\beta\gamma}{(1+\beta)(1-\gamma)}}}{1-(1-\phi)^{\frac{\beta\gamma}{(1+\beta)(1-\gamma)}}} \geq d_0(1-\delta)$$

Derivations in Appendix B.1.

Unconstrained households

Unconstrained households derive utility from their consumption in non-durables (c_t) and services from durables (d_t). However, they don't need access to credit to increase their expenditure in durable goods since they have unlimited access to credit provided by banks. Preferences are symmetric to those of constrained households.

As in Brennan et al. (1988), these households default with probability 0 in their credit contract. This implies banks offer them credit loans at rate equal to the risk free interest rate. We assume that unconstrained households not only have first period income net of debt payments greater than that of constrained households but also no uncertainty regarding their second period income. This is aligned with data suggesting households with financial inclusion tend to have higher income, more assets and overall lower default risk. For simplicity, we assume there is no income heterogenity among unconstrained households.

In the two period optimization problem, the unconstrained households choose non-durable consumption for two periods (c_1, c_2) and decide to purchase one unit of durable good in the first period or not. They face the following maximization problem:

$$\begin{aligned} \max_{\{c_1, c_2, \textit{Purchase or No Purchase}\}} \quad & U(c_1, d_1) + \beta U(c_2, d_2) \\ \textit{subject to:} \quad & c_1 + z_1 x_1 + \frac{c_2}{R_1^B} = y_1 + \frac{y_2}{R_1^B} \\ & d_1 = x_1 + (1-\delta) d_0 \end{aligned} \tag{2.3}$$

where z_1 is the relative price of durable goods and $x_1 \in \{0, 1\}$ stands for units of durable goods purchased. Remember we assume that if a household decides to purchase durable goods, they can only buy one unit per period.

The first order condition for c_1 yields:

$$\begin{aligned} U_1(c_1^*, d_1) =& \beta U_1(c_2^*, d_2) R_1^B \\ & \textit{with: } c_2^* = R_1^B (y_1 - c_1^* - z_1 x_1) + y_2 \end{aligned}$$

If the household finds purchasing the durable good optimal, $x_1 = 1$ and durable services for the first and second period are $d_1 = 1 + (1-\delta)d_0$ and $d_2 = (1-\delta) + (1-\delta)^2 d_0$, respectively. The first order condition for c_1 yields:

$$\begin{aligned} U_1(c_1^{p*}, 1 + (1-\delta)d_0) =& \beta U_1(c_2^{p*}, (1-\delta) + (1-\delta)^2 d_0) R_1^B \\ & \textit{with: } c_2^{p*} = R_1^B (y_1 - c_1^{p*} - z_1) + y_2 \end{aligned}$$

If household finds not purchasing the durable good optimal, $x_1 = 0$ and durable services for the first and second period are $d_1 = (1-\delta)d_0$ and $d_2 = (1-\delta)^2 d_0$, respectively. Then, first order condition for c_1 yields:

$$\begin{aligned} U_1(c_1^{np*}, (1-\delta)d_0) =& \beta U_1(c_2^{np*}, (1-\delta)^2 d_0) R_1^B \\ & \textit{with: } c_2^{np*} = R_1^B(y_1 - c_1^{np*}) + y_2 \end{aligned}$$

To determine the decision of buying the durable good or not, the household compares the value of buying (V_r^b) versus the value of not buying (V_r^{nb}):

$$\begin{aligned} V_r^b =& U(c_1^{p*}, 1 + (1-\delta)d_0) + \beta U(R_1^B(y_1 - c_1^{p*} - z_1) + y_2, (1-\delta) + (1-\delta)^2 d_0) \\ V_r^{nb} =& U(c_1^{np*}, (1-\delta)d_0) + \beta U(R_1^B(y_1 - c_1^{np*}) + y_2, (1-\delta)^2 d_0)) \end{aligned}$$

An unconstrained household will choose to purchase one unit of durable good as long as:

$$V_r^b \geq V_r^{nb}$$

Notice the value of purchase is negatively related to the relative price of durable goods z_1 and the value of no purchase is independent of z_1. This will guarantee that there is a unique intersection (z_1^*) of both value functions such that for values of $z_1 < z_1^*$, it is optimal to purchase the good, ceteris paribus.

Let $y_1 = y_2 = \bar{y}$, then the maximum cash price accepted by unconstrained households is

$$\frac{(1 + R_1^B)}{R_1^B}\bar{y} \;\; \Omega(d_0, \delta, \gamma) = z_1^* \tag{2.4}$$

where

$$\Omega(d_0, \delta, \gamma) = 1 - \left(\frac{1}{(1-\delta)d_0} + 1\right)^{-\frac{(1-\gamma)}{\gamma}}$$

Note, the lower their durable good stock (d_0) or the higher their income ($\bar{y}$), the higher is the maximum cash price (z_1^*) at which they accept to purchase the durable good.

2.3.2 Banks

This section builds on the profit function of banks described in Livshits et al. (2016)[7]. Banks are competitive, they borrow at the exogenously given gross interest rate R^F and make loans to borrowers. Loans take the form of one period non-contingent bond contracts. However, to offer a new contract, financial intermediaries incur in a fixed cost χ.

The fixed cost to create a lending contract represents the cost of developing a screening technology (i.e scorecards), which allows the lender to perfectly assess borrower's risk types[8]. Thus, upon paying the fixed cost χ, a lender observes borrower's type. Since each prospective borrower is infinitesimal relative to this fixed cost, lending contracts have to pool the different constrained household types to recover the cost of creating the contract.

The contract posted is characterized by $(z1, R^B, \varrho)$, where R^B is the gross interest rate and ϱ is the probability of repayment cut-off defining which households are eligible. The amount advanced in period 1 is denoted by z_1 and is equivalent to the cash price of durable goods set optimally by the vendor.

Since the eligibility decision is made after the fixed cost has been incurred, lenders are willing to accept any household who yields non negative operating profits. In other words, the riskiest household accepted makes no contribution to the overhead cost χ. Hence a lender offering a risky loan at interest rate R^B rejects all applicants with risk type below a cutoff ϱ such that the expected return from the marginal borrower is zero: $\frac{\varrho z_2}{R^F} - z_1 = 0$, where z_2 $(= z_1 \times R^B)$ is the repayment value. The marginal type accepted into the contract is

$$\varrho = \frac{R^F}{R^B} \tag{2.5}$$

[7]See section 7 for a brief explanation on why we choose to differ from the stylized bank described in Brennan et al. (1988)

[8]We assume perfect information

The profit to the lender of extending the credit contract $(z1, R^B, \underline{\rho})$ to constrained households is:

$$\Pi = -\chi + \int_{\underline{\rho}}^{1} \left(\frac{\rho R^B}{R^F} - 1 \right) z_1 \times f(\rho) d\rho$$

where $f(\rho)$ is the probability density function evaluated at ρ. Note the upper limit of the integral is set at 1. This follows from the assumption that unconstrained households have such low durable good stock that -regardless of their risk profile- the value of accepting the credit offer and purchase the good is greater than the value of remaining in autarky.

Since banks are perfectly competitive, profits in equilibrium are zero. In equilibrium, and after substituting R^B using equation (5), we get:

$$\chi = \int_{\underline{\rho}}^{1} \left(\frac{\rho}{\underline{\rho}} - 1 \right) z_1 \times f(\rho) d\rho \tag{2.6}$$

Since the right hand side of equation (6) is decreasing in $\underline{\rho}$, there will be a unique $\underline{\rho}$ for each z_1, given χ, R^F and the distribution of ρ. All households with $\rho \geq \underline{\rho}$ are offered (and accept) this contract.

In the section describing unconstrained households, we stated that they have unlimited access to credit provided by banks, they have zero probability of default and borrow at the risk free interest rate. This can be rationalized by the existence of a lender offering a one period bond contract only to these households. In this setup with fixed costs, this lender would have zero fixed costs (i.e $\chi = 0$)[9].

Recall from section 2.3.1, that if these households receive high income in second period ($y_2 = y_H$), they won't default on their debt. This implies repayment value (z_2) should be lower or equal than the income lost if household defaults (ϕy_H).

[9]If fixed costs are not zero, the interest rate charged to unconstrained households will be a function of fixed costs, the amount advanced in period 1 and the risk free interest rate

This condition defines an upper bound z_1^c such that for all z_1 higher than that value, banks are not able to extend credit to constrained households since all borrowers will default with certainty.

In particular, the value z_1^c solves:

$$z_1^c = \phi y_H \underline{\rho}^c$$

where $\underline{\rho}^c$ is derived from:

$$\chi = \int_{\underline{\rho}^c}^{1} (\rho - \underline{\rho}^c)\, \phi y_H \times f(\rho) d\rho \tag{2.7}$$

Note $\underline{\rho}^c$ is a function of ϕ, y_H, the distribution of $\rho \sim Beta(\alpha, \beta)$ and fixed costs χ.

At the same time, there will be a value z_1^{min} at which for all z_1 lower than that value, the corresponding $\underline{\rho}$ derived from 2.6 yields an interest rate higher than the ceiling rate policy (R^{max}). We will **assume** hereafter that $\boldsymbol{z_1^{min} < z_1^c}$. If this assumption doesn't hold, then neither banks nor vendors have incentives to pay the fixed cost and offer a new credit contract since all borrowers will default at the implied repayment value.

Define the region $z_1 \in [z_1^{min}, z_1^c]$ as the feasible set over which banks extends credit to constrained consumers. Then, the corresponding total number of risky borrowers is defined as:

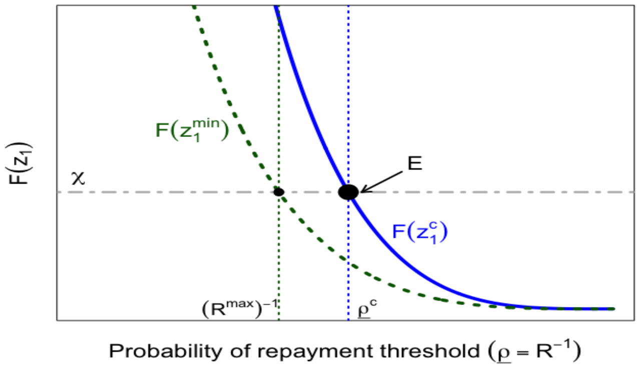
$$q(z_1) = \begin{cases} 0 & \textit{If } z_1 < z_1^{min} \\ N^c \times (1 - G(\underline{\rho})) & \textit{If } z_1 \in [z_1^{min}, z_1^c] \\ 0 & \textit{If } z_1 > z_1^c \end{cases} \tag{2.8}$$

where N^c is the total number of constrained households and $G(.)$ is the cumulative distribution function of risk types.

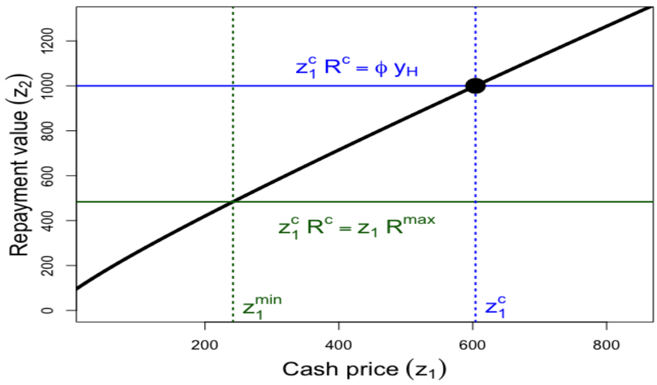
Figure 2.5 illustrates the bank problem. Figure 2.5a illustrates the corresponding cutoff of probability of repayment at z_1^{min} and z_1^c. The dashed and continuous lines evaluate the right hand side of equation 2.6 at z_1^{min} and z_1^c, respectively. The intersection of the continuous line with the fixed cost given by the horizontal line determines the probability of repayment of the marginal borrower and therefore the interest rate of the contract. Figure 2.5b shows the repayment value z_2 as an increasing function of the amount advanced in period 1 (z_1). See proof in Appendix B.2. Note that the feasible region $[z_1^{min}, z_1^c]$ will also yield a lower and upper bound for the repayment value represented in the y-axis. Figure 2.5c represents number of risky borrowers as function of the cash price. It is zero for low values, peaks at z_1^{min} and is a decreasing function of the cash price up to z_1^c.

Figure 2.5: The bank problem

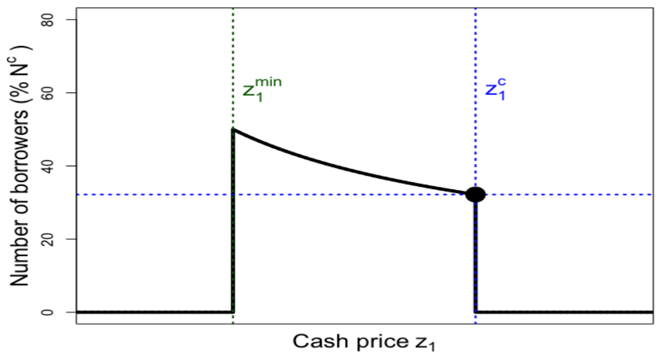
(a) Deriving $\underline{\rho}$ given z_1 and fixed costs



(b) Repayment value (z_2) in equilibrium



(c) Credit consumers (% of total constrained) in equilibrium



Notes: Value z_1^c satisfies $z_1^c = \phi y_H \underline{\rho}^c$ where $\underline{\rho}^c$ is financial intermediary probability of repayment threshold at z_1^c. Value z_1^{min} corresponds to value of cash price for which financial intermediary's probability threshold corresponds to the inverse of ceiling rate (R^{max}). All subfigures assume $\chi = 40$, $\phi = 0.1$, $yh = 10000$, $R^{max} = 2$, $E(\rho) = 0.5$ and $\sigma^2(\rho) = 3.5\%$.

2.3.3 The vendor

Consider a company that sells consumption goods to households. The goods that are produced at a constant marginal cost ν, may be purchased by the households either using cash or credit. Credit can be offered by the competitive banking system -previously described- or by the vendor itself (through its captive finance subsidiary).

Remember there are two types of consumers: constrained households and unconstrained households. The former are considered "credit customers" by the vendor since they require access to credit to purchase durable goods they sell. The latter are considered "cash customers" since they have unlimited access to a risk free credit market and can pay using cash. As in Brennan et al. (1988), vendors find profitable to extend credit to constrained customers because they differ in their price elasticity relative to cash customers. By doing so it enables them to price discriminate and increase overall sales.

Absence of vendor financing

The vendor chooses the cash price z_1 that maximizes profits. As it will be presented in the next section, under certain conditions, the optimal z_1 may attract both credit and cash customers.

The problem of the manufacturer in the absence of vendor financing is:

$$\max_{z_1} \Pi(C) = N_r(z_1 - v) + q(z_1)(z_1 - v)$$

subject to:

$$V_r^b(z_1) \geq V_r^{nb}$$

where N^r is the number of cash customers and q is the number of credit customers defined in the Bank section. The constraint guarantees that cash customer buys the good. That is the value of purchasing the good for cash customers is equal or greater than the value of no purchase.

With vendor financing

The problem of the manufacturer who offers vendor financing is to figure out two prices. In addition to the price offered to cash customers (z_1), they need to solve for the internal transfer price at which goods are sold to a captive finance subsidiary. That is, the manufacturer is able to charge a lower price to constrained households by setting the internal transfer price (z_1') below the cash price.

The competitive captive financial subsidiary faces the same fixed costs χ, same gross interest rate R^F at which they borrow and same optimization problem relative to banks. The only difference is that they observe a lower cash price. That is, the cutoff $\underline{\rho}$ solves:

$$\chi = \int_{\underline{\rho}}^{1} \left(\frac{\rho}{\underline{\rho}} - 1 \right) z_1' \times f(\rho) d\rho \tag{2.9}$$

As with the Bank, the total number of risky borrowers that results depends on the value of z_1' :

$$q(z_1', \chi) = \begin{cases} 0 & \textit{If } z_1' < z_1^{min} \\ N^c \times (1 - G(\underline{\rho})) & \textit{If } z_1' \in [z_1^{min}, z_1^c] \\ 0 & \textit{If } z_1' > z_1^c \end{cases} \tag{2.10}$$

With vendor financing, the manufacturer's profit maximization problem is:

$$\max_{z_1, z_1'} \Pi(z_1, z_1') = N_r(z_1 - v) + q(z_1', \chi)(z_1' - v) \tag{2.11}$$

Subject to:

$$V_r^b(z_1) \geq V_r^{nb}(z_1) \tag{2.11a}$$

$$z_1' R^V \geq z_1 R^F \tag{2.11b}$$

$$z_1' \leq z_1 \tag{2.11c}$$

$$z_1' R^V \leq \phi y_H \tag{2.11d}$$

Contraint (11a) is a condition guaranteeing that cash customer buys the good. This sets the upper bound for the cash price z_1.

Constraint (11b) guarantees that no cash customer buys on credit provided by the vendor. This constraint ensures that the present value of the quoted credit price ($z_1' R^V / R^F$) is not less than the cash price z_1. Derivations in Appendix B.3.

Constraint (11c) implies banks won't be able to offer a better credit contract to credit customers than vendors. By subsidizing the amount advanced in period 1, the captive financial intermediary is able to charge a lower repayment value z_2 to credit customers[10].

Finally, the last constraint (11d) defines an upper bound for the internal transfer price z_1'. All values above this upper bound imply that its corresponding repayment value is greater than the cost of default and all borrowers choose to default. By setting this constraint, the vendor ensures that the captive financial intermediary is able to extend credit to constrained households.

[10] The repayment value is an increasing function of z_1. Proof in Appendix B.2

2.4 Solving vendor's optimization problem

2.4.1 Absence of vendor financing

The problem of the manufacturer in the absence of vendor financing is:

$$\begin{aligned}\max_{z_1} \Pi(z_1) =& N_r(z_1 - v) + q(z_1)(z_1 - v) \\ &\textit{subject to:}\end{aligned} \tag{2.12}$$

$$z_1^{max}(R^F, \bar{y}, d_0^u) \geq z_1 \tag{2.12a}$$

where $z_1^{max}(R^F, \bar{y}, d_0^u)$ is the maximum cash price at which unconstrained consumers purchases the vendor's good

$$z_1^{max}(R^F, \bar{y}, d_0^u) = \frac{(1 + R^F)}{R^F}\bar{y}\ \ \Omega(d_0^u, \delta, \gamma)$$

$$\Omega(d_0^u, \delta, \gamma) = 1 - \left(\frac{1}{(1-\delta)d_0^u} + 1\right)^{-\frac{(1-\gamma)}{\gamma}}$$

Parameters $\bar{y}$ and d_0^u are income per period and durable good stock of unconstrained consumers, respectively. See derivation of z_1^{max} in Appendix B.5.2.

Remember the number of customers purchasing the good using credit not only depends on the credit customer market size (N^c) but also on the distribution of probability of repayment and the cash price set by the vendor. The cash price set by the vendor influences the interest rate and the number of constrained consumers receiving a credit offer. If it surpasses a given ceiling z_1^c then no constrained consumer can pay back and no credit contract is offered. If it is lower than z_1^{min}, the equilibrium interest rate is larger than that allowed by the ceiling rate policy and no credit is offered.

$$q(z_1) = \begin{cases} 0 & \textit{If } z_1 < z_1^{min} \\ N^c \times (1 - G(\underline{\rho})) & \textit{If } z_1 \in [z_1^{min}, z_1^c] \\ 0 & \textit{If } z_1 > z_1^c \end{cases}$$

Ceiling z_1^c is the maximum amount advanced in period 1 at which credit customer is able to pay back in period 2 when they receive income y_H. That is z_1^c is the maximum z_1 that satisfies $y_H - z_1 \times R^B \geq y_H - \phi y_H$. In simpler terms, $z_1^c R^B = \phi y_H$ where ϕy_H is the amount of high income lost if consumer defaults on its debt. The value z_1^c solves

$$\chi = \int_{z_1^c/(\phi y_H)}^{\bar{a}} \left(\frac{\rho}{z_1^c/(\phi y_H)} - 1 \right) z_1^c \times f(\rho) d\rho$$

Next we present the optimal solution by case.

Case I: $z_1^c < z_1^{\boldsymbol{max}}$

Since $q(z_1)$ takes three functional forms depending on the value of z_1, we define three Lagrangians for the vendor's optimization problem.

For $\mathbf{z_1} > \mathbf{z_1^c}$,

$$\mathcal{L}(z_1, \lambda) = N_r(z_1 - v) + \lambda[z_1^{max} - z_1]$$

The corresponding Kuhn-Tucker conditions

$$\begin{aligned} \mathcal{L}_1(z_1^*, \lambda^*) =& N_r - \lambda^* = 0 \\ \mathcal{L}_2(z_1^*, \lambda^*) =& [z_1^{max} - z_1^*] \geq 0 \\ & \lambda^* \geq 0 \\ & \lambda[z_1^{max} - z_1^*] = 0 \end{aligned}$$

These conditions are satisfied when:

$$z_1^* = z_1^{max} \qquad \lambda^* = N_r$$

For $\mathbf{z_1^{min} < z_1 \leq z_1^c}$,

$$\mathcal{L}(z_1, \lambda) = N_r(z_1 - v) + q(z_1)(z_1 - v) + \lambda[z_1^c - z_1]$$

The corresponding Kuhn-Tucker conditions

$$\begin{aligned}
\mathcal{L}_1(z_1^*, \lambda^*) =& N_r + q(z_1^*) + (z_1^* - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1=z_1^*} - \lambda^* = 0 \\
\mathcal{L}_2(z_1^*, \lambda^*) =& [z_1^c - z_1^*] \geq 0 \\
& \lambda^* \geq 0 \\
& \lambda[z_1^c - z_1^*] = 0
\end{aligned}$$

These conditions are satisfied when:

$$\begin{aligned}
& z_1^* = z_1^c \qquad \lambda^* = N_r + q(z_1^*) + (z_1^* - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1=z_1^*} > 0 \\
& Note \quad \lambda^* > 0 \quad since \quad \frac{dq(z)}{dz_1} > 0 \quad \forall z_1 \in [v, z_1^{max}]
\end{aligned}$$

Result $\lambda^* > 0$, follows from $\frac{d(q(z_1)\times(z_1-v))}{dz_1} > 0$. Derivation in Appendix B.4.

For $\mathbf{z_1 \leq z_1^{min}}$, the lagrangian at the optimum is

$$\mathcal{L}(z_1^*, \lambda^*) = N_r(z_1^* - v) + q(z_1^*)(z^* - v) + \lambda[z_1^{min} - z_1]$$

where Kuhn-Tucker conditions are defined similarly as above and are satisfied when:

$$z_1^* = z_1^{min} \qquad \lambda^* = N_r + q(z_1^*) + (z_1^* - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1=z_1^*}$$

Given these three solutions, we define three profit functions:

$$\begin{aligned}
\Pi_0^{I,A} =& N_r(z_1^{max} - v) \\
\Pi_0^{I,B} =& N_r(z_1^c - v) + q(z_1^c)(z_1^c - v) \\
\Pi_0^{I,C} =& N_r(z_1^{min} - v) + q(z_1^{min})(z_1^{min} - v)
\end{aligned}$$

Note $\Pi_0^{I,C} < \Pi_0^{I,B}$ $\forall v$ and N_r. Therefore, the optimal choice z_1^* can be summarized as follows:

$$z_1^* = \begin{cases} z_1^{max} & \textit{If} \quad \frac{z_1^{max}-v}{z_1^c-v} \geq 1 + \frac{N^c}{N^r}\left(1 - G(\varrho(z_1^c))\right) \\ \\ z_1^c & \textit{If} \quad \frac{z_1^{max}-v}{z_1^c-v} < 1 + \frac{N^c}{N^r}\left(1 - G(\varrho(z_1^c))\right) \end{cases}$$

The corresponding number of credit customers at each solution

$$q(z_1^*, \chi) = \begin{cases} 0 & \textit{If } z_1^* = z_1^{max} \\ \\ N^c\left(1 - G(\varrho(z_1^c))\right) & \textit{If } z_1^* = z_1^c \end{cases}$$

The corresponding profit functions at each solution

$$\Pi_I^{NVF} = \begin{cases} N_r(z_1^{max} - v) & \textit{If} \quad \frac{z_1^{max}-v}{z_1^c-v} \geq 1 + \frac{N^c}{N^r}\left(1 - G(\varrho(z_1^c))\right) \\ \\ N_r(z_1^c - v) + q(z_1^c, \chi)(z_1^c - v) & \textit{If} \quad \frac{z_1^{max}-v}{z_1^c-v} < 1 + \frac{N^c}{N^r}\left(1 - G(\varrho(z_1^c))\right) \end{cases}$$

Note that the solution $z_1^* = z_1^c$ is more likely when the number of credit customers $q(z_1^c)$ is significantly higher than that of cash consumers (N^r). Another set of conditions under which z_1^c may be the optimal solution is when z_1^{max} decreases and moves closer to z_1^c. In other words, when second period income for the cash customer $\bar{y}$ decreases and/or their durable good stock is high enough.

Case II: $z_1^c \geq z_1^{\boldsymbol{max}}$

Assuming that is always optimal to sell to cash customers, there are two subcases.

If $\mathbf{z_1^{max}} > \mathbf{z_1^{min}}$,

$$\mathcal{L}(z_1, \lambda) = N_r(z_1 - v) + q(z_1, \chi)(z_1 - v) + \lambda[z_1^{max} - z_1]$$

The corresponding Kuhn-Tucker conditions

$$\begin{aligned}
\mathcal{L}_1(z_1^*, \lambda^*) =& N_r + q(z_1^*, \chi) + (z_1^* - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1=z_1^*} - \lambda^* = 0 \\
\mathcal{L}_2(z_1^*, \lambda^*) =& [z_1^{max} - z_1^*] \geq 0 \\
& \lambda^* \geq 0 \\
& \lambda[z_1^{max} - z_1^*] = 0
\end{aligned}$$

These conditions are satisfied when:

$$z_1^* = z_1^{max} \qquad \lambda^* = N_r + q(z_1^{max}, \chi) + (z_1^{max} - v)\frac{dq(z_1, \chi)}{dz_1}\bigg|_{z_1=z_1^{max}}$$

If $\mathbf{z_1^{max}} < \mathbf{z_1^{min}}$

$$\mathcal{L}(z_1, \lambda) = N_r(z_1 - v) + \lambda[z_1^{max} - z_1]$$

The corresponding Kuhn-Tucker conditions

$$\begin{aligned}
\mathcal{L}_1(z_1^*, \lambda^*) =& N_r - \lambda^* = 0 \\
\mathcal{L}_2(z_1^*, \lambda^*) =& [z_1^{max} - z_1^*] \geq 0 \\
& \lambda^* \geq 0 \\
& \lambda[z_1^{max} - z_1^*] = 0
\end{aligned}$$

These conditions are satisfied when:

$$z_1^* = z_1^{max} \qquad \lambda^* = N_r$$

Note that it is always optimal to set $\boldsymbol{z_1^* = z_1^{max}}$. The corresponding number of credit customers:

$$q(z_1^{max}) = \begin{cases} 0 & \textit{If } z_1^{max} < z_1^{min} \\ N^c\left(1 - G(\varrho(z_1^{max}))\right) & \textit{If } z_1^{max} \geq z_1^{min} \end{cases}$$

The corresponding profit:

$$\Pi_{II}^{NVF} = \begin{cases} N_r(z_1^{max} - v) & \textit{If } z_1^{max} < z_1^{min} \\ N_r(z_1^{max} - v) + q(z_1^{max})(z_1^{max} - v) & \textit{If } z_1^{max} \geq z_1^{min} \end{cases}$$

2.4.2 With vendor financing

With vendor financing, the manufacturer's profit maximization problem is:

$$\begin{aligned}
\max_{z_1, z_1'} \Pi(z_1, z_1') =& N_r(z_1 - v) + q(z_1', \chi)(z_1' - v) \\
& \textit{subject to:}
\end{aligned} \tag{2.13}$$

$$z_1^{max}(R^F, \bar{y}, d_0^u) \geq z_1 \tag{2.13a}$$

$$\frac{z_1'}{\varrho(z_1')} \geq z_1 R^F \tag{2.13b}$$

$$z_1' \leq z_1 \tag{2.13c}$$

$$\frac{z_1'}{\varrho(z_1')} \leq \phi y_H \tag{2.13d}$$

where

$$z_1^{max}(R^F, \bar{y}, d_0^u) = \frac{(1+R^F)}{R^F}\bar{y} \times \Omega(d_0^u, \delta, \gamma)$$

$$\Omega(d_0^u, \delta, \gamma) = 1 - \left(\frac{1}{(1-\delta)d_0^u} + 1\right)^{-\frac{(1-\gamma)}{\gamma}}$$

Next we present the optimal solution by case.

Case I: $z_1^c < z_1^{\boldsymbol{max}}$

We define the Lagrangian as

$$\begin{aligned}\mathcal{L}(z_1, z_1', \lambda_1, \lambda_2, \lambda_3, \lambda_4) =& N_r(z_1 - v) + q(z_1')(z_1' - v) + \\ &+ \lambda_1[z_1^{max} - z_1] + \lambda_2\left[\frac{z_1'}{\varrho(z_1')} - z_1 R^F\right] + \\ &+ \lambda_3[z_1 - z_1'] + \lambda_4\left[\phi y_H - \frac{z_1'}{\varrho(z_1')}\right]\end{aligned}$$

The corresponding Kuhn-Tucker conditions

$$\begin{aligned}
\mathcal{L}_1(z_1^*, z_1'^*, \boldsymbol{\lambda^*}) =& N_r - \lambda_1^* - \lambda_2^* R^F + \lambda_3^* = 0 \\
\mathcal{L}_2(z_1^*, z_1'^*, \boldsymbol{\lambda^*}) =& q(z_1'^*) + (z_1'^* - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1=z_1'^*} + \lambda_2^* \left[\frac{1}{\varrho(z_1)} - \frac{z_1}{\varrho(z_1)^2}\frac{d\varrho}{dz_1}\right]\bigg|_{z_1=z_1'^*} + \dots \\
& - \lambda_3^* - \lambda_4^* \left[\frac{1}{\varrho(z_1)} - \frac{z_1}{\varrho(z_1)^2}\frac{d\varrho}{dz_1}\right]\bigg|_{z_1=z_1'^*} = 0 \\
\frac{d\mathcal{L}(z_1^*, z_1'^*, \boldsymbol{\lambda^*})}{d\lambda_1} =& z_1^{max} - z_1 \geq 0 \\
\frac{d\mathcal{L}(z_1^*, z_1'^*, \boldsymbol{\lambda^*})}{d\lambda_2} =& \frac{z_1'}{\varrho(z_1')} - z_1 R^F \geq 0 \\
\frac{d\mathcal{L}(z_1^*, z_1'^*, \boldsymbol{\lambda^*})}{d\lambda_3} =& z_1 - z_1' \geq 0 \\
\frac{d\mathcal{L}(z_1^*, z_1'^*, \boldsymbol{\lambda^*})}{d\lambda_4} =& \phi y_H - \frac{z_1'}{\varrho(z_1')} \geq 0
\end{aligned}$$

$$\begin{aligned}
&\lambda_1^* \geq 0 \;\; \lambda_2^* \geq 0 \;\; \lambda_3^* \geq 0 \;\; \lambda_4^* \geq 0 \\
&\lambda_1^*[z_1^{max} - z_1] = 0 \\
&\lambda_2^*\left[\frac{z_1'}{\varrho(z_1')} - z_1 R^F\right] = 0 \\
&\lambda_3^*[z_1 - z_1'] = 0 \\
&\lambda_4^*\left[\phi y_H - \frac{z_1'}{\varrho(z_1')}\right] = 0
\end{aligned}$$

We have two cases,

a) If $R^F z_1^{max} \leq \phi y_H$

The K-T conditions are satisfied at

$$\begin{aligned}
&z_1^* = z_1^{max} \qquad\qquad z_1'^* = z_1^c \\
&\lambda_1^* = N^r; \;\; \lambda_2^* = 0; \;\; \lambda_3^* = 0 \\
&\lambda_4^* = \left(q(z_1^c) + (z_1^c - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1=z_1^c}\right) \times \left(\left[\frac{1}{\varrho(z_1)} - \frac{z_1}{\varrho(z_1)^2}\frac{d\varrho}{dz_1}\right]^{-1}\bigg|_{z_1=z_1^c}\right) > 0
\end{aligned}$$

b) If $R^F z_1^{max} > \phi y_H$

The K-T conditions are satisfied at

$$z_1^* = \frac{\phi y_H}{R^F} \qquad\qquad z_1'^* = z_1^c$$
$$\lambda_1^* = 0; \;\; \lambda_2^* = \frac{N^r}{R^F}; \;\; \lambda_3^* = 0$$
$$\lambda_4^* = \left(q(z_1^c) + (z_1^c - v)\frac{dq(z_1)}{dz_1}\bigg|_{z_1 = z_1^c} \right) \times \left(\left[\frac{1}{\varrho(z_1)} - \frac{z_1}{\varrho(z_1)^2}\frac{d\varrho}{dz_1} \right]^{-1} \bigg|_{z_1 = z_1^c} \right) + \frac{N^r}{R^F} > 0$$

Summarizing, the optimal choice $(z_1^*, z_1'^*)$ can be described as follows:

$$(z_1^*, z_1'^*) = \begin{cases} (z_1^{max}, z_1^c) & \textit{If} \quad R^F z_1^{max} \leq \phi y_H \\ \\ (\frac{\phi y_H}{R^F}, z_1^c) & \textit{If} \quad R^F z_1^{max} > \phi y_H \end{cases}$$

Note that it is always optimal to set the internal transfer price z_1' at the maximum z_1^c, since the first derivative of the profit function relative to z_1' is always positive, regardless of the mean and variance of probability of repayment distribution[11].

The profit function for each corresponding case:

$$\Pi_I^{VF} = \begin{cases} N^r(z_1^{max} - v) + q(z_1^c, \chi)(z_1^c - v) & \textit{If} \quad R^F z_1^{max} \leq \phi y_H \\ \\ N^r\left(\frac{\phi y_H}{R^F} - v\right) + q(z_1^c, \chi)(z_1^c - v) & \textit{If} \quad R^F z_1^{max} > \phi y_H \end{cases}$$

[11]This result follows from $\frac{d(q(z_1)\times(z_1 - v))}{dz_1} > 0$, proved in Appendix.

Case II: $z_1^c \geq z_1^{\boldsymbol{max}}$

We define the Lagrangian as

$$\begin{aligned}\mathcal{L}(z_1, z_1', \lambda_1, \lambda_2, \lambda_3, \lambda_4) = & N_r(z_1 - v) + q(z_1', \chi)(z_1' - v) + \\ & + \lambda_1[z_1^{max} - z_1] + \lambda_2 \left[\frac{z_1'}{\varrho(z_1')} - z_1 R^F\right] + \\ & + \lambda_3[z_1 - z_1'] + \lambda_4 \left[\phi y_H - \frac{z_1'}{\varrho(z_1')}\right]\end{aligned}$$

In this case, it is always optimal to set $\boldsymbol{z_1^* = z_1'^* = z_1^{max}}$. That means price discrimination doesn't increase profits. The corresponding number of credit customers:

$$q(z_1^{max}, \chi) = \begin{cases} 0 & \textit{If } z_1^{max} < z_1^{min} \\ N^c\left(1 - G(\varrho(z_1^{max}))\right) & \textit{If } z_1^{max} \geq z_1^{min} \end{cases}$$

The corresponding profit:

$$\Pi_{II}^{VF} = \begin{cases} N_r(z_1^{max} - v) & \textit{If } z_1^{max} < z_1^{min} \\ N_r(z_1^{max} - v) + q(z_1^{max}, \chi)(z_1^{max} - v) & \textit{If } z_1^{max} \geq z_1^{min} \end{cases}$$

2.5 Vendor financing gains

To derive vendor financing gains, we will only focus in the case $z_1^c < z_1^{max}$. The previous section showed that if this condition doesn't hold, then there are never incentives to use vendor financing as a mean to price discriminate customers.

Given all structural parameters in the economy, we define vendor financing gains (VF) as the difference between profits with vendor financing at the optimal choices of z_1 and z_1' and profits in the absence of vendor financing at the optimal cash price z_1.

In the previous section, we found that in the absence of vendor financing there are two cases: one in which vendors find profitable to sell to cash customers only and another one in which vendors set a lower cash price to attract both cash and credit customers. Under vendor financing we also found two cases: one in which vendors set the cash price equal to the maximum price accepted by cash customers and another one in which they set a lower cash price so that cash customers won't turn credit customers. For this reason, we derive and summarize below four cases defining vendor financing gains.

Case 1. $\frac{z_1^{max}-v}{z_1^c-v} \geq 1+\frac{N^c}{N^r}\left(1-G(\varrho(z_1^c))\right)$ *and* $R^F z_1^{max} \leq \phi y_H$

$$VF^{(1)} = q(z_1^c, \chi)(z_1^c - v) \tag{2.14}$$

Case 2. $\frac{z_1^{max}-v}{z_1^c-v} \geq 1+\frac{N^c}{N^r}\left(1-G(\varrho(z_1^c))\right)$ *and* $R^F z_1^{max} > \phi y_H$

$$VF^{(2)} = N^r\left(\frac{\phi y_H}{R^F} - z_1^{max}\right) + q(z_1^c, \chi)(z_1^c - v) \tag{2.15}$$

Note $VF^{(2)} > 0$ *if*

$$\frac{N^c}{N^r}\left(1-G(\varrho(z_1^c))\right)(z_1^c - v) > z_1^{max} - \frac{\phi y_H}{R^F}$$

Case 3. $\frac{z_1^{max}-v}{z_1^c-v} < 1+\frac{N^c}{N^r}\left(1-G(\varrho(z_1^c))\right)$ *and* $R^F z_1^{max} \leq \phi y_H$

$$VF^{(3)} = N^r(z_1^{max} - z_1^c) \tag{2.16}$$

Case 4. $\frac{z_1^{max}-v}{z_1^c-v} < 1 + \frac{N^c}{N^r}\left(1 - G(\underline{\rho}(z_1^c))\right)$ *and* $R^F z_1^{max} > \phi y_H$

$$VF^{(4)} = N^r \left(\frac{\phi y_H}{R^F} - z_1^c \right) \tag{2.17}$$

Cases 1 and 2 correspond to the scenario at which the vendor, absent of vendor financing, finds profitable to sell only to cash customers. In cases 3 and 4 the vendor, absent of vendor financing, optimally chooses a lower cash price so that she sells to both cash and constrained consumers (the latter through bank credit).

2.6 Comparative statics

The core results of this section are derived from comparative statics exercises on gains from vendor financing- defined as the difference between profit of the manufacturer with vendor financing and in the absence of it.

We will evaluate how gains from vendor financing changes when

1. There is an increase in the market size of credit customers N^c.
2. There is a rise in the mean of repayment probability in the credit customer market.
3. There is a change in the fixed cost χ incurred by the financial sector (proxy for financial development).
4. There is a change in default costs (proxy for a change in bankruptcy policy)

We won't present comparative statics on vendor financing gains under cases 3 and 4 described in the previous section. These cases reflect a scenario in which a rise of vendor financing gains, ceteris paribus, is not associated with an increase in credit supply on its extensive margin but with a switch of source of credit for the constrained household sector. Instead, section 2.2 presents evidence that there was indeed an increase in consumption credit in Chile during the recent decade and that it was particularly driven by the emergence of vendors as new credit suppliers. Furthermore, there is evidence that this led to a rise in credit on its extensive margin as loans from vendors tend to be held by new "middle class" shoppers who need credit to purchase their goods (Casanova and Renck, 2015).

By focusing on vendor financing gains derived for cases 1 and 2, we are more aligned with data. Under both of these cases, a rise in vendor financing is correlated with greater credit access for constrained households.

2.6.1 An increase in the credit customer market size N^c

The following equation illustrates the partial derivative of VF with respect to the credit customer market size N^c.

$$\frac{dVF}{dN^c} = (1 - G(\varrho))\,(\phi y_H \varrho - v) > 0 \tag{2.18}$$

As the number of credit customers increase, vendor financing gains unambigously rise.

2.6.2 An increase in the mean of the distribution of ρ

Equation below illustrates the partial derivative of VF with respect to the mean μ.

$$\frac{dVF}{d\mu} = \frac{dq(N^c, \varrho)}{d\mu} \times (\phi y_H \varrho - v) + q(N^c, \chi, \phi, \mu, \sigma^2) \times \phi y_H \frac{d\varrho}{d\mu} \tag{2.19}$$

where

$$\frac{dq(N^c, \underline{\rho})}{d\mu} = N^c \int_{\underline{\rho}}^{1} \frac{df(\rho)}{d\mu} d\rho - N^c f(\underline{\rho}) \frac{d\underline{\rho}}{d\mu} \tag{2.20}$$

where $f(\rho)$ is the density function, $\frac{df(\rho)}{d\mu}$ its derivative relative to the mean and $\frac{d\underline{\rho}}{d\mu} > 0$ (see proof in Appendix B.6.1).

A rise in the mean on the probability of repayment from constrained households implies that a higher mass of credit customers have now a lower risk of default. The pooling of borrowers to cover the same fixed costs stops at a marginal borrower relatively safer than previously. This means that the probability of repayment cutoff above which constrained households are offered a credit offer is higher. Equivalently, the interest rate offered in the contract is lower. Figure 2.6a illustrates the higher probability of repayment threshold after an increase in the mean.

We proved earlier that the vendor finds optimal to set the internal transfer price at its largest feasible value, i.e that at which its corresponding repayment value equals the cost of defaulting. Since there is no change in the default cost and the increase in mean decreases the interest rate, the internal transfer price will have to increase. This will tend to increase vendor financing gains. Figure 2.6b illustrates the higher internal transfer price on the x-axis after an increase in the mean.

At the same time, given assumptions of a relatively dispersed probability of repayment distribution (i.e variance=1.97%), a higher mean will also result in a larger number of credit borrowers. Therefore, a rise in the mean will unambiguously increase vendor financing gains. Figure 2.6c illustrates this result for a variance=3.97%.

However, it is worth noting that under sufficiently low variances, a higher mean will decrease the number of borrowers. But even in this case, we may still derive a condition under which vendor financing gains may still increase. In particular, gains will increase after a rise in the average probability of repayment as long as the marginal cost is higher than a threshold $v^{*\mu}$ defined as

$$\left(\underline{\rho}+\frac{\left(\int_{\underline{\rho}}^{1}f(\rho)d\rho\right)\times\int_{\underline{\rho}}^{1}(\rho-\underline{\rho})\times\frac{df(\rho)}{d\mu}d\rho}{\left(\int_{\underline{\rho}}^{1}f(\rho)d\rho\int_{\underline{\rho}}^{1}\frac{df(\rho)}{d\mu}d\rho+f(\underline{\rho})\int_{\underline{\rho}}^{1}(\rho-\underline{\rho})\times\frac{df(\rho)}{d\mu}d\rho\right)}\right)\phi y_H=v^{\mu*} \tag{2.21}$$

See its derivation in Appendix B.7.1.

2.6.3 A rise in financial sector' fixed costs

The partial derivative of VF with respect to fixed costs χ is defined as:

$$\frac{dVF}{d\chi}=\frac{dq(N^c,\chi,\phi,\mu,\sigma^2)}{d\chi}\times(\phi y_H\underline{\rho}-v)+q(N^c,\chi,\phi,\mu,\sigma^2)\times\phi y_H\frac{d\underline{\rho}}{d\chi} \tag{2.22}$$

where

$$\frac{dq(N^c,\chi,\phi,\mu,\sigma^2)}{d\chi}=-N^c f(\underline{\rho})(\phi y_H\underline{\rho}-v)\frac{d\underline{\rho}}{d\chi} \tag{2.23}$$

A rise in fixed costs will require a greater pool of borrowers to cover them and this will have two opposite effects.

First, it will decrease the internal transfer price. Since more constrained households need to be pooled, the marginal borrower accepted will tend to be riskier. That is $\frac{d\underline{\rho}}{d\chi}<0$, see proof in Appendix B.6.2. This lower probability of repayment cutoff will yield a higher interest rate offered in the credit contract. Given default costs (ϕy_H), the vendor will optimally choose a lower internal transfer price and this decreases vendor financing gains.

Second, a rise in fixed costs will unambiguosly increase the number of credit borrowers, since $\left(\frac{dq(N^c,\chi,\phi,\mu,\sigma^2)}{d\chi}\right)>0$. This will increase vendor financing gains.

Figures 2.7b and 2.7c illustrate the opposite effect on the internal transfer price and number of credit borrowers.

To pin down the net effect we need to know the size of marginal cost v relative to default costs ϕy_H. When v is higher than a given threshold v^*, a rise in fixed costs will reduce vendor financing gains. On the contrary, when v is lower than v^* a rise in fixed costs increases vendor financing gains. The marginal cost threshold is derived in Appendix B.7.2 and defined as:

$$v^* = \left(\varrho - \frac{\int_{\varrho}^{1} f(\rho) d\rho}{f(\varrho)} \right) \phi y_H$$

In general, vendor financing gains after a marginal change in fixed costs decreases in the marginal cost. That is, given default costs ϕy_H, an increase in fixed costs will yield higher vendor financing incentives the lower is v.

2.6.4 A change in bankrupcty cost for consumer

Unlike previous comparative exercises, the partial derivative of vendor financing gains for case 1 and case 2 won't be equal, instead $\frac{dVF^{(1)}}{d\phi} < \frac{dVF^{(2)}}{d\phi}$.

We choose to illustrate case 1. The partial derivative of $VF^{(1)}$ with respect to default cost ϕ is defined as:

$$\frac{dVF^{(1)}}{d\phi} = \frac{dq(N^c, \chi, \phi, \mu, \sigma^2)}{d\phi} \times (\phi y_H \varrho - v) + q(N^c, \chi, \phi, \mu, \sigma^2) \phi y_H \frac{d\varrho}{d\phi} + q(N^c, \chi, \phi, \mu, \sigma^2) \varrho y_H \tag{2.24}$$

where

$$\frac{dq(N^c, \chi, \phi, \mu, \sigma^2)}{d\phi} = -N^c f(\varrho) \frac{d\varrho}{d\phi} \tag{2.25}$$

A rise in default costs will increase the maximum repayment value to be charged by the captive financial intermediary and this will have two opposite effects.

First, it will increase the maximum internal transfer price that vendors are able to charge and profit maximization would yield a higher z_1^c (figure 2.8b). This higher amount advanced in the first period by the captive financial intermediary, will require less constrained households to be pooled (figure 2.8a). Then the marginal borrower accepted will tend to be safer[12] and vendor financing gains increase.

Second, a rise in default costs will unambiguously decrease the number of credit borrowers, since $\left(\frac{dq(N^c,\chi,\phi,\mu,\sigma^2)}{d\phi}\right) < 0$. This will reduce vendor financing gains. Figure 2.8c illustrates the effect of a higher internal transfer price on the number of credit borrowers.

To pin down the net effect we need to know the size of marginal cost v relative to default costs ϕy_H. When v is higher than a given threshold v^{**}, a rise in default cost will increase vendor financing gains. On the contrary, when v is lower than v^{**} a rise in default costs reduces vendor financing gains. The marginal cost threshold is derived in Appendix B.7.3 and defined as:

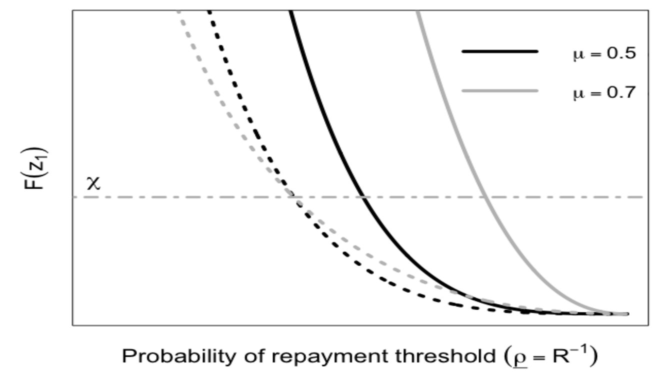
$$v^{**} = \left(\underline{\rho} - \frac{\underline{\rho}\phi y_H}{\chi} \times \frac{\left(\int_{\underline{\rho}}^{1} f(\rho) d\rho\right)^2}{f(\underline{\rho})} - \frac{\int_{\underline{\rho}}^{1} f(\rho) d\rho}{f(\underline{\rho})} \right) \phi y_H$$

In general, vendor financing gains after a marginal change in default costs increase in the marginal cost. That is, given default costs ϕy_H, an increase in default costs will yield higher vendor financing incentives the higher is v.

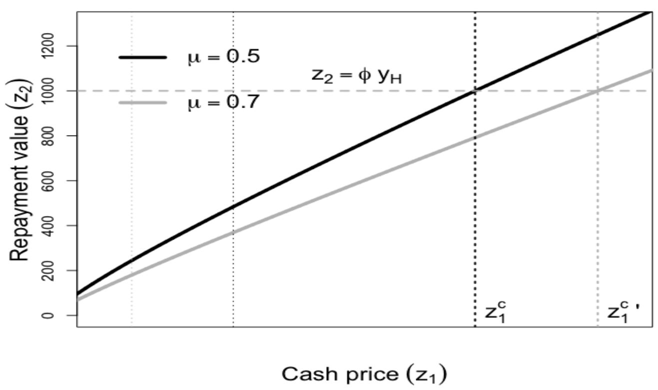
[12]This follows $\frac{d\underline{\rho}}{d\phi} > 0$, see proof in Appendix B.6.3

Figure 2.6: An increase in the mean

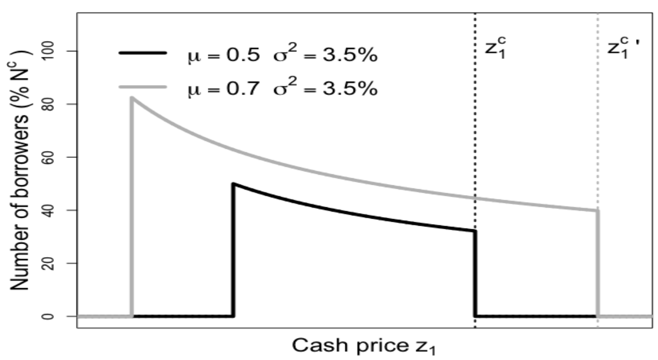
(a) Deriving $\underline{\rho}(z_1^c)$, given χ, ϕ and y_H



(b) Repayment value z_2 $(= z1/\underline{\rho}(z_1))$



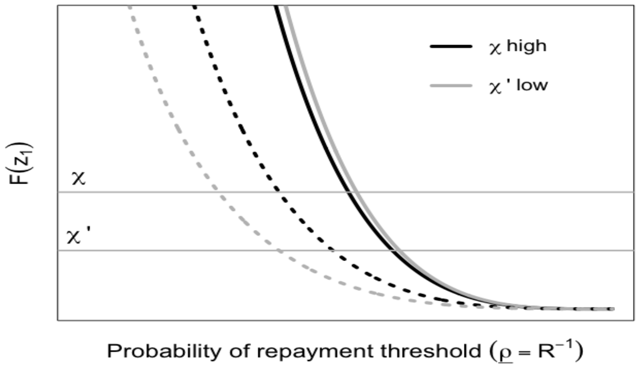
(c) Credit consumers (% of total constrained) in equilibrium



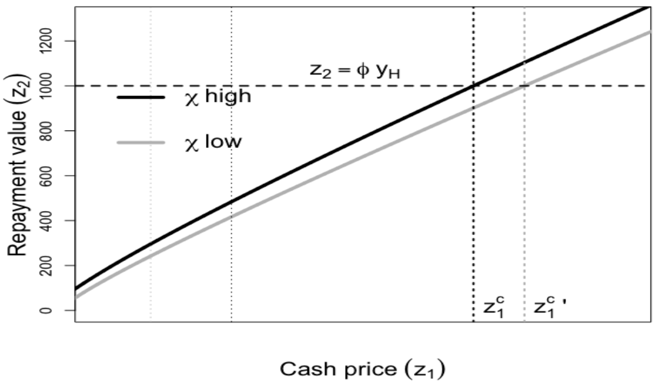
Notes: Continuous and dashed lines in (a) represent $F(z_1^c)$ and $F(z_1^{min})$ respectively. Value z_1^c satisfies $z_1^c = \phi y_H \underline{\rho}^c$ where $\underline{\rho}^c$ is probability of repayment threshold at z_1^c. Value z_1^{min} is value of cash price at which its probability threshold corresponds to the inverse of ceiling rate (R^{max}). All subfigures assume $\chi = 40$, $\phi = 0.1$, $yh = 10000$ and $R^{max} = 2$

Figure 2.7: A rise in financial sector's fixed cost

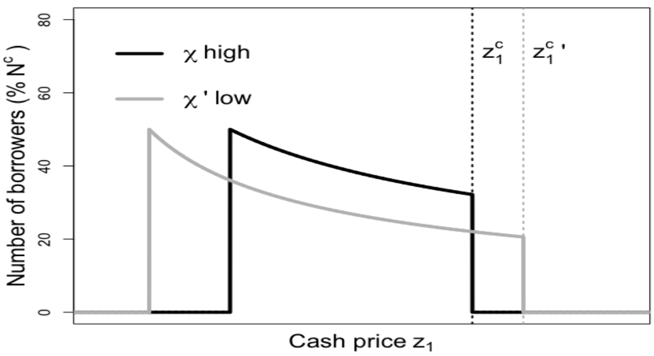
(a) Deriving $\underline{\rho}(z_1^c)$, given χ, ϕ and y_H



(b) Repayment value z_2 $(= z1/\underline{\rho}(z_1))$



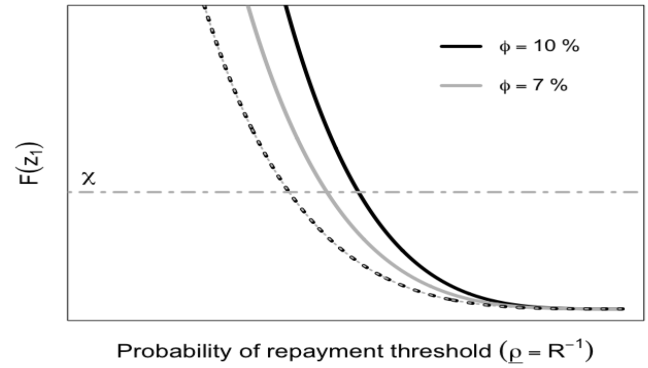
(c) Credit consumers (% of total constrained) in equilibrium



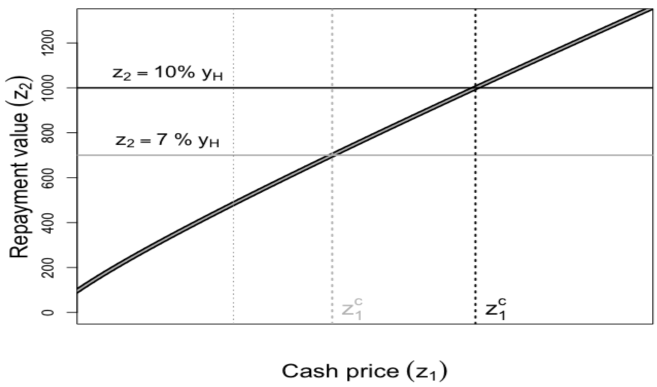
Notes: Continuous and dashed lines in (a) represent $F(z_1^c)$ and $F(z_1^{min})$ respectively. Value z_1^c satisfies $z_1^c = \phi y_H \underline{\rho}^c$ where $\underline{\rho}^c$ is probability of repayment threshold at z_1^c. Value z_1^{min} is value of cash price at which its probability threshold corresponds to the inverse of ceiling rate (R^{max}). All subfigures assume $\phi = 0.1$, $yh = 10000$, $R^{max} = 2$, $E(\rho) = 0.5$ and $\sigma^2(\rho) = 3.5\%$

Figure 2.8: An increase in default costs

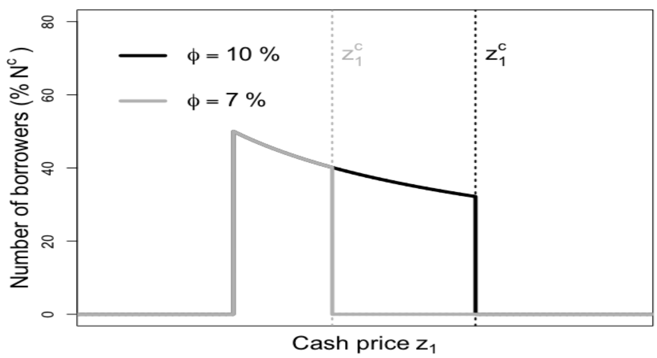
(a) Deriving $\underline{\rho}(z_1^c)$, given χ, ϕ and y_H



(b) Repayment value z_2 $(= z1/\underline{\rho}(z_1))$



(c) Credit consumers (% of total constrained) in equilibrium



Notes: Continuous and dashed lines in (a) represent $F(z_1^c)$ and $F(z_1^{min})$ respectively. Value z_1^c satisfies $z_1^c = \phi y_H \underline{\rho}^c$ where $\underline{\rho}^c$ is probability of repayment threshold at z_1^c. Value z_1^{min} is value of cash price at which its probability threshold corresponds to the inverse of ceiling rate (R^{max}). All subfigures assume $\chi = 40$, $yh = 10000$, $R^{max} = 2$, $E(\rho) = 0.5$ and $\sigma^2(\rho) = 3.5\%$

2.7 Testing model implications and assumptions

2.7.1 Supporting bank framework

We differ from the stylized bank sector described in Brennan et al. (1988) for two reasons. First, banks in our model offer unsecured credit contracts. Second, banks in our model choose who to lend to and won't merely supply credit to everyone demanding it as Brennan et al. assume.

If we use their setup, financial exclusion (measured by lack of use of bank credit services) could only be derived from lack of demand. Extending our simple framework by including durable good stock heterogeneity among constrained households, financial exclusion not only would derive from lack of demand but also from some supply barriers that impede individuals from accessing credit services. This is highly relevant as financial inclusion is a particularly important priority for developing and emerging countries of Latin America (García et al., 2013). Empirical evidence for the region suggests financial exclusion can't be attributed solely to barriers limiting credit demand or to those limiting supply, but rather is jointly determined by both (Rojas-Suarez and Amado, 2014).

Fixed costs is the key mechanism that leads banks in our setup to choose who receives credit and through which supply barriers arise. Unlike in Brennan et al. where lenders never know borrower's risk type, in our model, banks can have some information (in this case, perfect) after paying this fixed cost.

There is supporting evidence that fixed costs for banks in the region are significantly high. A common indicator of banks' operational inefficiency is the ratio of overhead (administrative) costs to total assets. High ratios tend to increase the fixed costs of extending loans. Rojas-Suarez and Amado (2014) find that the median value for Latin America is over 50 percent higher than the median value for countries with similar real income per capita. This evidence supports our setup over the simple framework of Brennan with no fixed costs.

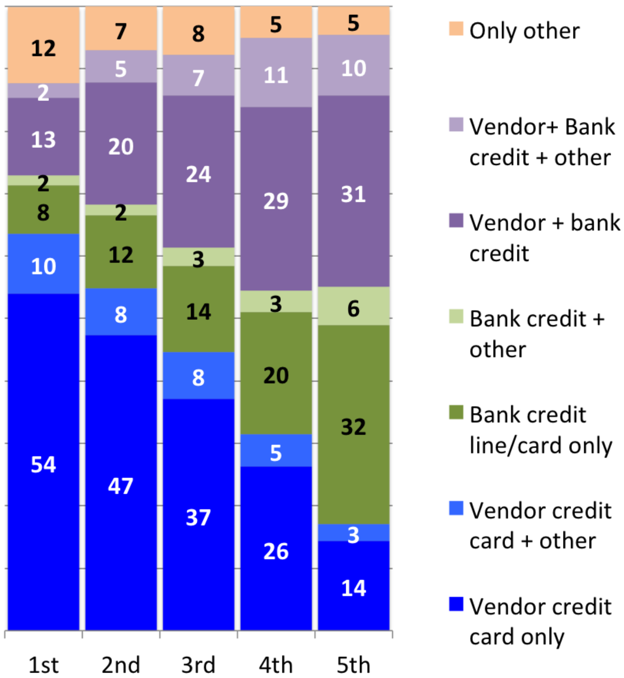
Finally, our model allow us to derive implications of reducing fixed costs on the percentage of constrained households using credit services. This is an interesting comparative statics exercise since high operational costs is one of many causes of financial exclusion in Latin America.

2.7.2 Vendor supplies credit to financially constrained households only

An assumption by the model is that vendors wish to only offer credit contracts to households in need of credit to purchase their goods. In addition, their optimization problem leads them to offer better credit contract terms than banks. Put together, we expect to see a higher percentage of households holding vendor credit at the lower quintiles of income distribution.

To check this we use the Household financial survey 2007 conducted by the Central Bank of Chile and measure the percentage of total households holding vendor credit by income quintile. Figure 2.9 shows that commercial stores are the main consumption credit provider for the lower income quintiles in Chile. On the contrary, there is greater tendency to hold bank credit in the form of credit lines or credit cards as income increases. Interestingly, as income increases the tendency to hold both types of lending also increases.

Figure 2.9: Source of consumption credit by income quintile (% of reporting Households in 2007)



Source: Household financial survey 2007. Central Bank of Chile
Notes: Other credit is the sum of educational credit, auto loans and other credit provided by the government for social purposes.

2.8 Concluding remarks

Motivated by the emergence of the vendor financing channel in the consumption credit market of various latin american countries, this paper proposes a vendor financing model in the market for unsecured credit, following the intuition by Brennan et al. (1988).

Using the comparative statics exercises for the model, we find that the improvement of economic conditions of the low income and financially constrained households raises vendor financing incentives, as suggested by earlier papers. Improved economic conditions are interpreted by the model as either an increase in the size of the credit customers market, or an increase in their average repayment probability. The model's definition of *credit customers* is mainly an income-based one. *Credit customers* are defined as households with a certain income level and a low durable good stock, who require access to credit to purchase the vendor's durable good.

There are two main findings in this study. First, an increase in the market size of those regarded as credit customers unambiguously raises vendor financing incentives. The higher number of *credit customers* can be interpreted as additional households crossing poverty thresholds. Second, as credit customers become relatively safer, i.e the mean of probability of repayment increases, vendor financing incentives increase, provided the distribution of riskiness is dispersed enough.

In addition, we also explore how a change in financial development and default costs, affect vendor financing incentives through the lens of the model.

In the model, higher financial development is reflected by a lower cost of developing a screening technology to assess borrower risk types. The lower this cost is, the lower is the number of credit customers potentially served by vendors' captive financial intermediary. This will tend to decrease vendor financing incentives. On the other hand, since fewer credit customers need to be pooled to cover lower fixed costs, the credit contract will offer a lower interest rate. Vendors will, therefore, optimally increase the internal transfer price and this in turn will increase vendor financing gains. The net effect of higher financial development will be pinned down by the *size of marginal cost relative to default costs*. If marginal costs are low enough, the net effect is a decrease in vendor financing gains.

We also find that as default cost increases, the maximum repayment value charged to borrowers increases, yielding a higher upper bound for the choice of internal transfer price. Since the profit function from selling to credit customers is increasing in the subsidized price, vendors will optimally choose a higher internal transfer price and vendor financing gains increase. At the same time, given the higher amount advanced in the first period, the captive financial intermediary will have to pool fewer borrowers to cover fixed costs. This decrease in the number of borrowers decreases vendor financing gains. Similarly, as in the case of fixed costs, the net effect will depend on the relative size of marginal costs v. If marginal costs are low enough, the net effect of higher default costs is a decrease in vendor financing gains.

Our ongoing research is testing theoretical results derived in the comparative statics section and summarized above, using Household financial surveys and vendor financing available data in Chile.

Even though the segmentation of the maximum interest rate is another plausible reason behind the rise in vendor financing in Chile, we don't include the analysis in this paper. We believe that analysis would be more rigorous in models allowing an equilibrium with both banks and vendors supplying unsecured credit to the constrained household sector. The model we proposed yields an equilibrium in which only vendors supply credit to constrained households. This is -partially- derived from the simplifying assumption that credit contracts offered by banks has the sole purpose to finance durable goods sold by the vendor. I leave these extensions for future research.

Chapter 3

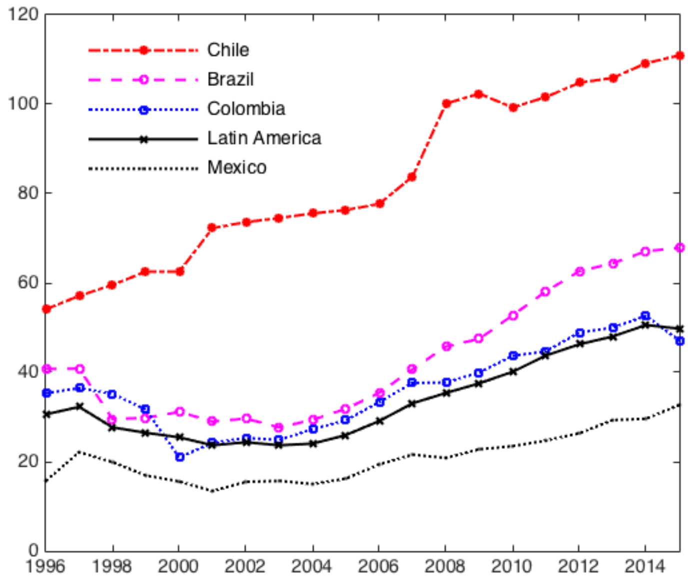
Business cycle implications of rising household credit market participation in emerging countries

3.1 Introduction

According to the literature on emerging market business cycles, emerging economies are subject to greater financial frictions relative to developed small open economies. Even though financial systems in emerging countries of Latin America are still less developed than those in their more advanced counterparts, private credit -a common measure of financial depth- has been steadily increasing during the last two decades (figure 3.1). Hansen and Sulla (2013) examine the rise of credit to private sector in 18 countries from Latin America and finds that the increase was mainly driven by unsecured credit to households.

During the period 1995-2010, countries in the region were also observing a significant increase in their middle income class population as poverty rates declined (Ferreira et al., 2013). This not only increased credit demand but also motivated the entry of new suppliers in the consumer credit market. According to Obermann (2006) and Montero and Tarzijan (2010), in countries such as Mexico, Colombia, Chile and Brazil, new providers from international and national-level retail chains emerged as main credit suppliers for "new middle class shoppers".

Figure 3.1: Domestic credit to private sector in Latin America (% GDP)



Source: World Bank - World Development Indicators (WDI)

Both the increase in the fraction of population that is more likely to have financial access (middle class) and the increase in credit supply particularly for lower income households are indicative of a rise in credit market participation by households in emerging Latin America. We study the business cycle implications of this phenomenon in a dynamic general equilibrium model suitable for emerging economies. We focus on the effect of rising household credit market participation on consumption growth volatility.

We choose to extend Chang and Fernández (2013) model (CF hereafter) with an exogenous fraction of rule-of-thumb consumers coexisting with households that are able to smooth income fluctuations. The model by CF is chosen since it encompasses two alternative mechanisms typically used by the literature to explain business cycles in emerging markets. In the model, rule of thumb consumers are households that do not own any assets nor have any liabilities; they just consume their current labor income. While there may be several interpretations for this behavior, one is their lack of access to capital markets [1]. The assumed behavior for rule-of-thumb consumers follows Galí et al. (2004) and Bilbiie and Straub (2013)[2]; it is admittedly simplistic and justified only on tractability grounds.

Using Mexico as case study, we estimate the extended model and find that a rise in credit market participation by households has a positive effect on aggregate volatility of key macro aggregates (i.e consumption and trade balance). We find that financial frictions play a key role on the relationship between credit market participation and volatility. Finally, standard measures of predictive accuracy suggest that the extended business cycle model with rule of thumb households outperforms the standard restricted version.

A side contribution of this paper is that it is the first attempt to estimate the fraction of financially excluded households in an emerging country using aggregate data and a structural approach. Figure 3.2 presents selected measures of financial depth and access across two types of small open economies and following Cihak et al. (2012). Measures related to access are also typically used to reflect financial inclusion (Demirguc-Kunt et al., 2015). As emerging countries of Latin America tend to have lower financial inclusion relative to developed small open economies, it is reasonable to expect a significant fraction of financially constrained households in emerging economies. Our estimation results suggest that approximately 75% of total households in Mexico are financially excluded. Quantifying the fraction of rule of thumb consumers is an important contribution since it has monetary policy implications. Iyer (2016) derives optimal monetary policy rules in a small open economy model embedding both rule of thumb and unconstrained households. As

[1] Other interpretations include myopia, fear of saving and ignorance of intertemporal trading opportunities.

[2] Both papers embed rule of thumb consumers in a otherwise conventional sticky price model. Galí et al. (2004) shows how their presence can change dramatically the properties of widely used interest rate rules. Bilbiie and Straub (2013) show that the relatively low level in asset market participation was behind macroeconomic performance and passiveness of monetary policy during the Great Inflation episode (pre-Volcker period).

financial exclusion and openness increase, the optimal weight placed on minimizing output gap volatility relative to domestic inflation volatility, also increases. The author finds that targeting nominal exchange rate stability -not inflation targeting- seems to be the optimal monetary policy in emerging economies with limited financial inclusion.

This paper is related to two strands of literature.

The first corresponds to the literature on emerging market business cycles. The key moments characterizing data from emerging countries are: the marked countercyclicality of the trade balance, the high volatility of consumption and investment relative to output, and the countercyclicality of real interest rates. In its attempt to match these stylized facts, this literature has offered two leading approaches. The first one is the theoretical framework of Aguiar and Gopinath (2007) that incorporates shocks to the growth trend of income. A second approach leaded by Neumeyer and Perri (2005) is that of financial frictions which induce endogenous fluctuations in real interest rates and imply an aggregate labor demand sensitive to real interest rate shocks. Other influential papers within this approach are Uribe and Yue (2006), García-Cicco et al. (2010) and Fernández-Villaverde et al. (2011). Chang and Fernández (2013) embeds both approaches and finds that the financial frictions story is relatively more relevant when explaining business cycles in Mexico. However, nothing has been yet said about whether data supports a model with limited credit market participation by households. If it does, a reappraisal of the trend versus financial frictions race may be called upon.

The second related literature is that examining the link between financial development and aggregate volatility. On the empirical side, Fulford (2013) finds that increased access to credit in rural India yielded a consumption boom in the short run, followed by a reduction in consumption in the long run. Kose et al. (2003) document the non linear relationship between financial openness and the volatility of consumption growth relative to that of output growth. At low levels of financial openness, a marginal rise in gross capital flows tends to increase the ratio of consumption volatility to output volatility. Bekaert et al. (2006) show that financial liberalization is mostly associated with lower consumption growth volatility and even though results are weaker for liberalizing emerging markets, they never observe a significant increase in real volatility.

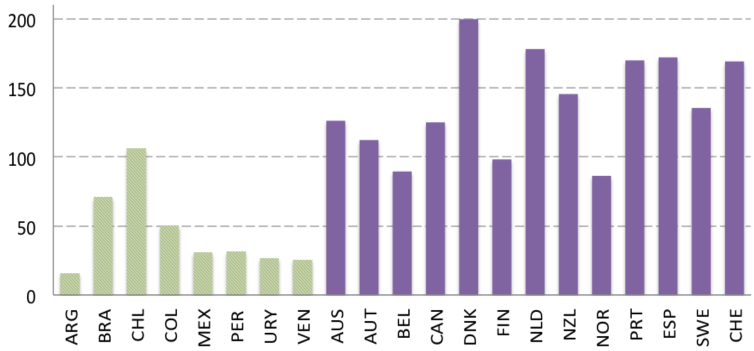
On the theoretical side, Philippe et al. (2004) shows that in economies with intermediate level of financial development, temporary shocks will have large and persistent real effects. The main mechanism yielding this result is that investment by firms within economies with an intermediate level of financial development tend to be more sensitive to cash flows shocks relative to investment in more financially developed economies. Levchenko (2005) finds that when access to international markets is not available to all members of society, financial liberalization would reduce the amount of risk sharing attained at home and raise the volatility of consumption. Leblebicioğlu (2009) illustrates that non-traded sector firms, facing collateral constrains and that can only borrow from the domestic financial system, are inherently more volatile than firms from the traded sector. Under financial integration, households supplying labor to the non traded sector have international assets to insure themselves with and do not need to resort to supply labor to the traded sector as a mean of insurance. Then the terms of trade remain relatively stable and consumption tends to be more volatile than under financial autarky. Aghion et al. (2010) find that relaxing credit constrains leads to lower aggregate volatility through its effect on the cyclical composition of investment. Basu and Macchiavelli (2015) argue that a plausible explanation on why emerging countries tend to have higher volatility of consumption relative to output, is that households in emerging economies are subject to significant borrowing constrains relative to those in more developed economies. Better ability to borrow reflected by a relaxation of collateral constrains during economic expansions leads to greater consumption volatility relative to output. The authors provide empirical evidence that higher indices of financial development in emerging economies tend to increase consumption volatility relative to output, opposite to what is observed in developed countries.

We differ from this literature in that our model illustrates the effect of financial access and stability -two characteristics behind the broad definition of financial development- on consumption growth volatility. The model interprets higher financial access as a decline in the fraction of financially excluded households. An increase in financial stability is associated with a reduction in parameters governing reduced form financial frictions affecting output volatility. Our findings suggest that an increase of financial access within an emerging country leads to higher consumption growth volatility and that lesser financial frictions would dampen the marginal effect.

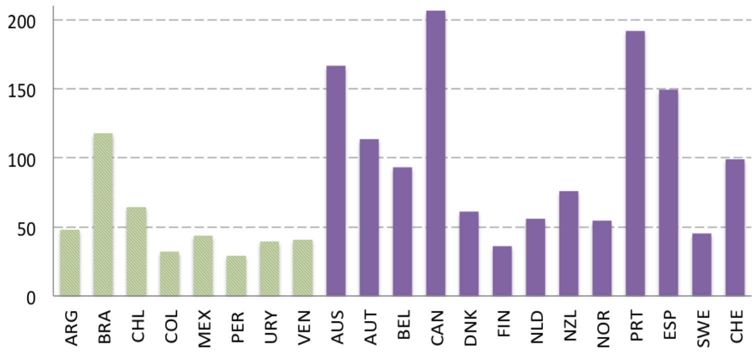
The rest of the paper is organized as follows. Section I presents the extended model. Section II estimates the model using Mexican data and by adopting the Bayesian framework. In Section III, using the full sample estimates, we illustrate the relationship between credit market participation and aggregate volatility of key aggregates (i.e consumption growth and trade balance) in an emerging country. In addition, we show the key role of financial frictions. Section IV verifies that macroeconomic data of Mexico suggests a significant rise in credit market participation in the recent decade and that this structural change lead to an increase in consumption growth volatility relative to output. Section V concludes.

Figure 3.2: Financial inclusion in emerging Latin America versus small open economies

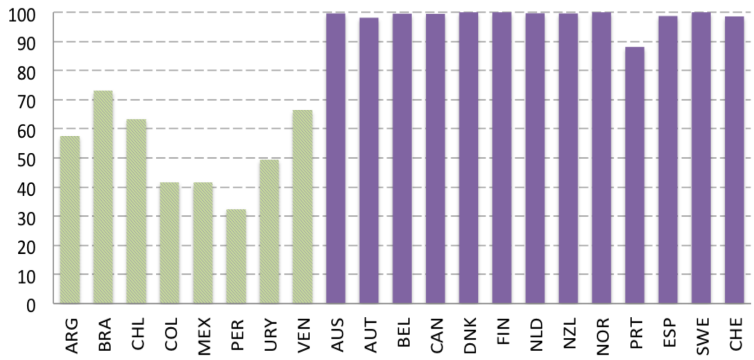
(a) Domestic credit to private sector as % of GDP



(b) Automated teller machines (ATMs) per 100,000 adults



(c) Account at a financial institution (% of adults)



Source: Global Findex Database 2014, World Bank

Notes: Countries in light green represent emerging countries in Latin America. Countries in dark purple represent small open economies (SOE). Classification of countries follows García-Cicco et al. (2010).

Emerging countries in Latin America: ARG: Argentina, BRA: Brazil, CHL: Chile, COL: Colombia, MEX: Mexico, PER: Peru, URY: Uruguay, VEN: Venezuela.

Developed small open economies: AUS: Australia, AUT: Austria, BEL: Belgium, CAN: Canada, DNK: Denmark, FIN: Finland, NLD: Netherlands, NZL: New Zealand, NOR: Norway, PRT: Portugal, ESP: Spain, SWE: Sweden, CHE: Switzerland

3.2 The general model

3.2.1 The household sector

We assume a continuum of infinitely-lived households, indexed by $i \in [0,1]$. A fraction $1-\lambda$ of households have access to an international financial market where they can trade a non-contingent real bond. In addition, these households have access to a competitive capital market where they can buy and sell physical capital (which they accumulate and rent it to firms). We refer to this subset as unconstrained households. The remaining fraction λ of households do not own any assets nor have any liabilities; they just consume their current labor income. We refer to them as rule-of-thumb consumers.

Unconstrained households

Let C_t^u and L_t^u represent consumption and leisure for unconstrained consumers. Preferences are defined by the discount factor $\beta \in (0,1)$ and the period utility $U(C_t^R, L_t^R)$. These consumers seek to solve the following problem:

$$\max \sum_{t=0}^{\infty} \beta^t U(C_t^u, L_t^u) \tag{3.1}$$

subject to the sequence of budget constraints

$$C_t^u + I_t^u - q_t D_{t+1}^u \leq W_t h_t^u + u_t K_t^u - D_t^u - T_t^u \tag{3.1a}$$

and the capital accumulation equation

$$K_{t+1}^u = (1-\delta)K_t^u + I_t^u - \frac{\phi}{2} K_t^u \left(\frac{K_{t+1}^u}{K_t^u} - \mu \right)^2 \tag{3.1b}$$

$$L_t^u + h_t^u = 1 \tag{3.1c}$$

Hence, at the beginning of the period the representative unconstrained household receives labor income $W_t h_t$ (where W_t denotes real wage), and income from renting her capital holdings K_t to firms at (real) rental cost u_t. Besides these factor receipts in period t, the household pays taxes to the government T_t^u and has access to a world capital market for noncontingent debt at price q_t. At this price, they can sell a promise to deliver one unit of goods at $t+1$ and D_{t+1} is number of such promises issued. The household uses the sum of these four income sources to finance consumption goods, investment and current debt payments. The capital accumulation constraint indicates that there is a cost when adjusting the capital stock. This is commonly used in business cycles of small open economies in order to avoid excessive volatility of investment in response to variations in the domestic-foreign interest rate differential.

Following both Neumeyer and Perri (2005) and CF, we assume GHH preferences, i.e :

$$U(C_t, h_t, \Gamma_{t-1}) = \frac{(C_t - \tau\Gamma_{t-1}(h_t)^{\omega})^{1-\sigma}}{1-\sigma}$$

We include Γ_{t-1} in the period utility function U to allow for a balanced growth[3]. For this type of preferences, a well-behaved steady state of the deterministic linearized model requires $\beta \frac{1}{q} = \mu^{\sigma}$.

The first order conditions for the household's problem can be written as:

$$\tau\Gamma_{t-1}\omega(h_t^u)^{\omega-1} = W_t \tag{3.2}$$

$$\left(1 + \phi\left(\frac{K_{t+1}^u}{K_t^u} - \mu\right)\right) = E_t\Lambda_{t,t+1}\left(u_{t+1} + 1 - \delta - \frac{\phi}{2}\left(\mu^2 - \left(\frac{K_{t+2}^u}{K_{t+1}^u}\right)^2\right)\right) \tag{3.3}$$

[3]Since supply of work hours is independent of consumption, the absence of Γ_{t-1} would imply non stationary hours. Benhabib et al. (1991) show that these preferences can be interpreted as reduced form preferences for an economy with home production and technological progress in the home production sector.

$$q_t = E_t \Lambda_{t,t+1} \tag{3.4}$$

where $\Lambda_{t,t+k}$ is the stochastic discount factor for real k-period ahead payoffs given by

$$\Lambda_{t,t+k} \equiv \beta^k \left(\frac{C^u_{t+k} - \tau \Gamma_{t+k-1} (h^u_{t+k})^\omega}{C^u_t - \tau \Gamma_{t-1} (h^u_t)^\omega} \right)^{-\sigma} \tag{3.5}$$

Rule of thumb households

By definition, these households behave in a "hand-to-mouth" fashion; i.e., each period they fully consume their labor income and government transfers if any. While there may be several interpretations for rule of thumb consumers, one is their lack of financial access and (continuously) binding borrowing constrains. Other reasons are myopia, fear of saving and ignorance of intertemporal trading opportunities. Each period they solve a static problem:

$$\begin{aligned} &\max U(C^r_t, L^r_t) \\ &s.t: \end{aligned} \tag{3.6}$$

$$C^r_t \leq W_t h^r_t + T^r_t \tag{3.6a}$$

$$L^r_t + h^r_t = 1 \tag{3.6b}$$

Preferences are symmetric to those of unconstrained households and their first order condition is:

$$\tau \Gamma_{t-1} \omega (h^r_t)^{\omega - 1} = W_t \tag{3.7}$$

Substituting hours in the budget constraint yields:

$$C^r_t = (\tau \Gamma_{t-1} \omega)^{\frac{-1}{\omega-1}} W_t^{\frac{\omega}{\omega-1}} + T^r_t \tag{3.8}$$

Aggregation

Consumption good aggregate demand and hours aggregate supply are a weighted average of individual demand and supply, respectively. Formally:

$$C_t \equiv \lambda C_t^r + (1-\lambda) C_t^u \tag{3.9}$$

$$h_t^S \equiv \lambda h_t^r + (1-\lambda) h_t^u \tag{3.10}$$

Note, under symmetrically parameterized GHH preferences and homogenous labor productivity, $h_t^r = h_t^u = h_t^S$.

Similarly, aggregate investment, aggregate supply of capital stock and aggregate debt stock:

$$I_t \equiv (1-\lambda) I_t^u \tag{3.11}$$

$$K_t^S \equiv (1-\lambda) K_t^u \tag{3.12}$$

$$D_t \equiv (1-\lambda) D_t^u \tag{3.13}$$

Aggregate euler for investment (derivation in Appendix)

$$\begin{aligned}&\left(1+\phi\left(\frac{K_{t+1}}{K_t}-\mu\right)\right) = \\ &E_t\beta\left(\frac{C_{t+1}-\tau\Gamma_t h_t^\omega \Omega - \lambda T_{t+1}^r}{C_t - \tau\Gamma_{t-1} h_t^\omega \Omega - \lambda T_t^r}\right)^{-\sigma}\left(u_{t+1}+1-\delta+\frac{\phi}{2}\left(\left(\frac{K_{t+2}}{K_{t+1}}\right)^2-\mu^2\right)\right)\end{aligned} \tag{3.14}$$

Aggregate euler for international bonds (derivation in Appendix)

$$q_t = E_t\beta\left(\frac{C_{t+1}-\tau\Gamma_t h_t^\omega \Omega - \lambda T_{t+1}^r}{C_t - \tau\Gamma_{t-1} h_t^\omega \Omega - \lambda T_t^r}\right)^{-\sigma} \tag{3.15}$$

where $\Omega = \lambda(\omega - 1) + 1$

3.2.2 Government

We assume the government runs a balanced budget period by period. Transfers to rule of thumb households are financed by lump sum taxes collected from unconstrained households.

$$(1-\lambda)T_t^u = \lambda T_t^r$$

Transfers and taxes are exogenous variables in the model. Since we don't allow time variation of λ during the period and subperiods considered in the estimation section, the ratio T_t^r/T_t^u also remains stable.

3.2.3 Firms

Firms are perfectly competitive. They hire labor h_t and rent capital K_t to produce the final good. Technology is characterized by a Cobb-Douglas production function:

$$Y_t = A_t {K_t}^{\alpha}(\Gamma_t h_t)^{1-\alpha} \tag{3.16}$$

where α is capital's share of output, A_t is temporary productivity and Γ_t reflects trend productivity. These two productivity processes are characterized by the following stochastic properties:

$$ln\left(\frac{A_t}{\mu_A}\right) = \rho_A\left(\frac{A_{t-1}}{\mu_A}\right) + \epsilon_t^A \qquad \epsilon_t^A \sim N(0, \sigma_A^2) \tag{3.17}$$

$$\Gamma_t = g_t\Gamma_{t-1} = \prod_{s=0}^{t} g_s \tag{3.18}$$

$$ln\left(\frac{g_t}{\mu}\right) = \rho_g\left(\frac{g_{t-1}}{\mu}\right) + \epsilon_t^g \qquad \epsilon_t^g \sim N(0, \sigma_g^2) \tag{3.19}$$

A positive realization of ϵ_t^g has a permanent effect on total productivity. In what follows, we will loosely refer to the realizations of g as "growth shocks" as they constitute the stochastic trend of productivity.

To produce, firms need to borrow working capital at the beginning of the period due to a friction in the technology for transferring resources to households providing labor services. In order to transfer wage payments to workers firms need to set aside a fraction θ of the wage bill at the beginning of the period and a fraction $(1-\theta)$ at the end of the period. Because production becomes available only at the end of the period, firms have to borrow $\theta W_t h_t$ units of goods (the working capital) between the beginning and end of period t, at rate R_{t-1}.

There is no friction in the technology for transferring resources to households that supply capital to firms. At the end of the period, once output becomes available, firms pay wages $(W_t h_t)$, rental fees to owners of capital $(u_t K_t)$ and repay the working capital loan plus interest $(\theta W_t h_t R_{t-1})$. Each period they solve a static problem:

$$\begin{aligned} &\max Y_t - W_t h_t - u_t K_t - (R_{t-1}-1)\theta W_t h_t \\ &s.t: \\ &Y_t = A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha} \end{aligned} \tag{3.20}$$

The term $(R_{t-1}-1)\theta W_t h_t$ represents the net interest on the fraction of the wage bill that was paid with borrowed funds.

First order conditions give capital demand and labor demand equations, respectively

$$\alpha A_t {K_t}^{\alpha-1} (\Gamma_t h_t)^{1-\alpha} = u_t \tag{3.21}$$

$$(1-\alpha) A_t {K_t}^{\alpha} (\Gamma_t h_t)^{-\alpha} \Gamma_t = (1 + (R_{t-1}-1)\theta)\, W_t \tag{3.22}$$

3.2.4 Market equilibrium

Given initial conditions on capital stock K_{-1}, debt stock D_{-1}, labor augmenting productivity Γ_{-1} and sequences of real interest rates $\{R_t\}_{-1}^{\infty}$, prices for noncontingent debt $\{q_t\}_0^{\infty}$, productivity $\{A_t\}_0^{\infty}$ and growth shocks $\{g_t\}_0^{\infty}$, an *equilibrium* is a sequence of allocations $\{C_t, h_t, D_{t+1}, I_t, K_{t+1}\}$ and of prices $\{W_t, u_t\}$ such that

1. Allocations solve the firm's and the household problem at the equilibrium prices

2. Markets for inputs clear

A balanced growth path for the economy is an equilibrium in which R_t, A_t and g_t are constant. Along a balanced growth path u_t, h_t and q_t are constant and all other variables grow at rate μ.

Country's net exports (NX_t) is production net of working capital loan payments and that are not spent in consumption or investment:

$$NX_t = Y_t - C_t - I_t = D_t - q_t D_{t+1} + \frac{(R_t - 1)\theta(1-\alpha)}{1 + (R_t - 1)\theta} Y_t \tag{3.23}$$

The aggregate resource constraint (derived in appendix)

$$C_t + I_t - q_t D_{t+1} = \frac{Y_t(1 + (R_{t-1} - 1)\theta\alpha)}{1 + (R_{t-1} - 1)\theta} - D_t \tag{3.24}$$

Aggregate investment

$$I_t = K_{t+1} - (1-\delta)K_t + \frac{\phi}{2} K_t \left(\frac{K_{t+1}}{K_t} - \mu \right)^2 \tag{3.25}$$

3.2.5 Interest rates and country risk

As discussed in Schmitt-Grohé and Uribe (2003), since households face an incomplete asset market and the rate of return is partly exogenously determined, the steady state of the model depends on initial conditions; in particular, on net foreign asset position. Put differently, the equilibrium dynamics are no longer stationary. Therefore, serious computational difficulties arise.

To induce stationarity of the equilibrium dynamics we also follow CF by choosing the technique of specifying a debt elastic interest rate premium $p(.)$. Interest on foreign borrowing is therefore specified as the sum of the real interest rate and the premium:

$$\frac{1}{q_t} = R_t + p(.) \tag{3.26}$$

with

$$p(D_{t+1}, \Gamma_t) = \psi \left(exp \left(\frac{D_{t+1}}{\Gamma_t} - d \right) - 1 \right)$$

Note that in choosing the optimal amount of debt, households do not internalize the fact that there is an upward-sloping supply of loans.

The real interest rate at which international investors are willing to lend to the emerging economy has two sources of fluctuations: the perceived default risk and international investors preferences for risky assets. As in Neumeyer and Perri (2005), these two sources of fluctuations are captured by decomposing the interest rate faced by the emerging economy as

$$R_t = S_t {R_t}^* \tag{3.27}$$

where R_t^* is an international rate for risky assets (not specific to any emerging economy) and S_t is the country spread paid by borrowers to international investors.

The CF model assumes a simple country risk determination[4]. In their model as in ours, expected total productivity - measured by Solow Residual - drives country risk. Formally,

$$ln\left(\frac{S_t}{S}\right) = -\eta E_t ln\left(\frac{SR_{t+1}}{SR}\right) + \epsilon_t^S \qquad \epsilon_t^S \sim N(0, \sigma_S^2) \tag{3.28}$$

where SR_{t+1} is the Solow residual. Under Cobb-Douglas production technology with constant returns to scale

$$SR_t = A_t {g_t}^{1-\alpha}$$

Finally, the foreign rate of risky assets is modeled as a stochastic process completely independent from domestic conditions

$$ln\left(\frac{R_t^*}{R^*}\right) = \rho_{rf} ln\left(\frac{R_{t-1}^*}{R^*}\right) + \epsilon_t^{R^*} \qquad \epsilon_t^{R^*} \sim N(0, \sigma_{rf}^2) \tag{3.29}$$

3.3 Empirical approach

3.3.1 Does data support a model with limited credit market participation?

Calibrated and estimated parameters

We estimate some parameters and calibrate others. The choice of which parameters to estimate or calibrate is guided by our research interest. The parameter λ is the most relevant object of estimation as it reflects the fraction of rule of thumb households in the economy.

[4] This idea is based on models of default and incomplete markets in which default probabilities are high when expectations of positive shocks to productivity are low. See Eaton and Gersovitz (1981) and Arellano (2008)

In addition, we estimate exogenous processes for all shocks to productivity (ρ_a, ρ_g, σ_a, σ_g) and to spread component (σ_S). We estimate the spread elasticity to domestic fundamentals (η) and working capital requirement parameter (θ). Introducing working capital requirement in production is useful to match the volatility of output.

Following most papers we also estimate the parameter (ϕ) governing the capital adjustment function and the long run yearly growth rate (ζ). Note that the latter implies that the value of long run productivity quarterly growth μ will be determined by posterior estimates of ζ, since $\mu = (\zeta/100 + 1)^{1/4}$.

We calibrate the remaining parameters of the model. A period is taken to be one quarter. Calibrated values are given in Table 3.1 and set at conventional values following CF, Akinci (2014) and references therein. The coefficient of risk aversion (σ) affecting the intertemporal elasticity of substitution is set to the conventional value of 2. The parameters ω and τ are set so that labor supply elasticity equals 1.67 and the fraction of time spent working equals 1/3 in the long run, respectively.

The parameter α is set so that labor share of income is 0.68. Following CF and Aguiar and Gopinath (2007), the baseline value of debt to GDP ratio is set to 10%.

Calibration of steady state interest rate and spread is based on corresponding historical data, calculated as Uribe and Yue (2006) and described further in the next subsection. Annualized foreign interest rate and country gross spreads are set to 1.01 and 1.0081 respectively. We also choose to calibrate parameters related to the foreign interest rate process (σ_{rf} and ρ_{rf}) to match its standard deviation and first order serial correlation for the sample period used (1995:II-2014:IV).

The quarterly depreciation rate is assumed to be 5% as in Aguiar and Gopinath (2007) and CF. We set the elasticity of interest rates to debt (ψ) to a small value and equal to 0.001. The main purpose of this parameter is to guarantee the equilibrium solution to be stationary.

Furthermore, note that a well behaved steady state of the deterministic linearized model requires $\beta R = \mu^{\sigma}$. As previously explained, long run productivity quarterly growth μ is linked to the posterior distribution of ζ. Therefore the bounds of the discount factor β $(= \frac{\mu^{\sigma}}{R_{ss}})$, the calibrated steady state value of gross domestic interest rate and the calibrated coefficient of risk aversion σ will impose restrictions on the domain of ζ when we define its prior.

Finally, I calibrate the ratio of net transfers to gdp (γ_t) at 7.5%. Transfers as % of GDP were extracted for Mexico from OECD (2014). The series correspond to average annual social expenditures as % of GDP for the period 1990-2012. It is the total of cash benefits and benefits in kind for all social policy areas (Active labour market programmes, family, health etc).

Table 3.1: Calibrated parameters

Parameter	Description	Value
α	Capital share of income	0.32
δ	Depreciation rate of capital	0.05
dy_{ss}	Debt to GDP ratio	0.1
rf_{ss}	Gross foreign interest rate	1.01
ψ	Debt elastic interest rate parameter	0.001
μ_a	Mean of Transitory Tech. process	1
γ_t	Ratio net transfers/ GDP	0.075
σ	Intertemporal elasticity of substitution (=1/σ)	2
ω	Labor supply elasticity ($1/(\omega-1) = 1.67$)	1.6
r_{ss}	Long run country interest rate	1.0182
s_{ss}	Long run gross country interest rate premium	1.0081
τ	Leisure preference parameter so that hss=1/3	1.75
σ_{rf}	S.D of foreign interest rate shock (%)	0.588
ρ_{rf}	AR(1) coef. Foreign interest rate process	0.96

Notes: The value used as σ_{rf} matches a foreign interest rate with a standard deviation of 2.1% , given the calibrated value of ρ_{rf}.

Table 3.2: Parameters linked to estimated parameters

Parameter	Description	Linked with	Linking equation
μ	Long run gross quarterly growth rate	ζ	$\mu = (\zeta/100 + 1)^{1/4}$
β	Discount factor	ζ	$\beta = \frac{\mu^{\sigma}}{r_{ss}}$
Ω	Parameter in aggregate Euler	λ	$\Omega = \lambda(\omega - 1) + 1$

Data and implementation

Observables

We retrieve aggregate series of final private consumption (C), gross fixed capital formation (I) and the trade balance (TB) for Mexico from the OECD database. All series are measured in national currency at constant prices (national base year) and are seasonally adjusted. The output series (Y) used to estimate the extended model is the sum of private final consumption, gross capital formation and the trade balance. The initial sample for Mexican data covers the years 1993 to 2014 (quarterly frequency). We drop the period 1993:I-1995:I as it is common in the literature on mexican business cycles; fluctuations during this period were mostly driven by the Tequila crisis.

In addition, we use quarterly data of foreign risky interest rate and spreads. We follow Uribe and Yue (2003) in constructing these series. We use real interest rates in the US to calibrate the process of foreign risky interest rate and data on spreads to estimate the extended model.

The real interest rate (r_t^*) for the US is constructed as the 3-month Treasury Bill Secondary market rate (%) (TB3MS) minus a measure of expected annual inflation. This measure is the average of annual inflation of 4 previous quarters (including current).

$$r_t^* = TB3MS_t - \sum_{t-3}^{t}(ln(DEF_t) - ln(DEF_{t-4}))/4$$

The price index used to calculate inflation is the GDP Implicit Price Deflator (DEF). The inputs for constructing US real interest rate are extracted from FRED.

Country spreads are based on JP Morgan's Emerging Markets Bond Index Plus (EMBI+) which tracks total returns for traded external debt instruments (i.e. foreign currency denominated fixed income) in emerging markets. We download from DATASTREAM, the JPM EMBI GLOBAL+ (stripped spread in basis points /100) for Mexico.

Following CF, we estimate the model using log differences of C, I and Y and the first difference of TBy. As García-Cicco et al. (2010) and CF pointed out, although TBy has no trend, it is convenient to feed the model with its first differences when fitting small open economy models. The reason is that these models typically and counterfactually deliver a quasi random walk process in the trade balance level inherited by the nature of the endowment process. The observables therefore considered are

$$DATA_t = \left[\Delta ln(Y_t), \Delta ln(C_t), \Delta ln(I_t), \Delta TBy_t, ln(\bar{S}_t)\right]$$

where: $\Delta ln(Y_t)$ is real GDP growth, $\Delta ln(C_t)$ is real consumption growth, $\Delta ln(I_t)$ is real Investment growth, ΔTBy_t is the first difference of trade balance to GDP ratio and $ln(\bar{S}_t)$ is log of gross spreads for Mexican bonds (demeaned)[5]. See appendix for derivation of model counterpart of selected series.

Implementation and choice of priors

To sample from the posterior distribution, we implement a Random Walk Metropolis Algorithm described in An and Schorfheide (2007). We make 4 million

[5]We demean a variable X in the following way :

$$ln(\bar{X}_t) = ln(X_t) - \sum_{t=0}^{T} \frac{ln(X_t)}{T}$$

draws from posterior and burn the first 1 million draws[6].

Regarding priors, we follow CF in several choices. For example, we choose a considerable diffuse prior for ϕ since previous studies have found different values when trying to mimic investment volatility. In addition we choose a similar prior distribution for η and θ. We follow Akinci (2014) when setting the prior distributions for parameters related to shock processes (ρ_a, σ_a, ρ_g, σ_g, σ_s)[7]. However, we allow a higher mode when setting the prior of σ_a and σ_g in order to align them better with those implied by priors in CF.

The choice of a prior distribution for our parameter of interest λ follows similar previous studies. Bilbiie and Straub (2013) used a beta prior distribution centered at 0.35 and with a standard deviation of 10% for the US supported by previous empirical estimates. There is far less evidence on estimates for developing countries. One paper is that of Vaidyanathan (1993). The author estimates λ using aggregate data on consumption growth and output growth for a sample of 94 countries and found a mean of 0.6 for the southamerican sample. Ponce (2003) estimated similar reduced form regressions for Mexico and his results suggest that the fraction of rule of thumb in Mexico would be around 0.4. We choose to center the prior at a mean of 0.4 and allow a relatively high dispersion of 10 %.

Since we have more observables (5) than structural shocks (4), we add measurement error shocks for all our observables and estimate them. We assume flat priors with a standard deviation not larger than 25% of each corresponding series total standard deviation.

[6] Convergence analysis of chains (running means plot) can be sent upon request.

[7] We follow Akinci (2014) since CF assumes a Gamma prior distribution for the standard deviation of technology and spread shocks

Table 3.3: Prior distributions

	Description	Density	Mean	S.D (%)	min	max
λ	Fraction of rule of thumb households	Beta	0.4	10	0	1
ρ_a	AR(1) transitory tech. process	Beta	0.8	10	0.001	0.999
σ_a	S.D of transitory tech. shock (%)	Inv. Gamma	0.02	1.5	0.001	0.03
ρ_g	AR(1) permanent tech. process	Beta	0.8	10	0.001	0.999
σ_g	S.D of permanent tech. shock (%)	Inv. Gamma	0.02	1.5	0.001	0.03
η	Spread elasticity	Gamma	1	10	0.001	10
ϕ	Capital adjustment cost parameter	Gamma	40	500	1	100
σ_s	S.D spread shock (%)	Inv. Gamma	0.01	1.5	0.001	0.02
θ	Working cap. requirement	Beta	0.5	10	0	1
ζ	Long run yearly growth rate (%)	Gamma	2.5	20	0	3.6
$\sigma_{me}^{\gamma_Y}$	S.D (%) measurement error in γ_Y	Uniform	0.15	0.63	0.01	0.28
$\sigma_{me}^{\gamma_C}$	S.D (%) measurement error in γ_C	Uniform	0.28	2.47	0.01	0.55
$\sigma_{me}^{\gamma_I}$	S.D (%) measurement error in γ_I	Uniform	0.32	3.22	0.01	0.63
σ_{me}^{dTby}	S.D (%) measurement error in $dTby$	Uniform	0.10	0.25	0.01	0.18
σ_{me}^{S}	S.D (%) measurement error in S	Uniform	0.08	0.17	0.01	0.15

Posterior estimates

Estimated posterior distributions of the parameters of both restricted and unrestricted models are summarized in Table 3.4. Figure 3.3 plots priors and posterior distributions for the unrestricted model and figure 3.4 for the restricted model.

The most important result is that related to the posterior distribution of the fraction of rule of thumb households (λ). Data is very informative regarding our key parameter of interest; the posterior distribution is to the right of its prior. The parameter λ in our model would represent households with no savings nor access to (or demand of) consumption loans. Its posterior median is 0.754 and this estimate is aligned with financial exclusion measures derived from household surveys in Mexico. The National Report of Financial Inclusion in Mexico (CONAIF, 2016) provides evidence that in 2011, 73 % of adults in Mexico not only didn't have any account (savings, deposits etc) in a financial institution, but also spent at least all their income and therefore have not saved during the previous 12 months of the survey.

Several other results are also worth mentioning.

First, data seems very informative when estimating both versions. The estimated posteriors for almost all parameters appear much more precise than the priors. However, data has little to say about the long run annual growth parameter ζ which basically reproduces the prior. Unlike CF and García-Cicco et al. (2010), we are able to identify the parameter ρ_g which is a key parameter when assessing the importance of trend shocks relative to transitory shocks.

Second, trend shocks seem dominant in both versions. To asses the importance of trend shocks, we use the measure derived in Aguiar and Gopinath (2007) expressed below. This measure is derived from recognizing the Solow residual (in logs) implied by the model $log(SR_t) = log(A_t) + (1-\alpha)log(\Gamma_t)$ can be rewritten as the sum of a random walk component τ_t and a transitory component s_t. Then, a measure of the importance of trend shocks is the variance of the random walk component $\Delta\tau$ relative to the overall variance in $\Delta log(SR)$. As Table 3.4 shows, in the model of limited credit market participation ($\lambda \geq 0$), the implied RWC calculated at the median, mode and mean of the relevant parameters seem far above the values found under the restricted version ($\lambda = 0$).

$$RWC = \frac{\frac{(1-\alpha)^2}{(1-\rho_g)^2}\sigma_g^2}{\frac{2}{(1+\rho_a)}\sigma_a^2 + \frac{(1-\alpha)^2}{(1-\rho_g^2)}\sigma_g^2}$$

Third, the parameters related to financial frictions appear quite significantly different than zero. The tight posterior distribution of η, with a median of approximately 0.86 is robust when restricting the model and is fairly close to the estimates in CF. This result reveals a significant elasticity of the spread to expected fluctuations in the Solow residual. The posterior median, mode and mean values of the parameter θ governing working capital requirement are also robust when restricting the model and are found to be lower than those found in CF. While in CF the posterior distribution shifts right relative to the prior, here it shifts left. This may be indicating a decline in this parameter, since we are including a more recent period than in CF.

Finally, the estimated values of the capital adjustment cost parameter ϕ differ across the restricted and unrestricted model. One interpretation is that even if λ has no effect on investment dynamics per se (as evidenced in the aggregate euler for capital), when there are rule of thumb households in the economy, a higher relevance of trend shocks relative to transitory shocks is needed to match the data. Therefore, capturing investment dynamics in the presence of limited credit market participation requires higher capital adjustment costs.

Table 3.4: Estimation results. Period 1995:II-2014:IV

		Restricted model ($\lambda = 0$)						Unrestricted model ($\lambda \geq 0$)				
		Mode	Mean	Median	90% credible set			Mode	Mean	Median	90% credible set	
λ	Fraction of rule of thumb households	-	-	-	-	-		0.765	0.752	0.754	0.692	0.811
ρ_a	AR(1) transitory tech. process	0.907	0.874	0.879	0.814	0.924		0.938	0.907	0.917	0.847	0.958
σ_a	S.D transitory tech. shock (%)	0.496	0.358	0.354	0.291	0.431		0.459	0.354	0.351	0.292	0.420
ρ_g	AR(1) permanent tech. process	0.744	0.743	0.749	0.660	0.820		0.844	0.794	0.800	0.720	0.860
σ_g	S.D permanent tech. shock (%)	0.633	0.442	0.437	0.349	0.542		0.614	0.481	0.477	0.379	0.590
η	Spread elasticity	0.788	0.859	0.856	0.751	0.970		0.821	0.846	0.843	0.740	0.956
ϕ	Capital adjustment cost parameter	47.923	41.523	41.196	35.864	47.710		52.689	53.448	53.361	47.656	59.251
σ_s	S.D spread shock (%)	0.358	0.246	0.238	0.167	0.335		0.196	0.240	0.232	0.162	0.325
θ	Capital work. Requirement	0.348	0.384	0.386	0.263	0.502		0.293	0.367	0.361	0.263	0.479
σ^{γ_Y}	S.D m.e. output growth (%)	0.010	0.011	0.011	0.010	0.012		0.010	0.011	0.010	0.010	0.012
σ^{γ_C}	S.D m.e. C growth (%)	0.010	0.011	0.011	0.010	0.012		0.010	0.011	0.011	0.010	0.012
σ^{γ_I}	S.D m.e. investment growth (%)	0.039	0.036	0.035	0.026	0.047		0.010	0.016	0.014	0.011	0.023
σ^{dTby}	S.D m.e. dTBy (%)	0.010	0.011	0.011	0.010	0.012		0.010	0.011	0.010	0.010	0.011
σ^S	S.D m.e. spread (%)	0.010	0.010	0.010	0.010	0.011		0.010	0.010	0.010	0.010	0.011
ζ	Long run yearly growth rate (%)	2.507	2.499	2.503	2.245	2.757		2.507	2.551	2.540	2.294	2.835
RWC	Random walk component	4.208	4.047	4.197	2.526	6.888		8.707	5.983	6.269	3.682	10.257

Figure 3.3: Posterior estimates of the unrestricted model ($\lambda \geq 0$)

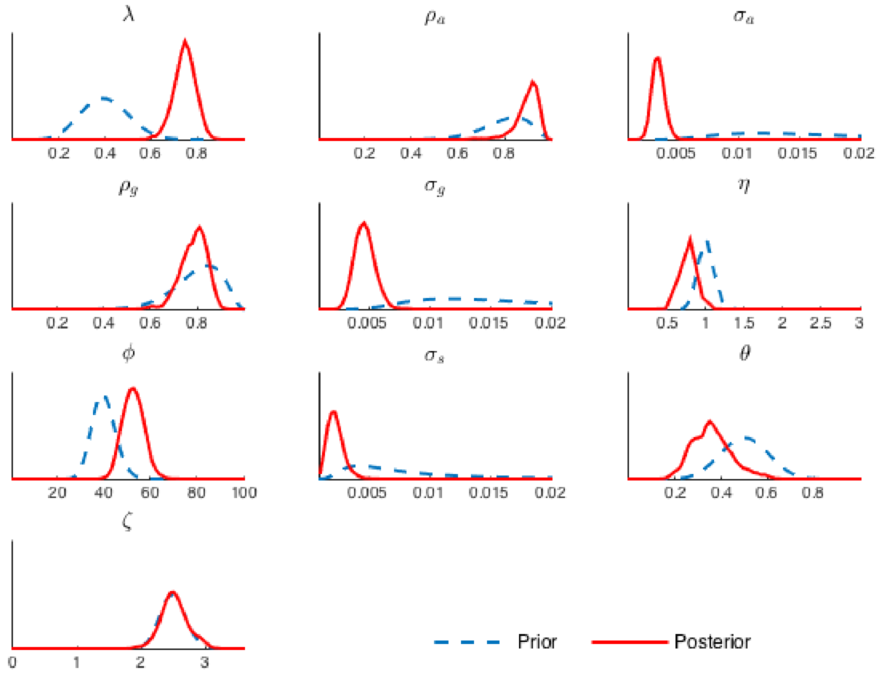
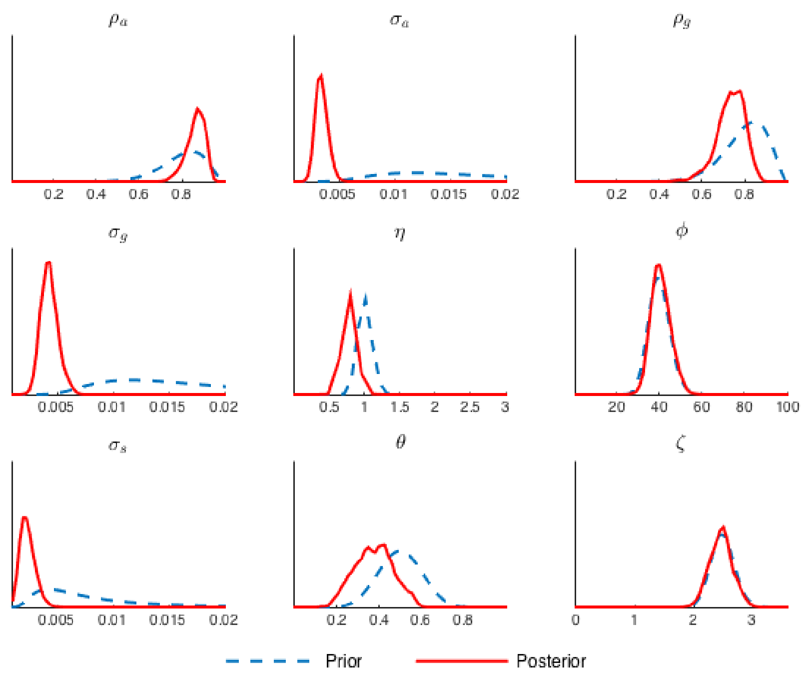


Figure 3.4: Posterior estimates of the restricted model ($\lambda = 0$)



Model evaluation

a) *Marginal data densities*

Table 3.5 reports standard measures of predictive accuracy: log values of the likelihood, the posterior -both computed at the posterior mode- and model comparison based on posterior odds (marginal data density). The last measure captures the relative one-step ahead predictive performance. All measures suggest that the unrestricted model outperforms the restricted version.

Table 3.5: Model comparison. Period 1995:II-2014:IV

	Restricted model ($\lambda = 0$)	Unrestricted model ($\lambda \geq 0$)
Log posterior at mode	1157.26	1203.80
Log likelihood at mode	1149.49	1205.22
Log marginal data density	1083.86	1123.83

Notes: The log marginal data densities are computed based on Geweke (1999) modified harmonic mean with truncation parameter 0.5. Results hold when used different truncation values.

b) *Matching moments*

Another metric to evaluate the relative merits of alternative models is the comparison on how well model implied moments fit those observed by data.

Results are gathered in Table 3.6 where sample moments of the data, in terms of standard deviation, serial correlation and cross correlation with output growth are compared to the theoretical moments implied by median estimates from the two models. Regarding its ability to match observed standard deviations, the unrestricted model does a better job at matching volatility of all series but one (spreads). Note the main difference across implied standard deviations is at the series of consumption growth and the trade balance ratio.

Table 3.6: Matching moments at median estimates. Period 1995:II-2014:IV

	γ_Y	γ_C	γ_I	$dTby$	S
Standard deviation (%)					
Data	1.112	1.211	2.531	0.787	0.615
Restricted model ($\lambda = 0$)	1.017	2.663	3.588	2.575	0.780
Unrestricted model ($\lambda \geq 0$)	1.034	1.290	3.125	1.015	0.902
Serial correlation					
Data	0.390	0.396	0.324	0.053	0.778
Restricted model ($\lambda = 0$)	0.119	0.054	-0.005	-0.082	0.766
Unrestricted model ($\lambda \geq 0$)	0.165	0.145	0.000	-0.093	0.826
Correlation with γ_Y					
Data	1.000	0.746	0.649	0.053	-0.036
Restricted model ($\lambda = 0$)	1.000	0.507	0.316	-0.052	-0.434
Unrestricted model ($\lambda \geq 0$)	1.000	0.952	0.414	-0.084	-0.448

Contrasting variance decomposition results across models

We assess the role of each exogenous shock by computing the variance decomposition implied by both the unrestricted and restricted models at their median estimates and over a time horizon of 40 quarters.

Table 3.7 suggests that approximately 27% of gdp growth variance and 25% of consumption growth variance is driven by shocks to the trend when the fraction of financially excluded households is not restricted to zero. When there are no rule of thumb consumers in the economy, these percentages decrease to 17% and 13.9%, respectively. The inclusion of λ in the estimation, enhances the contribution of non stationary technology shocks on consumption growth volatility by approximately 10 percentage points. Same directional change but at a much lower scale is observed for stationary technology shocks. The inclusion of λ in the estimation, rises the contribution of stationary technology shocks on consumption growth volatility by 3 percentage points. Finally, the unrestricted model decreases substantially the contribution of the world interest rate on the volatility of all observables, particularly of consumption and output.

Table 3.7: Variance decomposition predicted by model. Period 1995:II-2014:IV

	γ_Y	γ_C	γ_I	$dTby$	S
Predicted by Restricted Model ($\lambda = 0$)					
Nonstationary technology σ_g	0.171	0.139	0.072	0.018	0.242
World Interest rate σ_R	0.788	0.820	0.911	0.981	0.000
Stationary technology σ_z	0.041	0.041	0.017	0.001	0.665
Exogenous spread σ_S	0.000	0.000	0.000	0.000	0.093
Predicted by Unrestricted Model ($\lambda \geq 0$)					
Nonstationary technology σ_g	0.275	0.257	0.140	0.022	0.256
World Interest rate σ_R	0.660	0.671	0.825	0.976	0.000
Stationary technology σ_z	0.064	0.071	0.035	0.002	0.678
Exogenous spread σ_S	0.000	0.000	0.000	0.000	0.066

Notes: The estimated contribution of measurement errors (not shown) is negligible for all five variables

3.4 The predicted macroeconomic effect of a rise in credit market participation in an emerging economy

Given our results from the previous section, this section conducts impulse response analyses to illustrate the intuition on the role of an increase in credit market participation in an emerging economy. Figure 3.5 presents the impulse responses of our key macro aggregates to a 1 standard deviation shock on non stationary productivity, foreign interest rate and stationary productivity. The continuous line depicts the responses after setting parameters at their median estimates. The dashed line illustrates the counterfactual responses if there is a higher credit market participation ($\lambda = 0.3$) in this economy.

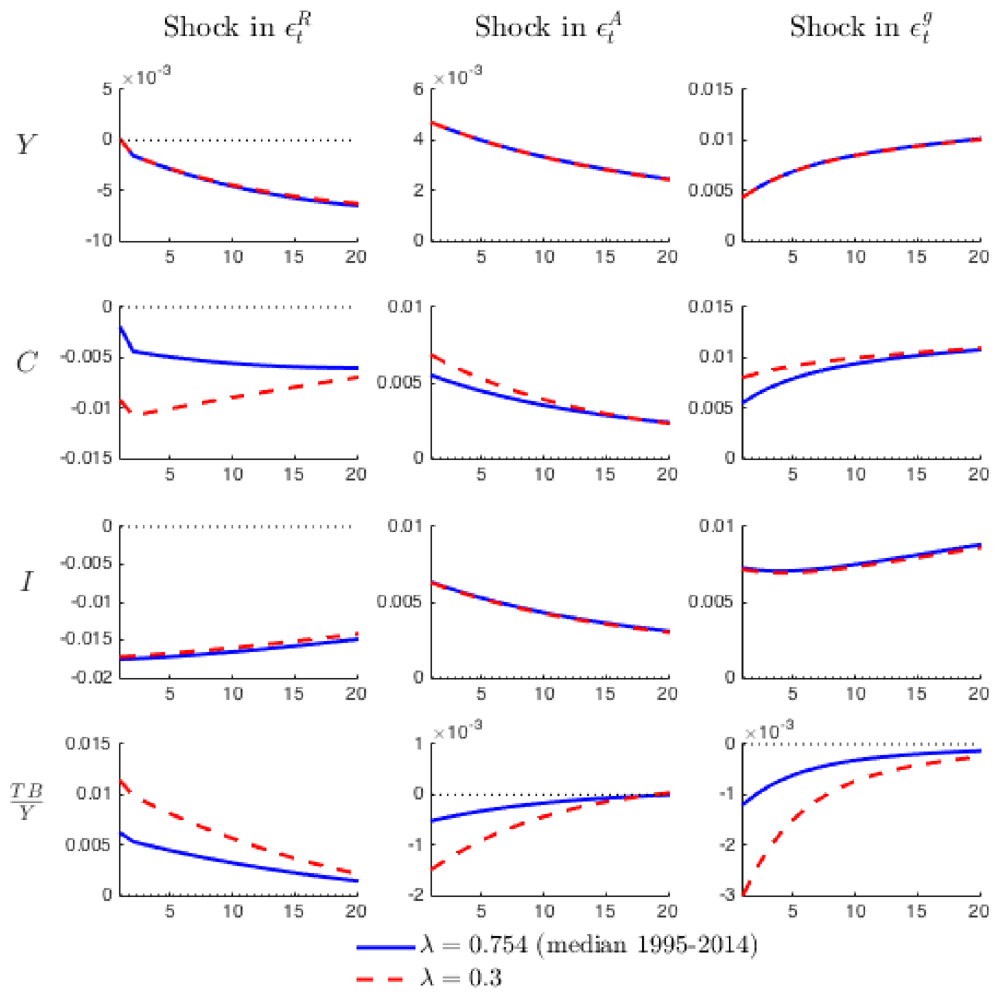
The first column in 3.5 plots the responses (deviation from steady state) to a one standard deviation positive shock in the foreign risky rate (ϵ_t^R). On impact, consumption of unconstrained households suffers a decrease proportional to the intertemporal elasticity of substitution. Given that the working capital requirement links current labor demand with the predetermined interest rate, output doesn't change on impact. However, labor demand decreases in the subsequent period, leading to a further decrease of aggregate consumption. In addition, the decrease in expected marginal productivity of capital yields a reduction of investment on impact. As output responds less and more slowly to the shock on the real interest rate relative to both Consumption and Investment, there is a trade surplus.

The second column in 3.5 illustrates the responses of one standard deviation impulse in the temporary productivity component. A positive productivity shock increases marginal product of inputs and labor demand increases. Given GHH preferences, an increase in labor demand induces a movement along the labor supply curve and an increase of hours (and output) in equilibrium. Foreign lenders perceive a lower probability of default and therefore real interest rate declines. Unconstrained households have a temporary increase in income which leads them to increase savings in order to smooth consumption through a PIH reasoning. However, the decrease in real interest rates provides these households stronger incentives to consume and consumption rises a bit more than output. This translates in a trade deficit.

The last column illustrates a one standard deviation shock in growth (ϵ_t^g). A positive growth shock increases marginal product of inputs and labor demand increases; thus hours and output rise on impact. As before, foreign lenders perceive a lower probability of default in the economy and real interest rate declines. Households observe an increasing profile of income and the unconstrained ones increase consumption beyond current income. Furthermore, the decrease in real interest rates provides these type of households further reasons to incur in debt.

The key message delivered by the dashed line responses is that for all shocks, a lower fraction λ of rule of thumb households (rise in credit market participation), would amplify the response of consumption and the trade balance ratio, ceteris paribus. That is, as more households gain access to credit, volatility of consumption and the trade balance in this emerging economy will tend to increase regardless of the relative contribution of each exogenous shock in aggregate fluctuations.

Figure 3.5: Impulse response functions



3.4.1 The role of financial frictions

To examine the role of financial frictions on the relationship between credit market participation and aggregate volatility in an emerging economy, we perform the following exercises.

First, we derive new impulse responses by fixing all parameters at their corresponding median but setting both η (spread elasticity) and θ (working capital requirement) to zero. We do so to compare them with impulse responses derived under financial frictions.

Figure 3.6 illustrates that an increase of credit market participation still amplifies the response of consumption and the trade balance ratio to each corresponding shock. The key difference lies in the impulse response functions of temporary productivity shocks. First, without financial frictions, we fail to deliver a countercyclical trade balance. Second, since the real interest rate is now constant, unconstrained households have no incentives to incur in debt. As more households become unconstrained, more households would be able to smooth income fluctuations through savings and aggregate volatility of consumption would decrease, ceteris paribus. The impulse response analysis suggests that the effect of a rise in credit market participation on volatility of consumption in an economy with no financial frictions would depend on the relative relevance of each of these structural shocks on aggregate fluctuations.

Second, we derive the unconditional volatility of output, consumption, investment and trade balance implied by the model at different combinations of the fraction of rule of thumb households (λ) and parameters controlling financial frictions.

Figure 3.6: Impulse response functions assuming no financial frictions

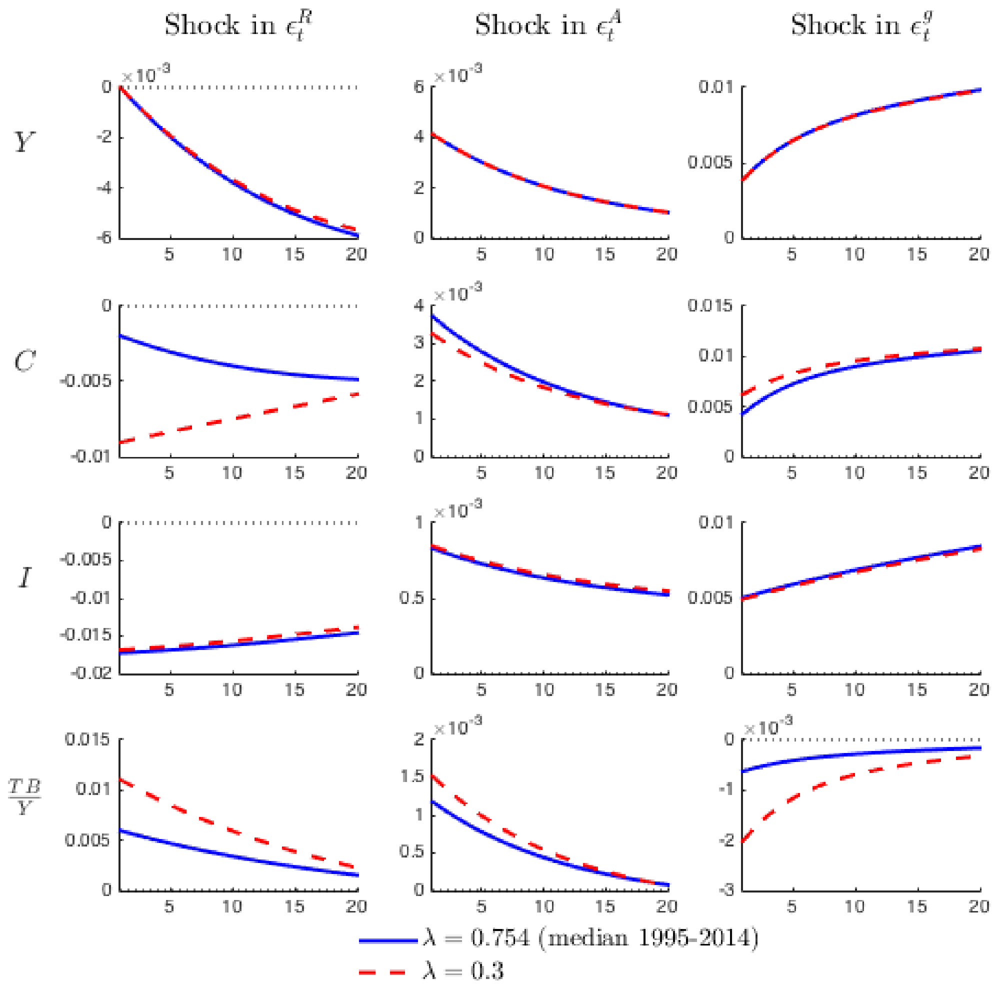
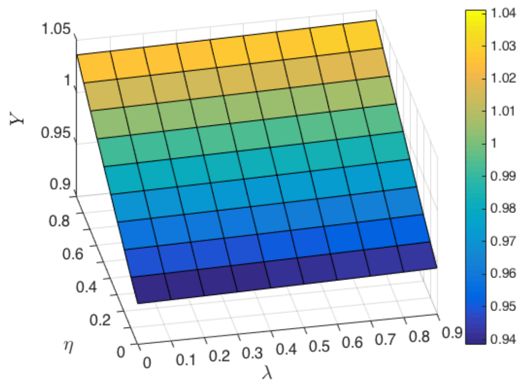


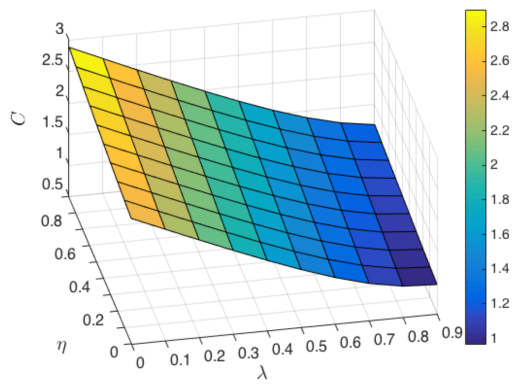
Figure 3.7 plots the unconditional volatility of key macro aggregates for different combinations of the fraction of rule of thumb households (λ) and the spread elasticity (η). All other parameters remain fixed at median estimates of the unrestricted model. The graph shows that while output and investment growth are more sensitive to η than λ, consumption growth and the first difference of the trade balance ratio are more sensitive to λ. The main message is that given the degree of financial frictions (measured here by η), as financial exclusion decreases ($\downarrow \lambda$) and a greater percentage of households can smooth income fluctuations, volatility of both consumption and the trade balance increases. The second key observation is that the lesser financial frictions are ($\downarrow \eta$), the lower is the unconditional volatility

of output, consumption and investment growth.

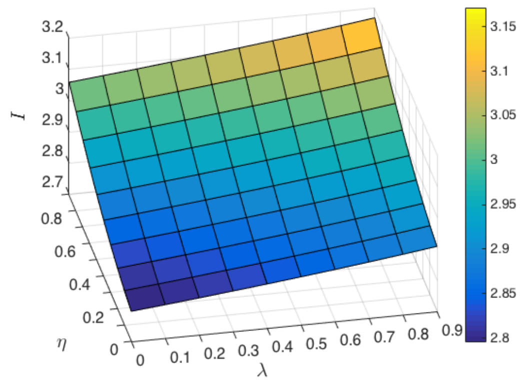
Figure 3.7: Unconditional standard deviation of key macroeconomic aggregates at different λ and η combinations



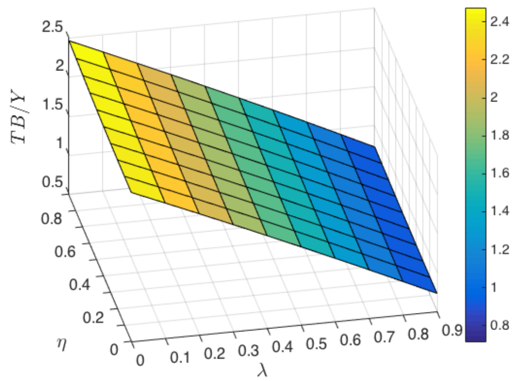
(a) Output growth



(b) Consumption growth



(c) Investment growth

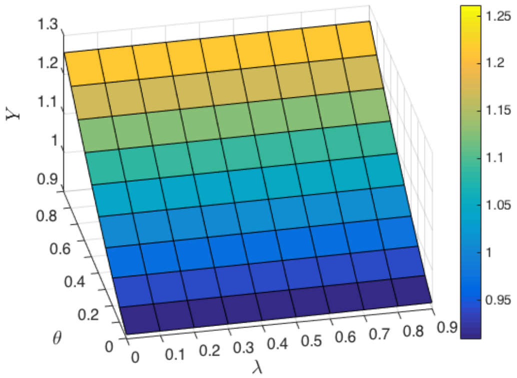


(d) Trade balance ratio (first difference)

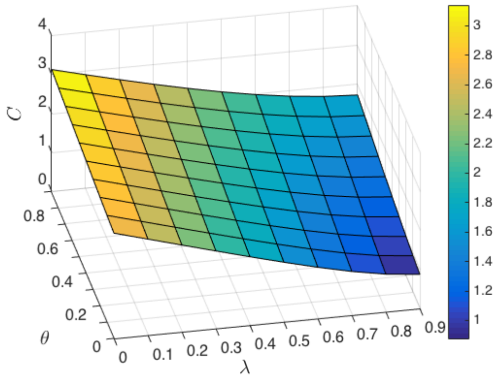
Notes: Remaining parameters are fixed at median estimates of unrestricted model

Figure 3.8 illustrates how unconditional volatilities change for different combinations of λ and the parameter controlling working capital requirements (θ). Similar results emerge. As financial exclusion decreases without any other improvement of financial conditions, consumption growth volatility will tend to increase in an emerging market.

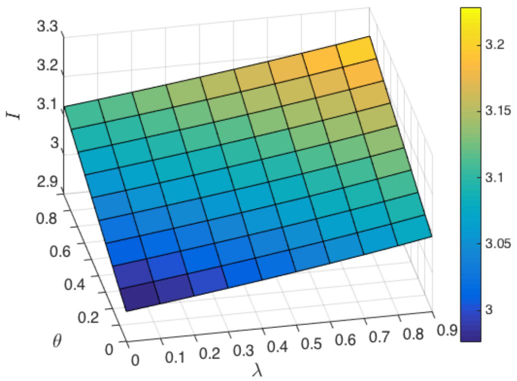
Figure 3.8: Unconditional standard deviation of key macroeconomic aggregates at different λ and θ combinations



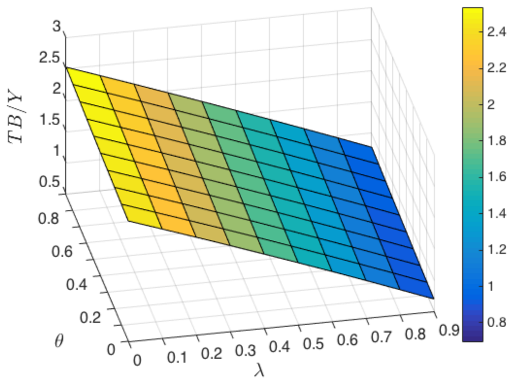
(a) Output growth



(b) Consumption growth



(c) Investment growth



(d) Trade balance ratio (first difference)

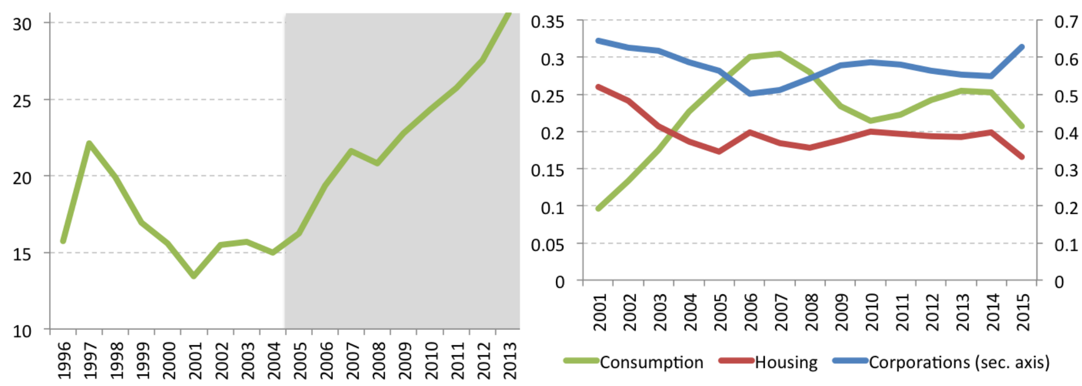
Notes: Remaining parameters are fixed at median estimates of unrestricted model

3.5 Rising credit market participation in Mexico and its effect on aggregate fluctuations

3.5.1 Splitting the full sample in two subperiods

We first proceed by splitting the sample in two subperiods: 1995:II - 2004:IV (39 quarters) and 2005:I- 2014:4 (40 quarters). We choose 2005 as the beginning of the second subperiod since figure 3.9a suggests that financial depth measured by domestic credit to private sector (as % of GDP) started to rise significantly around 2005. The choice for splitting the sample is also aligned with the findings by Hansen and Sulla (2013) who find that domestic credit to private sector increased significantly from 2004 to 2011 in most latin american countries (including Mexico). Figure 3.9b supports that most of the rise was driven by consumption credit growth.

Figure 3.9: Evolution of private credit in Mexico



(a) Domestic credit to private sector as % GDP

(b) Credit by type as % of domestic credit to private sector

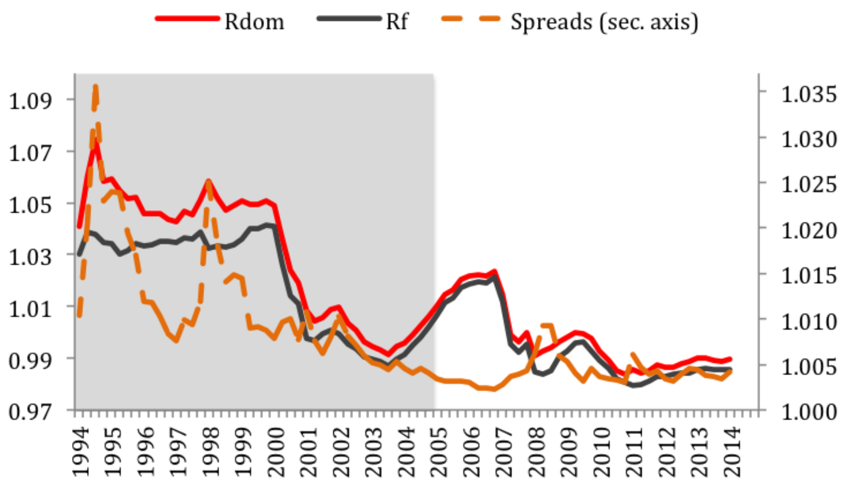
Sources: World Bank Global Financial database. Comision Nacional Bancaria y de Valores de Mexico.

3.5.2 Calibration and priors

We keep stable the calibration of all parameters except that used to match the standard deviation of the foreign interest rate process (σ_{rf}). The reason to not keep it stable is supported by Figure 3.10. The value used as σ_{rf} for the first and second subperiod matches a foreign interest rate with a standard deviation of 1.96% and 1.3% respectively.

Since splitting the sample reduces significantly the sample size, we choose to calibrate the AR(1) coefficients in the transitory and the permanent technology processes, financial frictions parameters (θ and η) and the long run yearly growth rate ζ. The calibrated values are set at the median of the correspondent posterior distribution from the full sample estimation. Table 3.8 summarizes the calibration chosen for each subperiod. The list of estimated parameters is therefore restricted to 10: λ, σ_a, σ_g, ϕ, σ_S and standard deviations of all five measurement errors. We use the same prior distributions as those described earlier when estimating the full sample.

Figure 3.10: Interest rate data



Notes: *Rf* is gross real interest rate for the US, constructed using data from FRED. *Spreads* is JP Morgan's EMBI Global + index for Mexico, downloaded from DATASTREAM. *Rdom* is gross real domestic interest rate for Mexico, constructed following Uribe and Yue (2003).

Table 3.8: Calibration by subperiod

Parameter	Description	First Period 1995:II-2004:IV	SecondPeriod 2005:I-2014:4
α	Capital share of income	0.32	0.32
δ	Depreciation rate of capital	0.05	0.05
dy_{ss}	Debt to GDP ratio	0.1	0.1
rf_{ss}	Gross foreign interest rate	1.01	1.01
ψ	Debt elastic interest rate parameter	0.001	0.001
μ_a	Mean of Transitory Tech. process	1	1
γ_t	Ratio net transfers/ GDP	0.075	0.075
σ	Intertemporal elasticity of substitution (=$1/\sigma$)	2	2
ω	Labor supply elasticity ($1/(\omega-1) = 1.67$)	1.6	1.6
r_{ss}	Long run country interest rate	1.018	1.018
s_{ss}	Long run gross country interest rate premium	1.008	1.008
τ	Leisure preference parameter so that hss=1/3	1.757	1.757
ρ_a	AR(1) transitory tech. process	0.920	0.920
ρ_g	AR(1) permanent tech. process	0.800	0.800
η	Spread elasticity	0.840	0.840
θ	Capital work. Requirement	0.360	0.360
ζ	Long run yearly growth rate (%)	2.530	2.530
ρ_{rf}	AR(1) coef. Foreign interest rate process	0.960	0.960
σ_{rf}	S.D of foreign interest rate shock (%)	0.550	0.364

3.5.3 Posterior estimates

The posterior distributions of key parameters and for each subperiod are illustrated in Figure 3.11 and summarized in Table 3.9. As it can be inferred from the non overlapping credible sets, the estimated value for λ across subperiods is significantly different.

Whereas in the first subperiod of 1995-2004, median estimates suggest that around 72% of total households had a behavior consistent with rule of thumb consumers, during the most recent decade 2005-2014, that fraction fell to around 49%. Conversely, the fraction of total households participating in the credit market and able to smooth income fluctuations in Mexico reached 51% in the recent decade; that is, an increase of 23 percentage points.

The significant rise in the number of households smoothing income fluctuations, is aligned with the observed trend of financial sector outreach measures derived for Mexico and proposed by The World Bank in Beck et al. (2005). As argued by the authors, measures of bank penetration (both geographic and demographic) closely predict harder-to-collect micro-level statistics of households. In addition, due to lack of household surveys with information on use of financial services, there are no other financial inclusion indicators for Mexico that date back to 2005 or earlier. The first National Financial Inclusion Report (CNBV, 2009), finds that the number of bank branches per 1,000 km2 increased from 3.61 in 2001 to 5.06 in 2009 and the number of bank branches per 100 people increased from 73 in 2001 to 93 in 2009. In addition to their upward trend, both measures experienced a significant increase on their annual compounded growth rate at the beginning of 2006. The other main conclusion that emerges from the estimation results is that no other parameter changed significantly across subperiods.

Figure 3.11: Posterior estimates by subperiod

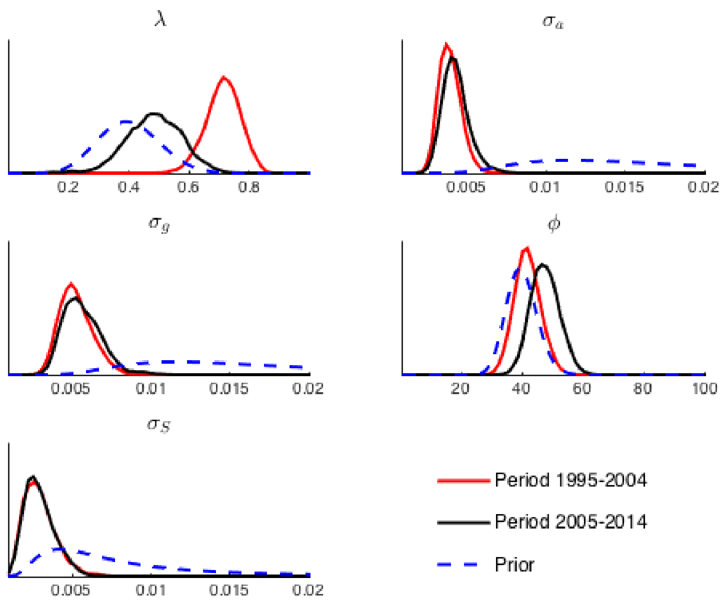


Table 3.9: Estimation results by subperiod

		Period 1995:II-2004:IV						Period 2005:I-2014:IV				
		Mode	Mean	Median	90% credible set			Mode	Mean	Median	90% credible set	
λ	Fraction of rule of thumb households	0.723	0.721	0.724	0.646	0.794		0.587	0.491	0.493	0.376	0.605
σ_a	S.D transitory tech. shock (%)	0.347	0.411	0.405	0.327	0.501		0.519	0.446	0.438	0.348	0.555
σ_g	S.D permanent tech. shock (%)	0.736	0.538	0.527	0.413	0.681		0.413	0.579	0.563	0.435	0.737
ϕ	Capital adjustment cost parameter	42.109	42.655	42.492	37.241	48.304		43.713	48.413	48.244	42.548	54.628
σ_s	S.D spread shock (%)	0.245	0.308	0.294	0.192	0.443		0.182	0.306	0.293	0.194	0.441
σ^{γ_Y}	S.D m.e. output growth (%)	0.010	0.011	0.011	0.010	0.013		0.010	0.011	0.011	0.010	0.013
σ^{γ_C}	S.D m.e. C growth (%)	0.010	0.011	0.011	0.010	0.013		0.010	0.011	0.011	0.010	0.013
σ^{γ_I}	S.D m.e. investment growth (%)	0.011	0.027	0.023	0.012	0.046		0.011	0.014	0.013	0.010	0.019
σ^{dTby}	S.D m.e. dTBy (%)	0.010	0.011	0.011	0.010	0.013		0.010	0.011	0.011	0.010	0.013
σ^{S}	S.D m.e. spread (%)	0.010	0.011	0.011	0.010	0.012		0.010	0.011	0.011	0.010	0.012
RWC	Random walk component	7.624	6.112	6.091	5.966	6.249		3.939	6.071	6.037	5.929	6.166

Variance decomposition analysis

We do a variance decomposition analysis calculated over a time horizon of 40 quarters for each subperiod and compare the role of each shock on aggregate volatility.

Table 3.10 suggests that in the first decade of 1995 to 2004 the world interest rate was the main driver of aggregate fluctuations, explaining around 63 % of real gdp and consumption fluctuations. In the recent decade from 2005 to 2014, non stationary technology shocks were the main driver, explaining around 50 % of total variance in same aggregate series as above.

Table 3.10: Variance decomposition predicted by subperiod estimates.

	γ_Y	γ_C	γ_I	$dTby$	S
Predicted by first subperiod median estimates (1995:II-2004:IV)					
Nonstationary technology σ_g	0.262	0.267	0.119	0.042	0.231
World Interest rate σ_R	0.641	0.630	0.820	0.951	0.000
Stationary technology σ_z	0.098	0.103	0.062	0.007	0.690
Exogenous spread σ_S	0.000	0.000	0.000	0.000	0.079
Predicted by second subperiod median estimates (2005:I-2014:IV)					
Nonstationary technology σ_g	0.507	0.495	0.328	0.116	0.229
World Interest rate σ_R	0.337	0.332	0.556	0.861	0.000
Stationary technology σ_z	0.155	0.173	0.116	0.023	0.703
Exogenous spread σ_S	0.000	0.000	0.000	0.000	0.068

Notes: The estimated contribution of measurement errors (not shown) is negligible for all five variables

3.5.4 Isolating the role of a rise in credit market participation on busines cycles for the recent decade.

During the recent decade 2005-2014, the Mexican economy faced a less volatile foreign risky interest rate and less volatile spreads. Table 3.11 shows standard deviations for key macroeconomic series across subperiods.

Relative to the previous decade, the recent subperiod 2005-2014 is also associated with:

1. An **increase** of 0.29 percentage points in GDP growth (γ_Y) volatility.
2. A **decrease** of 1.72 in the ratio of standard deviation in investment growth to standard deviation in gdp growth (γ_I/γ_Y).
3. An **increase** of 0.20 in the ratio of standard deviation in consumption growth to standard deviation in gdp growth (γ_C/γ_Y).
4. An **increase** of 0.14 percentage points in trade balance ratio ($dTby$) volatility.

Remember that our calibration and estimates presented in the previous subsection reflect two key differences emerging across subperiods: a rise in credit market participation and a decrease in the volatility of the foreign risky interest rate process.

To illustrate the role of a rise in credit market participation on aggregate fluctuations we need to isolate it from the change in the foreign risky interest rate process. For this purpose we conduct the following experiment.

We start by illustrating the effect of a reduction in volatility of foreign interest rate process by keeping all other parameters of baseline scenario fixed. The baseline scenario uses the calibration and implied median estimates of the first subperiod (1995-2004). The observed decrease in volatility of the foreign interest rate, lowers the volatility of all aggregate series, mainly γ_I/γ_Y (reduced by 0.67) followed by $dTby$ (reduced by 0.36).

Next, we replicate a rise in credit market participation by 23 percentage points- as implied by second subperiod estimates of λ- and keep all other parameters of baseline scenario fixed (including the volatility of foreign interest rate). This estimated increase in credit market participation would per se increase the ratio γ_C/γ_Y by 0.34 and $dTby$ by 0.44 percentage points.

Putting both structural changes together, the model is able to generate:

1. A relatively stable volatility of γ_Y.
2. A **decrease** of 0.68 in the ratio of volatilities γ_I/γ_Y.
3. An **increase** of 0.25 in the ratio of volatilities γ_C/γ_Y.
4. A relatively stable $dTby$.

Finally, allowing all parameters to be reestimated using second subperiod data, we are able to move closer to second subperiod data. Even though we are far from matching a 0.29 increase in the volatility of γ_Y, we at least generate the desired directional change. We are also able to decrease by more the ratio of volatilities γ_I/γ_Y, moving closer to what is implied by data.

The key message of this exercise can be split in three parts. First and foremost, a rise in credit market participation is crucial to deliver a higher ratio of volatility of consumption growth relative to volatility of GDP growth. In addition, it moves us closer to data because it increases the volatility of the trade balance ratio amid a less volatile interest rate environment. Second, a lower volatility of the foreign interest rate is crucial to yield a less volatile investment growth relative to GDP growth and to discipline down the volatility of the trade balance ratio. Third, reestimating the model is able to generate more volatility in GDP growth without changing the main results.

Table 3.11: Implied standard deviations at median estimates by subperiod

	γ_Y	γ_C/γ_Y	γ_I/γ_Y	$dTby$	S	R^f
Period 1995:II-2004:IV						
Data	0.959	0.955	3.189	0.708	0.674	1.961
Model	1.162	1.255	3.167	1.162	1.044	1.961
Period 2005:I-2014:4						
Data	1.248	1.152	1.466	0.852	0.150	1.301
Model	1.209	1.505	2.175	1.074	1.120	1.301

Table 3.12: Rising credit market participation in Mexico and implied standard deviations

	γ_Y	Δ^{**}	γ_C/γ_Y	Δ^{**}	γ_I/γ_Y	Δ^{**}	$dTby$	Δ^{**}
Data subperiod 1995-2004	0.96		0.96		3.19		0.71	
Data subperiod 2005-2014	1.25	0.29	1.15	0.20	1.47	-1.72	0.85	0.14
Baseline model*	1.16		1.25		3.17		1.16	
Baseline + new λ	1.16	0.00	1.60	0.34	3.14	-0.02	1.60	0.44
Baseline + new $\sigma(R^f)$	1.13	-0.03	1.24	-0.01	2.50	-0.67	0.81	-0.36
Baseline + new λ + new $\sigma(R^f)$	1.13	-0.03	1.51	0.25	2.48	-0.68	1.12	-0.04
Reestimated model	1.21	0.05	1.51	0.25	2.18	-0.99	1.07	-0.09

Notes:

* Baseline model uses median estimates from the first subperiod estimation. New λ is baseline but setting λ to the median estimate for second subperiod (0.493). New $\sigma(rf)$ is baseline but setting the calibration of foreign interest rate standard deviation to value observed for second subperiod (0.364). Reestimated model uses median estimates from the second subperiod estimation.

** Change (Δ) implied by data is relative to first subperiod. Change implied at different parameterizations is relative to baseline.

3.6 Robustness check

3.6.1 Estimating financial frictions parameters

This section checks whether main results change when instead of calibrating parameters reflecting financial frictions (θ and η), we estimate them. As before, we choose to calibrate the AR(1) coefficients in both the transitory technology process and the permanent technology process and the long run yearly growth rate ζ. In addition, we calibrate the standard deviation in both the transitory technology process (σ_a) and the permanent technology process (σ_g). The calibrated values are set at the median of the correspondent posterior distribution from the full sample estimation.Table 3.13 summarizes the calibration chosen. We use the same prior distributions as those described earlier when estimating the full sample.

Table 3.13: Additional calibrated values by subperiod

Parameter	Description	First Period 1995:II-2004:IV	SecondPeriod 2005:I-2014:4
ρ_a	AR(1) transitory tech. process	0.920	0.920
ρ_g	AR(1) permanent tech. process	0.800	0.800
σ_a	S.D transitory tech. shock (%)	0.351	0.351
σ_g	S.D permanent tech. shock (%)	0.477	0.477
ζ	Long run yearly growth rate (%)	2.530	2.530
ρ_{rf}	AR(1) coef. Foreign interest rate process	0.960	0.960
σ_{rf}	S.D of foreign interest rate shock (%)	0.550	0.364

Estimation results reported in Table 3.14 once more suggest that 72% of total households had a behavior consistent with rule of thumb consumers in the first subperiod of 1995-2004 and that the fraction fell to around 48% during the most recent decade 2005-2014. As before, no other parameter - i.e financial frictions (θ and η) spread shocks, capital adjustment cost parameter ϕ - seemed that changed significantly across subperiods.

Table 3.14: Estimation results by subperiod (financial frictions estimation)

		Period 1995:II-2004:IV					Period 2005:I-2014:IV				
		Mode	Mean	Median	90% CI		Mode	Mean	Median	90% CI	
λ	Fraction of rule of thumb households	0.734	0.720	0.725	0.638	0.795	0.379	0.474	0.472	0.361	0.588
η	Spread elasticity	0.823	0.932	0.929	0.819	1.050	0.879	0.877	0.874	0.767	0.991
ϕ	Capital adjustment cost parameter	38.978	43.066	42.825	37.531	48.883	46.812	48.348	48.182	42.259	54.704
σ_S	S.D spread shock (%)	0.255	0.295	0.282	0.190	0.414	0.283	0.281	0.270	0.181	0.396
θ	Capital work. Requirement	0.441	0.404	0.401	0.285	0.531	0.482	0.456	0.457	0.329	0.577
σ^{γ_Y}	S.D m.e. output growth (%)	0.011	0.011	0.011	0.010	0.013	0.010	0.012	0.011	0.010	0.014
σ^{γ_C}	S.D m.e. C growth (%)	0.010	0.011	0.011	0.010	0.013	0.010	0.011	0.011	0.010	0.013
σ^{γ_I}	S.D m.e. investment growth (%)	0.010	0.026	0.023	0.012	0.045	0.011	0.014	0.013	0.010	0.019
σ^{dTby}	S.D m.e. dTBy (%)	0.010	0.011	0.011	0.010	0.013	0.010	0.011	0.011	0.010	0.013
σ^{S}	S.D m.e. spread (%)	0.010	0.011	0.011	0.010	0.012	0.010	0.011	0.011	0.010	0.012

3.7 Concluding remarks

This chapter examines the business cycle implications of a rise in household credit market participation in an emerging market. To address this question, we allowed an exogenous fraction of rule-of-thumb consumers to coexist with households that are able to smooth income fluctuations in an otherwise standard RBC model for emerging economies.

The extended model is taken to aggregate data of Mexico and measures of predictive accuracy suggest that it outperforms the more restricted standard version. The estimation results suggest that the structural increase in credit market participation by households lead to an increase in the volatility of both consumption growth relative to output and the trade balance ratio during the recent decade 2005-2014.

In general, the presence of financial frictions is the main mechanism by which rising credit market participation will unambiguously increase aggregate consumption volatility in an emerging economy. Under no financial frictions, the relationship will depend on the variance decomposition of total factor productivity into exogenous fluctuations in the trend versus transitory component.

The key message of this paper is that as more households participate in consumption credit markets in emerging countries, a greater need of improving broad financial development measures arise. We find that a simultaneous reduction of the level of financial frictions would dampen the positive effect of lower financial exclusion on consumption and trade balance volatility.

Appendices

Appendix A

Chapter 1:

Additional Tables and Figures

Table A.1: Descriptive statistics for full sample of developing and emerging countries

Variable		Mean	Std. Dev.	Min	Max	Observations
Std(Δ c)	overall	4.00	3.64	0.25	30.77	N = 192
	between		2.93	0.66	15.50	n = 52
	within		2.39	-3.04	19.27	T-bar = 3.7
GINI	overall	43.55	10.52	21.97	74.33	N = 192
	between		10.52	26.38	66.52	n = 52
	within		2.44	36.04	52.12	T-bar = 3.7
SH5to3	overall	3.81	1.58	1.92	14.33	N = 192
	between		1.55	2.10	10.01	n = 52
	within		0.53	1.17	8.14	T-bar = 3.7
SH234	overall	44.52	6.55	20.27	54.95	N = 192
	between		6.58	26.32	54.10	n = 52
	within		1.55	38.47	49.70	T-bar = 3.7
SH23	overall	23.75	4.96	8.29	32.98	N = 192
	between		4.99	12.02	31.45	n = 52
	within		1.14	20.03	27.79	T-bar = 3.7
PRIVY	overall	39.72	29.99	2.17	148.31	N = 189
	between		27.23	6.97	130.43	n = 51
	within		11.20	13.41	74.36	T-bar = 3.7
M2	overall	48.17	28.07	10.75	158.98	N = 192
	between		24.67	15.51	120.04	n = 52
	within		10.96	-4.38	92.05	T-bar = 3.7
BANKDY	overall	34.65	22.67	4.36	114.58	N = 183
	between		20.39	4.60	103.35	n = 51
	within		7.78	9.20	60.15	T-bar = 3.7
FINDY	overall	35.24	22.89	4.36	114.58	N = 183
	between		20.66	4.60	103.35	n = 51
	within		7.67	9.79	57.12	T-bar = 3.7
LIQY	overall	43.86	27.73	4.52	147.68	N = 183
	between		24.36	4.77	112.85	n = 51
	within		10.17	-1.81	85.87	T-bar = 3.7

Table A.2: Descriptive statistics for restricted sample: Latin American countries

Variable		Mean	Std. Dev.	Min	Max	Observations
Std(Δ c)	overall	4.64	4.27	0.25	30.77	N = 111
	between		3.04	0.98	13.13	n = 20
	within		3.06	-2.17	22.27	T-bar = 5.55
GINI	overall	51.41	5.27	40.08	59.69	N = 78
	between		4.92	41.44	58.12	n = 20
	within		2.10	44.31	55.78	T-bar = 3.9
SH5to3	overall	4.59	0.86	3.00	6.45	N = 79
	between		0.81	3.09	5.95	n = 20
	within		0.32	3.74	5.27	T-bar = 3.95
SH234	overall	40.37	3.78	33.73	48.00	N = 79
	between		3.60	35.08	47.87	n = 20
	within		1.33	37.51	43.77	T-bar = 3.95
SH23	overall	20.32	2.57	15.67	26.02	N = 79
	between		2.41	16.70	25.19	n = 20
	within		1.00	18.42	23.12	T-bar = 3.95
PRIVY	overall	34.30	18.53	10.72	94.63	N = 111
	between		15.31	18.15	71.33	n = 20
	within		10.44	10.91	70.17	T-bar = 5.55
M2	overall	36.76	15.18	11.01	83.52	N = 111
	between		11.37	17.93	61.56	n = 20
	within		10.01	4.45	63.74	T-bar = 5.55
BANKDY	overall	25.90	13.88	3.21	76.40	N = 105
	between		11.17	5.33	54.63	n = 19
	within		8.10	5.54	48.02	T-bar = 5.52632
FINDY	overall	26.43	14.45	3.21	76.40	N = 105
	between		11.80	5.33	54.63	n = 19
	within		8.15	6.07	48.56	T-bar = 5.52632
LIQY	overall	30.53	15.01	4.00	80.23	N = 105
	between		12.02	6.36	58.24	n = 19
	within		8.79	8.00	56.02	T-bar = 5.52632

Table A.3: A snapshot of the sample regarding distribution of means during 1985-2010

Percentile of Distribution	x= GINI (1)	x= GINI (2)	x= SH234 (1)	x= SH234 (2)	x= SH23 (1)	x= SH23 (2)	x= SH5to3 (1)	x= SH5to3 (2)	x= FINDY (1)	x= FINDY (2)	x= PRIVY (1)	x= PRIVY (2)	x= M2 (1)	x= M2 (2)
x≤P25	13	0	13	10	13	10	13	0	16	5	14	6	15	7
P25< $x \leq P50$	13	1	13	9	13	9	13	1	15	8	16	4	15	6
P50< $x \leq P75$	13	9	13	1	13	1	13	9	16	5	15	7	15	6
P75<x	28	13	28	3	28	3	28	13			22	6	22	4
Sum	67	23	67	23	67	23	67	23	47	18	67	23	67	23
P75< x≤ $P90$	7	7	8	0	7	0	8	8	9	2	9	4	9	2
x>P90	21	6	20	3	21	3	20	5	11	3	13	2	13	2

Notes: Column (1) represents unrestricted sample and column (2) represents the latin american sample.This table presents frequency across different percentile ranges of distribution of corresponding variable x. Percentiles are calculated over arithmetic mean of x during entire sample period 1985-2010.

Table A.4: Percentiles for entire sample

	GINI	SH234	SH23	SH5TO3	FINDY	PRIVY	M2
P25	32.2	39.6	20.1	2.5	18.1	22.7	28.9
P50	42.1	46.2	24.6	3.3	30.2	30.8	41.0
P75	51.9	49.9	28.8	4.6	46.6	47.2	56.2
P90	56.4	53.0	30.5	5.4	68.2	82.3	95.1

Table A.5: Social indicators in selected developing and emerging countries (Part 1)

Country	GINI		SH23		SH5TO3		POV2		SH234	
	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009
Azerbaijan	-11.87	23.10	4.14	32.56	-0.58	1.98	-48.56	5.29	3.45	54.26
Brazil	-2.41	56.54	1.45	17.68	-0.65	5.51	-8.28	15.15	1.76	36.26
Chile	-2.33	53.44	1.28	18.92	-0.49	5.18	-4.92	3.93	1.57	37.04
El Salvador	-3.55	48.84	1.39	21.82	-0.40	4.02	-6.92	17.01	1.87	42.79
Guatemala	-1.50	54.30	0.42	18.96	-0.22	4.96	-0.93	29.13	1.31	38.50
Iran	-5.29	38.28	2.62	26.45	-0.55	2.91	-1.86	8.03	3.17	48.41
Jordan	-4.76	35.13	2.11	27.39	-0.46	2.76	-7.75	5.31	2.89	48.92
Kazakhstan	-3.52	30.47	1.25	29.75	-0.17	2.32	-9.41	8.76	0.87	52.30
Kyrgyz Republic	-11.16	33.68	4.71	28.05	-1.05	2.61	-0.05	45.38	5.46	50.34
Malaysia	-5.07	43.37	2.46	23.73	-0.68	3.46	-5.36	4.34	3.83	45.56
Mexico	-0.94	49.18	0.72	21.35	-0.16	4.20	-7.85	9.49	0.66	41.36
Namibia	-11.72	62.61	5.59	13.88	-6.49	7.84	-15.11	47.13	9.08	29.35
Nicaragua	-2.15	43.09	0.99	24.08	-0.28	3.43	-7.60	23.80	1.84	45.31
Pakistan	-0.55	31.08	0.01	28.96	0.00	2.51	-16.57	62.76	-0.17	49.99
Panama	-2.93	54.71	0.89	18.63	-0.30	4.99	-6.23	16.28	0.78	38.69
Paraguay	-2.75	53.12	1.37	19.60	-0.34	4.80	-2.58	15.84	1.11	38.95
Russian Federation	-5.54	38.44	1.94	26.04	-0.47	2.99	-7.05	1.98	2.43	48.01
Thailand	-2.09	41.92	1.10	23.83	-0.33	3.50	-12.18	10.90	1.70	44.77
Tunisia	-1.68	39.27	0.79	25.95	-0.13	3.01	-9.47	10.23	0.67	47.82
Turkey	-1.29	40.24	0.84	25.80	-0.19	3.03	-2.61	6.30	1.50	48.02
Ukraine	-3.78	28.49	1.45	30.76	-0.25	2.18	-6.58	0.88	1.54	53.26

Table A.6: Social indicators in selected developing and emerging countries (Part 2)

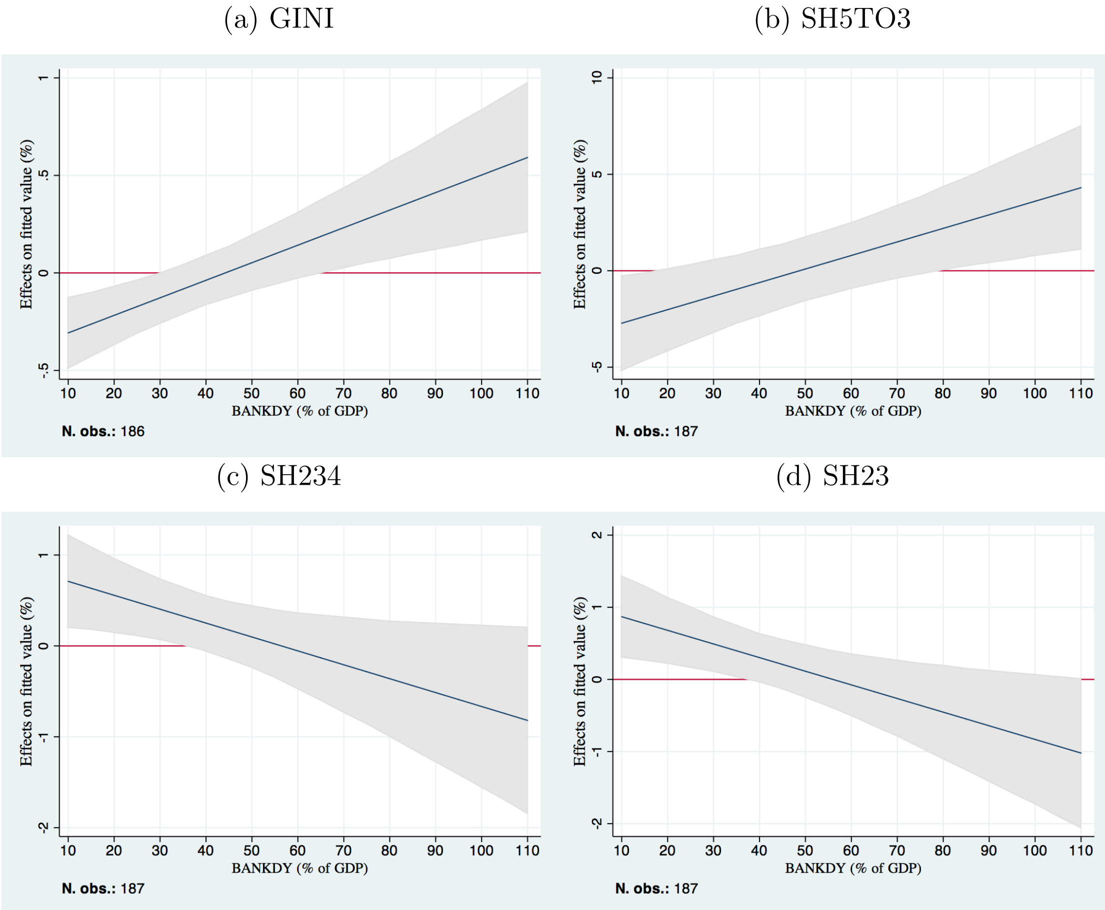
Country	GINI		SH23		SH5TO3		POV2		SH234	
	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009
Argentina	1.94	49.84	-0.84	21.18	0.16	4.10	5.14	11.18	-0.46	42.79
Belarus	1.52	28.06	-0.61	31.29	0.08	2.10	-0.66	0.80	-0.51	54.08
Bolivia	3.59	56.55	-1.26	18.27	0.45	5.23	0.92	26.13	-1.82	37.83
Botswana	1.64	62.60	-1.63	13.83	1.11	7.86	-14.71	34.69	-1.68	30.20
Bulgaria	2.58	31.11	-0.37	30.51	0.06	2.26	1.93	3.30	0.18	53.20
China	6.85	42.57	-2.66	24.40	0.51	3.26	-34.79	38.36	-2.63	46.77
Colombia	2.29	56.91	-1.36	17.68	0.57	5.61	1.33	21.50	-2.20	35.96
Costa Rica	3.24	49.50	-2.02	21.26	0.60	4.21	-4.46	7.71	-3.24	41.82
Croatia	3.14	31.22	-1.56	29.57	0.26	2.38	-0.09	0.08	-2.12	51.75
Dominican Republic	1.26	50.50	-0.94	20.51	0.28	4.47	0.53	12.76	-1.25	40.27
Ecuador	-0.01	53.38	-0.07	19.47	-0.02	4.87	-5.47	19.26	-0.07	38.70
Egypt	0.82	31.88	-0.30	28.79	0.09	2.57	-8.68	18.29	-0.74	49.65
Honduras	2.08	56.70	-1.05	17.67	0.31	5.36	-11.36	33.58	-0.78	37.27
Hungary	0.90	28.28	-0.08	31.19	0.00	2.13	-0.17	0.08	0.38	53.67
India	2.82	33.64	-1.33	27.93	0.26	2.70	-9.54	72.19	-1.95	48.83
Indonesia	2.92	32.62	-1.39	28.38	0.23	2.59	-23.28	58.66	-1.57	49.67
Macedonia	11.46	39.59	-5.74	26.02	0.95	2.99	1.01	4.71	-6.59	48.25
Morocco	1.43	40.76	-0.58	24.87	0.19	3.29	-0.88	19.29	-1.32	45.72
Peru	1.92	50.05	-0.72	20.97	-0.02	4.24	-3.73	18.31	-0.38	41.57
Philippines	0.11	44.40	-0.14	22.67	0.00	3.74	-8.58	44.57	0.14	43.63
Poland	2.75	33.81	-1.26	28.33	0.20	2.56	-2.62	0.43	-1.34	50.65

Table A.7: Social indicators in selected developing and emerging countries (Part 3)

Country	GINI		SH23		SH5TO3		POV2		SH234	
	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009	Δ r.t 1990-1999	Mean 2000-2009	Δ r.t. 1990-1999	Mean 2000-2009
Romania	1.68	29.81	-0.80	30.54	0.11	2.21	-5.78	6.52	-0.81	53.31
South Africa	4.81	62.77	-2.25	13.14	1.80	8.30	-4.08	36.43	-4.09	29.57
Uruguay	4.10	46.38	-2.50	22.36	0.57	3.79	1.08	3.29	-3.18	43.79
Venezuela	1.40	47.68	-0.34	22.84	0.07	3.71	6.24	24.71	-0.08	44.65
Vietnam	0.90	36.42	-0.14	26.76	-0.01	2.85	-22.93	55.13	0.53	48.50
Mean	-0.43	43.26	0.12	23.87	-0.12	3.80	-6.71	18.80	0.20	44.64
Median	0.82	42.57	-0.14	24.08	0.00	3.43	-5.47	15.15	0.14	45.56
Min	-11.87	23.10	-5.74	13.14	-6.49	1.98	-48.56	0.08	-6.59	29.35
Max	11.46	62.77	5.59	32.56	1.80	8.30	6.24	72.19	9.08	54.26

Notes: Mean is the arithmetic average of the variable over the period 2000-2009.
The Δ refers to the difference between the mean in the 2000s and the mean observed for the period 1990-1999.
The average is calculated for the period for which observations are available.

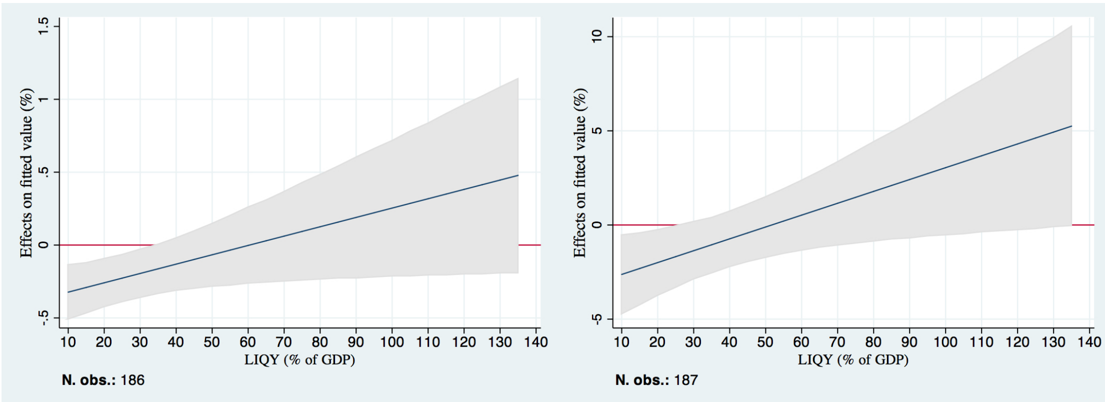
Figure A.1: Marginal effects of inequality indicators conditional to BANKDY as proxy for financial development



Notes: The proxy for financial development in this graph is Bank deposits over GDP (BANKDY). GINI is the World Bank estimate of the Gini index in the scale of 0 to 100. SH5TO3 is income share held by fifth quintile over income share held by third quintile of income distribution. SH234 is income share held by second,third and fourth quintile of income distribution. SH23 is income share held by second and third quintile of income distribution. Controls included in the regression model are evaluated at means and shaded area is 90 % confidence interval. Each subfigure represents the effect of an unit increase on the correspondent inequality indicator on the standard deviation of real consumption per capita annual growth over a 5 year period. For example: an increase of one point in the GINI index (say from 50 to 51) is associated with a larger decline in volatility at lower levels of BANKDY. As BANKDY increases this marginal effect becomes less negative. At levels above the 50% a marginal increase in the GINI index is associated with an increase in volatility.

Figure A.2: Marginal effects of inequality indicators conditional to LIQY as proxy for financial development

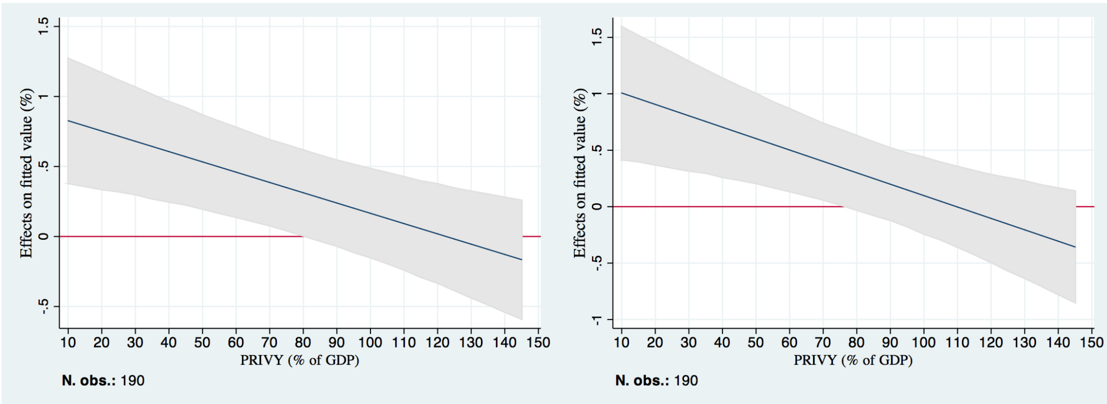
(a) GINI (b) SH5TO3



Notes: The proxy for financial development in this graph is Liquid liabilities to GDP (LIQY). GINI is the World Bank estimate of the Gini index in the scale of 0 to 100. SH5TO3 is income share held by fifth quintile over income share held by third quintile of income distribution. Controls included in the regression model are evaluated at means and shaded area is 90 % confidence interval. Each subfigure represents the effect of an unit increase on the correspondent inequality indicator on the standard deviation of real consumption per capita annual growth over a 5 year period. For example: an increase of one point in the GINI index (say from 50 to 51) is associated with a larger decline in volatility at lower levels of LIQY. As LIQY increases this marginal effect becomes less negative. At levels above the 50% a marginal increase in the GINI index is associated with an increase in volatility.

Figure A.3: Marginal effects of inequality indicators conditional to PRIVY as proxy for financial development

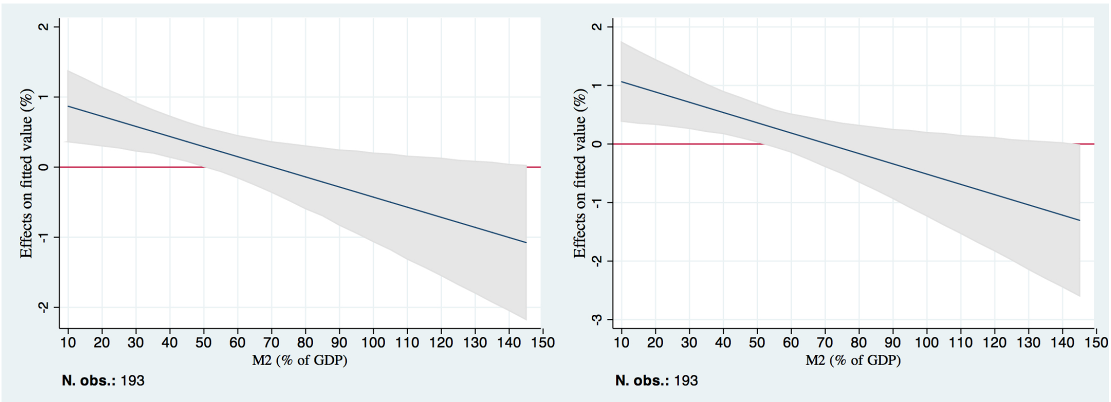
(a) SH234 (b) SH23



Notes: The proxy for financial development in this graph is Domestic credit to the private sector as percentage of GDP (PRIVY). SH234 is income share held by second,third and fourth quintile of income distribution. SH23 is income share held by second and third quintile of income distribution. Controls included in the regression model are evaluated at means and shaded area is 90 % confidence interval. Each subfigure represents the effect of an unit increase on the correspondent inequality indicator on the standard deviation of real consumption per capita annual growth over a 5 year period. For example: an increase of one point in SH234 (say from 50 to 51 %) is associated with a larger increase in volatility at lower levels of PRIVY. As PRIVY increases this marginal effect decreases. At very high levels of PRIVY a marginal increase in SH234 may potentially decrease volatility.

Figure A.4: Marginal effects of inequality indicators conditional to M2 as proxy for financial development

(a) SH234 (b) SH23



Notes: The proxy for financial development in this graph is the ratio M2 over GDP (M2). SH234 is income share held by second,third and fourth quintile of income distribution. SH23 is income share held by second and third quintile of income distribution. Controls included in the regression model are evaluated at means and shaded area is 90 % confidence interval. Each subfigure represents the effect of an unit increase on the correspondent inequality indicator on the standard deviation of real consumption per capita annual growth over a 5 year period. For example: an increase of one point in SH234 (say from 50 to 51 %) is associated with a larger increase in volatility at lower levels of M2. As M2 increases this marginal effect decreases. At levels of M2 above the 60 % of GDP, a marginal increase in SH234 may potentially decrease volatility.

Table A.8: GINI and consumption growth volatility with latin american dummy.

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	2.304	1.333	5.202*	5.490*	0.0923
	[2.740]	[4.563]	[2.806]	[2.770]	[4.515]
pop	1.082	0.210	0.906	1.040	-0.632
	[1.557]	[2.236]	[2.233]	[2.099]	[1.901]
trade	2.257	2.080	3.260	3.324	2.368
	[2.517]	[2.353]	[2.329]	[2.321]	[1.934]
gov	0.00661	-0.772	-2.617	-2.544	-1.987
	[3.018]	[2.765]	[1.790]	[1.749]	[2.551]
GINI	-0.352**	-0.379**	-0.385***	-0.388***	-0.401***
	[0.175]	[0.187]	[0.129]	[0.128]	[0.130]
FINDEV	-0.109	-0.201	-0.378***	-0.373***	-0.328**
	[0.198]	[0.139]	[0.115]	[0.111]	[0.134]
GINIxFINDEV	0.00240	0.00438	0.00869***	0.00853***	0.00690*
	[0.00435]	[0.00332]	[0.00275]	[0.00270]	[0.00346]
Hansen statistic	15.79	16.74	10.03	9.990	13.37
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.326	0.270	0.760	0.763	0.498
AR(2) test statistic	0.777	0.114	-0.472	-0.413	-1.340
p-value of AR(2)	0.437	0.909	0.637	0.679	0.180
Number of instruments	27	27	27	27	27
Countries	51	52	51	51	51
N	189	192	186	186	186

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.9: SH5TO3 and consumption growth volatility with latin american dummy.

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	1.668	0.0152	5.527*	5.894*	-0.317
	[4.766]	[5.366]	[3.224]	[3.239]	[4.651]
pop	1.513	1.358	0.984	1.124	0.389
	[1.860]	[2.611]	[3.137]	[2.985]	[2.272]
trade	4.096	2.317	3.986	4.070	2.038
	[3.621]	[3.664]	[3.030]	[3.119]	[3.547]
gov	-1.662	-2.397	-3.670	-3.504	-3.868
	[2.551]	[2.934]	[2.190]	[2.222]	[2.916]
SH5TO3	-1.634	-1.383	-3.382**	-3.440**	-3.225**
	[1.133]	[1.227]	[1.518]	[1.525]	[1.390]
FINDEV	-0.0759	-0.0757	-0.259***	-0.257***	-0.268***
	[0.0691]	[0.0666]	[0.0956]	[0.0910]	[0.0790]
SH5TO3xFINDEV	0.0130	0.00956	0.0699***	0.0689***	0.0651**
	[0.0156]	[0.0178]	[0.0252]	[0.0246]	[0.0292]
Hansen statistic	15.31	16.01	12.53	12.31	14.37
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.357	0.313	0.564	0.581	0.423
AR(2) test statistic	1.065	0.914	-0.518	-0.444	-1.558
p-value of AR(2)	0.287	0.361	0.604	0.657	0.119
Number of instruments	27	27	27	27	27
Countries	51	52	51	51	51
N	190	193	187	187	187

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.10: SH234 and consumption growth volatility with latin american dummy

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	1.992	3.117	3.961	3.718	1.911
	[2.813]	[4.455]	[3.032]	[3.028]	[3.017]
pop	3.299*	2.018	0.609	0.677	-0.259
	[1.894]	[2.145]	[2.334]	[2.202]	[2.073]
trade	3.922*	3.330	2.987	2.944	3.538
	[2.224]	[2.074]	[2.351]	[2.357]	[2.178]
gov	-0.621	-3.164	-2.796	-2.763	-1.967
	[2.144]	[2.817]	[2.816]	[2.817]	[2.681]
SH234	0.898***	1.008***	0.902**	0.918***	0.775*
	[0.321]	[0.365]	[0.356]	[0.335]	[0.439]
FINDEV	0.312**	0.680**	0.741	0.759*	0.514
	[0.145]	[0.334]	[0.442]	[0.433]	[0.516]
SH234xFINDEV	-0.00695**	-0.0149**	-0.0169*	-0.0173*	-0.0119
	[0.00313]	[0.00690]	[0.00959]	[0.00937]	[0.0106]
Hansen statistic	10.72	11.89	10.24	10.01	11.97
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.708	0.615	0.745	0.761	0.609
AR(2) test statistic	0.441	-1.122	-0.818	-0.888	-0.855
p-value of AR(2)	0.659	0.262	0.414	0.375	0.392
Number of instruments	27	27	27	27	27
Countries	51	52	51	51	51
N	190	193	187	187	187

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.11: SH23 and consumption growth volatility with latin american dummy

	(1) PRIVY	(2) M2	(3) BANKDY	(4) FINDY	(5) LIQY
lgdppc	1.145	2.418	3.742	3.655	2.078
	[2.694]	[3.668]	[2.394]	[2.348]	[2.206]
pop	3.011	2.047	0.858	0.920	0.0148
	[1.942]	[2.494]	[2.288]	[2.155]	[2.070]
trade	3.329	2.749	2.895	2.918	3.285
	[2.018]	[1.886]	[2.022]	[2.036]	[2.026]
gov	-0.228	-2.165	-2.134	-2.124	-1.070
	[2.172]	[2.695]	[2.543]	[2.518]	[2.520]
SH23	1.101***	1.241**	1.096**	1.118***	0.961*
	[0.385]	[0.508]	[0.410]	[0.390]	[0.505]
FINDEV	0.221**	0.424*	0.443*	0.457*	0.344
	[0.0980]	[0.233]	[0.253]	[0.248]	[0.323]
SH23xFINDEV	-0.00942**	-0.0177*	-0.0189*	-0.0195**	-0.0149
	[0.00392]	[0.00892]	[0.00982]	[0.00957]	[0.0121]
Hansen statistic	11.94	12.49	9.081	8.843	12.22
Hansen d.f.	14	14	14	14	14
p-value of Hansen	0.611	0.567	0.826	0.841	0.589
AR(2) test statistic	0.339	-0.889	-0.623	-0.693	-0.710
p-value of AR(2)	0.735	0.374	0.534	0.488	0.478
Number of instruments	27	27	27	27	27
Countries	51	52	51	51	51
N	190	193	187	187	187

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix B

Chapter 2 Derivations

B.1 Maximum durable good stock of constrained households

Definition B.1.1. *Durable good stock* d_0^{max} *is the maximum level at which households -regardless their probability of repayment- are indifferent between accepting credit offer to purchase durable good or rejecting it and therefore not buying it.*

$$\frac{(1-\phi)^{\frac{\beta\ \gamma}{(1-\gamma)(1+\beta)}}}{1-(1-\phi)^{\frac{\beta\ \gamma}{(1-\gamma)(1+\beta)}}} = (1-\delta)d_0^{max}$$

We will proceed to derive this. Remember period utility take Cobb-Douglas functional form:

$$U(c_t, d_t)) = \frac{\left(c_t^{\gamma} d_t^{1-\gamma}\right)^{1-\sigma}}{1-\sigma}$$

Consider its log transformation:

$$u(c_t, d_t)) = log(U(c_t, d_t)) = \psi_c log(c_t) + \psi_d log(d_t) - log(\psi_c + \psi_d)$$

where $\psi_c = (1-\sigma)\gamma$, $\psi_d = (1-\sigma)(1-\gamma)$ and $\psi_c + \psi_d = 1-\sigma$.

The value of autarky is

$$v^{nb}(d_0, \rho) = u(y_1, (1-\delta)d_0) + \beta\rho\, u(y_H, (1-\delta)^2 d_0) + \beta(1-\rho)\, u(y_L, (1-\delta)^2 d_0)$$

The value of accepting credit offer to purchase durable good is

$$\begin{aligned} v^{b}(d_0, \rho, z_2) =& u(y_1, 1 + (1-\delta)d_0) + \beta\rho\, u(y_H - z_2, (1-\delta) + (1-\delta)^2 d_0) + \dots \\ &+ \beta(1-\rho)\, u((1-\phi)y_L, (1-\delta) + (1-\delta)^2 d_0) \end{aligned}$$

Given durable good stock and probability of repayment, if $v^b(d_0, \rho, z_2) \geq v^{nb}(d_0, \rho)$, then household accepts credit offer and purchases one more unit of durable good.

Simplifying and rearranging this expression yields

$$\begin{aligned} &\psi_d(1+\beta)\, log\left(\frac{1 + (1-\delta)d_0}{(1-\delta)d_0}\right) + \beta\psi_c\, log(1-\phi) \\ \geq& \\ &\beta\rho\, \psi_c\, log\left(\frac{y_H}{y_H - z_2}(1-\phi)\right) \end{aligned}$$

Note left hand side of equation above is decreasing in durable good stock. Then there will be a maximum d_0 such that for all values below it, $v^b(d_0, \rho, z_2) \geq v^{nb}(d_0, \rho)$. The value d_0^{max} solves:

$$\psi_d(1+\beta)\, log\left(\frac{1 + (1-\delta)d_0^{max}}{(1-\delta)d_0^{max}}\right) + \beta\psi_c\, log(1-\phi) = \beta\, \psi_c\, log\left(\frac{y_H}{y_H - z_2}(1-\phi)\right)$$

Substituting $y_H(1-\phi) = y_H - z_2$ and solving for d_0^{max} yields the following:

$$\frac{(1-\phi)^{\frac{\beta\ \gamma}{(1-\gamma)(1+\beta)}}}{1-(1-\phi)^{\frac{\beta\ \gamma}{(1-\gamma)(1+\beta)}}} = (1-\delta)d_0^{max}$$

If $d_0 > d_0^{max}$, then value of rejecting credit offer is higher than value of accepting it, regardless the probability of repayment.

B.2 Repayment value is an increasing function of z_1

The repayment value z_2 can be expressed as $z_1 \times R$, where $R = 1/\varrho$. Note ϱ is the probability of repayment threshold derived from the bank problem.

$$\frac{dz_2}{dz_1} = \frac{1}{\varrho} - \frac{z_1}{\varrho^2}\frac{d\varrho}{dz_1} = \frac{1}{\varrho}\left(1 - \frac{z_1}{\varrho}\frac{d\varrho}{dz_1}\right)$$

To get $\frac{d\underline{\rho}(z_1)}{dz_1}$ we apply the implicit function theorem on Bank Profits:

$$\Pi^B = \int_{\underline{\rho}(z_1)}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}(z_1)} - 1 \right) z_1 \times f(\rho) d\rho - \chi = 0$$
$$\Pi^B = -\frac{1}{\underline{\rho}(z_1)} \int_{\bar{a}}^{\underline{\rho}(z_1)} \rho z_1 \times f(\rho) d\rho + \int_{\bar{a}}^{\underline{\rho}(z_1)} z_1 \times f(\rho) d\rho - \chi$$

$$\frac{d\Pi^B}{dz_1} = \int_{\underline{\rho}}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}} - 1 \right) \times f(\rho) d\rho$$

$$\frac{d\Pi^B}{d\underline{\rho}} = \frac{1}{\underline{\rho}^2} \int_{\bar{a}}^{\underline{\rho}} \rho z_1 \times f(\rho) d\rho$$

$$\frac{d\underline{\rho}}{dz_1} = -\frac{d\Pi^B/dz_1}{d\Pi^B/d\underline{\rho}}$$
$$\frac{d\underline{\rho}}{dz_1} = \frac{\underline{\rho}^2 \int_{\underline{\rho}}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}} - 1 \right) \times f(\rho) d\rho}{z_1 \int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} = \frac{\underline{\rho} \int_{\underline{\rho}}^{\bar{a}} (\rho - \underline{\rho}) \times f(\rho) d\rho}{z_1 \int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} > 0$$

Substituting in dz_2/dz_1 yields

$$\frac{dz_2}{dz_1} = \frac{1}{\underline{\rho}} - \frac{z_1}{\underline{\rho}^2} \frac{d\underline{\rho}}{dz_1} = \frac{1}{\underline{\rho}} \left(1 - \frac{\int_{\underline{\rho}}^{\bar{a}} (\rho - \underline{\rho}) \times f(\rho) d\rho}{\int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} \right) > 0$$

B.3 Constraint: Cash customer doesn't buy on credit

We will prove the following: "*If $z_1' \frac{R^V}{R_r^B} > z_1$, cash customer won't buy on credit provided by vendor*".

Assume $z_1' \frac{R^V}{R_r^B} > z_1$ and cash customer finances the purchase of one unit of durable good with credit provided by vendor. Let c_1^* and c_2^* be the optimal first and second period non durable consumption. Then the first period budget constraint is

$$c_1^* + z_1' = y_1 + b_1 + b_1^V$$

where b_1 is total consumption credit provided by banks and b_1^V is consumption credit by vendor.

The second period budget constraint is

$$c_2^* = y_2 - b_1 R_r^B - b_1^V R^V$$

Substituting b_1 in first period budget constraint yields the lifetime budget constraint

$$c_1^* + z_1' + \frac{c_2^*}{R_r^B} = y_1 + \frac{y_2}{R_r^B} + b_1^V \left(\frac{R_r^B - R^V}{R_r^B} \right)$$

Note that $b_1^V = z_1'$ since credit provided by vendors covers exactly the subsidized price. Then

$$c_1^* + \frac{c_2^*}{R_r^B} = y_1 + \frac{y_2}{R_r^B} - z_1' \left(\frac{R^V}{R_r^B} \right)$$

Recall that lifetime budget constraint of cash customer not financing purchase of durable good with vendor credit is

$$c_1 + \frac{c_2}{R_r^B} = y_1 + \frac{y_2}{R_1^B} - z_1$$

Given assumption $z_1' \frac{R^V}{R_r^B} > z_1$,

$$c_1 + \frac{c_2}{R_r^B} > c_1^* + \frac{c_2^*}{R_r^B}$$

a contradiction to the statement that cash customer will finance the purchase of one unit of durable good with credit provided by vendor.

B.4 Characterizing profits from selling to credit customers

Profits from selling to credit customers is defined as

$$\Pi(z_1) = q(z_1, \chi)(z_1 - v)$$

First derivative with respect to z_1

$$\begin{aligned}
\frac{d\Pi(z_1)}{dz_1} &= q(z_1, \chi) + (z_1 - v)\frac{dq(z_1, \chi)}{dz_1} \\
&= N^c \times (1 - G(\underline{\rho}(z_1))) - (z_1 - v)N^c \frac{dG(\underline{\rho}(z_1)}{d\underline{\rho}} \frac{d\underline{\rho}}{dz_1} \\
&= N^c \times (1 - G(\underline{\rho}(z_1))) - (z_1 - v)N^c f(\underline{\rho}(z_1)) \frac{d\underline{\rho}}{dz_1}
\end{aligned}$$

To get $\frac{d\underline{\rho}(z_1)}{dz_1}$ we apply the implicit function theorem on Bank Profits and get

$$\frac{d\underline{\rho}}{dz_1} = \frac{\underline{\rho}^2 \int_{\underline{\rho}}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}} - 1\right) \times f(\rho) d\rho}{z_1 \int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} > 0$$

Next we prove that

$$\frac{d\Pi(z_1)}{dz_1} > 0$$

$$\begin{aligned}
\frac{d\Pi(z_1)}{dz_1} &= N^c \times (1 - G(\underline{\rho}(z_1))) - (z_1 - v)N^c f(\underline{\rho}(z_1)) \left(\frac{\underline{\rho}^2 \int_{\underline{\rho}}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}} - 1\right) \times f(\rho) d\rho}{z_1 \int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} \right) \\
\frac{d\Pi(z_1)}{dz_1} &= N^c \left(\int_{\underline{\rho}}^{\bar{a}} f(\rho) d\rho \right) - (z_1 - v)N^c f(\underline{\rho}(z_1)) \left(\frac{\underline{\rho}^2 \int_{\underline{\rho}}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}} - 1\right) \times f(\rho) d\rho}{z_1 \int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} \right) \\
\frac{d\Pi(z_1)}{dz_1} &= N^c \left(\int_{\underline{\rho}}^{\bar{a}} f(\rho) d\rho - (z_1 - v) f(\underline{\rho}(z_1)) \left(\frac{\underline{\rho}^2 \int_{\underline{\rho}}^{\bar{a}} \left(\frac{\rho}{\underline{\rho}} - 1\right) \times f(\rho) d\rho}{z_1 \int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho) d\rho} \right) \right)
\end{aligned}$$

Note both relations below

$$\int_{\underline{\rho}}^{\bar{a}} f(\rho)d\rho > \int_{\underline{\rho}}^{\bar{a}} \rho f(\rho)d\rho$$

$$\frac{z_1 - v}{z_1} f(\underline{\rho}(z_1))\underline{\rho} > \frac{z_1 - v}{z_1} f(\underline{\rho}(z_1)) \left(\frac{\underline{\rho} \int_{\underline{\rho}}^{\bar{a}} (\rho - \underline{\rho}) \times f(\rho)d\rho}{\int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho)d\rho} \right)$$

Since...

$$\frac{\int_{\underline{\rho}}^{\bar{a}} \rho f(\rho)d\rho}{f(\underline{\rho})\underline{\rho}} > 1 \Rightarrow \frac{\int_{\underline{\rho}}^{\bar{a}} \rho f(\rho)d\rho}{f(\underline{\rho})\underline{\rho}} > \frac{z_1 - v}{z_1}$$

We can prove that

$$\int_{\underline{\rho}}^{\bar{a}} f(\rho)d\rho > \frac{z_1 - v}{z_1} f(\underline{\rho}(z_1)) \left(\frac{\underline{\rho} \int_{\underline{\rho}}^{\bar{a}} (\rho - \underline{\rho}) \times f(\rho)d\rho}{\int_{\underline{\rho}}^{\bar{a}} \rho \times f(\rho)d\rho} \right)$$

This implies $\frac{d\Pi(z_1)}{dz_1} > 0$

B.5 Restriction on z_1 so that cash customer purchases

B.5.1 Deriving optimal non durable consumption for the cash customer

In their two period optimization problem, unconstrained households choose non durable consumption for their two periods (c_1, c_2) and whether they purchase one unit of durable good in the first period or not. That is, they maximize utility:

$$\begin{aligned}
\max_{\{c_1, c_2, \textit{Purchase or No Purchase}\}} \quad & u(c_1, d_1) + \beta u(c_2, d_2) \\
\textit{subject to:} \quad & c_1 + z_1 x_1 + \frac{c_2}{R_1^B} = y_1 + \frac{y_2}{R_1^B} \\
& d_1 = x_1 + (1-\delta) d_0
\end{aligned} \tag{B.1}$$

where z_1 is the relative price of durable goods, x_1 is units of durable goods purchased. Remember we assume each household can only but one unit of durable good.

The first order condition for c_1 yields:

$$\begin{aligned}
u_1(c_1^*, d_1) =& \beta u_1(c_2^*, d_2) R_1^B \\
& \textit{with: } c_2^* = R_1^B (y_1 - c_1^* - z_1 x_1) + y_2
\end{aligned}$$

where u_1 be the derivative of the transformed period utility function.

Let c_1^{p*} be optimal non durable consumption if a household purchases one unit of durable good. Then, c_1^{p*} solves

$$\begin{aligned}
u_1(c_1^{p*}, 1 + (1-\delta) d_0) =& \beta u_1(c_2^{p*}, (1-\delta) + (1-\delta)^2 d_0) R_1^B \\
& \textit{with: } c_2^{p*} = R_1^B (y_1 - c_1^{p*} - z_1) + y_2
\end{aligned} \tag{B.2}$$

Let c_1^{np*} be optimal non durable consumption if household doesn't purchase any durable good. Then, c_1^{np} solves

$$\begin{aligned}
u_1(c_1^{np*}, (1-\delta) d_0) =& \beta u_1(c_2^{np*}, (1-\delta)^2 d_0) R_1^B \\
& \textit{with: } c_2^{np*} = R_1^B (y_1 - c_1^{np*}) + y_2
\end{aligned} \tag{B.3}$$

Assuming period utility takes the Cobb-Douglas functional form (in logs):

$$u(c_t, d_t)) = \psi_c log(c_t) + \psi_d log(d_t) - log(\psi_c + \psi_d)$$

Then

$$u_1(c_t, d_t)) = \frac{\psi_c}{c_t} \tag{B.4}$$

Substitute (11) in (9) and the F.O.C solving for c_1^{p*} is:

$$\begin{aligned} \frac{\psi_c}{c_1^{p*}} =& \beta \frac{\psi_c}{c_2^{p*}} R_1^B \\ \textit{with: } c_2^{p*} =& R_1^B(y_1 - c_1^{p*} - z_1) + y_2 \end{aligned} \tag{B.5}$$

Eliminating common terms and rearranging:

$$c_1^{p*} = \frac{1}{(1+\beta)} \left[y_1 - z_1 + \frac{y_2}{R_1^B} \right] \tag{B.6}$$

Substitute (11) in (10) and the F.O.C solving for c_1^{np*} is:

$$\begin{aligned} \frac{\psi_c}{c_1^{np*}} =& \beta \frac{\psi_c}{c_2^{np*}} R_1^B \\ \textit{with: } c_2^{np*} =& R_1^B(y_1 - c_1^{np*}) + y_2 \end{aligned} \tag{B.7}$$

Eliminating common terms and rearranging:

$$c_1^{np*} = \frac{1}{(1+\beta)} \left[y_1 + \frac{y_2}{R_1^B} \right] \tag{B.8}$$

B.5.2 Deriving restriction on z_1

We consider the log transformation of Cobb-Douglas utility function

$$u(c_t, d_t)) = log(U(c_t, d_t)) = \psi_c log(c_t) + \psi_d log(d_t) - log(\psi_c + \psi_d) \tag{B.9}$$

where $\psi_c = (1-\sigma)\gamma$, $\psi_d = (1-\sigma)(1-\gamma)$ and $\psi_c + \psi_d = 1 - \sigma$.

Let v_r^b be the value of purchasing the good:

$$\begin{aligned}
v_r^b =& u(c_1^{p*}, 1 + (1-\delta)d_0) + \beta u(R_1^B(y_1 - c_1^{p*} - z_1) + y_2, (1-\delta) + (1-\delta)^2 d_0) \\
=& \psi_c \, log(c_1^{p*}) + \psi_d \, log(1 + (1-\delta)d_0) - log(\psi_c + \psi_d) + \dots \\
& + \beta\psi_c \, log(R_1^B(y_1 - c_1^{p*} - z_1) + y_2) + \beta\psi_d \, log((1-\delta) + (1-\delta)^2 d_0) + \dots \\
& - \beta \, log(\psi_c + \psi_d)
\end{aligned} \tag{B.10}$$

where $c_1^{p*} = \frac{1}{(1+\beta)}\left[y_1 - z_1 + \frac{y_2}{R_1^B}\right]$.

Let v_r^{nb} be the value of not purchasing the good:

$$\begin{aligned}
v_r^{nb} =& u(c_1^{np*}, (1-\delta)d_0) + \beta u(R_1^B(y_1 - c_1^{np*}) + y_2, (1-\delta)^2 d_0)) \\
=& \psi_c \, log(c_1^{np*}) + \psi_d \, log((1-\delta)d_0) - log(\psi_c + \psi_d) + \dots \\
& + \beta\psi_c \, log(R_1^B(y_1 - c_1^{np*}) + y_2) + \beta\psi_d \, log((1-\delta)^2 d_0) - \beta \, log(\psi_c + \psi_d)
\end{aligned} \tag{B.11}$$

where $c_1^{np*} = c_1^{np*} = \frac{1}{(1+\beta)}\left[y_1 + \frac{y_2}{R_1^B}\right]$.

An unconstrained household will choose to purchase one unit of durable good as long as:

$$v_r^b \geq v_r^{nb}$$

Substituting in c_1^{p*} and c_1^{np*},rearranging and using log properties yields

$$\begin{aligned}
& \psi_c \, log\left(1 - \frac{z_1}{y_1 + \frac{y_2}{R_1^B}}\right) + \dots \\
& + \beta\psi_c \, log\left(1 - \frac{\beta z_1 R_1^B/(1+\beta)}{R_1^B(y_1 - \frac{1}{(1+\beta)}\left[y_1 + \frac{y_2}{R_1^B}\right]) + y_2}\right) \\
\geq & \\
& \psi_d \, log\left(\frac{(1-\delta)d_0}{1 + (1-\delta)d_0}\right) + \dots \\
& + \beta\psi_d \, log\left(\frac{(1-\delta)^2 d_0}{(1-\delta) + (1-\delta)^2 d_0})\right)
\end{aligned}$$

Simplifying

$$log\left(1-\frac{z_1}{y_1+\frac{y_2}{R_1^B}}\right)\geq-\frac{\psi_d}{\psi_c}\,log\left(\frac{1}{(1-\delta)d_0}+1\right)$$

Exponentiation of both sides

$$\left(y_1+\frac{y_2}{R_1^B}\right)\left(1-\left(\frac{1}{(1-\delta)d_0}+1\right)^{-\frac{\psi_d}{\psi_c}}\right)\geq z_1$$

Let $y_1 = y_2 = \bar{y}$, and since $\frac{\psi_d}{\psi_c} = \frac{(1-\gamma)}{\gamma}$ then:

$$\frac{(1+R_1^B)}{R_1^B}\bar{y}\;\;\Omega(d_0,\delta,\gamma)\geq z_1 \tag{B.12}$$

where

$$\Omega(d_0,\delta,\gamma)=1-\left(\frac{1}{(1-\delta)d_0}+1\right)^{-\frac{\psi_d}{\psi_c}}$$

.

Note

$$\frac{d(\Omega(d_0,\delta,\gamma))}{d(d_0)}=\frac{1-\gamma}{\gamma}\left(\frac{1}{(1-\delta)d_0}\right)^{-\frac{1}{\gamma}}\frac{(-1)}{(1-\delta)d_0^2}<0$$

That is, the greater d_0 (or the lower $\bar{y}$), the lower is the upper bound of price z_1 such that cash customer accepts to purchase the durable good.

B.6 Analytical derivatives

B.6.1 Derivative of probability of repayment threshold with respect to $E(\rho)$

To get $\frac{d\underline{\rho}}{dE(\rho)}$, we use the implicit function theorem on bank's optimality equation

$$F = \int_{\underline{\rho}}^{1} (\rho - \underline{\rho}) \times f(\rho) d\rho - \frac{\chi}{\phi y_H} = 0 \tag{B.13}$$

$$\frac{d\underline{\rho}}{dE(\rho)} = -\frac{dF/dE(\rho)}{dF/d\underline{\rho}} = \frac{\int_{\underline{\rho}}^{1} (\rho - \underline{\rho}) \times \frac{df(\rho)}{dE(\rho)} d\rho}{\int_{\underline{\rho}}^{1} f(\rho) d\rho} > 0 \tag{B.14}$$

where $\rho \sim Beta(\alpha, \beta)$, $\frac{df(\rho)}{dE(\rho)}$ is the derivative of the density with respect to the mean of the distribution.

B.6.2 Derivative of probability of repayment threshold with respect to χ

To get $\frac{d\underline{\rho}}{d\chi}$ we use the implicit function theorem on equation B.13.

$$\frac{d\underline{\rho}}{d\chi} = -\frac{dF/d\chi}{dF/d\underline{\rho}} = \frac{-(\phi y_H)^{-1}}{\int_{\underline{\rho}}^{1} f(\rho) d\rho} < 0 \tag{B.15}$$

B.6.3 Derivative of probability of repayment threshold with respect to ϕ

To get $\frac{d\underline{\rho}}{d\phi}$ we use the implicit function theorem on equation B.13.

$$\frac{d\underline{\rho}}{d\phi} = -\frac{dF/d\phi}{dF/d\underline{\rho}} = \frac{\chi/(y_H \phi^2)}{\int_{\underline{\rho}}^{1} f(\rho) d\rho} > 0 \tag{B.16}$$

B.7 Deriving marginal cost threshold for comparative statics

B.7.1 Rise in the mean section

Let

$$\frac{dVF}{dE(\rho)} = N^c \left((\phi y_H \underline{\rho} - v) \int_{\underline{\rho}}^1 \frac{df(\rho)}{d\mu} d\rho + \left(\phi y_H \int_{\underline{\rho}}^1 f(\rho) d\rho - f(\underline{\rho})(\phi y_H \underline{\rho} - v) \right) \times \frac{\int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho}{\int_{\underline{\rho}}^1 f(\rho) d\rho} \right) \tag{B.17}$$

Equivalently,

$$\frac{dVF}{dE(\rho)} = \frac{N^c}{\int_{\underline{\rho}}^1 f(\rho) d\rho} \left((\phi y_H \underline{\rho} - v) \int_{\underline{\rho}}^1 \frac{df(\rho)}{d\mu} d\rho \int_{\underline{\rho}}^1 f(\rho) d\rho + \left(\phi y_H \int_{\underline{\rho}}^1 f(\rho) d\rho - f(\underline{\rho})(\phi y_H \underline{\rho} - v) \right) \times \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho \right)$$

For $\frac{dVF}{dE(\rho)} > 0$ we need

$$\int_{\underline{\rho}}^1 f(\rho) d\rho \left(\frac{\phi y_H \underline{\rho} - v}{\phi y_H} \int_{\underline{\rho}}^1 \frac{df(\rho)}{d\mu} d\rho + \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho \right) > \frac{\phi y_H \underline{\rho} - v}{\phi y_H} f(\underline{\rho}) \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho$$

$$\frac{\left(\int_{\underline{\rho}}^1 f(\rho) d\rho \right) \times \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho}{\left(\int_{\underline{\rho}}^1 f(\rho) d\rho \int_{\underline{\rho}}^1 \frac{df(\rho)}{d\mu} d\rho + f(\underline{\rho}) \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho \right)} \phi y_H < -\underline{\rho} \phi y_H + v \tag{B.18}$$

$$\underline{\rho} + \frac{\left(\int_{\underline{\rho}}^1 f(\rho) d\rho \right) \times \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho}{\left(\int_{\underline{\rho}}^1 f(\rho) d\rho \int_{\underline{\rho}}^1 \frac{df(\rho)}{d\mu} d\rho + f(\underline{\rho}) \int_{\underline{\rho}}^1 (\rho - \underline{\rho}) \times \frac{df(\rho)}{d\mu} d\rho \right)} < \frac{v}{\phi y_H} \tag{B.19}$$

B.7.2 Fixed cost section

Let

$$\begin{aligned}\frac{dVF}{d\chi} &= -N^c f(\underline{\rho})\frac{d\underline{\rho}}{d\chi} \times (\phi y_H \underline{\rho} - v) + q(N^c, \chi, \phi, \mu, \sigma^2) \times \phi y_H \frac{d\underline{\rho}}{d\chi} \\ &= N^c \left(-f(\underline{\rho})(\phi y_H \underline{\rho} - v) + \int_{\underline{\rho}}^1 f(\rho)d\rho \times \phi y_H\right)\frac{d\underline{\rho}}{d\chi}\end{aligned} \tag{B.20}$$

Since $\frac{d\underline{\rho}}{d\chi} < 0$, $\frac{dVF}{d\chi} < 0$ if,

$$\frac{\int_{\underline{\rho}}^1 f(\rho)d\rho}{f(\underline{\rho})} > \underline{\rho} - \frac{v}{\phi y_H}$$

Equivalently,

$$\left(\underline{\rho} - \frac{\int_{\underline{\rho}}^1 f(\rho)d\rho}{f(\underline{\rho})}\right)\phi y_H < v$$

B.7.3 Default cost section

Let

$$\begin{aligned}\frac{dVF}{d\phi} =& \frac{dq(N^c, \chi, \phi, \mu, \sigma^2)}{d\phi} \times (\phi y_H \underline{\rho} - v) + \ldots \\ & q(N^c, \chi, \phi, \mu, \sigma^2)\phi y_H \frac{d\underline{\rho}}{d\phi} + q(N^c, \chi, \phi, \mu, \sigma^2)\underline{\rho} y_H\end{aligned} \tag{B.21}$$

Substitute in terms and yields

$$\begin{aligned}
\frac{dVF}{d\phi} &= N^c \left(-f(\underline{\rho})(\phi y_H \underline{\rho} - v) + \int_{\underline{\rho}}^{1} f(\rho) d\rho \times \phi y_H \right) \frac{d\underline{\rho}}{d\phi} + N^c \underline{\rho} y_H \times \int_{\underline{\rho}}^{1} f(\rho) d\rho \\
&= N^c \left(-f(\underline{\rho})(\phi y_H \underline{\rho} - v) + \int_{\underline{\rho}}^{1} f(\rho) d\rho \times \phi y_H \right) \frac{\chi/(y_H \phi^2)}{\int_{\underline{\rho}}^{1} f(\rho) d\rho} + \dots \\
&+ N^c \underline{\rho} y_H \times \int_{\underline{\rho}}^{1} f(\rho) d\rho \\
&= N^c \left(-f(\underline{\rho})(\phi y_H \underline{\rho} - v) + \int_{\underline{\rho}}^{1} f(\rho) d\rho \times \phi y_H \right) \frac{\chi}{(y_H \phi^2) \int_{\underline{\rho}}^{1} f(\rho) d\rho} + \dots \\
&+ N^c \underline{\rho} y_H \times \int_{\underline{\rho}}^{1} f(\rho) d\rho
\end{aligned} \tag{B.22}$$

Rearranging,

$$\frac{dVF}{d\phi} =$$

$$\frac{N^c}{(y_H \phi^2) \int_{\underline{\rho}}^{1} f(\rho) d\rho} \times \left(\left(-f(\underline{\rho})(\phi y_H \underline{\rho} - v) + \int_{\underline{\rho}}^{1} f(\rho) d\rho \times \phi y_H \right) \chi + \underline{\rho} (\phi y_H)^2 \times \left(\int_{\underline{\rho}}^{1} f(\rho) d\rho \right)^2 \right)$$

The first derivative is positive ($\frac{dVF}{d\phi} > 0$) if,

$$\frac{\underline{\rho} \phi y_H}{\chi} \times \frac{\left(\int_{\underline{\rho}}^{1} f(\rho) d\rho \right)^2}{f(\underline{\rho})} + \frac{\int_{\underline{\rho}}^{1} f(\rho) d\rho}{f(\underline{\rho})} > \underline{\rho} - \frac{v}{\phi y_H}$$

Equivalently,

$$\left(\underline{\rho} - \frac{\underline{\rho} \phi y_H}{\chi} \times \frac{\left(\int_{\underline{\rho}}^{1} f(\rho) d\rho \right)^2}{f(\underline{\rho})} - \frac{\int_{\underline{\rho}}^{1} f(\rho) d\rho}{f(\underline{\rho})} \right) \phi y_H < v$$

Appendix C

Chapter 3 Derivations

C.1 Aggregate resource constraint

Recall resource constraint of ricardian consumer:

$$C_t^u + I_t^u - q_t D_{t+1}^u = W_t h_t^u + u_t K_t^u - D_t^u - T_t^u \tag{C.1}$$

Substitute
$C_t^u = \frac{C_t - \lambda C_t^r}{1-\lambda}$, $I_t^u = I_t/(1-\lambda)$, $D_t^u = D_t/(1-\lambda)$, $h_t^u = (h_t - \lambda h_t^r)/(1-\lambda)$ and $T_t^u = \frac{\lambda}{1-\lambda} T_t^r$:

$$C_t - \lambda C_t^r + I_t + q_t g_t D_{t+1} = W_t h_t - \lambda W_t h_t^r + u_t K_t - D_t - \lambda T_t^r \tag{C.2}$$

Cancel common terms and use resource constraint of rule-of-thumb-consumer:

$$C_t + I_t - q_t g_t D_{t+1} = W_t h_t + u_t K_t - D_t \tag{C.3}$$

Use first order conditions of firm to derive:

$$
\begin{aligned}
W_t h_t + u_t K_t = &(1-\alpha)\frac{A_t {K_t}^{\alpha} (h_t)^{1-\alpha} \Gamma_t^{1-\alpha}}{(1+(R_t-1)\theta)} + \alpha A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha} \\
= &\frac{(1-\alpha) A_t {K_t}^{\alpha} (h_t)^{1-\alpha} \Gamma_t^{1-\alpha} + (1+(R_t-1)\theta)\, \alpha A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha}}{(1+(R_t-1)\theta)} \\
= &\frac{A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha} + (R_t-1)\theta\alpha A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha}}{(1+(R_t-1)\theta)} \\
= &\frac{A_t {K_t}^{\alpha} (\Gamma_t h_t)^{1-\alpha} (1+(R_t-1)\theta\alpha)}{(1+(R_t-1)\theta)}
\end{aligned}
$$

Substitute aggregate output and the equation remain as follows:

$$
W_t h_t + u_t K_t = \frac{Y_t (1+(R_t-1)\theta\alpha)}{(1+(R_t-1)\theta)} \tag{C.4}
$$

Substitute (A.1.4) in (A.1.3):

$$
C_t + I_t - q_t D_{t+1} = \frac{Y_t (1+(R_t-1)\theta\alpha)}{(1+(R_t-1)\theta)} - D_t \tag{C.5}
$$

where aggregate investment is:

$$
I_t = K_{t+1} - (1-\delta)K_t + \frac{\phi}{2} K_t \left(\frac{K_{t+1}}{K_t} - \mu\right)^2 \tag{C.6}
$$

C.2 Aggregate Euler equations

Recall aggregate hours and aggregate consumption equations:

$$
h_t = \lambda h_t^r + (1-\lambda) h_t^u \tag{C.7}
$$

$$
C_t = \lambda C_t^r + (1-\lambda) C_t^u \tag{C.8}
$$

Substitute h_t^r and h_t^u in (A.2.1) with their corresponding first order conditions to get aggregate labor supply:

$$h_t = \left(\frac{W_t}{\Gamma_{t-1}\tau\omega}\right)^{\frac{1}{\omega-1}} \rightarrow W_t = \Gamma_{t-1}\tau\omega h_t^{\omega-1} \tag{C.9}$$

Note in equilibrium $h_t = h_t^r = h_t^u$. Remember that combining optimality and budget constraint of rule-of-thumb-consumer:

$$C_t^r = (\tau\omega\Gamma_{t-1})^{\frac{-1}{\omega-1}} W_t^{\frac{\omega}{\omega-1}} + T_t^r$$

Substituting W_t in the previous equation with (A.2.3) yields:

$$C_t^r = \tau\omega\Gamma_{t-1}{h_t}^{\omega} + T_t^r \tag{C.10}$$

Next, isolate C_t^u in (A.2.2) and substitute C_t^r with (A.2.4):

$$C_t^u = \frac{C_t - \lambda\tau\omega\Gamma_{t-1}h_t^{\omega} - \lambda T_t^r}{1-\lambda} \tag{C.11}$$

We will use this last identity together with $h_t^u = h_t$ in the expression for marginal utility of consumption of ricardian household:

$$\lambda_t = (C_t^u - \tau\Gamma_{t-1}(h_t^u)^{\omega})^{-\sigma}$$

$$\lambda_t = \left(\frac{C_t - \lambda\tau\omega\Gamma_{t-1}h_t^{\omega} - \lambda T_t^r}{1-\lambda} - \tau\Gamma_{t-1}(h_t)^{\omega}\right)^{-\sigma}$$

$$\lambda_t = \left(\frac{C_t - \tau\Gamma_{t-1}h_t^{\omega}\Omega - \lambda T_t^r}{1-\lambda}\right)^{-\sigma} \tag{C.12}$$

Then, the stochastic discount factor as function of aggregates is

$$\Lambda_{t+1,t} = \beta \left(\frac{C_{t+1} - \tau \Gamma_t h^{\omega}_{t+1} \Omega - \lambda T^r_{t+1}}{C_t - \tau \Gamma_{t-1} h^{\omega}_t \Omega - \lambda T^r_t} \right)^{-\sigma} \tag{C.13}$$

where $\Omega = \lambda(\omega - 1) + 1$.

Now, we are able to substitute $\Lambda_{t+1,t}$ in the euler equations of ricardian households. Recall that capital is solely accumulated by ricardian households.

$$\left(1 + \phi \left(\frac{K_{t+1}}{K_t} - \mu \right)\right) =$$
$$E_t \beta \left(\frac{C_{t+1} - \tau \Gamma_t h^{\omega}_t \Omega - \lambda T^r_{t+1}}{C_t - \tau \Gamma_{t-1} h^{\omega}_t \Omega - \lambda T^r_t} \right)^{-\sigma} \left(u_{t+1} + 1 - \delta + \frac{\phi}{2} \left(\left(\frac{K_{t+2}}{K_{t+1}} \right)^2 - \mu^2 \right) \right) \tag{C.14}$$

$$q_t = E_t \beta \left(\frac{C_{t+1} - \tau \Gamma_t h^{\omega}_t \Omega - \lambda T^r_{t+1}}{C_t - \tau \Gamma_{t-1} h^{\omega}_t \Omega - \lambda T^r_t} \right)^{-\sigma} \tag{C.15}$$

C.3 Linearized equilibrium conditions

Given that a realization of g_t permanently influences Γ_t; output is nonstationary with a stochastic trend. We proceed to detrend the non-stationary variables by normalizing them by trend productivity through period t-1 (i.e divide by Γ_{t-1}) [1]. To simplify notation we use lower case letters to denote the corresponding detrended variable. Remember, however, q_t, u_t , g_t, h_t did not need to be detrended. We denote percentage deviation of detrended variable relative to its steady state with a circumflex symbol: i.e $\hat{x}_t$.

We solve the normalized model numerically by log-linearizing the first order conditions and resource constraints around the deterministic steady state. Given

[1] The detrended variable x_t will be denoted as $\tilde{x}_t$. This choice of normalization ensures that if a variable x_t is on information set as of t-1, so it is $\hat{x}_t$. Finally, the choice of normalization does not affect the solution to the model.

a solution to the normalized equations, we can recover the path of the non normalized equilibrium by multiplying through by Γ_{t-1}.

Households

The aggregate labor supply schedule under GHH preferences, perfectly competitive labor markets and homogenous labor productivity

$$\hat{h}_t = \frac{1}{\omega - 1}\hat{w}_t \tag{C.16}$$

The log-linearized equation describing optimality of capital investment

$$\begin{aligned} E_t\hat{c}_{t+1} - \hat{c}_t = &\frac{\Omega\bar{\bar{W}}}{c}\left(E_t\hat{h}_{t+1} - \hat{h}_t\right) + \frac{\lambda}{\gamma_c}\left(E_t\hat{t}^r_{t+1} - \hat{t}^r_t\right) + \dots \\ &\left(1 - \frac{\Omega\bar{\bar{W}}}{\omega c} - \frac{\lambda\gamma_T}{\gamma_c}\right)\left(-\frac{\sigma + \mu\phi}{\sigma}\hat{g}_t + \frac{\beta\phi\mu^{2-\sigma}}{\sigma}E_t\hat{g}_{t+1}\right) + \dots \\ &\left(1 - \frac{\Omega\bar{\bar{W}}}{\omega c} - \frac{\lambda\gamma_T}{\gamma_c}\right)\left(\frac{\beta\phi\mu^{2-\sigma}}{\sigma}E_t\hat{k}_{t+2} - \left(\frac{\beta\phi\mu^{2-\sigma}}{\sigma} + \frac{\mu\phi}{\sigma}\right)\hat{k}_{t+1} + \frac{\mu\phi}{\sigma}\hat{k}_t\right) + \dots \\ &+ \frac{\beta\mu^{-\sigma}u}{\sigma}\left(1 - \frac{\Omega\bar{\bar{W}}}{\omega c} - \frac{\lambda\gamma_T}{\gamma_c}\right)E_t\hat{u}_{t+1} \end{aligned} \tag{C.17}$$

The log-linearized capital accumulation equation:

$$\hat{i}_t = \frac{\mu}{\mu - (1-\delta)}\hat{g}_t - \frac{(1-\delta)}{\mu - (1-\delta)}\hat{k}_t + \frac{\mu}{\mu - (1-\delta)}\hat{k}_{t+1} \tag{C.18}$$

The log-linearized aggregate euler equation for debt

$$\begin{aligned} E_t\hat{c}_{t+1} - \hat{c}_t = &\frac{\Omega\bar{\bar{W}}}{c}\left(E_t\hat{h}_{t+1} - \hat{h}_t\right) + \frac{\lambda}{\gamma_c}\left(E_t\hat{t}^r_{t+1} - \hat{t}^r_t\right) - \left(1 - \frac{\Omega\bar{\bar{W}}}{\omega c} - \frac{\lambda\gamma_T}{\gamma_c}\right)\hat{g}_t + \dots \\ &+ \frac{1}{\sigma}\left(1 - \frac{\Omega\bar{\bar{W}}}{\omega c} - \frac{\lambda\gamma_T}{\gamma_c}\right)\left(\hat{R}_t + \frac{\psi d}{R}\hat{d}_{t+1}\right) \end{aligned} \tag{C.19}$$

where $\tilde{\bar{\bar{W}}} \equiv \tilde{W}h = \tau\omega h^{\omega}$ is total (detrended) wage payments in the economy in steady state, $\gamma_T \equiv \frac{T^r}{Y}$, $\gamma_c \equiv \frac{C}{Y}$ and $\Omega = \lambda(\omega - 1) + 1$.

Firms

The aggregate production function

$$\hat{y}_t = \hat{A}_t + (1-\alpha)\hat{g}_t + \alpha\hat{k}_t + (1-\alpha)\hat{h}_t \tag{C.20}$$

Capital rental rate equates marginal product of capital

$$\hat{u}_t = (1-\alpha)\left(\hat{g}_t + \hat{h}_t - \hat{k}_t\right) + \hat{A}_t \tag{C.21}$$

Labor demand schedule is sensitive to real interest rate under working capital requirement assumption

$$(1-\alpha)\hat{g}_t + \hat{A}_t + \alpha\hat{k}_t - \alpha\hat{h}_t = \frac{\theta R}{1+(R-1)\theta}\hat{R}_t + \hat{w}_t \tag{C.22}$$

Market clearing and equations closing model

Log linearization of the market clearing condition of the final good around the steady state yields

$$\begin{aligned}(\gamma_c)\hat{c}_t + \gamma_i\hat{i}_t + (q\mu\gamma_d)\hat{d}_{t+1} + (q\mu\gamma_d)\hat{q}_t + (q\mu\gamma_d)\hat{g}_t = &\left(\frac{1+(R-1)\theta\alpha}{1+(R-1)\theta}\right)\hat{y}_t + (\gamma_d)\hat{d}_t + \dots \\ &- \left(\frac{(1-\alpha)\theta R}{(1+(R-1)\theta)^2}\right)\hat{R}_t + (\gamma_T)\hat{T}_t\end{aligned} \tag{C.23}$$

Next we present the log-linearization of price of non-contingent debt q_t. It is a function of real interest rate (R) and is elastic to stock of debt

$$-\hat{q}_t = \hat{R}_t + \frac{\psi d}{R}\hat{d}_{t+1} \tag{C.24}$$

C.4 Derivations showing model counterparts

The observables considered are

$$DATA_t = \left[\Delta ln(Y_t), \Delta ln(C_t), \Delta ln(I_t), \Delta TBy_t, ln(\bar{R}_t^*), ln(\bar{S}_t)\right]$$

.

Their corresponding model counterparts:

$$MODEL_t = \left[\hat{\gamma_{Y_t}}, \hat{\gamma_{C_t}}, \hat{\gamma_{I_t}}, \gamma_{T\hat{B}y_t}, \hat{R}_t^*, \hat{S}_t)\right]$$

Lets illustrate the model counterpart for output growth ($\hat{\gamma_{Y_t}}$). First note $\frac{Y_t}{Y_{t-1}} = g_{t-1}\frac{\tilde{Y}_t}{\tilde{Y}_{t-1}}$. Log linearization yields:

$$ln\left(\frac{Y_t}{Y_{t-1}}\right) - ln(\mu_g) = \hat{g}_{t-1} + \hat{\tilde{Y}}_t - \hat{\tilde{Y}}_{t-1}$$

Then we can define its exact model counterpart:

$$\hat{\gamma_{Y_t}} \equiv \Delta ln(Y_t) = \hat{g}_{t-1} + \hat{\tilde{Y}}_t - \hat{\tilde{Y}}_{t-1} + ln(\mu_g)$$

Same applies for consumption and investment log differences.

$$\hat{\gamma_{C_t}} \equiv \Delta ln(C_t) = \hat{g}_{t-1} + \hat{\tilde{C}}_t - \hat{\tilde{C}}_{t-1} + ln(\mu_g)$$

$$\hat{\gamma_{I_t}} \equiv \Delta ln(I_t) = \hat{g}_{t-1} + \hat{\tilde{I}}_t - \hat{\tilde{I}}_{t-1} + ln(\mu_g)$$

The model counterpart for $\Delta TB/Y$ is defined by the following equation in the model:

$$\begin{aligned}
\gamma_{TBy_t} =& \frac{1}{TBy_{ss}} exp\left(TBy_t - TBy_{t-1}\right) \\
ln(\gamma_{TBy_t}) =& TBy_t - TBy_{t-1} - ln(TBy_{ss}) \\
ln(\gamma_{TBy_t}) - ln(\gamma_{TBy_{ss}}) =& TBy_t - TBy_{t-1} \\
\gamma_{T\hat{B}y_t} =& \Delta TBy_t
\end{aligned}$$

Model counterpart for interest rates

$$\begin{aligned}
\hat{S}_t =& -\eta\left(\hat{A}_{t+1} + (1-\alpha)\hat{g}_{t+1}\right) + \hat{\epsilon}_{S_t} \\
\hat{R}^*_t =& \rho_{R^*}\hat{R}^*_{t_1} + \hat{\epsilon}_{R^*_t} \\
\hat{R}^*_t \approx& ln(R^*_t) - ln(R^*_{ss}) = ln(\bar{R}^*_t) \\
\hat{S}_t \approx& ln(S_t) - ln(S_{ss}) = ln(\bar{S}_t)
\end{aligned}$$

Bibliography

Aghion, P., Angeletos, G.-M., Banerjee, A., and Manova, K. (2010). Volatility and growth: Credit constraints and the composition of investment. *Journal of Monetary Economics*, 57(3):246 – 265.

Aghion, P., Banerjee, A., and Piketty, T. (1999). Dualism and macroeconomic volatility. *Quarterly journal of economics*, pages pp. 1359–1397.

Aguiar, M. and Gopinath, G. (2007). Emerging market business cycles: The cycle is the trend. *Journal of Political Economy*, 115(1):pp. 69–102.

Akinci, O. (2014). Financial frictions and macroeconomic fluctuations in emerging economies. International Finance Discussion Papers 1120, Board of Governors of the Federal Reserve System (U.S.).

Alesina, A. and Perotti, R. (1996). Income distribution, political instability, and investment. *European economic review*, 40(6):1203–1228.

An, S. and Schorfheide, F. (2007). Bayesian analysis of dsge models. *Econometric Reviews*, 26(2-4):113–172.

Aparici, G. and Yáñez, Á. (2004). Financiamiento de los hogares en chile. Technical report, SBIF.

Arellano, C. (2008). Default risk and income fluctuations in emerging economies. *The American Economic Review*, pages 690–712.

Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The review of economic studies*, 58(2):277–297.

Arellano, M. and Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of econometrics*, 68(1):29–51.

Barrionuevo, A. (2011). Rise of consumer credit in chile and brazil leads to big debts and lender abuses. Available at http://www.nytimes.com/2011/07/24/business/global/abuses-by-credit-issuers-in-chile-and-brazil-snare-consumers.html.

Barro, R. J. (2000). Inequality and growth in a panel of countries. *Journal of economic growth*, 5(1):5–32.

Basu, S. and Macchiavelli, M. (2015). Consumption volatility and borrowing constraints in small open economies.

Beck, T., Demirguc-Kunt, A., and Martinez Peria, M. S. (2005). *Reaching Out : Access To And Use Of Banking Services Across Countries*. The World Bank.

Beck, T., Levine, R., and Loayza, N. (2000). Finance and the sources of growth. *Journal of Financial Economics*, 58(1-2):261–300.

Bekaert, G., Harvey, C. R., and Lundblad, C. (2006). Growth volatility and financial liberalization. *Journal of international money and finance*, 25(3):370–403.

Benado, E. (2011). Tasa máxima: usura legalizada y origen de todos los problemas. *El Mostrador*.

Benhabib, J., Rogerson, R., and Wright, R. (1991). Homework in macroeconomics: Household production and aggregate fluctuations. *Journal of Political economy*, pages 1166–1187.

Bilbiie, F. O. and Straub, R. (2013). Asset market participation, monetary policy rules, and the great inflation. *Review of Economics and Statistics*, 95(2):377–392.

Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87(1):115–143.

Breen, R. and García-Peñalosa, C. (2005). Income inequality and macroeconomic volatility: an empirical investigation. *Review of Development Economics*, 9(3):380–398.

Brennan, M. J., Miksimovic, V., and Zechner, J. (1988). Vendor financing. *The Journal of Finance*, 43(5):1127–1141.

Calderón Hoffmann, A. (2006). The expansion model of the major chilean retail chains. *Cepal Review*.

Casanova, L. and Renck, H. B. B. (2015). *Business Sector Responses to the Rise of the Middle Class*, pages 150–172. Palgrave Macmillan UK, London.

Cavanagh, J. and Long, R. (1999). Introducing the jp morgan emerging markets bond index global (embi global). *Emerging markets research, JP Morgan Securities Inc.*

Central Bank of Chile (2009). Endeudamiento de los hogares en chile: Análisis e implicancias para la estabilidad financiera. Technical report.

Chang, R. and Fernández, A. (2013). On the sources of aggregate fluctuations in emerging economies. *International Economic Review*, 54(4):1265–1293.

Cihak, M., Demirgüç-Kunt, A., Feyen, E., and Levine, R. (2012). Benchmarking financial systems around the world. *World Bank Policy Research Working Paper*, (6175).

CNBV (2009). Reporte nacional de inclusión financiera (national financial report) 1. Technical report, Comisión Nacional Bancaria y de Valores.

CONAIF (2016). Reporte nacional de inclusión financiera (national financial report) 7. Technical report, Consejo Nacional de Inclusión Financiera, Mexico.

Dang, H.-A. H. and Lanjouw, P. F. (2015a). Poverty dynamics in india between 2004 and 2012: insights from longitudinal analysis using synthetic panel data. *World Bank Policy Research Working Paper*, (7270).

Dang, H.-A. H. and Lanjouw, P. F. (2015b). Toward a new definition of shared prosperity: a dynamic perspective from three countries. *World Bank Policy Research Working Paper*, (7294).

Demirguc-Kunt, A., Klapper, L., Singer, D., and Van Oudheusden, P. (2015). The global findex database 2014 : measuring financial inclusion around the world. Policy Research working paper WPS 7255, World Bank Group, Washington, D.C.

Drozd, L. A. and Serrano-Padial, R. (2016). Modeling the revolving revolution: The debt collection channel.

Easterly, W. (2001). The middle class consensus and economic development. *Journal of economic growth*, 6(4):317–335.

Easterly, W. (2007). Inequality does cause underdevelopment: Insights from a new instrument. *Journal of Development Economics*, 84(2):755 – 776.

Eaton, J. and Gersovitz, M. (1981). Debt with potential repudiation: Theoretical and empirical analysis. *The Review of Economic Studies*, pages 289–309.

Evans, M. (2014). Arrival of financial cards to latin america led to credit binge. Available at http://blog.euromonitor.com/2014/08/arrival-of-financial-cards-to-latin-america-led-to-credit-binge.html.

Fernández-Villaverde, J., Guerrón-Quintana, P., Rubio-Ramírez, J. F., and Uribe, M. (2011). Risk matters: The real effects of volatility shocks. *American Economic Review*, 101(6):2530–61.

Fernández-Villaverde, J. and Krueger, D. (2011). Consumption and saving over the life cycle: How important are consumer durables? *Macroeconomic Dynamics*, 15(5):725–770.

Ferreira, F. H., Messina, J., Rigolini, J., Lopez-Calva, L.-F., Lugo, M. A., and Vakis, R. (2013). *Economic Mobility and the Rise of the Latin American Middle Class*. Number 11858 in World Bank Publications. The World Bank.

Fulford, S. L. (2013). The effects of financial development in the short and long run: Theory and evidence from india. *Journal of Development Economics*, 104:56 – 72.

Galí, J., López-Salido, J. D., and Vallés, J. (2004). Rule-of-thumb consumers and the design of interest rate rules. *Journal of Money, Credit and Banking*, pages 739–763.

García, N., Grifoni, A., López, J. C., and Mejía, D. (2013). Financial education in latin america and the caribbean. rationale, overview and way forward. *OECD Working Papers on Finance, Insurance and Private Pensions*, (33).

García-Cicco, J., Pancrazi, R., and Uribe, M. (2010). Real business cycles in emerging countries? *American Economic Review*, 100(5):2510–31.

Geweke, J. (1999). Using simulation methods for bayesian econometric models: inference, development,and communication. *Econometric Reviews*, 18(1):1–73.

Ghiglino, C. and Venditti, A. (2007). Wealth inequality, preference heterogeneity and macroeconomic volatility in two-sector economies. *Journal of Economic Theory*, 135(1):414–441.

Hansen, N.-J. and Sulla, O. (2013). El crecimiento del credito en america latina: desarrollo financiero o boom crediticio? *Revista Estudios Economicos*, 25(1).

Hirschman, A. O. and Rothschild, M. (1973). The changing tolerance for income inequality in the course of economic development. *The Quarterly Journal of Economics*, pages 544–566.

Iyer, T. (2016). Optimal monetary policy in an open emerging market economy (2016-06-20). FRB of Chicago Working Paper WP-2016-6.

Iyigun, M. F. and Owen, A. L. (2004). Income inequality, financial development, and macroeconomic fluctuations. *The Economic Journal*, 114(495):352–376.

Kharas, H. (2010). The emerging middle class in developing countries. *OECD Development Centre Working Papers*, (285).

Kharas, H. (2017). *The unprecedented expansion of the global middle class AN UPDATE*. The Brookings Institution.

Knowledge@Wharton (2011). La polar's accounting scandal sends a chill through chile. Available at http://knowledge.wharton.upenn.edu/article/la-polars-accounting-scandal-sends-a-chill-through-chile/.

Kochhar, R. (2015). A global middle class is more promise than reality: From 2001 to 2011, nearly 700 million step out of poverty, but most only barely. Technical report, Pew Research Center.

Kose, M. A., Prasad, E. S., and Terrones, M. E. (2003). Financial integration and macroeconomic volatility. *IMF Economic Review*, 50(1):119–142.

Leblebicioğlu, A. (2009). Financial integration, credit market imperfections and consumption smoothing. *Journal of Economic Dynamics and Control*, 33(2):377–393.

Levchenko, A. (2005). Financial liberalization and consumption volatility in developing countries. IMF Staff Papers 2.

Levine, R. (2005). Finance and growth: theory and evidence. *Handbook of economic growth*, 1:865–934.

Livshits, I. (2015). Recent developments in consumer credit and default literature. *Journal of Economic Surveys*, 29(4):594 – 613.

Livshits, I., Mac Gee, J. C., and Tertilt, M. (2016). The democratization of credit and the rise in consumer bankruptcies. *The Review of Economic Studies*, 83(4):1673–1710.

Lopez-Calva, L. F. and Ortiz-Juarez, E. (2011). *A Vulnerability Approach to the Definition of the Middle Class*. The World Bank.

Marshall, E. (2004). Regulación y desarrollo del sistema financiero. In *Seminario "Profundizando el Mercado de Capitales chileno"*. SBIF Chile.

McMillan, M. (2012). The case of empresas la polar: Encouraging whistleblowers can serve a firm's interest. Available at www.blogs.cfainstitute.org/investor/2012/10/11/o-whistleblower-where-art-thou/.

Montero, J. P. and Tarzijan, J. (2010). El éxito de las casas comerciales en chile : Regulación o buena gestión. Working Papers Central Bank of Chile 565, Central Bank of Chile.

Neumeyer, P. A. and Perri, F. (2005). Business cycles in emerging economies: the role of interest rates. *Journal of monetary Economics*, 52(2):345–380.

Obermann, T. (2006). A revolution in consumer banking: Developments in consumer banking in latin america.

OECD (2014). *OECD Factbook 2014: Economic, Environmental and Social Statistics*. OECD Publishing.

Philippe, A., Bacchetta, P., and Banerjee, A. (2004). Financial development and the instability of open economies. *Journal of Monetary Economics*, 51(6):1077 – 1106.

Ponce, R. A. (2003). Restricciones de liquidez, canal de crédito y consumo en méxico. *economía mexicana. NUEVA ÉPOCA*, 12(1).

Rodrik, D. (1999). Where did all the growth go? external shocks, social conflict, and growth collapses. *Journal of economic growth*, 4(4):385–412.

Rojas, E. (2011). Existe usura en chile?: El debate sobre los cobros abusivos en los créditos que encendió el caso la polar. *La Segunda*.

Rojas-Suarez, L. and Amado, M. A. (2014). Understanding latin america's financial inclusion gap. Working Papers 367, Center for Global Development.

Roodman, D. (2014). xtabond2: Stata module to extend xtabond dynamic panel data estimator. *Statistical Software Components*.

Ruiz-Tagle, J., García, L., and Miranda, Á. (2013). Proceso de endeudamiento y sobre endeudamiento de los hogares en chile. Working Papers Central Bank of Chile 703, Central Bank of Chile.

Samsing, F. (2011). Tarjetas de crédito no bancarias: Sistema de esclavitud. Conadecus.

SBIF (2015). Informe de endeudamiento de los clientes bancarios 2015. Technical report.

Schmitt-Grohé, S. and Uribe, M. (2003). Closing small open economy models. *Journal of international Economics*, 61(1):163–185.

Uribe, M. and Yue, V. (2006). Country spreads and emerging countries: Who drives whom? *Journal of International Economics*, 69(1):6–36.

Uribe, M. and Yue, V. Z. (2003). Country spreads and emerging countries: Who drives whom? Working Paper 10018, National Bureau of Economic Research.

Vaidyanathan, G. (1993). Consumption, liquidity constraints and economic development. *Journal of Macroeconomics*, 15(3):591 – 610.

World Bank (2014). *Purchasing Power Parities and the Real Size of World Economies: A Comprehensive Report of the 2011 International Comparison Program*. The World Bank.