Financial Policies and Income and Wealth Inequality:  
A Kuznetsian Story of Financial Deepening and Human Capital Accumulation

DISSERTATION

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Abstract

This dissertation examines whether and how financial policies affect the distributions of income and wealth. It also explores and compares the evolution of income inequality, along an inverted U-shaped Kuznetsian path, when only human capital formation takes place and when the structural transformation of the labor force is accompanied by financial development.

This is accomplished by numerically solving for the steady-state equilibrium of a dynamic, stochastic, general equilibrium model of an economy with heterogeneous households (subject to labor productivity shocks), heterogeneous firms (subject to production shocks), and competitive banks that face frictions from policy-induced repression, incomplete institutions, and market imperfections.

Policy simulations contrast the effects —of direct interventions in financial markets (namely, changes in required reserve ratios on deposits) and indirect interventions that improve the market environment (namely, infrastructure and institutions that differentially reduce default rates and costs of lending)— on the wedge between loan and deposit interest rates, deposits mobilized, credit available, output levels, wage earnings and shares in the wage bill, wealth levels (household deposits), and the dispersion of wage earnings and wealth (Gini coefficients).
Simulation results reveal that, while direct policy interventions (manipulating required reserve ratios) may slightly improve income distributions, they do it at the cost of substantially lowering financial deepening and output and wage levels. While these adverse effects subside at advanced stages of development, these are not appropriate tools to pursue distributional goals.

In contrast, pro-informal, pro-poor biased indirect policy interventions, resulting in lower default rates from informal firms or lower costs of lending to informal firms, show strong impacts in increasing output and wages (efficiency) and in reducing inequality in the distributions of income and wealth (equity), especially at early stages of economic development, when acute frictions in financial markets asymmetrically penalize informal firms and low-skilled households.

At more advanced stages of development, the results are mixed. The distribution of income may improve at the cost of lower levels of output and wealth accumulation (when default rates decline) or inequality in the distribution of wealth may rise (when the costs of lending decline).

When the original Kuznetsian story of a relationship between the structural transformation of the labor force and inequality is augmented by financial development, the Gini coefficient for the distribution of wage incomes is lower, at every stage of human capital formation, the peak values of the coefficient are lower, and the distribution of income starts to improve at an earlier stage in the development process.
The combined effect of human capital formation and financial development leads to monotonic and larger reductions in the wedge between the interest rates charged on loans and paid on deposits and to improved indicators of financial deepening, the volume of deposits, and the GDP level.

The results for the augmented Kuznetsian scenario are confirmed when the model parameters are calibrated with data for Pakistan. In this case, there is monotonically less inequality in the distribution of wealth, along the Kuznetsian path, when financial development accompanies human capital formation.
Dedicated to my family:

Ladies: Mubarak Jan (mom); Naheed, Ishret and Saima (sisters); Anoushia (wife);

Tayyaba and Ayesha (daughters);

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Chapter 1: Introduction

Do financial policies affect the distributions of income and wealth? The answer to this question involves a long chain of inter-connected and, at times, conflicting impacts, going from the choice of financial policies to their actual impact on the degree and style of a country’s financial development and, through numerous direct and indirect channels, to the influence of the resulting differential access to various types of financial services on income and wealth inequality.

This dissertation explores a few dimensions of this chain of impacts. It relies on and takes as granted the existing academic consensus that financial policies do affect an economy’s factor productivity and the rate of growth of output, through first influencing the level and manner of the country’s financial development which, in turn, affects these and other non-financial outcomes. The dissertation focuses, instead, on the distributive (rather than the growth or stability) consequences of financial deepening.

Specifically, with respect to direct channels of influence, the dissertation explores circumstances under which changes in the level of a country’s financial development—as an outcome both of the extent of prevailing financial market imperfections and of the nature of government interventions in financial markets—may affect the degree of inequality of the distributions of income and wealth, under steady-state equilibrium.
In addition, with respect to indirect channels of influence, the dissertation examines the impact—on inequality—of changes in some fundamental characteristics of the economy, which interact and evolve with financial development and are, at least in part, induced by it—such as human capital accumulation and the accompanying changes in the distribution of skills across the population.

Moreover, the environment for the operation of financial markets is also influenced by several dimensions of the general process of economic development, also subject to government influence: (a) as the physical infrastructure is improved and transaction costs decline, (b) as the institutional framework is completed and contract design and enforcement improve, and (c) as tools for the management of risk are sharpened. The authorities can thus influence the country’s financial development either through direct policy interventions in financial markets or, indirectly, by modifying the environment for the operation of these markets.

The dissertation explores both these direct and indirect channels of influence of government policies on financial development and, thereby, on the distributions of income and wealth. Further, it attempts to assess the comparative strength of these two types of government interventions in influencing the levels of output and wages, in different sectors of the economy, and the distributions of labor incomes and of wealth (deposit) holdings. On the basis of the analytical results, it discusses the appropriateness of each policy approach during different stages of the process of economic development. The purpose is to suggest criteria for evaluating a pro-poor financial policy mix.
To this end, the dissertation first develops a general equilibrium model and it then numerically solves for the steady state of an economy with heterogeneous households, heterogeneous firms, and formal financial intermediaries (banks). While households are made vulnerable to idiosyncratic —skill-level— shocks, which influence their wage income levels, and firms are subject to idiosyncratic —production— shocks, which influence the expected rates of default on their loans, in order to simplify the analysis, aggregate uncertainty (i.e., a systemic shock) is ignored in the model.

The desired stylized facts —for a developing country— are captured by prominent features of the general equilibrium model developed here. In particular, it is assumed that household labor is employed either in traditional sector (informal) firms or corporate sector (formal) firms, depending on labor productivity (namely, household skills). In turn, for their participation in credit markets, borrowing firms are classified as high-risk (when they operate in the traditional sector) or low-risk (if they belong to the corporate sector), based on differential default rates expected by banks.

Financial intermediation emerges in the model: (a) from the willingness of households to deposit their savings at the banks (as their only wealth-holding choice), (b) from the demand for credit from the firms, based on their production opportunities, and (c) from the households’ inability to properly assess the creditworthiness (expected default) of the firms (Diamond 1984). In recognition of constraints frequently found in developing countries (McKinnon 1973 and 1989), the market for equity is ignored and no explicit residual claimants for the firms and the banks are included in the model. Under competitive equilibrium, their profits are zero.
In the model, the banks use the deposits mobilized from households (as their only liability) to make asset portfolio choices (by granting loans to firms), while: (a) facing differential and non-correlated default risk from formal and informal firms, (b) incurring increasing costs in screening and monitoring borrowers, and (c) being constrained by policy-induced financial market frictions. In contrast to households, banks possess a comparative advantage in evaluating credit risks and competitively engage in the delegated screening and monitoring of different types of borrowing firms.

The economy’s level of financial development is measured by the extent of the frictions observed in financial markets. These frictions result either from financial market imperfections (market failure), incomplete infrastructure and institutions, or inappropriate government interventions (financial repression). Here, the impact of financial and other government policies is hypothesized either from their ability to reduce the influence of market imperfections or incomplete institutions and thereby lower barriers to access to financial services (i.e., financial deepening) or from the extent to which they actually contribute to these frictions (i.e., financial repression).

Two outcomes are associated with the presence of these frictions. On the one hand, frictions in financial markets introduce a wedge between the interest rates paid to depositors and the interest rates charged to borrowers. The presence of this wedge increases disparities in the marginal productivities and/or marginal utilities faced — in equilibrium — by heterogeneous agents throughout the economy and, thereby, the wedge increases the fragmentation of the economy and reduces the efficiency of resource allocation.
On the other hand, a consequence of the frictions is a reduction of the gains from financial intermediation, as not all of the command over resources mobilized from savers (via deposits) becomes available to productive firms (via loans). Rather, resources either disappear from productive efforts, in reflection of transaction costs, or are kept idle, such as in stocks of reserves required by the monetary authorities (Shaw 1973).

Some other policies of financial repression, such as interest rate ceilings, distort the allocation of the command over resources across the economy and lead to various types of credit rationing (Jaffee and Modigliani 1969, Gonzalez-Vega 1976 and 1977, Baltensperger 1978, Keeton 1979, Stiglitz and Weiss 1981, Jaffee and Stiglitz, 1990). While these policies have historically had strong —and typically adverse— impacts on income distribution, their consequences are not explicitly explored in this dissertation. In particular, the solution of the model for a competitive equilibrium precludes the consideration of the influence of market power, as a source of frictions, and of non-price credit rationing.

In the model developed in this dissertation, therefore, the influence of policies on financial development is explored through two different types of channels. First, direct financial policy interventions, represented by a required reserve ratio on the deposits mobilized from households, both determine the volume of purchasing power intermediated by the banks and affect the magnitude of the wedge between loan and deposit interest rates. Because of these effects, this particular policy instrument can be used —in the policy simulations based on the model— to represent a whole range of policy interventions that typically have the same two consequences on financial development.
Thus, the policy implications obtained from these simulations can be generalized, in recognition of similar impacts on the level of intermediation and on the interest rate gap, in an analysis of other policy interventions.

Second, a broad range of financial and non-financial government interventions also —indirectly— influence the level of financial development, by affecting the environment for the operation of financial markets. These interventions improve the stock of information about the creditworthiness of potential borrowers (such as accounting standards, credit bureaus, property registries) and, thereby, reduce the banks’ costs of screening and monitoring borrowers. They also strengthen the mechanisms for contract design and enforcement (such as the definition and protection of property rights, legal frameworks for effectively pledging different types of assets as collateral, or the resolution of disputes through courts).

Still, other government interventions, which strengthen insurance markets, provide safety nets and disaster relief, and facilitate the development of more efficient risk-management tools, together with the development of the physical infrastructure (such as roads, clinics and hospitals, irrigation systems) and institutions that deter crime and promote social capital, reduce the probability that adverse production outcomes lead to loan default.

Thus, in the model, in addition to levying required reserve ratios (as a classical tool of financial repression), policy interventions may also be reflected in their impact on the screening and monitoring costs of the banks and in a reduction of the expected rates of default due to idiosyncratic production shocks.
Further, in exploring the impact of financial policies on the distributions of income and wealth, the dissertation seeks to explore the relative effectiveness of these direct and indirect influences of government policies on financial development, taking into account different stages of economic development.

To accomplish this, once the model is solved for a steady-state equilibrium, a number of policy simulations attempt to assess the potential influence of changes in the required reserve ratio (such as those due to increasing degrees of financial liberalization) and of changes in bank screening, monitoring, and contract enforcement costs (such as those due to an improved physical and institutional infrastructure) as well as changes in the riskiness of borrowing firms (such as those due to a reduction of the probability of adverse shocks and their severity as well as those due to improved access to risk mitigating tools, such as those available in insurance markets).

The sensitivity of these simulations, to different levels of key exogenous parameters, is also analyzed. To capture the role of financial policies along different stages of economic development, the sensitivity of the simulations is undertaken with respect to exogenously considered changes in the levels of human capital formation. In addition, data for a developing country, Pakistan, are used to calibrate the model and to explore its consistency with actual real world outcomes.

Thus, for the purposes of this dissertation, the most important sensitivity analysis is undertaken with respect to the composition of the labor force, by levels of household skills. In this way, the dissertation acknowledges that the process of financial development is usually associated with the process of economic development at large.
Indeed, both processes proceed simultaneously and mutually reinforce each other. Thus, in the real world, the income and wealth distribution effects of financial development cannot be disentangled from these circular interactions: financial deepening contributes to economic development, while the pace and style of economic development influences the size and structure of the financial system (Cameron et al. 1967, Goldsmith 1969, Levine 1997 and 2004, Levine, Loayza and Beck 2000). As a simple but relevant proxy for the structural transformation that accompanies the process of economic development, the dissertation uses the composition, by skills, of the labor force.

Because the influence of financial policies on the distribution of income thereby depends on the stage of economic development (reflected, in the model, by the gradual transformation of the labor force from low-skilled to high-skilled households), the possibility for a Kuznetsian story thus emerges, where financial development may at first worsen and then improve the distribution of income (Kuznets 1955).

This path of the evolution of inequality, as labor productivity increases, would be mostly governed by the rate of human capital accumulation. However, in contrast to the original statement by Kuznets (who never considered financial intermediation in his models), this dissertation augments the Kuznetsian hypothesis, by explicitly or implicitly recognizing two roles for financial policies and financial development in this process. On the one hand, for a particular structure of the economy taken as given (i.e., for a given steady-state equilibrium), the model shows the extent and direction of the impact on distribution of different types of financial policies, either direct market interventions or improvements in the environment for the operation of financial markets.
On the other hand, financial development itself is an important determinant of the process of human capital accumulation (Jacoby and Skoufias 1997, Fallon and Lucas 2002, Beegle, Dehejia and Gatti 2003 and 2006, Guarcello, Mealli and Rosati 2003, Maldonado and Gonzalez-Vega 2008). Thus, the combined and interrelated influence of: (a) human capital accumulation (given exogenously in the analysis of this dissertation) and (b) the process of financial deepening —jointly— determine the paths of income and wealth inequality and the speed at which a given country would move along these paths.

In summary, the a priori expectation is that the joint interaction between financial deepening and human capital accumulation has a significant —albeit, nonlinear— influence on the distributions of income and wealth and that an augmented Kuznets curve hypothesis offers a good approximation to characterize this evolution.

Further, since financial development may be influenced by two quite different policy approaches, either: (a) through direct interference with the operation of markets (financial repression or financial liberalization) or (b) through improvements in the environment for the operation of financial markets (namely, infrastructure and institution building), the dissertation explores the contrasting impacts of these two approaches.

While the focus of the dissertation is an identification of the income and wealth distribution impacts of financial policies, it is not a rigorous exploration of the optimality of financial policies as a tool to promote a particular distribution. Actually, in a general equilibrium framework, financial policies have consequences on the aggregate level of output, labor productivity, household wages, and the accumulation of wealth (deposits), which must be considered in the welfare evaluation of any distribution outcomes.
1.1 Earlier Literature and Contributions

Between financial and other policy decisions and their income and wealth distribution implications, there is a complex chain of interactions. While some of the pieces of the answer to the question raised in the first sentence of this dissertation have been individually looked into earlier, as separate pieces of the puzzle, the complete chain of relationships, going from financial policies to inequality, has not been systematically addressed. The equally modest purpose of this dissertation is to explore this question by focusing on one of the links in the chain that has been examined the least.

In effect, the field of monetary economics has dealt with the assessment of the impact of financial policies on the rate of growth of output and on its stability (Bofinger 2001, Aghion, et al. 2004 and 2010, Cermeno, Roa Garcia and Gonzalez-Vega 2012). Key questions have been the relative effectiveness of different instruments of monetary and other financial policies and their intended and unintended consequences. In this dissertation, which does not address these issues, the specific actual results of monetary policies are represented by their influence on the extent of financial market frictions, as reflected by interest rate spreads, and on the extent of financial deepening.

In turn, development economists have analyzed, in detail, the different channels through which financial development influences the efficiency of resource allocation, factor productivity, technological change, the accumulation of physical and human capital, and the rate of growth of output. In particular, Levine (1997) claimed that “the preponderance of theoretical reasoning and empirical evidence suggests a first-order relationship between financial development and economic growth” (p. 688).
The dissertation suggests that the influence of financial policies on the income and wealth distributions proceeds through the same channels identified by this finance and development literature (Demirgüc-Kunt 2006), while specific distributional impacts emerge as an outcome of the heterogeneity of the users of financial services (depositing households and borrowing firms) and of the differentiation in the supply of financial services across the population, on the basis of risk profiles, transaction costs, and/or policy mandates.

The output growth-inequality nexus and the financial development-inequality nexus have also been reviewed in some detail. Aghion, Caroli, and Garcia-Peñalosa (1999), Barro (2000), Banerjee and Duflo (2003), among others, have examined the extent and direction of causation between growth and inequality. In turn, Beck, Demirgüc-Kunt and Levine (2004) and Clarke, Xu, and Zou (2006) have explored the relationship between financial deepening and inequality. An earlier examination of the impact of financial development on income inequality, using dynamic general equilibrium modeling, has been attempted with data from Thailand (Gine and Townsend 2004, Townsend and Ueda 2006, Jeong and Townsend 2008).

The explicit impact of different types of policies on inequality, working their way through financial development, has been least explored (Demirgüc-Kunt and Levine 2009). This dissertation builds on these earlier pieces of research and attempts to identify potential, direct and indirect, channels through which the influence of financial policies might be transmitted to the real economy, via their impact on financial development, thereby affecting the level of output and the distributions of income and wealth.
This dissertation thus attempts to add to the existing literature by: (a) explicitly incorporating in the model an independent banking sector, which assesses credit risk and performs intermediation between households and firms, in a general equilibrium environment. It also contributes to the analysis by: (b) making endogenous the simultaneous determination of wages and interest rates, (c) making endogenous the interactions between the differential amounts of credit available to the formal and informal sectors of the economy, their levels of output, and income inequality, and (d) analyzing the interactions between financial development and income and wealth inequality at the intensive margin —where the removal of constraints to financial transactions reduces the extent of market frictions and allows the matching of the demand and supply of financial services through a smaller interest rate differential. Further: (e) the dissertation links the influence of financial policies on distribution to the broader development literature, by weaving in a Kuznetsian interpretation.

1.2 Motivation

As a bank examiner and as a mid-level policymaker at the State Bank of Pakistan, I have casually observed the potential impact of financial sector deepening on the state of the economy, in general, and on the lives of the people, in particular. During my visits to the urban and rural areas of the country, I have witnessed how financial services can help households to cope with adverse circumstances, thereby protecting their income-generating capacity, and can facilitate their saving and investment efforts, leading to the accumulation of wealth.
This dissertation is an effort to develop a formal framework for better understanding these stylized facts from my earlier observations in the field and to generate rigorous criteria for the evaluation of policy initiatives that may have distributive consequences.

Distribution matters. In a developing country like Pakistan, where 21 percent of the population earns incomes below US$1.25 per day and where the share of the wealthiest 10 percent of the population is 26 percent of aggregate household income (World Bank 2011), poverty and inequality are rife. While Pakistan is classified by The World Bank as a lower middle-income country, with a per capita income of US$ 1,120 (as per the Atlas method, in 2011), making financial services affordable and providing access to these services to the bulk of its population of 176 million people remains a daunting challenge.

Indicators of shallow financial development can also be found in Pakistan. In 2010, the interest rate spread between the weighted average lending and deposit interest rates was 9.34 percentage points (State Bank of Pakistan 2010). Moreover, not only these averages ignore the actual dispersion of the interest rates faced by different segments of the population, as they gain access to a variety of formal, semi-formal and informal providers of financial services. Also, by not including the typically high and very dispersed transaction costs incurred by different kinds of depositors and borrowers, this indicator underestimates the true gap between the total cost of funds for borrowers and the net return on deposits for savers as well as the extent of fragmentation of financial markets in the country (Gonzalez-Vega 2003).
Numerous pieces of evidence reveal, in turn, the determinants of high transaction costs for all financial market participants, particularly in the rural areas of Pakistan. Moreover, prohibitively high transaction costs have excluded important segments of the population from access to institutional financial services and are responsible for missing segments and dimensions of the financial market (Aleem 1990, Gonzalez-Vega 1993). Numerous households and firms remain credit-constrained or do not have access to safe and convenient deposit facilities (Meyer and Nagarajan 2000, Llanto and Badiola 2011).

While country-wide data on these transaction costs are not readily available, their influence has to be considered, however, in evaluating any policy options. Empirical work based only on available spreads between banking interest rates would underestimate, therefore, the potential impact of financial development on income distribution in a developing country like Pakistan.

Financial inclusion is constrained in Pakistan by the limited outreach of the institutional infrastructure. There were only 8.75 commercial bank branches per 100,000 people in the year 2011. Conventional indicators also reveal the limited extent of financial deepening in Pakistan. Domestic credit to the private sector—as a percentage of the GDP—was only 18 percent in 2011. In turn, the gross savings (from the national income accounts) to the GDP ratio was 21.8 percent (World Bank 2011). These stylized facts and my own experience motivated my interest in the linkages between the financial and real sectors of the economy and in understanding how they interact to affect income and wealth inequality.
Moreover, the recent recession in the United States, since 2008, has brought to the forefront the critical role that the financial sector plays in the smooth performance of the economy. It was a financial crisis—triggered by systemic defaults in subprime mortgages—that precipitated the recession (Caprio, Demirgüc-Kunt and Kane 2008, Brunnermeier 2009, Kane 2009). This episode has been a dramatic illustration of how, for better or for worse, financial performance can influence the real economy and, as a result, income distribution.

Among other things, it has been explicitly claimed that this crisis has had an impact on poverty and inequality (Hurd and Rohwedder 2010, Rajan 2010). The Gini coefficient for the distribution of income for the United States increased from 0.463 in 2007 to 0.469 in 2010 (FRED, Federal Reserve Economic Data 2010). While the actual path of causality from the financial crisis to the deterioration of the distribution of income is still being researched, this experience is an indication of the potential influence of finance on income distribution.

In general, the literature on income distribution implicitly assumes financial market imperfections as given and it focuses on other determinants of inequality, such as schooling levels, savings rates, fertility decisions and the like (Barro 2000). There has been, however, heavy reliance on finance and financial constraints in some theoretical explanations of persistent inequality and poverty traps (Galor and Zeira 1993, Mookherjee and Ray 2003). These predictions have also been captured in empirical results (Barro 2000, Roine, Vlachos and Waldenstrom 2009).
The degree of financial deepening is not immutable, however (Demirgüç-Kunt and Levine 2009). Rather, it is an evolving process, whose pace and style may be influenced by financial policies. The purpose of this dissertation is to explore how these policies may impact income and wealth inequality. Moreover, aggregate economic development (namely, the structural transformation of the real sector) and financial deepening take place simultaneously and can be mutually reinforcing. While recognizing that financial development has an influence on the pace of human capital accumulation, the dissertation relies on an exogenous evolution of the distribution of skills across the labor force to explore the impact of financial policies, along the process of economic development, on the distribution of income.

1.3 Concepts, Definitions and Preliminaries

Financial development can be defined in several ways. Shaw (1973) defined financial deepening as an increase in financial wealth with respect to total wealth, in order to emphasize the productivity-enhancing consequences when a larger share of the available resources (wealth) is allocated through the discipline of financial intermediation. Limited financial development may be associated, in turn, with the shallowness that results from the classical features of underdevelopment, in particular a limited physical and institutional infrastructure, which increases transaction costs and risks and creates barriers to the emergence of financial transactions (Gonzalez-Vega 2003). Alternatively, financial repression would result from inappropriate policy interventions that hinder the development of the financial system (McKinnon 1973).
Given recent public policy concerns about financial inclusion, many define financial development as an improvement in the access of the bulk of the population to various types of financial services (Greenwood and Jovanovic 1990, Gine and Townsend 2004), thereby emphasizing the breadth, depth, and other dimensions of outreach (Schreiner 1998, Gonzalez-Vega and Villafani-Ibarnegaray 2011).

Limited financial progress —either from shallow market development, missing markets, and broad exclusion from access to financial services or from policy-induced financial repression—is reflected, in all cases, by the extent of the frictions prevailing in financial markets. These frictions are reflected, in turn, by differences between the total cost of funds for marginal borrowers—the interest rates charged on loans plus borrower non-interest transaction costs—and the net return on deposits for marginal savers—the interest rates paid on deposits minus depositor transaction costs (Gonzalez-Vega 1976).

Financial development would then be associated with the reduction of these frictions. A crude approximation of the wedge associated with these frictions would be the gap between the lending and the deposit interest rates observed in the process of intermediation. A proxy for financial development would then be a reduction of this spread. It is important, however, to keep in mind the limitations of the spread as an accurate representation of the frictions, particularly in economies where the outreach of finance is still limited (Brock and Rojas-Suarez 2000). In particular, when the transaction costs faced by potential financial market participants are prohibitively high, a reduction of these frictions would lead to an expansion of the breadth of outreach (financial inclusion) and to the emergence of theretofore missing markets (Gonzalez-Vega 2003).
In turn, empirical researchers working with country-level information have generally used as a proxy for financial deepening the ratio of credit to the private sector with respect to the GDP (Beck, Demirgüç-Kunt and Levine 2004, Clarke, Xu and Zou 2006), but some have also used the ratio of deposits mobilized to the GDP, as an indicator of financial development (McKinnon 1973, Roine, Vlachos and Waldenstrom 2009).

The basic premise behind using these indicators for financial development is to gauge both the affordability and the outreach of financial services. This dissertation follows the approach of Gonzalez-Vega (2003) and assesses financial development by the evolution of the gap or wedge between the lending and deposit interest rates (as proxies for total borrowing costs and net returns to savers) and measures the impact of financial policies on this gap. As will be discussed below, however, the magnitude of this gap and the relative size of the financial sector (i.e., financial deepening) are intimately related.

The authorities can adopt several types of policies, monetary and non-monetary, to influence the performance of the financial sector (Shaw 1973). These include interest rate and other influences or controls on the prices of financial services, including the levying of the inflation tax, quantitative and qualitative credit controls, required reserve ratios on deposits, rediscounting rules and access to a lender of last resort, credit and deposit insurance, capital adequacy ratios and other prudential rules for loan-loss reserves as well as risk-exposure limits, bank and branch licensing and other barriers to entry, corporate governance requirements, the establishment of credit bureaus and other mechanism for the rating of risk and information sharing and the like.
Non-financial interventions, which influence the country’s physical infrastructure (roads, communications, energy) and its institutional infrastructure (law and order, property rights, contract definition and enforcement, courts and business regulations, crop insurance) influence financial deepening through reducing or augmenting transaction costs and risks for actual and potential market participants (Gonzalez-Vega 2003).

Specific strategies for financial inclusion have been recently recommended by international agencies and adopted by numerous governments, including Pakistan (State Bank of Pakistan 2008, Alliance for Financial Inclusion 2011). The aims of these policies have been to improve the access of the bulk of the population to financial services and, for those who already have access, to improve the benefits of making formal financial transactions, by broadening the range, improving the quality, and reducing the cost of services (Ardeva and Rhyne 2011).

In this dissertation, the impact of the different types of financial policies is explored by incorporating—in the general equilibrium model—the required reserve ratio on the deposits mobilized by banks from households (as a proxy for a variety of policy interventions) and by observing its implications on the wedge between loan and deposit interest rates and on the volumes of deposits mobilized and loans granted (credit availability). Given the heterogeneous risk profiles of the firms and the heterogeneity of the labor supply that is matched with the different types of firms, differential changes in credit availability generate income distribution consequences. While acknowledging that the reverse channel might also exist, the causal direction of the relationship emphasized in the dissertation is from policies to inequality.
In the model, the direct policy intervention variable (the required reserve ratio), is given exogenously. Thus, this required reserve ratio is used as a proxy for a wide range of policy actions that are discrete and controllable.

In a more explicit political economy framework, not examined here, it may be possible to relate the (endogenous) adoption of specific policies to the relative power of different vested interest groups. Their differential ability for lobbying and for collective action would make it possible for them to induce policy choices that favor their shares in the distributions of income and wealth. These effects are ignored here, although they may be important in explaining actual outcomes in developing countries.

Simulation results from the model reveal that direct policy interventions, such as manipulating the required reserve ratio, lead to a trade-off between potentially improving the distribution of income versus lessening financial deepening and lowering the level of wages and aggregate output. Using this kind of policy tools, the authorities might induce small improvements in the distribution of income, but this would occur at a large loss in terms of output and financial deepening. These adverse effects are particularly strong during the early stages of economic development. The required reserve ratio and similar repressive policy instruments are, therefore, not recommended for achieving the public policy goal of lowering the inequality in the distributions of income and wealth.

Pro-informal, pro-poor biased indirect policy interventions, resulting either in a lower default rate in the informal sector or lower costs of lending to the informal sector, have a positive and comparatively stronger impact in reducing the inequality of the distributions of income and wealth, especially at the early stages of development.
At more advanced stages of development, however, the results are mixed. There may be a trade-off between: (a) improving the distributions of income and wealth and (b) reducing the level of output and the rate of accumulation of wealth (when the informal sector default rate is cut down). The inequality of the distribution of wealth may even rise (when the costs of lending to the informal sector are lowered). Nevertheless, sector-specific indirect policy interventions, which improve the environment for the operation of credit markets, are better tools to improve the distributions of income and wealth, without losses of output, when the economy is at an early stage of economic development and when financial market frictions are particularly acute in the informal sector.

When the original Kuznetsian story of economic development and inequality in the distribution of income is augmented by also considering financial development, the combined effect of the structural transformation, from a low-skilled to a high-skilled labor force (as the engine for economic development), and financial liberalization leads to lower inequality in the distribution of wage incomes, at each level of the human capital stock, along the inverted-U shaped path.

Moreover, the peak values of the Gini coefficient (as a measure of inequality in the distribution of income) are lower for the augmented Kuznetsian case than the peak values for the original Kuznetsian scenario, and the economy reaches these peak values, at the level when the distribution of household wage incomes starts to improve, at an earlier stage in the development process. Further, the difference between the two series of Gini coefficients grows larger as further financial development takes place, along with the structural transformation of the labor force.
Not only does sustained financial deepening eventually improve the distribution of income, but it also contributes to greater efficiency in resource allocation. There is a monotonic and more substantial reduction in the wedge between the interest rate charged on loans and the interest rate paid on deposits in the augmented than in the original Kuznetsian story. The volume of deposits mobilized is also larger, at every stage of the structural transformation, and there is a greater increase in GDP. The indicators of financial deepening (i.e., ratios of credit to the GDP, deposits to the GDP, and reserves to the GDP) all show better improvements in the augmented scenario.

These results for the augmented Kuznetsian case are confirmed when the analysis is performed with the model parameters calibrated with data from a developing country, Pakistan. Additionally, in this case, there is less wealth inequality, along the Kuznetsian path, when financial development accompanies human capital development than if not.

1.4 Organization

The rest of the dissertation is organized as follows.

Chapter 2 reviews the relevant literature and states the objectives of this research. Chapter 3 introduces and explains the general equilibrium model. Chapter 4 presents the strategy for computing the numerical solution of the model. Chapter 5 presents the results of the policy simulations and examines the sensitivity of these results to changes in some of the exogenous parameters. Chapter 6 discusses some modifications made to the model, considering the data from Pakistan. It also describes the calibration strategy followed and the results from the model. Chapter 7 concludes and proposes a future research agenda.
Chapter 2: Literature Review and Research Objectives

The aims of this chapter are to review some conceptual issues and earlier contributions on the topic, argue in favor of adopting the methodology of general equilibrium modeling in studying the relationship between financial policies and income and wealth inequality, and specify the objectives of the research.

2.1 Finance, Output, and Economic Growth

While some economists consider the financial sector to be not that important for economic growth (Lucas 1988) and some even dismiss its relevance altogether (Robinson 1952), there is a vast theoretical and empirical literature that not only discusses the possible channels through which linkages between finance, output, and growth might exist, but which also supports the arguments with empirical evidence (Schumpeter 1934, Shaw 1973, King and Levine 1993, Levine 1997 and 2004, Beck, Levine and Loayza 2000, Levine, Loayza and Beck 2000, Ahlin and Jiang 2005 and 2008, Cermeño, Roa Garcia and Gonzalez-Vega 2012). The basic premise of these contributions to the literature is that, once one moves away from the Arrow-Debreu world of perfect markets, financial instruments and financial intermediaries sprung up naturally to ameliorate the costs and mitigate the risks associated with transactions performed in markets with frictions and limited information.
These financial intermediaries alter the path of economic development because they mobilize savings (while, in some instances, increasing the savings rate) and influence the efficient allocation of the savings so mobilized, thereby augmenting output and promoting the accumulation of physical and human capital. They also improve corporate governance, through the monitoring of projects and of managers, and they spur technological innovations, by lowering the costs associated with research and development (R&D). By providing intermediation services between depositors and borrowers, banks and other financial institutions thus influence the level of output and the rate of economic growth. A detailed review of this literature is available in Levine, Loayza, and Beck (2000), Levine (2004), and Cermeño, Roa Garcia, and Gonzalez-Vega (2012).

While this literature suggests different indicators to measure progress in the process of financial deepening, the gap between the total cost of borrowing —which deficit units equate to their marginal rates of return— and the net return to deposits —which surplus units equate, in turn, to their marginal rates of return— captures the potential influence of financial development (Gonzalez-Vega 1976 and 2003). The total cost of borrowing includes, in addition to interest payments, non-interest transaction costs for borrowers, while the net return on deposits reduces saver rewards below their interest rate earnings (Adams and Nehman 1979). The intermediation spread earned by banks must cover, in turn, the transaction costs associated with mobilizing funds and managing a loan portfolio, including the losses due to default, and generate a profit.
By reducing differences in marginal rates of return across the economy (i.e., by reducing the extent of fragmentation), financial intermediation improves the allocation of resources. All types of financial policies influence the gap between the total cost of funds and the net return on deposits and, therefore, have an impact on real magnitudes in the economy. In the model, the dissertation ignores the transaction costs of borrowers and depositors and, for simplification, describes this wedge as the difference between loan and deposit interest rates. It is important to keep in mind, however, the limitations of the intermediation spread as an accurate representation of these frictions, particularly in economies where the outreach of finance is still limited (Brock and Rojas-Suarez 2000).

Among various policy instruments, required reserve ratios are particularly influential, as they both increase this wedge and also introduce a leakage in the process of intermediation, with a portion of the deposits mobilized not being available for lending. Moreover, required reserve ratios create a friction that similarly influences the aggregate volume of deposits mobilized and, therefore, all components of bank loan portfolios.

In contrast, policies that modify the environment for the operation of financial markets (such as the development of institutions and infrastructure, or risk-reducing tools) may have biased impacts, reducing costs and risks in a non-uniform fashion and favoring some components of the loan portfolio more than others. This has been the case, for example, with microfinance as an innovation and its differential ability to modify the relative costs of lending to different clienteles (Navajas, Conning and Gonzalez-Vega 2003, Gonzalez-Vega and Villafani-Ibarneagaray 2011). Such non-uniform changes in loan portfolios have significant impacts on the distribution of income.
In the model developed in the next chapter, the required reserve ratio influences the aggregate amount of deposits mobilized by the banks and the allocation of those funds to loans for formal and informal firms, depending on the elasticity of the household supply of deposits and the elasticity of the demands for credit from the two types of firms. In turn, biased (pro-poor) improvements in the environment for the operation of financial markets are reflected in changes in the relative riskiness of both types of firms and in the threat of default emerging from adverse idiosyncratic shocks experienced by them as well as in non-uniform reductions in the banks’ costs of screening and monitoring borrowers and enforcing loan contracts.

2.2 Financial Development and Inequality

The determinants of inequality have been explored by economists and sociologists alike. Kuznets (1955) identified several opposing forces at work in a dynamic economy that might influence income inequality. He focused on the concentration of wealth (and of high-return assets) in the hands of the rich and on growing industrialization, which results in the wages of urban workers to increase more rapidly than their rural (agricultural) counterparts, as the two catalysts in increasing inequality over the structural transformation of the economy. The trend towards concentration is countered by redistribution policies, due to political and social pressures, demographic transitions, and technological progress. In summary, he argued that, as the economy develops and the work force moves from a low-paying primitive agricultural sector to a high-rewarding industrial sector, inequality would initially rise.
As the flow of workers from agriculture to industry decreases, however, inequality would decrease, due to saturation of labor markets in the industrial sector and the obsolescence of old sectors. Thus, Kuznets proposed a non-linear, inverted U-shaped relationship between inequality and the stages of growth, with the latter being proxied by levels of per capita income. Later, in a series of articles, he presented some empirical evidence to support his hypothesis.

In an article in 1963, using both cross-country and time series data, Kuznets found the inverted U-shaped relationship between inequality and GNP per capita (Aghion, Caroli and Garcia-Peñalosa 1999). Inherent in his argument is a direction of causation from growth to inequality and not the reverse. Also, Kuznets did not mention any role of finance or the financial sector in influencing inequality. Actually, most development economists in the post-World War II era neglected the role of finance (Shaw 1973, Long 1983).

Kuznets’ work spurred interest among development and growth economists in frameworks for the identification of the major determinants of inequality, including finance, and the explanation of trends in income distribution. In the early years after Kuznets (1955), his hypothesis was widely accepted as an empirical stylized fact, but later on researchers challenged his views, as income inequality in developed countries started to rise in the 1980s. They argued that the relationship between economic development and inequality is constantly evolving, due to the interplay of various forces, and that economic growth may actually increase wage inequalities (Aghion, Caroli and Garcia-Peñalosa 1999).
Sociologists have also contributed to the study of income and wealth inequality (Neckerman and Torche 2007, McCall and Percheski 2010). Acknowledging that direct interventions that drive inequality have not been fully explored, their focus has largely been on organizational structures and labor markets. They have argued that the matching between heterogeneous workers and firms, based on the supply and demand of skills, effects income inequality, by allowing the heterogeneity in worker productivity to be reflected in wage earnings (Sorensen 2007, Neckerman and Torche 2007). Thus, differences in labor productivity become one of the key determinants of inequality, a stylized feature that is reflected in the model developed in this dissertation.

Another strand of the literature relates inequality to political economy circumstances. The basic argument is that the existing inequality leads to a redistribution of wealth from rich to poor (e.g., through taxes and transfers), which in turn leads to market distortions and low investment rates. This redistribution hurts economic growth (Barro 2000, Banerjee and Duflo 2003). According to this argument, the direction of causality is from inequality to reduced economic growth.

Gonzalez-Vega (1976 and 1977) explored the influence of financial policies, in the shape of constraints on interest rate determination, on income distribution. Ceilings and other mechanisms that enforce uniform interest rates and lead to a pooling equilibrium result in various types of credit rationing (Jaffee and Stiglitz 1990). Under some circumstances, these policies exclude segments of potential borrowers from access to credit, thereby forcing them into self-financing and liquidity constraints.
Gonzalez-Vega (1976) distinguishes between rationed borrowers (those who are left with an excess demand for credit at the equilibrium uniform interest rates) and non-rationed borrowers (those who receive the amounts of credit they demand at the going interest rate). When interest rate ceilings become more restrictive, the size of loans granted to rationed borrowers declines (as banks cannot cover the higher marginal costs of the existing loans, with the lower uniform interest rate), while the size of loans to non-rationed borrowers increases (along their demand for credit schedules).

According to what Gonzalez-Vega calls “the iron law of interest rate restrictions”, as constraints on interest rate determination become more binding, the share of the (shrinking) loan portfolios going to non-rationed (usually richer) borrowers increases, while the share of loan portfolios going to rationed (usually poorer) borrowers declines. As a consequence, the distribution of income worsens. Researchers at The Ohio State University and elsewhere then reported on the empirical evidence of numerous instances when the iron law has been in effect during periods of financial repression (Ladman and Tinnermeier 1981, Von Pischke, Adams and Donald 1983, Adams, Graham and Von Pischke 1984, Graham and Cuevas 1984, Vogel 1984, Braverman and Guash 1986, Chaves and Gonzalez-Vega 1996, Yaron, Benjamin and Piprek 1997, Gonzalez-Vega 1998, Westley 1999, Zeller and Meyer 2002, Armendariz and Morduch 2010).

The interactions between finance, inequality and poverty alleviation have been discussed further in the literature, albeit more recently (Levine 2004). Greenwood and Jovanovic (1990), in particular, showed the complementarities between economic growth and financial development and how they combine to affect income inequality.
In their analysis, a growing economy helps the development of costly financial structures of intermediation, which in turn promote growth by making the returns to savings (capital) higher. Similar to Kuznets (1955), in their model, inequality first rises, in the early stages of development, because only the wealthy have access to financial markets and higher-return projects. With increases in both the economic growth rate and the savings rate, more people can join financial markets and earn higher incomes.

Eventually, the distribution of income becomes stable, when extensive financial structures of intermediation have already been developed and the economy is sufficiently mature, due to a convergence of the growth rate to a higher level than that prevailing at infancy and to a decline in the savings rate. The direction of causation, from economic and financial development to income inequality, is apparent in their analysis.

In contrast, Galor and Zeira (1993), in a two-period overlapping generations (OLG) model with skilled and unskilled labor, imperfect credit markets, and indivisible investment in human capital, showed that the initial distribution of wealth affects aggregate output and investment. Due to the high costs of borrowing, unskilled individuals with a small amount of wealth (which is the outcome of bequests from earlier generations) cannot invest in human capital skills and are unable to break out of a poverty trap. The evolution of the aggregate economy to a “developed” or a “less developed” state thus depends upon the size of the unskilled (skilled) labor force, which in turn depends upon inherited wealth and wages.
An economy is classified as developed only when the wages of unskilled workers are higher than the minimum amount needed to invest in indivisible human capital. This is only possible when wealth is evenly distributed. According to these authors, an economy with a large initial but concentrated stock of wealth would end up poorer in the long run. Further, exogenous adverse shocks to the productivity of unskilled laborers reduce their permanent income and exacerbate inequality even further for less developed economies, while developed economies simply suffer a temporary loss of income, because they have the resources (wealth) to invest in human capital. Though they do not rule out a Kuznets curve, Galor and Zeira (1993) highlight the importance of the initial inequality on the subsequent rates of growth and pattern of development.

Similarly, Banerjee and Newman (1993) and Aghion and Bolton (1997) show that credit constraints—produced by information asymmetries—are particularly binding for the poor, because they do not have the resources to fund their own projects or the collateral to access credit. These credit constraints, on the one hand, restrict the flow of capital to its best-value use, thereby lowering output and the rate of growth, and, on the other hand, increase inequality, by excluding the “wealth-deficient” entrepreneurs. Thus, financial development can improve the allocation of credit, by reducing information and transaction costs and by allowing more people to obtain finance. Thus, access to finance can have a pro-poor impact (Levine 2004).

This theoretical literature highlights the debate about the impacts of financial development, possible causes of inequality, and the direction of causality between economic growth and inequality and financial development and inequality.
The ambiguous theoretical predictions discussed above suggested exploring these links through empirical evaluations. Empirically, researchers have generally focused on estimating a reduced-form relationship between economic growth and income inequality and between financial development and income inequality. Along with the type of relationship (linear or nonlinear), the direction of causality between economic growth and income inequality has also been of interest to researchers, due to the different predictions emerging from theory. As with theory, the empirical literature also presents a divergent picture.

When looking at the inequality-to-growth channel, Barro (2000) found no significant relationship at all. The estimated coefficients on his different measures of inequality, the Gini coefficient and its variants, were essentially zero. However, when Barro separated the sample into rich and poor countries, he found that greater inequality retards growth in poor countries, but that it encourages growth in richer countries. He attributed this result to the differential severity of the credit constraints existing in either type of economies. In turn, while estimating the model for the reverse causality, Barro found a robust inverted U-shaped (Kuznets curve) association between the process of economic development and inequality.

Banerjee and Duflo (2003) pointed out that, depending upon the econometric methodology (OLS, Fixed Effects, Random Effects, 3SLS, GMM) used by the researchers, the relationship between economic growth and income inequality may be negative, positive, or neutral. They attributed this disagreement in earlier instances of research to having ignored the non-linear relationship between the two series of data.
Unlike Barro (2000), Banerjee and Duflo showed, through various empirical models, that the growth rate is an inverted U-shaped function of net changes in inequality. However, they did not test for the reverse causality.

The impact of financial development on income inequality has also been empirically assessed by several researchers. Beck, Demirgüç-Kunt and Levine (2004) reported that financial development reduces income inequality. Using a cross-country sample and the rate of income growth of the poorest quintile as a dependent variable, they showed that financial development (proxied by the ratio of credit to the private sector to the GDP) increases the growth rate of the incomes of the poor more than the rate of growth of the GDP.

To control for the potential endogeneity of financial development, these authors used the legal origin of the countries (Anglo-Saxon or not) and the absolute value of the latitude of the capital city as instrumental variables. The former captures the favorable legal environment and the later captures the natural resource endowment in a country. These authors also showed that financial development has had a positive effect in reducing the growth of the Gini coefficient.

Similarly, Clarke, Xu and Zou (2006) showed that greater financial development leads to lesser inequality in the long run. They also used instruments to control for the endogeneity of financial development and, besides the ratio of credit to the private sector to the GDP, they used the claims on the nonfinancial domestic sector by the banks to the GDP as the second measure of financial development.
Unlike Beck, Demirgüç-Kunt and Levine (2004), Clarke, Xu and Zou checked for a non-linearity between financial development and income inequality and they found no significant relationship.

Similarly, Roine, Vlachos, and Waldenstrom (2009), while analyzing the determinants of inequality for a panel of 16 countries over the entire 20th century, showed that financial development, measured by either the deposits to GDP or credit to GDP ratios, influences the income earned by the richest one percent of the population. They concluded that finance is pro-rich, especially for countries at the beginning of the process of economic development. They also report that, in their data, banking crises negatively affect the income of the rich.

From this empirical literature, it is apparent that the direction of causality between economic growth and income inequality is not obvious (or unambiguous), but that there is some agreement about the relationship between financial development and income inequality. However, the direction of impact of financial development on inequality is not simple or evident, either.

Clarke, Xu and Zou (2006) showed that inequality declines with financial development and Beck, Demirgüç-Kunt and Levine (2004) suggested that the growth of inequality (Gini) decreases with financial development, while, in contrast, Roine, Vlachos, and Waldenstrom (2009) showed that financial development improves the income of the richest one percent of the population, thereby increasing inequality.
These disparities in the predictions by the theoretical literature and the results of the empirical literature point towards the complexities of the phenomenon being analyzed, due to dynamic endogenous interactions, direct and indirect (spill over) effects, and lack of reliable data. One possibility, then, is to study these relationships in a quantitative general equilibrium environment (Demirgüc-Kunt and Levine 2009), in which some of the possible channels of endogenous interactions could be modeled, while exogenously controlling for others. This strategy has been followed by Robert Townsend who, with various coauthors, has developed, estimated and/or calibrated general equilibrium models, to analyze the impact of financial development on growth, income inequality, and household welfare, using his famous Thai dataset.

Using an earlier framework of occupational choice by Lloyd-Ellis and Bernhardt (2000), Gine and Townsend (2004), after incorporating access to credit in the general equilibrium environment, were able to explain the fast economic growth achieved in Thailand after financial liberalization. They, however, implied that while the rapid expansion of the financial sector brought about growth in Thailand but it worsened the distribution of income. In their model, financial deepening was exogenously controlled, there was no variation in wages due to skills, and lending and borrowing was done at the same gross interest rate. Moreover, their model focused on the extensive margin (i.e., removing credit constraints and improving access to financial services for those who do not have access), but it ignored the intensive margin, wherein the effects of financial liberalization can be analyzed for those who already have access to financial services.
In another contribution, Townsend and Ueda (2006) took the Greenwood and Jovanovic (1990) model to the data from Thailand. They modified their model of financial participation, to make it tractable for quantitative analysis, by making assumptions about the stationarity of the distributions, high risk aversion of the households, and desirable savings rate. Since the Greenwood and Jovanovic model has aggregate shocks that impact the income of all those who participate in financial markets, Townsend and Ueda analyzed the transition dynamics of the model instead of undertaking an equilibrium analysis. In the results, Townsend and Ueda were able to match the averages and time trends in financial deepening and income inequality of the Thai economy but they missed the rate of economic growth.

This important contribution sets forth the basis for quantitatively studying the transition dynamics of non-stationary models. However, in their work, factor prices (wages and interest rates) were exogenous and the effects of aggregate shocks were asymmetric (affecting only financial sector participants). Also, there was no exit for the agents from the financial sector, which means that the economy is bound to grow and inequality to decline, as more and more agents are able to overcome the initial fixed cost of entry.

Several conclusions, of interest to this dissertation, can be obtained from this literature review:

(i) complex relationships between financial development and income and wealth inequality can be better analyzed in a general equilibrium setting, instead of a reduced-form econometric exercise;
(ii) indeed, the data-generating process suggested by the theoretical models is not the same as the data series generally used in reduced-form econometric exercises, thereby rendering the estimated coefficients sketchy (Townsend and Ueda 2006);

(iii) the nexus between financial development and income inequality has so far not been sufficiently analyzed from a policy angle (Demirgüç-Kunt and Levine 2009);

(iv) most theoretical and quantitative models have explored the interactions between financial development and inequality at the extensive margin, where the agents’ lack of access to financial services has been addressed (Gine and Townsend 2004), but not at the intensive margin, where the issues arising after access has already occurred could be explored (Demirgüç-Kunt and Levine 2009);

(v) issues about the endogeneity of financial development and income flows and wealth accumulation have not been looked into in detail, and

(vi) the financial sector has been assumed to work without frictions and devoid of any allocation decisions of its own.

Further, among other things, any model about income inequality must recognize that heterogeneity in household labor productivity may be the harbinger for an explanation of differences in wage incomes and wealth accumulation.
Thus, a model about the impact of financial policies on income distribution must take into account (at least exogenously) household differences in labor productivity. It must also take into account differences across borrowing firms, from the perspective of the costs and risks perceived by banks in the allocation of their credit portfolios to different types of firms. In the model developed in the next chapter, both household heterogeneity and firm heterogeneity (which leads to different marginal cost schedules in the supply of bank credit) play a key role, as they interact with the consequences of different financial policies.

2.3 Research Objectives

The foremost objective of this dissertation is to show that, in a general equilibrium environment, financial intermediation, the simple mechanism of mobilizing deposits and efficiently allocating the corresponding command over resources to productive firms, has a measurable impact not only on the level of output and the accumulation of assets, but also on the distributions of income and wealth.

The second objective is to assess how much, if at all, would the inequality of the distributions of income and wealth react to changes in direct financial policy interventions, the impact of which may be proxied by changes in the required reserve ratio. The results would shed light on the impact of policies that fail to reduce the wedge between the lending and deposit interest rates.
The third objective of the dissertation is to examine the impact — on the distributions of income and wealth — of government interventions that induce changes in the environment for the operation of financial markets. These interventions either reduce, in a non-uniform fashion, the risk of default by various types of firms or reduce, also in a non-uniform fashion, the bank costs of screening and monitoring borrowers and enforcing loan contracts. The dissertation would then contrast the implications of direct policy interventions in the operation of financial markets or indirect influences, through improvements in the environment for the operation of those markets.

The fourth objective of the dissertation is to reassess the various impacts of financial policies on the inequality of the distributions of income and wealth once human capital accumulation and its dependence on financial deepening are taken into account. This objective would establish under what circumstances the combined influences of human capital accumulation and financial deepening generate an augmented Kuznets path for the association between levels of income and wealth inequality and the progress of economic development at large.

One last objective is to calibrate and compare the outcome of the model with actual data. For this purpose, available data from a developing country, Pakistan, are used. Thus, building on the conclusions from the literature review and based on these research objectives, in this dissertation the impact of financial policies on income and wealth inequality is explored using a dynamic stochastic general equilibrium model, without aggregate (systemic) shocks, to be developed in the next chapter.
Chapter 3: A Dynamic Stochastic General Equilibrium Model with Heterogeneous Households

The purpose of this dissertation is to show, in a general equilibrium environment, that financial intermediation —the simple mechanism of mobilizing deposits from households, evaluating credit risk, and efficiently allocating the purchasing power over resources so mobilized towards productive firms— has an impact not only on the level of output and the accumulation of assets but also on the distributions of income and wealth in a developing economy. This chapter describes, in detail, the dynamic stochastic general equilibrium model developed in the dissertation to accomplish this purpose, it states the conditions for a stationary equilibrium in the model, and it lays the foundations for its numerical solution.

In order to explore the influence of financial behavior, policies, and development on income and wealth inequality, the model developed here must incorporate a minimum set of features that ensure the existence of inequality in the stylized economy under consideration. In particular, the two basic features that the model must consider are an explicit mechanism of intermediation between depositors and borrowers and some mechanisms to generate disparity in the distributions of income and wealth.
First, the process of intermediation can be modeled by explicitly including a banking sector, which mobilizes funds (purchasing power) from depositors (saving households) and allocates them to borrowers (productive firms).

The performance of the banking sector is constrained by the presence of a number of frictions, which introduce a wedge between the total cost of funds for borrowers (represented in the model by the interest rate charged on loans by banks, under the assumption of zero borrower non-interest transaction costs) and the net return on deposits for savers (represented in the model by the interest rate paid by banks on deposits, under the assumption of zero depositor transaction costs).

While recognizing the considerable importance of transaction costs in less developed financial markets, their influence on the wedge between the cost of funds for borrowers and the net return on deposits, and the role of policies in facilitating a reduction of these costs, for simplicity, the impact of these frictions is represented—in the model—by the spread between the loan and the deposit interest rates. In turn, the role of financial policies is examined through the introduction of a required reserve ratio on deposits, which influences the wedge between the loan and deposit interest rates. The consideration of the implications of changes in this policy variable is only made possible by modeling the banks as separate decision-makers.

In addition to policy-induced disparities between the loan and the deposit interest rates, frictions in financial markets also emerge from market imperfections, due to information asymmetries, lack of incentive compatibility, and insufficient tools for contract enforcement (Besley 1994).
Among the consequences of frictions and market imperfections are different rates of loan default expected by the banks from various types of firms, due both to limitations in the firms’ ability and willingness to repay loans and to shortcomings in the banks’ lending technologies—*i.e.*, deficiencies in their ability to properly assess these risks.

In turn, in the implementation of their lending technologies, the banks incur screening, monitoring, and contract enforcement costs. An exploration of the distributional consequences of financial policies requires acknowledgement—in the model—that the banks are aware of the differences in the costs associated with the management of the different segments of their loan portfolios. In particular, distributional outcomes from the allocation of the loan portfolio require the marginal costs of lending to increase at different rates, for different types of borrowers (Gonzalez-Vega 1976).

These differences in expected default rates and in loan portfolio management costs lead to differential terms and conditions (both different loan amounts—potentially, different degrees of credit rationing, a dimension not explored in this dissertation—and different interest rates) offered by the banks to different classes of borrowing firms.

The levels of these different expected rates of default (degrees of riskiness) and marginal costs of lending thus influence the rates of interest paid to depositors and the interest rates charged on loans to different types of firms. In the model, the separate decision-making by the banks in mobilizing funds and in allocating them to various types of firms enables the identification of the differential impact of the financial sector on production and wages. In this way, the performance of the financial and the real sectors of the economy can be intertwined.
Second, heterogeneity in the household sector must be introduced, in order to generate a disparity in the distribution of income and wealth. Since the households provide labor services, earn wage incomes, and hold wealth, without any diversity in the household sector, everyone would earn similar incomes and would hold similar amounts of wealth. Such a representative household economy would not be suitable for a study of the influence of finance on distributional outcomes.

Heterogeneity may be incorporated in the household sector either *ex ante* or *ex post*. *Ex-ante* heterogeneity (for example, the classification of households into workers and firm owners, without the possibility of a switch), imposes a restrictive structure on the economy, which exogenously ensures inequality and which may preclude the chances of a household switching from a given type to a different one.

This rigidity would not be a desirable feature for the model developed in this dissertation, particularly when recognizing that, especially in developing countries, such switching may be influenced, among other things, by the evolution of the financial system itself. Instead, at least to a certain extent, in the model developed here, inequality will be generated endogenously, rather than being entirely imposed on the basis of exogenous grounds.

There are several ways to introduce *ex-post* heterogeneity: through heterogeneity in preferences, heterogeneity in discount factors, and the like (Krusell and Smith 1998, Heer and Maussner 2005). In this dissertation, however, a simple device of *ex-post* heterogeneity in labor productivity helps to introduce diversity in the household sector.
As a result of differences in labor productivity, workers across different households do not earn uniform wages. Rather, their earnings are linked to their skills, assumed to be alterable (Sorensen 2007). In the model, at any given point in time, only a certain percentage of the labor force is high-skilled, while the rest is low-skilled (Heer and Maussner 2005).

By making households heterogeneous with regards to their skills, it becomes possible to explore the consequences of various proportions of high-skilled workers in the economy (including the structural transformation of the labor force that takes place with economic development), differences in skill levels between the low-productivity and high-productivity households, and differences in their wage earnings, which are then used to study inequality. Moreover, this approach would make it possible for a low-skilled household to become high-skilled (for example, through acquiring education, training and other investments in human capital formation) or for a high-skilled household to become low-skilled (for example, due to injury, inappropriate incentives, or a failure to learn new technologies).

The actual processes through which these shifts in the skill levels of households occur are not explicitly modeled here. Rather, the presence of these underlying processes—which may, in part, be related to improvements in access to financial services—is assumed. This assumption allows the introduction in the model of productivity shifts at the individual household level, with consequences on household behavior. In particular, savings behavior will be influenced by the threat of an adverse shift in the level of skills.
In effect, the switching is captured in the model by idiosyncratic labor-productivity shocks, which influence the household’s skill level in each period. With this approach, heterogeneous households earn different wage incomes, a prerequisite for inequality in the distributions of income and wealth.

Further, for heterogeneous households to earn different wage incomes, based on their different labor productivity, some sort of heterogeneity may also be required in the production sector. A simple mechanism to achieve this result is to introduce different production technologies. One possibility, followed here, is to assume that the low-skilled and the high-skilled workers are employed in two different sectors, characterized by different production functions.

In particular, low-skilled households work in small, traditional firms (in the informal sector), while high-skilled households work for high-tech corporate firms (in the modern formal sector). This distinction serves two purposes. On the one hand, it helps in introducing firm-specific expected default rates on loans, which allows an analysis of the impact of bank portfolio choices on the availability of credit in the economy and on the differential access to credit by various types of firms. On the other hand, it makes it possible for the marginal product of labor to differ, for a given amount of household labor supplied, according to skill levels. These are novel features of the model considered here, because usually models that incorporate idiosyncratic labor productivity shocks do not incorporate the financial sector and production is attributed to a single representative firm (Heer and Maussner 2005, Chang and Kim 2007).

Below, I present the general equilibrium model in detail.
3.1 Economic Environment

I assume that the model economy exists in isolation; *i.e.*, it is a closed economy. Three types of actors operate in this economy, namely: households, firms, and banks. A financial authority exogenously chooses levels of any of a number of potential policy interventions.

Since the aim of the exercise is to explore changes in the distributions of income and wealth, due to a process of financial development brought about by financial policy interventions, in contrast to models that assume a perfectly competitive credit market, such as the Real Business Cycle model (Lucas 1977, Kydland and Prescott 1982, Long and Plosser 1983, Plosser 1989), I assume that financial markets are not fully developed.

Numerous reasons may explain the frictions that characterize this imperfect market. Some are associated with the underdevelopment of the economy (in particular, missing physical and institutional infrastructure and unmitigated risk), which leads to high transaction costs, expected borrower default, and other barriers to intermediation (that is, there is financial shallowing, in contrast to financial deepening). Others are induced by inappropriate financial policies (financial repression).

In the model, the underdevelopment of the financial sector itself is denoted by two sets of key parameters, in representation of the two types of frictions: (a) the expected default rates on loans by two types of firms and the banks’ different costs of lending to those firms reflect barriers to intermediation associated with the environment, while (b) the required reserve ratio levied on the deposits mobilized by the banks represents policy-induced frictions.
While the required reserve ratio has been usually discussed as a potential monetary policy tool (Bofinger 2001) and more recently as a macro-prudential instrument (Tovar, Garcia-Escribano and Martin 2012, Glocker and Towbin 2012), what matters in the model developed in this dissertation is that, by diverting a portion of the deposits mobilized by the banks into idle, non-interest bearing reserves and away from their portfolio of loans, the requirement reduces the volume of credit available in the economy (with potential consequences on the level of economic activity) and it creates a wedge between the loan and the deposit interest rates (McKinnon and Mathieson 1981, Romer 1985, Brock 1989).

Indeed, this reserve requirement acts as a tax on the intermediation services provided by the banks and its incidence is shared by all the three types of actors that participate in financial markets: borrowers, depositors, and banks, on the basis of the relevant elasticities of the supply of deposits from households and the demands for credit by the two types of firms as well as the design of the intervention (Chamley 1991, Chamley and Honohan 1993, Reinhart and Reinhart 1999, Brock and Rojas-Suarez 2000, Brock and Franken 2003).

In the analysis undertaken in this dissertation, this “required reserve ratio” variable may then represent the various implicit taxes, policy-induced market imperfections and other frictions that create a wedge between the lending and the deposit interest rates. The policy simulations of the next chapter would be applicable, then, to several kinds of these policy interventions.
Ex-post idiosyncratic labor-productivity shocks create heterogeneity among households that are otherwise ex-ante identical in their preferences and labor endowments. A dichotomous shock classifies households into “low” and “high” productivity types. Each type of household then provides labor to a firm that employs the same kind of skills (high or low), a salient feature of the model.

That is, low-productivity households work for firms that are assumed to be small, traditional businesses operating in the informal, non-corporate sector, where the incidence and intensity of diverse types of idiosyncratic risks are higher, efficient tools for the mitigation of the consequences of adverse shocks are absent or scarce, and the enforcement of labor and credit contracts is more difficult. It is assumed, therefore, that the banks perceive higher expected default rates on their loans to these informal firms.

In contrast, high-productivity skilled households work in modern, corporate-sector firms, where the incidence of idiosyncratic adverse shocks and their intensity are lower (in reflection of their access to a more developed infrastructure, the availability of public services, and their ability to engage in precautionary measures), the availability of efficient risk-management tools (such as insurance programs and other instruments to mitigate the impact of shocks) is greater, and where superior contract enforcement leads the banks to expect lower default rates.

Since the two types of households work in two different types of firms, which produce different levels of (a homogeneous) output combining labor and other non-labor inputs, the wage rates they earn differ. Differences in the distribution of household wage incomes will then emerge from these features of the economy.
Low-skilled households earn lower wages than high-skilled households, depending on skill differences and on the levels of output of the corresponding types of firms, which in turn depend on their differential degrees of access to credit. Thus, heterogeneity at the individual (household) level is maintained at the group (firm) level, which enables the endogenous determination of different wage rates for the two types of households.

Households keep their wealth as a single, one-period financial asset, namely bank deposits. The main motivation to save is the desire to sustain (appropriately discounted) consumption levels over time, given the threat of adverse labor productivity shocks. Thus, most savers in this economy are high-skilled households, contingent on this fear.

Because there are no other ways of holding wealth, the period’s flow of savings leads to the accumulation of the period’s stock of deposits, which become available for withdrawal, upon maturity, at the end of the following period. On their deposits, households earn a uniform interest rate and no transaction costs are associated with making deposits to or withdrawing funds from their accounts. The interest rate on deposits is endogenously determined in the model and it represents the net return to depositors.

The banks perform intermediation between households and firms, constrained by the exogenously required reserve ratio on deposits. That is, the banks mobilize deposits from households and lend these funds to the firms, for a profit. I assume that banks operate in a competitive market, such that in equilibrium their profits will equal zero. If there were restrictions to entry, this would be another source of frictions.
Indeed, policy-induced restrictions on entry (such as the requirement of bank charters, minimum capital requirements, and other prudential regulation rules) would endow the banks with some market power, thereby leading to monopolistic profits, which would account for a particular type of friction. This issue has been ignored in the current analysis, but the impact of these policies would imply that there will be a similar spread between the lending interest rates and the deposit interest rates, in reflection of the monopolistic power of the banks.

In addition to differences in their demands for credit, the interest rates charged on loans to the two types of firms differ because of the different expected default rates associated with each type of business and the different costs for the banks in developing a separate loan portfolio for each type of firm. From the perspective of the banks, the two types of loans are like two different products. Thus, the banks behave as multiproduct producers, while no economies of scope are assumed (Gonzalez-Vega 1976).

The high-risk firms employ low-productivity households and pose the threat of a higher default rate on their loans, while the banks incur higher costs in managing loans to these firms. As a result, they receive loans at higher interest rates, compared to the low-risk firms, which employ high-productivity labor, represent lower default rates, and are less costly to screen and monitor for the banks. Default rates are defined as the proportion of the number of firms of each particular type that, because they suffer an adverse production shock in a given period, are expected not to be able to repay the principal and interest on their loans. Moreover, these firms will not be able to pay wages to the workers they hired.
Thus, each sector would have its own probability of defaulting firms. In this model, the banks are assumed to write-off all delinquent loans, subtracting the resulting losses from their profits, in every period. Default is a consequence of the lack of ability to repay, due to an exogenous idiosyncratic adverse production shock suffered by the firms. The model does not consider any penalties for the defaulting firms and, therefore, the banks are implicitly assumed to insure the firms against these shocks (Miranda and Gonzalez-Vega 2011). This simplification does not alter the basic results of the model.

The firms produce a single perishable good, using labor and loans in a Cobb-Douglas production function (Levhari and Patinkin 1968). Loans may be seen here as generalized purchasing power (liquidity), available to the firms for the acquisition of all necessary non-labor inputs, such as raw materials and supporting services, as well as for renting any required fixed capital (equipment), in each period. While borrowed funds, as such, do not actually enter into the production process, they represent the cost of a basket of a broad variety of inputs used in production. Moreover, given the competitive assumption of zero profits, which otherwise would have enabled them to accumulate equity (namely, their own funds), the firms do not possess liquidity of their own and entirely rely on credit for their production.

The implicit assumption then is that all saving and wealth accumulation is undertaken by the households and that, each period, the entire amount saved from household income is held as a deposit at a bank. The volume of deposits mobilized in the period determines the banks’ available loanable funds in the next period. In turn, each period, a firm’s liquidity is constrained by the amount it can borrow from a bank.
Given the default rates expected by the banks for each type of firm, due to the different idiosyncratic production shocks that they suffer, and the associated losses from default (write-offs) as well as the costs of developing that particular portion of their loan portfolio, the banks set differential interest rates to be charged on loans to the different types of firms. Because, in order to produce, the firms need access to credit to purchase non-labor inputs, their level of output is determined by the success of their borrowing efforts, reflected by the terms and conditions (loan amount and interest rate) of their credit contracts, in each period.

The heterogeneity of the production sector is thus reflected in the different production functions and in the different degrees of creditworthiness of the two types of firms. On the one hand, these differences are due to the different types of labor that they hire. The firms that employ low-productivity workers produce less — when hiring the same number of workers — and, therefore, pay lower wages — *ceteris paribus* — than the firms that employ high-productivity workers.

On the other hand, the banks perceive different risks of default and incur different lending costs for each type of firm. In their perspective, the firms — in the informal sector — that hire low-productivity workers are high-risk applicants for loans (they expect higher default rates from them), while the corporate firms that hire high-productivity workers are low-risk potential borrowers. As a consequence of these differential perceptions of risk, the banks offer different terms and conditions on their loan contracts and, thereby, influence the relative rate of expansion of each type of firm.
The resulting differences in output levels, demands for labor, and marginal labor productivity between the two sectors—as a consequence of their differential access to credit—contribute, in the end, to differences in wage levels, household incomes, and opportunities for wealth accumulation for the two types of households. Thus, the income and wealth distribution impacts of financial development will be associated with the parameters that influence the interest rate differentials across types of firms.

I further assume that, during each production period, the firms convert the loans into the required non-labor inputs and capital rentals costlessly. The price of the final good is normalized to one, and all other prices are then expressed in terms of the price of the final good. In competitive equilibrium, the firms take this price as given and earn zero profits. No systemic shocks at the economy-wide level are assumed in the model.

There are three types of markets in this economy: goods, labor, and financial markets. These markets must clear, if the economy is to be in competitive equilibrium. I assume that all trades between the agents take place in these markets, simultaneously, through some Walrasian auctioneer. Single prices for each, namely wage rates for low-productivity and for high-productivity workers, interest rates on bank deposits, interest rates on loans for low-risk firms and on loans for high-risk firms, and the price of the homogeneous good emerge when the auctioneer matches the corresponding total supplies and demands.

At the beginning of the period, every agent comes to the auction with the corresponding demands and supplies of goods and services. The auctioneer then simultaneously determines the market-clearing prices on all trades.
Once all prices are determined, all final decisions are made by banks, firms, and households and the trades are settled at the end of the period. To facilitate the solution of the dynamic model, however, an exception has been introduced in the timing of this process of price formation. In the model, households make their savings decisions in the current period and then hold a bank deposit that matures at the end of the next period. The actual interest rate to be earned on this deposit will be, in turn, determined at the auction that takes place at the beginning of the following period, once the banks know what the demand for credit will be for that period.

Thus, savings decisions and the supply of funds to be deposited by households in the current period—and available to the banks only in the next period—are made on the basis of an expectation about what that future interest rate will be. The assumption made here is that households have rational expectations when they make savings decisions, expecting to earn the same return on their deposits in the future. That is, they treat the current interest rate on their deposits as the expected interest rate that they will receive on their deposits in the next period. The actual rate may differ, however, from this expectation.

Thus, while the deposit contract faced by households in the model does not look like a typical bank deposit, it looks more like a deposit in cooperatives and other mutual financial intermediaries, where the return to depositor-cum-owners of the institution is in part determined by the performance of its credit portfolio. Some Muslim banking practices indeed take the form of a savings bank based on profit-sharing, such as the banks in the model for this dissertation (Ready 1981).
Moreover, recent research about the empirical behavior of bank deposit interest rates and the rate of return on retail Islamic profit-and-loss sharing investment accounts shows that the two rates exhibit strong long-run cointegration (Cevik and Charac 2011). Thus, while the assumptions about depositor choices, in the model of the dissertation, share these non-conventional characteristics, adopted here to facilitate the solution of the model, they do represent real-life situations. Moreover, their introduction does not modify the results and policy implications obtained here.

In summary, the model assumes that all markets open at the beginning of the period. Each household starts the period with a given level of a bank deposit, a result of its saving choices of the previous period, which is available for withdrawal at the end of the current period. Households are not allowed, however, to borrow. Households expect to earn an interest rate on their deposits, to be determined in the current period and which may differ from the expected rate that influenced their previous-period saving choices.

Indeed, the Walrasian auctioneer determines the market-clearing interest rate on deposits for the current period, based on the demand for depositor funds by the banks, which in turn is based on the credit demands by the firms, for their production purposes, and on the lending costs and expected default rates faced by the banks. The aggregate level of household deposits thus determines the availability of bank credit and, in combination with the demands for credit, the interest rates for the current period. The banks settle their earlier-period’s trade with the households by paying them the principal amount of their initial deposits plus the interest rate that emerges from the auction, at the end of the period, once loans have been repaid.
The banks, in turn, use these deposits, available at the beginning of the period, to lend to the firms, which utilize these loans along with labor inputs from the households to produce the output. At the end of the period, some of the firms repay the principal amount of the loan plus interest to the banks, but other firms do not repay because, after they had taken their loans, they suffered an exogenous idiosyncratic adverse production shock. It is assumed that the firms that suffer this shock lose all of their output and, therefore, cannot pay wages and cannot repay loans. The probability of these adverse productions shocks differs for the two types of firms.

The households, after receipt of their wage income and withdrawal of their past savings (principal amount of their deposits plus interest), decide how much to consume in the current period and save for the next period. They can, theoretically, utilize all of their deposits with the banks to smooth their current consumption and save nil amounts for the next period, but they cannot borrow (that is, deposits are non-negative).

All of the transactions are carried out within a period and markets close at the end of the period, leaving households with their deposits and an expectation about the interest rate for the next period. Changes in the amount of these deposits, across periods, will determine the pace of wealth accumulation by the households. Differences in this process of wealth accumulation will determine, in turn, changes in the distribution of wealth.

Below, I separately specify the behavior of the representative agents from each one of these categories of players.
3.1.1 Representative Household

Let us assume that the economy is populated by a large number of infinitely-lived households. In every period, a representative household derives utility from consumption, $c$, it saves—in order to optimize the inter-temporal flow of consumption—in the presence of idiosyncratic labor-productivity shocks and production shocks to the firms where it works, and it keeps the amount saved in a deposit, $d$.

The consumption-saving tradeoff is thus considered by the household by keeping in mind its labor productivity risk, $\tilde{I}_t$, the expected uniform interest rate to be earned on deposits, $r_D$, and the state-dependent expected wages, $(1 - p_l)W_l$ earned each period, given the probability $p_l$ that the firm where it works may suffer a production shock and may not pay wages.

In every period, the household faces an idiosyncratic labor-productivity shock and its labor productivity level, $\tilde{I}_t$, is decided on the basis of this shock. I assume that for $i = 0$, the household is of the “low-productivity or low-skill” type, and that for $i = 1$, the household is of the “high-productivity or high-skill” type.

The household’s productivity state, $i$, evolves as a Markov chain, with a transition probability matrix, $Q$, with a typical element $q_{it'}$. This element represents the probability that the household will be in productivity state, $i'$, in the next period, given that it is in state, $i$, in this period.

In the labor market, once these household productivity shocks are realized, the households provide a fixed and uniform amount of labor time, $\tilde{h}$, which is used by the firms to produce the single consumption good.
The household’s “effective” supply of labor is, however, a function of both this time of labor—inelastically provided—and of its productivity. Thus, its productivity level \( \bar{L}_t \) times the constant number of hours of labor supplied (namely, \( \bar{L}_t \bar{h} \)) determines the effective amount of labor supplied by each household. I will call this effective labor supply, \( l_t \), for ease of notation.

It is assumed that the households do not possess any independent ability for the evaluation of the creditworthiness of the firms and, therefore, that they have to rely upon the expertise of the banks to evaluate credit risks and the probabilities of default (on loans and on wages) by each of the two types of firms. Thus, these probabilities, which influence their state-contingent wage expectations, become known to the households through the banks. Hence, the households observe the same expected default rates by each type of firm as the banks do. Ex ante, neither the banks nor the households know which specific firms will suffer the production shock, but the banks have a comparative advantage in (perfectly) knowing what the probability of the shock is for each type of firm and the households observe these expectations.

Thus, when the banks either get more efficient in evaluating credit risks (through improvements in their lending technologies) or the riskiness of the firms declines (through improvements in the physical and institutional infrastructure), the households also benefit from these improvements in the environment for the operation of financial markets, through better information (in making their consumption and savings decisions) and the lower risks of not being able to earn their wages and through the higher interest rates that would be paid by the banks on deposits.
Hence, the households observe the expected probabilities of default, \( p_0 \) for the informal sector firms and \( p_1 \) for the formal sector firms, respectively. Depending upon its labor supply, \( l_i \), the firms’ demand for each type of labor, and the probabilities of adverse production shocks, \( p_i \) for \( i = 0 \) (the informal sector firms default) and \( i = 1 \) (the formal sector firms default), each household receives expected wages, \((1 - p_i)W_i + p_i0\).

I assume that \( l_1 > l_0 \), due to the labor productivity differences, and that \( W_1 > W_0 \), due both to these labor productivity differences and to differences in the levels of non-human inputs per effective unit of labor used and the levels of output produced, across the two types of firms, given their differential access to credit.

Since there are no other assets in the model, the household must save in deposits. I assume that the household cannot borrow, but that it can have nil savings; \( i.e., d = 0 \). If the household saves a positive amount in a given period, the bank can lend these savings to the firms in the next period and the household receives principal plus interest on the deposit, \((1 + r_D)d\), from the bank in the following period.

The aggregate level of bank deposits in the economy, \( D \), is the sum of the deposits held by all individual households. In interaction with the demands for credit by the firms and the banks’ expectation about rates of default and costs of lending, this aggregate level of deposits, \( D \), determines the interest rate, \( r_D \).

The discrete nature of the labor productivity shocks creates two distribution of wealth (deposits) in the economy. One distribution reflects the proportion of households that are in productivity state \( i = 0 \) and that hold a deposit of less than or equal to \( d \), namely \( F_0(d) \).
The other distribution reflects the proportion of households that are in productivity state \( i = 1 \) and hold a deposit of less than or equal to \( d \), namely \( F_1(d) \). These cumulative distributions \( F_i(d) \) are non-decreasing on \([0, \infty)\), with \( F_1(\infty) = N \) and \( F_0(\infty) = 1 - N \), where \( N \) is the steady-state proportion of high-skilled households in the economy. Exogenous changes in \( N \), as a proxy for a process of structural transformation and economic development, will be used to describe the Kuznetsian path of the distribution of household wage incomes over time.

Hence, the household begins the period with a given level of deposits (savings from the previous period), \( d_i \), an idiosyncratic labor-productivity state, \( i \), knowledge about the probability that a particular type of firm may suffer an idiosyncratic production shock \( p_l \) and knowledge about the aggregate distribution of deposits \( F_i \), and it then decides how much to consume and to save. The household maximizes the present value of the current and expected future utility of consumption over an infinite time horizon, keeping in view the discount factor, \( \delta \). The dynamic programming problem for the household then is:

\[
V_i(d_i; F_0, F_1) = \max_{c_i, d'_i} \left[ u(c_i) + \delta E[V_i'(d'_i; F_0', F_1')] \right]
\]  

(1)

subject to the constraints:

\[
c_i + d'_i = (1 + r_p)d_i + (1 - p_l)W_il_i
\]  

(2)

\[
c_i \geq 0, \quad d'_i \geq 0
\]  

(3)

where \( \delta \in [0,1] \), is the discount factor, which is related to the discount rate, \( \rho \), as

\[
\delta = \frac{1}{1+\rho}
\]
The utility function $u(.)$ is assumed to be strictly concave with $u'(.) > 0$ and $u''(.) < 0$. The functional form of the utility function is assumed to be $u(c) = \frac{c^{1-\gamma}-1}{1-\gamma}$, where $\gamma$ is the relative risk-aversion coefficient. For the constant relative risk aversion (CRRA) utility function, the inter-temporal elasticity of substitution is given by the reciprocal of the risk aversion coefficient, namely by $\frac{1}{\gamma}$.

If the household has a high degree of risk aversion, $\gamma > 1$ then the inter-temporal elasticity of substitution, $\frac{1}{\gamma}$, is small and the household is less sensitive to changes in the interest rate on deposits. It then prefers to consume today rather than save for tomorrow. In this case, the income effect of an interest rate change would dominate the substitution effect. On the contrary, if the inter-temporal elasticity of substitution is high (so that the household has a low degree of risk aversion, $\gamma < 1$), the substitution effect would dominate the income effect and the household would save, more, with an increase in the interest rate on deposits.

In the policy simulations of Chapter 5, I have assumed that the households have a higher degree of risk aversion and that $\gamma > 1$. But, in Chapter 6, no a priori assumption is made about the risk aversion coefficient and the data from Pakistan are allowed to determine the risk aversion/elasticity of substitution used in the calibration. These results are consistent with the expectation of high degree of inter-temporal substitution.
3.1.2 Representative Firms

Representative firms, in the informal and formal sectors, are indexed by \( j \). They produce the final perishable output according to a constant-returns-to-scale Cobb-Douglas production function, combining loans (that is, the ability to purchase non-labor inputs), \( L_j \), and effective labor, \( H_j \) from the households. The production function then is \( Y_j = G_j(L_j, H_j) \). I assume that, for \( j = 0 \), the representative firm belongs to a traditional, informal sector that employs low-skilled labor, \( H_0 \), and that, for \( j = 1 \), the firm operates in the formal, corporate sector and uses high-skilled labor, \( H_1 \), as an input.

To undertake their production, representative firms, in each of the two sectors, borrow from the banks, separately, loan amounts, \( L_j \), at an interest rate, \( r_{L_j} \), in every period. The demand for credit by each representative firm is determined by the requirements of its production function and the interest rates on loans. At the end of the period, each representative firm is required to pay back the expected principal amount of the loan plus interest. Thus, there are two separate credit markets in the economy, one for each type of firms, and the banks consider these loans to be non-homogeneous.

The banks perceive different default rates and costs of lending functions, according to firm type. Actually, the banks can distinguish the different riskiness of the two types of firms but, within each category, in the presence of imperfect information, they do not know which particular firms will repay or default. There is, thus, only one expectation of default across firms in each group.
Similarly, before they take their loans, individual firms do not know if they will suffer a production shock or not. I assume that the default rate for firms in the traditional sector is higher than for firms in the corporate sector; namely, $p_0 \gg p_1$.

These differences in expected default rates may reflect a broad range of circumstances. When they reflect, as here, differences in the firms’ exogenous ability to repay, they are a consequence of the different incidence of various kinds of risks related to production activities.

In a broader context, higher default rates might also be a reflection of the non-enforceability of contracts in the traditional sector, perhaps due to shortcomings of the institutional framework (such as insufficiently defined property rights, the absence of clear titles, inadequate legal mechanisms for the definition and registration of contracts, and the absence of efficient courts and other tools for contract enforcement, in addition to political shortcomings about foreclosing loans made to the poor and to small entrepreneurs). In the model developed in this chapter, however, exogenously given adverse shocks to production are the only source of idiosyncratic default.

Since, in the model, the firms own nothing by themselves, they simply hire the two factors of production at the going market interest rates and wage rates $(r_{Lj}, W_j)$, to produce output in every period, in their respective sectors.
The firms decide on their production plans and on their demand for labor and loans. Wages are determined by the interaction of this demand and the effective supplies of labor. Across each sector, not all firms repay the loans and pay wages, which generates the sector-specific default rates. Thus, after adjusting for the sector’s default rate, the representative firm expects to pay back to the bank \((1 - p_j)(1 + r_{L_j})L_j\) and pay households their wages \((1 - p_j)W_jH_j\).

Thus, the firms choose labor and loan amounts to maximize their expected profits, per period, by producing output, of price one, in a competitive market:

\[
E(\pi_j) = \max_{L_j, H_j} (1 - p_j) \left[ L_j^\alpha H_j^{1-\alpha} - W_jH_j - \left(1 + r_{L_j}\right)L_j \right]
\]  

(4)

3.1.3 Representative Bank

The model assumes that the banking sector is competitive and that there are numerous banks in this sector. A representative bank performs intermediation between the households and the two types of firms, given its comparative ability to assess credit risk and manage a loan portfolio, at a cost. These lending costs differ according to the type of firm and increase with the size of the loan portfolio. Thus, bank incurs costs \(\phi_j(L_j)\) for \(j = [0,1]\), every period, in screening and monitoring its two types of loans, \(L_j\).

As in the case of the firms, I assume that the representative bank owns nothing (that is, it keeps no equity) and that it has to go to the market, every period, to competitively mobilize the deposits of the households. The bank then uses these funds to make loans in the two separate credit markets.
A reserve requirement ratio, $\eta$, on the volume of deposits that the bank mobilizes from the households, $D$, represents the monetary authority’s policy intervention and it restricts the bank’s lending ability. Because of this reserve requirement, not all of the deposits mobilized are available as loanable funds.

The bank starts the period with the volume of deposits held by the households from the previous period. It lends the authorized portion of those deposits—in the two separate credit markets—to the two types of firms, in loan amounts, $L_j$, at the market interest rates, $r_{L_j}$, subject to its balance-sheet constraint.

At the end of the period, the bank collects the expected principal plus interest payments, net of default from each type of firm. All defaulted loans are written-off at the end of every period. The bank then pays back to the households, at the end of every period, the principal amount of their deposits plus their interest earnings, as a result of its portfolio performance.

So, every period, the bank chooses deposits and loans, to maximize its expected profits:

$$E(\pi) = \max_{D,L_0,L_1} \left[ (1 - p_0) (1 + r_{L_0}) L_0 + (1 - p_1) (1 + r_{L_1}) L_1 - \phi_0(L_0) - \phi_1(L_1) - (1 + \eta) D \right]$$

subject to the balance-sheet constraint and non-negativity constraints on loans:

$$L_0 + L_1 = (1 - \eta) D \quad (6)$$

$$L_0 \geq 0, \quad L_1 \geq 0 \quad (7)$$
where \( \phi_j(L_j) = a_j L_j + b_j L_j^2 \), represent the cost functions for the bank for administering the two types of loans. These cost functions capture the bank’s increasing marginal costs of lending.

3.2 Stationary Equilibrium

A stationary equilibrium of the modeled economy is a pair of value functions \( V_i(d) \), individual policy rules \( c_i(d) \) and \( d_i'(d) \) for consumption and deposits to be held over the next period, respectively, time invariant distribution functions \( F_0(d) \) and \( F_1(d) \), respectively, time invariant relative prices \( \{r_D, r_{L_0}, r_{L_1}, W_0, W_1\} \), and a vector of aggregates \( D, H_0, H_1, L_0 \) and \( L_1 \) such that:

(i) the amount of deposits, the level of consumption, and the effective labor supplies are obtained by aggregating over all households:

\[
D = \sum_{i \in \{0,1\}} \int_\mathbb{d}^\infty d F_i(dd) 
\]

\( i = 0, 1 \) (8)

\[
H_0 = \int_\mathbb{d}^\infty l_0 F_0(dd) 
\]

\( i = 0 \) (9)

\[
H_1 = \int_\mathbb{d}^\infty l_1 F_1(dd) 
\]

\( i = 1 \) (10)

\[
C = \sum_{i \in \{0,1\}} \int_\mathbb{d}^\infty c F_i(dd) 
\]

\( i = 0, 1 \) (11)

(ii) the optimal policy functions or decision rules, \( c_i(d) \) and \( d_i'(d) \), solve the household’s decision problem described in (1);
(iii) the factor marginal productivities are equal to factor prices, $r_{L_j}$ and $W_j$, from the firms’ profit maximization exercise in (4);

(iv) the interest rates on deposits $r_D$ and on loans $r_{L_j}$ are computed from the bank’s profit maximization problem in (5);

(v) all financial, labor, and goods markets clear. Thus, the amounts of credit demanded by each type of firms and the amounts of credit supplied by the banks, in each of the two separate credit markets, are equal. The amount of deposits supplied by the households equals the deposits demanded by the banks. As financial and labor markets clear, the goods market clears by Walras’ law;

(vi) the distribution of the individual state variables is stationary:

$$F_i'(d') = \sum_{t \in \{0,1\}} q_{t'i}F_i(d'^{-1})$$

3.3 Solution of the Model

There are two tiers in the solution of the stationary model. In the inner tier, the households make decisions about consumption and savings, given the economy-wide prices (deposit interest rates and wages). In the outer tier, given the optimal savings decisions of the households, aggregate quantities of deposits and loans are determined and the firms and the banks make their profit-maximization decisions, which determine wage rates for the households and interest rates to be earned on their deposits. All these interactions among the players take place within the same period.
The economy starts with *ex-ante* identical households and a given level of aggregate deposits (namely, the savings of all the households from the previous period). During the period, the households experience an idiosyncratic labor-productivity shock, which determines their effective labor supply. The banks hold aggregate deposits from the households, at the market interest rates, and lend them as loans to the firms. The firms then use the non-labor inputs purchased with these loans and the labor supplied by the low-skilled and high-skilled households to produce output. At the end of the period, the firms pay wages to the households and repay the loans with interest to the bank, except for a proportion of loans and wages in default for each group of firms. The households, after receipt of their state-contingent wages and given their deposits with the bank, decide how much to consume and to save for the next period.

The banks, after receipt of the loan repayments from the firms, respond to the deposit withdrawal requests of the households and pay interest on those deposits. The households’ optimal savings (deposits) at the end of the period determine the aggregate deposits at the banks for the next period. Thus, the solution of the model can be obtained by first solving for the wages and interest rates in the outer tier and then computing the optimal decisions of the households in the inner tier.

The solution of the model requires solving for the optimal quantities, using the first-order conditions for each of the players’ utility/profit maximization choices in the economy. I present the first-order conditions for maximization of their objective functions, separately for each agent, below.
3.3.1 First-Order Conditions for the Representative Household

After substituting the budget constraint in the functional equation for the utility of the representative household, we have:

$$V_i(d_i; F_0, F_1) = \max_{d'_i} \left[ u \left( (1 + r_D) d_i + (1 - p_i) W_i l_i - d'_i \right) + \delta E \{ V_i(d'_i; F_0', F_1') \} \right]$$

(13)

The value function of the representative household (13) contains a pair of state variables, $F_0$ and $F_1$, namely the distribution of low-skilled and high-skilled households over deposits, respectively, which are entire functions and hence infinite dimensional objects rather than finite dimensional objects.

The transition rules for these state variables are endogenous and determined jointly with the optimal policy functions of the representative household (Krusell and Smith 1998, Heer and Maussner 2005, Miranda 2012). However, in the absence of systemic shocks, as the prices in the economy do not change from period to period, these distribution functions are constant and also do not change in the steady state. Therefore, they can be dropped from the value function of the representative household.

So, taking the derivative of the value function $V_i(d_i)$ with respect to $d'$, I get:

$$u' \left( (1 + r_D) d_i + (1 - p_i) W_i l_i - d'_i \right) = \delta E \{ V_i'(d'_i) \}$$

Taking the derivative of the value function $V_i(d_i)$ with respect to $d$ (Benveniste and Schienkman condition) and taking it to one period forward, we have:
\[ V'_i(d'_i) = u'(1 + r_d')d'_i + W_il_i - d''(1 + r''_d) \]

Combining the above two equations and substituting back into the consumption equation \( c_i \), gives me the familiar Euler equation pair for the low-skilled and high-skilled households:

\[ u'(c_i) = \delta E[u'(c'_i)(1 + r'_d)] \] \hspace{1cm} (14)

To arrive at the Euler equation in (14), I have assumed that the budget constraint of the representative household holds with equality.

Since the utility function is assumed to be strictly concave, the marginal utility of consumption decreases with increases in consumption. However, at low levels of consumption, this marginal utility is very high. In order to have a well-behaved solution, I impose the assumption that households do not like to have zero or non-positive consumption in any period at all. Mathematically, this translates into:

\[ \frac{\partial u(c_i)}{\partial c_i} \rightarrow \infty \text{ if } c_i \rightarrow 0 \]

This means that \( c_i > 0 \) and the budget constraint would bind with equality in every period.

The Euler equation (14) states that the marginal utility of consumption today equals the discounted expected marginal utility of consumption tomorrow times the return on savings (deposits). The expectation is over the idiosyncratic labor-productivity shock, \( \delta \).
Assuming no change in labor income, if the interest rate to be earned on deposits into the next period increases, the household’s savings in the current period become more attractive, because this would allow the household to consume more in the next period (substitution effect). The current period’s consumption would, therefore, decline and the marginal utility of consumption would rise, to ensure compliance with the Euler equation.

In the case of a corner solution, though, the Euler equation may not hold, because at savings levels at the lower bound, the household would be compelled to consume all of its income and would, therefore, save nothing. Because of the non-negativity constraint on savings (as households are not allowed to borrow), in equilibrium a number of households will have zero savings. This will be particularly the case for low-skilled households, while high-skilled households would save to sustain their current levels of consumption into the next period. The possibility of a corner solution and the associated Euler conditions are discussed in detail in the next chapter, where the numerical approximation to the household’s dynamic optimization problem is presented.

3.3.2 First-Order Conditions for the Representative Firms

The first-order conditions for profit maximization for each of the $j$ type of representative firms, with respect to loans $L_j$ and labor supplies $H_j$, are:

\[
(1 + r_{L_0}) = \alpha L_0^{\alpha-1} H_0^{1-\alpha} \quad (15)
\]

\[
(1 + r_{L_1}) = \alpha L_1^{\alpha-1} H_1^{1-\alpha} \quad (16)
\]

\[
W_0 = (1 - \alpha) L_0^\alpha H_0^{-\alpha} \quad (17)
\]
Equations (15) and (16) show that, in equilibrium, the two types of firms demand credit based on the interest rates on loans, $r_{L_0}$ and $r_{L_1}$, for the high-risk and low-risk firms, respectively, and on the marginal product of the non-labor inputs purchased with the loans, which depend on the amount of loans they receive and on the amount of effective labor they hire. Since the default rate of the firms in the informal sector, $p_0$, is higher than the default rate of the firms in the formal sector, $p_1$, this, combined with differences in the marginal costs of lending to firms in the two sectors and in interaction with the different demands for credit, reflected in equations (15) and (16), typically leads to differences in loan interest rates, such that $r_{L_0} > r_{L_1}$, although the opposite is also possible.

From equations (17) and (18), the wage rates, $W_0$ and $W_1$, paid by the two types of firms to the low-skilled and high-skilled workers, depend on the marginal product of labor which, in turn, depends upon the amount of credit, $L_0$ and $L_1$, the firms receive from the bank and on the total effective labor, $H_0$ and $H_1$, supplied by the low-skilled and high-skilled households.

For appropriate values of the loan amounts and effective labor supplied, $L_0 \leq L_1$ and $H_0 \leq H_1$, the wages of the low-skilled workers are lower than the wages of the high-skilled workers. It may be possible, however, that the wages of the low-skilled workers are higher than the wages for the high-skilled workers, for certain ranges of values for the loan amounts and total labor supplied, i.e., $L_0 = L_1$ and $H_0 > H_1$. 

$$ W_1 = (1 - \alpha) L_1^\alpha H_1^{-\alpha} \quad (18) $$
However, I do not consider such scenarios in the simulations because I have already assumed that the default rate for the high-risk firms is sufficiently higher than the default rate for the low-risk firms, $p_0 \gg p_1$, so as to exclude such possibilities.

3.3.3 First-Order Conditions for the Representative Bank

The first-order conditions for maximum profits of the representative bank, with respect to loans $L_j$ and deposits $D$, are obtained after setting up the Lagrangian and taking the derivatives as follows:

$$\mathbf{L} = [(1 + r_{L_0})(1 - p_0)L_0 + (1 + r_{L_1})(1 - p_1)L_1$$
$$- (1 + r_D)D - \phi_0(L_0) - \phi_1(L_1)]$$
$$+ \lambda_1[(1 - \eta)D - L_0 - L_1] + \lambda_2L_0 + \lambda_3L_1$$

$$\frac{\partial \mathbf{L}}{\partial L_0} = (1 - p_0)(1 + r_{L_0}) - \frac{\partial \phi_0(L_0)}{\partial L_0} - \lambda_1 + \lambda_2 = 0$$  \hspace{1cm} (19)

$$\frac{\partial \mathbf{L}}{\partial L_1} = (1 - p_1)(1 + r_{L_1}) - \frac{\partial \phi_1(L_1)}{\partial L_1} - \lambda_1 + \lambda_3 = 0$$  \hspace{1cm} (20)

$$\frac{\partial \mathbf{L}}{\partial D} = -(1 + r_D) + \lambda_1(1 - \eta) = 0$$  \hspace{1cm} (21)

$$\lambda_1[(1 - \eta)D - L_0 - L_1] = 0$$  \hspace{1cm} (22)

$$\lambda_2L_0 = 0$$  \hspace{1cm} (23)

$$\lambda_3L_1 = 0$$  \hspace{1cm} (24)

where $\lambda_1$ is the Lagrangian multiplier for the balance sheet constraint and $\lambda_2$ and $\lambda_3$ are the Lagrangian multipliers for the two non-negativity constraints.
Since there is a positive supply of deposits from the households and the demand for loans from both types of firms, at the going market interest rates, is positive, therefore, the supply of both types of loans is positive and, as the bank would not like to keep idle funds, so the balance sheet constraint holds with equality. Thus \( \lambda_1 > 0 \) and \( \lambda_2 = \lambda_3 = 0 \).

Combing equations (19), (20) and (21) gives me the following two equations for the interest rates on loans:

\[
(1 + r_{L_0}) = \frac{(1 + r_D)}{(1 - \eta)(1 - p_0)} + a_0 + 2b_0L_0 \quad (25)
\]

\[
(1 + r_{L_1}) = \frac{(1 + r_D)}{(1 - \eta)(1 - p_1)} + a_1 + 2b_1L_1 \quad (26)
\]

Equations (25) and (26) show that the reserve requirement on deposits \( \eta \) (a direct policy intervention) as well as the default rates \( p_j \) and the parameters of the cost of lending functions \( a_j \) and \( b_j \) (which may be indirectly influenced by policies that modify the environment for the operation of financial markets) affect the interest rates on loans.

Any increase in the reserve requirement ratio \( \eta \) or in the default rates \( p_j \) or in the parameters of the marginal cost of lending function \( (a_j, b_j) \) increases the loan interest rates, because the derivative of \( (1 + r_{L_j}) \) with respect to the reserve requirement ratio, the default rate, or the marginal cost of lending is positive, namely:

\[
\frac{\partial (1 + r_{L_j})}{\partial \eta} = \frac{(1 + r_D)}{(1 - \eta)^2(1 - p_j)} > 0
\]
Since I have assumed that the bank does not differentiate between the deposits it receives from the low-skilled and the high-skilled households, as both of them equally provide the bank with liquid loanable funds, it pays a uniform interest rate on these deposits.

From the first-order conditions for profit maximization of the representative firms with respect to loans (equations (15) and (16)), for profit maximization of the representative bank with respect to loans and deposits (equations (25) and (26)), and the financial market clearing condition of the stationary equilibrium (condition (v)), the equilibrium amount of loans in the economy computes to:

\[
\frac{\partial \left(1 + r_{L_j}\right)}{\partial \epsilon_j} = \frac{(1 + r_D)}{(1 - \eta)(1 - p_j)^2} > 0
\]

Form equations (27) and (28), no analytical solution exists for the loan amounts, \(L_0\) and \(L_1\), and numerical techniques must be applied. As \(0 < \alpha < 1\), \(0 \leq \eta < 1\) and \(0 \leq p_j < 1\), it can also be seen from these two equations that, with an increase in the reserve requirement \(\eta\) or the defualt rate \(p_j\), the equilibrium level of loans declines towards zero and a corner solution is possible.
Similarly, if the marginal cost of lending for the bank rises either through increases in the cost parameters \( a_j \) or \( b_j \) or through a rise in the interest rate on deposits \( r_D \), a corner solution is also possible. To avoid such scenarios, in the policy simulations, values of all parameters in these equations must be chosen judiciously.

Thus, given the aggregate levels of loans, \( L_0 \) or \( L_1 \), or the interest rate on deposits \( r_D \), I can either determine the interest rate on deposits, \( r_D \), or the two loan amounts \( L_0 \) and \( L_1 \), respectively, using equations (27) and (28). Given \( L_j, r_D \) and \( H_j \), I can determine the aggregate amount of deposits \( D \), the interest rates on loans \( r_{L_j} \), and wages \( W_j \), using the balance-sheet constraint (6), the first-order conditions for profit maximization of the banks (25) and (26) or the first-order conditions for profit maximization with respect to loans of the firms (15) and (16) and the first-order conditions for profit maximization with respect to wages of the firms (17) and (18), respectively. This completes the outer tier of the model.

Once wages paid by the two types of firms, \( W_j \), and the interest rate on deposits, \( r_D \), are known, the optimal decisions of the household can be computed at the inner tier of the model. This step, which requires solving the functional (Bellman) equation of the representative household, is discussed in detail in the next chapter, where the complete algorithm to solve the model is presented.
Chapter 4: Numerical Solution of the Model

Dynamic stochastic general equilibrium (DSGE) models are widely used in macroeconomic modeling. The methodology for their solution falls into one of two broad categories: local approximations (e.g., perturbation methods) and global approximations (e.g., value function iterations). There are advantages and disadvantages of both methods and both can handle models with heterogeneous agents.

Global approximation methods possess better theoretical properties, but they cannot handle a large number of state variables; i.e., they suffer from the curse of dimensionality. Local approximation methods can handle many state variables, but they cannot handle non-linearities very well, and the solution that can be obtained must necessarily be close to a local point, usually a steady state.

The choice of technique to be used depends, in the end, upon the question at hand. Since there are few state variables in the model of this dissertation and it is anticipated that the policy functions of the households might have kinks close to the lower bound of the state space, I will use, as my approach of choice, a global approximation method. Below I describe the solution algorithm used to compute the steady state of the model.
4.1. Algorithm to Compute the Steady-State Solution

The solution algorithm is based on Miranda (2007) and on several similar algorithms described in Heer and Maussner (2005). The gist of the algorithm is that the outer tier of the model is solved first, in order to obtain interest rates and wages. Then, the inner tier of the model is solved, in order to obtain the optimal policy functions for the households. In the end, the aggregate consistency conditions are applied, to make sure that the individual decisions are consistent with the aggregates.

The following steps make up the algorithm:

(i) Based on the type of policy analysis to be performed, assume the steady-state proportion of high-skilled households, \( N \), and compute the total labor supply in the economy, \( H_0 \) and \( H_1 \), using equations (9) and (10).

(ii) Given \( N \), compute the state transition probability matrix, \( Q \).

(iii) Make an initial guess for the steady-state aggregate interest rate on deposits \( r_D \).

(iv) Given \( r_D \), compute the amounts of loans to the informal and formal sector firms, \( L_0 \) and \( L_1 \), using equations (27) and (28), respectively.

(v) Given \( L_0 \) and \( L_1 \), compute the amount of aggregate deposits \( D \) using equation (6), the interest rates on loans \( r_{L_0} \) and \( r_{L_1} \), using equations (25) and (26), as well as wages \( W_0 \) and \( W_1 \), for the low-skilled and high-skilled households, using equations (17) and (18), respectively.

(vi) Given the interest rate on deposits, \( r^D \), and wages, \( W_0 \) and \( W_1 \), compute the household’s policy function, \( d' \), by approximating the household’s Bellman equation using collocation.
(vii) Compute the steady-state distribution of assets $F_i$ using equation (12).

(viii) Compute the amount of deposits, $D$, that solves the aggregate consistency condition, using equation (8).

(ix) Given $L_1$ (or $L_0$) from the outer loop, use the bank’s balance-sheet constraint (6) and apply it to the new level of aggregate deposits, to obtain the level of loans $L_0$ (or $L_1$).

(x) Given the new levels of loans $L_0$ (or $L_1$), compute the new level of the interest rate on deposits, using equation (27) (or (28)).

(xi) If the change in the interest rate on deposits $r_D$ is small, stop; otherwise, return to step (iii).

(xii) After convergence, compute the inequality measures in the economy.

Some of the steps in the algorithm above require applying the already computed values/equations, while others require further detailed computations. Below, all the steps of the algorithm are discussed in detail.

4.2 Computation of the Aggregate Labor Supply

As per the assumptions about the distributions of wealth $F_i(d)$, for the low-skilled and high-skilled households, $F_i(d)$ are non-decreasing on $[0, \infty)$, with $F_1(\infty) = N$ and $F_0(\infty) = 1 - N$, where $N$ is the steady-state proportion of high-skilled agents in the economy. Applying these assumptions to the aggregate consistency conditions (9) and (10), I can obtain the total effective labor supplied by the low-skilled and high-skilled households as:
\[ H_0 = \int_{\frac{1}{2}}^{\infty} l_0 F_0 (dd) = l_0 (1 - N) \quad (29) \]
\[ H_1 = \int_{\frac{1}{2}}^{\infty} l_1 F_1 (dd) = l_1 N \quad (30) \]

4.3 Computation of the State Transition Probability Matrix

Since the idiosyncratic labor productivity shock \( i \) has only two states, the state transition probability matrix \( Q \) is a square matrix. A typical element \( q_{ii'} \) shows the probability of moving to the labor productivity state \( i' \), given that the current labor productivity state is \( i \). In the model, the high-skilled labor proportion \( N \) does not depend on any endogenous variables, such as wages \( W_i \) or the interest rate on deposits, \( r_D \). Being a Markov chain, it only depends upon the number of high-skilled workers in the previous period. In the steady state, the proportion of high-skilled labor \( N \) does not change from period to period, so that I can have:

\[ N = q_{01} (1 - N) + q_{11} N \quad (31) \]

The above condition, along with the two adding up restrictions, \( q_{00} + q_{01} = q_{10} + q_{11} = 1 \), impose a total of three restrictions on the four idiosyncratic labor productivity transition probabilities, affording one degree of freedom in specifying the probabilities. The additional constraint on probabilities is that they should be non-negative.
To specify the steady-state idiosyncratic labor productivity transition probabilities, I assume that the probability of being in the high productivity state $i' = 1$, given that the previous state was also high $i = 1$, equals the steady-state proportion of high skilled workers in the economy; i.e., $q_{11} = N$. Using condition (31), the two adding up restrictions then offer the remaining three transition probabilities $q_{00}$, $q_{01}$ and $q_{10}$.

4.4 Initial Value of the Interest Rate on Deposits

There is no systematic way to initialize the interest rates on deposits, $r_D$. The value is obtained after some trial and error. In the case of heterogeneous agents’ models, the literature usually suggests that the state space interval used to compute the individual policy functions should contain the steady-state level of the corresponding single/representative agent deterministic economy (Heer and Maussner 2005, Khan 2011). This requirement could be checked during the simulations, to confirm that the state space selected based on the initial guess of the interest rate on deposits indeed contains the steady-state level of aggregate deposits of the corresponding single/representative agent deterministic economy. Therefore, as suggested by the literature, I solve the following simplified version of the model economy to obtain the aggregate level of deposits.

4.4.1 Simple Non-Heterogeneous Agent Economy

In this simple version of the economy, I assume that there are only three representative players in the economy, namely a household, a firm, and a bank.
The infinitely-lived representative household makes consumption and savings decisions without any uncertainty about its labor productivity but with other parameters (discount factor and risk aversion) similar to those in the heterogeneous agent economy.

I assume, however, that the labor productivity level of the representative household, a constant, is equal to the mean labor productivity level in the corresponding heterogeneous household economy; \( i.e., l = \frac{l_0 + l_1}{2} \). With just a single agent there is no bifurcation of the households into low-skilled and high-skilled households and there is no distribution of assets, so that \( N = 1 \). This implies that the total labor supply of the household would be constant and would be equal to \( H = Nl = l \). For its labor contribution, the household receives a single wage rate, \( W_t \). The single representative agent, therefore, solves the following utility maximization problem:

\[
\max_{\{c_t, d_{t+1}\}_{t=0}^{\infty}} E \sum_{t=0}^{\infty} \delta^t u(C_t)
\]

Subject to:

\[
C_t + D_{t+1} \leq (1 + r_t^D)D_t + (1 - p)W_t l
\]

\[
C_t \geq 0, D_{t+1} \geq 0
\]

Assuming an interior solution, the Euler equation for the representative agent is:

\[
u'(C_t) = \delta E[u'(C_{t+1})(1 + r_t^D)] \quad (32)
\]

The representative firm uses the same Cobb-Douglas production technology, utilizing labor and loans as inputs.
However, I assume that the default rate of the representative firm is equal to the mean default rate of the two types of firms in the corresponding heterogeneous model; i.e., \( p = \frac{p_0 + p_1}{2} \). The firm also pays a uniform wage rate \( W_t \) to the household. The profit maximization problem of the representative firm is:

\[
\max_{L_t, H} (1 - p)[L_t^\alpha H^{1-\alpha} - W_t H - (1 + r^L_t)L_t]
\]

The first-order conditions of the representative firm’s profit maximization problem are:

\[1 + r^L_t = \alpha L_t^{\alpha-1} H^{1-\alpha} \quad (33)\]

\[W_t = (1 - \alpha)L_t^\alpha H^{\alpha-1} \quad (34)\]

The representative bank intermediates between the household and the firm. It maximizes its profits subject to the balance sheet constraint, namely:

\[
\max_{D_t, L_t}[(1 - p)(1 + r^L_t)L_t - (1 + r^D_t)D_t - \phi(L_t)]
\]

subject to:

\[L_t = (1 - \eta)D_t\]

This yields the following first-order condition:

\[ (1 + r^L_t) = \frac{(1 + r^D_t)}{(1 - \eta)(1 - p)} + \alpha + 2bL \quad (35)\]

In the steady state, quantities and prices do not change from period to period, so that \( C_t = C_{t+1} = C, D_t = D_{t+1} = D, r^D_t = r^D_{t+1} = r^D \) and so on.

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So, in the steady state I have the following set of equilibrium equations, obtained from the first-order conditions and the balance-sheet constraint for the bank, which yield the steady-state level of deposits:

\[ r_D = \frac{1}{\delta} - 1 \]  

\[ \alpha L^{a-1}H^{1-a} - \frac{1}{(1-p)} \left[ a + 2bL + \frac{(1 + r_D)}{(1 - \eta)} \right] = 0 \]  

\[ D = \frac{L}{1 - \eta} \]

Using equations (36) to (38), for the given parameter values, the steady-state level of deposits of the simple economy of a representative agent can be obtained.

4.5 Computation of Interest Rates, Loan Amounts and Wages

Given the initial guess for the interest rate on deposits, \( r_D \), in step (iii), and the aggregate labor supply, in step (i) of the algorithm, loan quantities \( L_0 \) and \( L_1 \), aggregate deposit amounts, \( D \), the interest rates on loans \( r_{L_0} \) and \( r_{L_1} \), as well as wage rates \( W_0 \) and \( W_1 \) are computed in steps (iv) to (vi), using the already computed first-order and equilibrium conditions, reproduced here for convenience, as:

\[ \alpha L_0^{a-1}H_0^{1-a} - \frac{1}{(1-p_0)} \left[ a_0 + 2b_0L_0 + \frac{(1 + r_D)}{(1 - \eta)} \right] = 0 \]  

\[ \alpha L_1^{a-1}H_1^{1-a} - \frac{1}{(1-p_1)} \left[ a_1 + 2b_1L_1 + \frac{(1 + r_D)}{(1 - \eta)} \right] = 0 \]
Since no analytical solution is available for computing: (a) either the loan amounts or (b) the interest rate on deposits in (27) and (28), the problem is restated as a root finding problem and then the Newton method is applied to obtain the approximate solution. The algorithm A.1.1 and A.1.2 in Appendix A provide the details of the procedures.

Once the values of the loan amounts, \( L_0 \) and \( L_1 \), are obtained using the Newton algorithm, the rest of the interest rates and quantities are computed by a straight-forward application of the first-order or equilibrium conditions above.

This completes the outer tier of the model solution and having computed the interest rate on deposits and wages for the low-skilled and high-skilled households, the inner tier of the model is then solved in the next step.
4.6 Computation of the Optimal Policy Rules of the Representative Household

At the inner tier of the model, given the interest rate on deposits, $r_D$, and wages, $W_i$, the important step in the algorithm is to solve for the optimal policy function of the representative household. At the core of the numerical solution approach, applied here, is the approximation of the functional (Bellman) equation (1) of the representative household, using the method of collocation described in Miranda and Fackler (2002).

In collocation, an unknown function, like the Bellman equation, is approximated using a linear combination of known basis functions (e.g., cubic splines or Chebyshev polynomials), whose coefficients are fixed by requiring the approximant to satisfy the functional equation, not at all possible points of the domain, but rather at judiciously chosen points called the collocation nodes.

The optimal value function and the associated policy function can then be obtained using either “function iteration” or “policy iteration”, provided the model has an infinite horizon. For finite horizon models, the method of “backward recursion” can be used. The ‘CompEcon Toolbox’ routine ‘dpsolve’ that accompanies Miranda and Fackler (2002) implements this technique efficiently in MATLAB. Although not essential, yet in order to make the exposition of the numerical strategy clear, I restate the representative household’s dynamic optimization problem (1) in a form suitable for the application of the method used and would discuss in detail the procedure.
4.6.1 Representative Household Problem Restated

Let us assume that, given the labor productivity shock, \( i \), associated Markov transition probabilities \( q_{ii'} \), effective labor supply \( l_i \), wages \( W_i \), the return on deposits, \( r_D \), and the beginning of the period level of deposits/wealth \( d \), the representative household decides how much to consume, \( c \), and how much to save, \( x \), in the current period.

The household is not allowed to borrow but it can save an unlimited amount. If the household saves a positive amount, \( x \), its deposit holdings at the beginning of the next period will be:

\[
d' = g(x) \equiv (1 + r_D)x
\]

The household maximizes the present value of current and expected future utility of consumption over an infinite time horizon. Given the deposits held, \( d \), and productivity state, \( i \), the dynamic programming problem of the household is:

\[
V_i(d) = \max_{0 \leq x \leq d + W_i l_i} \left\{ u(d + (1 - p_i)W_i l_i - x) \right. \\
\left. + \delta \sum_{i'} q_{ii'} V_{i'}(d') \right\}
\]

for \( d \geq 0 \). Here, consumption equals income from labor \((1 - p_i)W_i l_i\) plus net withdrawals from savings, \( d - x \) and the end of period deposits equal \( d' \).

The problem above has mixed states; i.e., it contains a purely continuous state \( d \in [0, \infty) \), a discrete state \( i \in \{0,1\} \), and a continuous action \( x \in [0, d + W_i l_i) \). So, the action is subject to bounds, \( 0 = a(d) \leq x \leq b(d) = d + W_i l_i \).
The solution of the problem can be obtained by applying the Karush-Kuhn-Tucker and envelope theorems to the optimization problem embedded in the Bellman equations. These conditions are:

\[
\begin{align*}
    u_x(d + (1 - p_i)W_i l_i - x) + \delta \sum_{i'} q_{ii'} \lambda_i(d) g_x(x) &= \mu_i \\
    u_d(d + (1 - p_i)W_i l_i - x) + \delta \sum_{i'} q_{ii'} \lambda_i(d) g_d(x) \\
    &+ \min(\mu_i, 0)a_d(d) + \max(\mu_i, 0)b_d(d) = \lambda_i(d)
\end{align*}
\]

where \(\lambda_i(d) = V_{i,d}(d)\), and \(x\) and \(\mu_i\) satisfy the complementarity condition:

\[
0 = a(d) \leq x \leq b(d) = d + W_i l_i
\]

\[
x > 0 \Rightarrow \mu_i \geq 0, \quad x < d + W_i l_i \Rightarrow \mu_i \leq 0
\]

In the above system of conditions, when \(\mu_i > 0\), it means that the marginal utility of current consumption is very high and the household prefers to consume all of its wealth in the current period and save a nil amount for the next period; i.e., \(x = 0\). This scenario may emerge when the household’s current income is low and its initial level of wealth is close to the lower bound, initially, or it gets closer to the lower bound due to bad luck. Thus, it is expected that for low-skilled households, which earn lower wage incomes, some households who are close to the lower bound of wealth might have nil savings for the next period. So, there might be kinks in the optimal policy functions for some low-skilled households, due to a corner solution.
The “dpsolve” routine uses a derivative based adaptive Newton-method to compute the policy functions, by solving the Karush-Khun-Tucker conditions as a non-linear complementarity problem. In order to assess the accuracy of the approximation, the “dpsolve” routine also computes and generates the residual function of the Bellman equation. The residual function is the difference between the left-hand and right-hand sides of the Bellman equation, over the entire domain of the continuous state variable \( d \), when the value function is replaced by its approximant.

Let \( x_i(d) \) denote the optimal carryover deposits for an agent who begins the period in productivity state, \( i \), with deposits, \( d \). Also, let \( g_i(d) = g(x_i(d)) \) denote the deposits the agent holds at the beginning of the next period, given the productivity state \( i \) and deposits, \( d \). The “dpsolve” computes the two dimensional policy vector \( x_i(d) \), using which the optimal next period deposits \( g_i(d) = g(x_i(d)) \) is then computed for the low-skilled and high-skilled households.

4.7 Computation of the Stationary Distribution of Assets

The two wealth distributions of the households, \( F_0 \) and \( F_1 \), are continuous objects that can be computed only approximately. There are three different ways in which these invariant distributions can be approximated numerically (Heer and Maussner 2005).

First, one can use a discrete number of grid points over the assets (deposits) to compute directly the cumulative distribution function (Miranda 2012) or compute the probability density function (Heer and Maussner 2005, Khan 2011).
Second, one can use Monte-Carlo simulations by constructing a sample of households and tracking their behavior over time (Heer and Maussner 2005, Miranda 2012).

Third, one can assume a specific functional form for the distribution and iterate over parameters of the functional form to compute the approximation (Den Haan 1997, Heer and Maussner 2005). All these methods have several advantages and disadvantages.

The grid-based (analytical) methods are fast and accurate for low dimensional problems. Monte Carlo simulations are easy to implement and for a higher dimensional state space they are an important alternative. The parameterized function approach requires the functional form of the original density function to be similar to the assumed functional form and it is a bit cumbersome to implement. Since, the model under consideration has low dimensions of the state space, I decided to use the grid-based method to approximate the cumulative distribution function (CDF) of assets $F_0$ and $F_1$.

To check for accuracy, I also approximated the probability density function (PDF) of assets $f_0$ and $f_1$, separately.

4.7.1 Computation of the Steady-State Cumulative Distribution Functions

The transition of the aggregate distributions depends upon the optimal savings decisions $d' = g(x_i(d))$ of all the agents. Assuming that productivity transitions are diversifiable across all agents in the economy, equation (12) can be restated as:

$$F_{i'}(d') = \sum_{l \in \{0,1\}} q_{i'\ell} F_i(g_{i}^{-1}(d'))$$  \hspace{1cm} (40)
where:

\[ g_i^{-1}(d') = \max\{d | g_i(d) \leq d'\} \]

The steady-state distributions are numerically approximated by discretizing the state space \( d \) with more nodes than used to approximate the Bellman equation (Rios-Rull 2001) and interpolating the approximated function values at these nodes.

Given the optimal end-of-period savings decisions of the agents, \( d' \), its inverse \( g_i^{-1}(d') \) is computed using interpolation. The nodal function values are then computed using interpolation again and equation (40).

### 4.7.2 Computation of the Steady-State Probability Density Functions

The steady-state density function \( f_i(d) \) is computed using the method described in Heer and Maussner (2005) and in Khan (2011). For the optimal level of next-period wealth, \( d_{j-1} < d' < d_j \), the following sums are computed:

\[
f_i^{t+1}(d_{j-1}) = \sum_{i \in \{0,1\}} \sum_{s \in S} q_{i't'} \omega f_i^t(d) \quad (41)
\]

\[
f_i^{t+1}(d_j) = \sum_{i \in \{0,1\}} \sum_{s \in S} q_{i't'} (1 - \omega) f_i^t(d) \quad (42)
\]

where \( \omega = \frac{(d_j - d')}{d_j - d_{j-1}} \) is the probability that next period’s wealth (deposits) will equal \( d_{j-1} \) and \( (1 - \omega) \) is the associated complementary probability. This assumption has to be made because next period’s deposits will be on the grid with probability zero (Heer and Maussner 2005).
In approximating the density functions, I do not need to compute the inverse of the policy function $g_i^{-1}(d)$, but I need to use interpolation to compute the policy functions at the finer grid used to compute the steady-state distribution of wealth.

4.8 Computation of Aggregate Deposits

Once the steady-state distribution of assets has been computed, the aggregate deposits can be computed using the cumulative distribution function (CDF) or the probability density function (PDF) as:

\[
D = \sum_{i \in \{0, 1\}} \int_{-\infty}^{\infty} d \, F_i(dd) \\
\approx \sum_{i} \left( \sum_{k=2}^{m} \left( F_i(dd_k) - F_i(dd_{k-1}) \right) \frac{(d_k + d_{k-1})}{2} \right) + F_i(dd_1)d_1
\]

where $m$ is the total number of grid points used to approximate the distributions.

4.9 Computation of the Fixed-Point over the Interest Rate on Deposits

After computation of the aggregate volume of deposits from the inner loop, the new level of the interest rate on deposits is computed by first applying the balance-sheet constraint of the bank to obtain $L_0$ (or $L_1$) and using the already computed loan amount $L_1$ (or $L_0$) in the outer loop.
Once the new level of $L_0$ (or $L_1$) is known, a Newton algorithm is applied again to equation (27) (or (28)) to compute the new level of the interest rate on deposits, $r_D$.

There are several methods to perform fixed-point iteration over a value (Judd 1998, Judd, Maliar and Maliar 2011).

In step (xi) of the algorithm, the following derivative-free method is used to obtain the fixed-point over the interest rate, $r_D$, which has been used in the related literature (Den Haan and Ocaktan 2009, Judd, Maliar and Maliar 2011):

$$r_D^{t+1} = \lambda r_D^t + (1 - \lambda) r_D^{t-1} \tag{44}$$

where $r_D^{t+1}$, $r_D^t$ and $r_D^{t-1}$ are the values of the interest rate on aggregate deposits for the next, current and previous iterations, respectively, and $\lambda \in (0,1]$ is the dampening parameter.

The advantage of this method is that it is derivative-free, easy to implement, and its cost does not considerably increase with the dimensionality of the problem. The disadvantage is that its convergence is not guaranteed. Typically, one requires the dampening parameter to be much less than 1 to achieve convergence (Judd, Maliar and Maliar 2011). This, however, slows down the speed of convergence.

4.10 Computation of the Gini Coefficients

There are two aspects of inequality that are analyzed in this dissertation: the inequality of income (proxied by the inequality of wage incomes emerging from the production process) and the inequality of wealth, associated with the accumulation of bank deposits.
Since, most of the empirical literature uses the Gini coefficient as the preferred measure of inequality, therefore, Gini coefficients are separately computed to measure the inequality of the distribution of income and the inequality of the distribution of wealth. Income inequality is measured by looking at the Gini of household wage incomes, Gini-I, for the low-skilled and the high-skilled households as two groups of households. Actually, $W_0H_0$ is the total wage income (given by the wage rate times the effective labor supplied) received by the low-skilled households and $W_1H_1$ is the total wage income received by the high-skilled households, respectively.

The income share of the low-skilled households in total labor income (as in a variation of the functional distribution of income, where low-skilled labor may be understood as the “pure labor” factor of production) is then given as $\psi_0 = \frac{W_0H_0}{W_0H_0 + W_1H_1}$.

The complementary share of total labor income, going to the high-skilled households, may be understood as the functional share of income associated with human capital, as a separate factor of production. This distinction will be useful in interpreting the Kuznetsian story to be developed below.

These shares determine a single point on the Lorenz curve, which traces the relationship between proportion of households of each type (that is their shares in the labor force, $(1 - N)$ for the low-skilled and $N$ for the high-skilled households, respectively) and their share in total wage income. The proportion of households is represented on the x-axis and the proportion of their wage income on the y-axis.
Using this single point, an approximate value for the Gini coefficient of the distribution of wage incomes can be computed by first finding out the area under the Lorenz curve $B$ and then using the well-known formula for the Gini-I $= \frac{A}{A+B}$, where $A$ is the area between the 45° line and the Lorenz Curve.

The inequality of wealth is, in turn, measured by computing the Gini coefficient using the two distributions of household wealth, $F_0(d)$ and $F_1(d)$. The algorithm used to compute the Gini coefficient for the distribution of wealth, Gini-W, is shown in Appendix A as A.2.
Chapter 5: Policy Analyses and Simulations

Several facets of the relationships between financial policies, financial development, and income and wealth inequality are examined in detail in this chapter, in the context of the model developed in this dissertation.

In the real world, all components of the economy move simultaneously and there are feedbacks across different sectors, which concurrently influence particular outcomes. To facilitate, however, the investigation of the determinants of those outcomes and to identify the impact of a particular policy intervention, the ceteris paribus assumption is used in simulations. Thus, the values of one or a few parameters of the model are changed at a time —while holding the values of all other parameters constant— and the corresponding steady-state solutions are obtained and compared.

Moreover, in this chapter, all parameters of the model are considered as free parameters and they are not restricted to a particular economy or dataset. However, keeping in view the particular scenario being analyzed, they are chosen in line with earlier work in the literature about developing economies and to support particular hypotheses. In turn, a calibration of the model parameters with actual data is performed in the next chapter. Below, I explain in detail the results of these simulations.
5.1 Alternative Scenarios: Analysis and Results

Because the influence of financial policies on the distributions of income and wealth might differ according to levels of development and other stylized features of the economy, the simulations reported in this chapter take into account several potential scenarios. In particular, I examine the behavior of the model in two extreme versions of these scenarios: (a) a relatively underdeveloped and financially repressed economy and (b) a comparatively advanced and liberalized economy (Shaw 1973).

A key objective of the exercise is to examine, under different scenarios, the influence—on these distributions—of government interventions that reduce those frictions in financial markets that are due to policy-induced repression, an incomplete physical and institutional infrastructure, and instances of market failure (North 1992, Gonzalez-Vega 1993, Besley 1994).

In such a scenario, it is expected that the aggregate amount of wealth and, in particular, financial wealth (deposit holdings) and, therefore, the size of the banking sector (constrained by the availability of deposits) would be small, in reflection of the prevalence of low-productivity informal firms. Given a generalized incidence of poverty, the inequality of the distribution of income would likely be low but increasing, as the economy evolves, driven mostly by productivity differences between low-skilled and high-skilled households and by the distribution of skills in the population. The inequality of the distribution of wealth, however, might be high, due to the presence of few sufficiently rich (high-skilled) households, with additional resources to spare to protect themselves against adverse idiosyncratic productivity and production shocks.

Second, in contrast to the first scenario, the analysis is then performed for an economy with a high level of financial development (supported by strong institutions) and a large human capital stock. Both the policy-induced frictions and financial market imperfections are assumed to be at a minimum level, as mechanisms that both reduce production risks and improve the banks’ assessment of those risks would have been developed (Townsend 2008). High-skilled labor is assumed to be in abundance, and human capital formation would have been facilitated, in part, by the process of financial development itself (Becker 1993, Jacoby and Skoufias 1997, Maldonado and Gonzalez-Vega 2008, Caucutt and Lochner 2012). The prevalence of high-productivity formal firms would have driven the accumulation of a substantial aggregate stock of wealth (deposits) and the corresponding growth in the size of the banking sector. In this scenario, it is expected that the inequality of income would be low and decreasing.
In full maturity, with a fully developed financial system, there would be a stable distribution of income across households in this second scenario. Similarly, the inequality of wealth is also expected to be low, due to the abundance of high-skilled savers.

This dissertation does not explore the theoretical foundations and empirical evidence for the existence of a Kuznets curve—the debated hypothesis that, as a country develops, there is a natural cycle of inequality, where at first economic development increases inequality and it then decreases it (Kuznets 1955, Klaus and Squire 1998, Fields 2001). In the simulation analysis reported here there is, however, an implicit recognition that the relationship between economic development—spurred by the gradual accumulation of human capital, exogenously considered in the simulations—and the inequality of the distribution of household labor incomes may lead to outcomes similar to those predicted by the Kuznets curve (Greenwood and Jovanovic 1990).

Thus, financial policies may actually have both direct impacts on the distributions of income and wealth—through their influence on the availability of credit, output levels, and wages paid by formal and informal firms—as well as indirect impacts—through their influence on the rate of human capital formation and, therefore, on the composition of the labor force, according to skill levels.

Moreover, the direction and extent of the influence of financial policies on inequality may depend on the stage of economic development (represented here by the level of human capital), namely, it may depend on how far along this process of structural transformation, from informal firms that hire low-skilled labor towards formal firms that hire high-skilled labor, the economy is.
Thus, while a particular steady-state solution of the model developed in this dissertation can only explicitly reveal the direct (but not the indirect) effects of financial policies on inequality, given a set of assumptions about the parameters involved, a number of alternative simulations, for economies at different moments in this transition, may suggest the role that financial policies may play along the transition from one scenario to another, in influencing distributional outcomes. To contrast the results from these alternative simulations is the purpose of this chapter.

5.1.1 Parameterization

Since I have assumed that high-skilled workers are more productive than low-skilled workers, per unit of labor time (i.e., \( \bar{l}_1 \gg \bar{l}_0 \)), I let \( \bar{l}_1 \) be three times as much as \( \bar{l}_0 \); i.e., \( \bar{l} = [\bar{l}_0 \ \bar{l}_1] = [1 \ 3] \). This selection of the differences in productivity is in line with the literature, where the productivity of low-skilled and high-skilled workers has been approximated to be 0.4476 and 1.7129, respectively, and the productivity difference to be equal to 3.8 times (Heer and Maussner 2005). I set the labor time constant, \( \bar{h} \), equal to \( 1/3 \), based on the assumption that out of a total time of unity, the households spend one-third of their time working. Thus, the effective labor supply of the two types of households becomes, \( l = [l_0 \ l_1] = [\bar{l}_0 \bar{h} \ \bar{l}_1 \bar{h}] = [\frac{1}{3} \ 1] \). I choose the discount factor \( \delta \) to be 0.85, which means that the discount rate \( \rho \) is 0.18. This choice of value for the discount factor allows the interest rate on deposits \( r_D \) to be as high as 18 percent as, for the model to converge, the interest rate on deposits should be less than the discount rate; i.e., \( r_D < \rho \). The risk aversion parameter \( \gamma \) is, in turn, set equal to 1.30.
For the first scenario, I assume that only 10 percent of the workforce in the economy is high-skilled \((N = 0.10)\), which means that the labor market is dominated by low-skilled workers, as 90 percent of the workforce is of the low-productivity type. This large difference in the number of workers according to skills type suggests that the aggregate effective supply of low-productivity labor, \(H_0\), would be strictly greater than the aggregate effective supply of high-skilled labor, \(H_1\), as per equations (9) and (10), and, as a result, that the demand for credit from the informal sector would be higher than the demand of credit from formal firms. In the second scenario, however, these proportions are reversed; the share of high-skilled labor in the population equals 90 percent of the households \((N = 0.90)\) and the share of low-skilled labor is 10 percent.

To reflect the assumption that the firms in the informal sector are riskier borrowers than the firms in the formal sector, \(p_0 \gg p_1\), in the first scenario the default rate for the high-risk firms is chosen to be 20 percent and for the low-risk firms 1 percent. This choice is not far off from reality because, as shown in the next chapter, where the model is calibrated with data from Pakistan, such differences do exist in the real world. Moreover, this choice has been made to keep the interest rates and amounts of loans within acceptable limits. In the second scenario, however, I choose the default rate in the high-risk sector to be 2 percent, while keeping the default rate in the low-risk sector at 1 percent. I set the financial policy indicator, the required reserve ratio, \(\eta\), equal to 30 percent, in the first scenario, and to 3 percent, in the second one. I keep the loan (non-human inputs) share in the production function, \(\alpha\), assumed to be the same for both types of firms, at 35 percent, in both scenarios.
Further, the lending cost parameters $a_j$ and $b_j$, in the bank’s optimization problem, are chosen to reflect differences in processing costs for the two types of loans. As loans to the informal sector firms are assumed to be more difficult to process and monitor than loans to the formal sector firms, $a_0$ and $b_0$ are set higher than $a_1$ and $b_1$, in both scenarios. Therefore, $a_0$, $a_1$, $b_0$ and $b_1$ are set equal to 0.10, 0.001, 0.08 and 0.01, in the first scenario, and equal to 0.003, 0.001, 0.02 and 0.01, in the second scenario, respectively. Both with respect to default rates and the costs of lending, the assumption is that the development of the physical and institutional infrastructure and the reduction of market imperfections have a pro-informal (pro-poor) sector bias (Gonzalez-Vega 2003). The parameters and their chosen values, in both scenarios, are shown in Table 1 below.

<table>
<thead>
<tr>
<th>Description</th>
<th>Parameters</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor</td>
<td>$\delta$</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td>Risk aversion</td>
<td>$\gamma$</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Labor productivity</td>
<td>$\bar{\ell}_0, \bar{\ell}_1$</td>
<td>1, 3</td>
<td>1, 3</td>
</tr>
<tr>
<td>Labor time</td>
<td>$\bar{\eta}$</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>Proportion of high-skilled workers</td>
<td>$N$</td>
<td>0.10</td>
<td>0.90</td>
</tr>
<tr>
<td>Share of loans in production</td>
<td>$\alpha$</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Default rates</td>
<td>$p_0, p_1$</td>
<td>0.20, 0.01</td>
<td>0.03, 0.01</td>
</tr>
<tr>
<td>Cost parameters</td>
<td>$a_0, a_1$</td>
<td>0.10, 0.001</td>
<td>0.003, 0.001</td>
</tr>
<tr>
<td></td>
<td>$b_0, b_1$</td>
<td>0.08, 0.01</td>
<td>0.02, 0.01</td>
</tr>
<tr>
<td>Required reserve ratio</td>
<td>$\eta$</td>
<td>0.30</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Table 1: Parameter Values for Alternative Scenarios
I choose the interpolation scheme to be “splines” and the number of collocation nodes \( n \) that are used to obtain the optimal policy functions of the households to be 301. This number is selected keeping in view time and accuracy constraints. The number of nodes \( m \) in the refined grid used to approximate the distribution functions is then set equal to \( 2n \). To ensure convergence, I set the dampening parameter, \( \lambda \), in the fixed-point iteration over the deposit interest rate, equal to 0.01 (Judd, Maliar and Maliar 2011).

5.1.2 Results

The steady-state solutions for the alternative scenarios, given the selected parameter values and using the cumulative distribution function to approximate the stationary distribution of assets, are presented below.

For the first scenario, Figure 1 and Figure 2 show the convergence of the interest rate on deposits and the aggregate level of deposits over the iterations. The solver starts with the initial value of the interest rate on deposits as negative 5 percent and this interest rate converges to a positive value of 5 percent. The aggregate levels of deposits in the outer and the inner loop start at very different initial values. Aggregate deposits, at the start of the iterations, equal 0.0538 in the outer loop and 0.0222 in the inner loop. This is because, with negative interest rates, the households save a very small amount, but the banks demand a larger amount of deposits. Thus, the households bear the costs of holding the deposits mobilized by the banks (enduring a negative return on their wealth), while the marginal product of loans for the firms and bank returns are higher.
Figure 1: Convergence of the Interest Rate on Deposits ($r_D$). Scenario 1

Figure 2: Convergence of Aggregate Deposits ($D$). Scenario 1
As the algorithm converges and the interest rate on deposits rises, in response to the excess demand for bank funds, thereby spurring the households’ supply and dampening the banks’ demand for deposits, the aggregate levels of deposits from the inner and the outer loops converge to a single value, of 0.0442 (Table 2).

Similarly, for the second scenario, Figure 3 and Figure 4 present the results of the convergence of the interest rate on deposits and the level of aggregate deposits. The solver starts with the interest rate on deposits at 6 percent, which then converges to 14 percent, higher than in scenario 1. At the start of the simulation, the aggregate levels of deposits, in the inner and the outer loops, are 0.057 and 0.169, respectively. They slowly converged to 0.147 (Table 2). This amount of aggregate deposits is substantially higher than the amount of aggregate deposits of 0.044 found in the first scenario.

![Figure 3: Convergence of the Interest Rate on Deposits ($r_d$). Scenario 2](image-url)
Hence, as expected, the aggregate level of wealth in the economy is lower (and the size of the financial system is smaller) at an early stage of development than at an advanced stage. This is because, in the advanced stage of financial development, the three types of financial market frictions considered in the model (policy-induced reserve requirements, credit risks, and the transaction costs of lending) are at their minimum, at a time when the stock of human capital is at a high level. As a result, a high proportion of the households are high-skilled and richer and they face attractive rewards on their deposits. Given the threat of adverse productivity shocks, their motivation to save is higher than for the low-skilled households.
Figure 5 displays the optimal policy functions for the low-skilled and high-skilled households, in the first scenario. Low-skilled households have little incentive to save. Rather, they use their savings from the previous period (as they withdraw a portion of their initial deposit; that is, as they dissave) to sustain their current consumption. Some low-skilled households, with wealth levels close to the lower bound, have no initial deposits at all and, therefore, neither save nor dissave. For these households, at subsistence levels of wealth, the marginal utility of current consumption is so high and the interest rates on deposits so comparatively unattractive that they do not sacrifice current consumption for the future nor can they borrow to consume more.
In contrast, high-skilled workers, with more wealth and a lower marginal utility of consumption, as well as a fear of suffering a labor productivity shock that may shift their status to low skills, save and keep adding to their deposits until they reach their optimum level of wealth or “target deposit level” of 1.315 (shown by the 45° line).

Figure 6 shows the optimal policy functions for the low-skilled and high-skilled households, in the second scenario. The policy functions show a similar behavior as in the first scenario, but with different slopes. The optimum level of deposits for the high-skilled households is 0.225, at a lower level. With 90 percent of the workers earning higher wage incomes and with the risk of ending up in a low-skilled state being just 10 percent, the motivation to save and hold deposits is lower than in the first scenario.

Figure 6: Optimal Policy Functions of the Households. Scenario 2
Figure 7: Value Functions for the Households. Scenario 1

Figure 8: Value Functions for the Households. Scenario 2
Figures 7 and 8 present the value functions for the low-skilled and high-skilled households in the first and second scenarios, respectively. The two value functions are concave and, at higher levels of wealth, similar for both types of households. This occurs more rapidly in the second scenario.

Figures 9 and 10 show the Bellman equation residuals in each case. The magnitudes of the errors in the approximation are in the range of $10^{-14}$ and $10^{-15}$, respectively, indicating a good fit. This means that the choice of the “spline” interpolation scheme and the number of collocation nodes has been appropriate.

Figure 9: Bellman Equation Residuals. Scenario 1
Table 2 shows the steady-state values of the interest rate on deposits, interest rates on loans for the high-risk and low-risk firms, and wages for the low-skilled and high-skilled households, in both scenarios. In the first scenario, the policy induced frictions, \( \eta \), as well as the market imperfections reflected by the threat of default rates, \( p_j \), and the costs of lending, \( a_j \) and \( b_j \), create a large wedge between the loan and deposit interest rates. The uniform interest rate on deposits is 5 percent, while the interest rates charged on loans to the high-risk and low-risk firms are 100 percent and 52 percent, respectively. These interest rates gaps indicate a high degree of financial repression in the economy.

Figure 10: Bellman Equation Residuals. Scenario 2
### Table 2: Interest Rates, Wages, Deposits and Loans. Alternative Scenarios

<table>
<thead>
<tr>
<th>Description</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rates (%)</td>
<td>$r_D$</td>
<td>5.05</td>
</tr>
<tr>
<td></td>
<td>$r_{L0}$</td>
<td>100.51</td>
</tr>
<tr>
<td></td>
<td>$r_{L1}$</td>
<td>51.71</td>
</tr>
<tr>
<td>Wages</td>
<td>$W_0$</td>
<td>0.2542</td>
</tr>
<tr>
<td></td>
<td>$W_1$</td>
<td>0.2951</td>
</tr>
<tr>
<td>Deposits</td>
<td>$D$</td>
<td>0.0442</td>
</tr>
<tr>
<td>Loans</td>
<td>$L_0$</td>
<td>0.0205</td>
</tr>
<tr>
<td></td>
<td>$L_1$</td>
<td>0.0105</td>
</tr>
<tr>
<td>Reserves</td>
<td>$\eta D$</td>
<td>0.0132</td>
</tr>
</tbody>
</table>

However, in the second scenario, as the frictions in financial markets have been reduced, the wedge between the steady-state interest rates on deposits and on loans is much smaller. The interest rate on deposits is higher than under financial repression, at 14 percent, while the interest rates on loans to the low-risk and high-risk firms are much lower, at 21 percent and 19 percent, respectively.

The greater volume of deposits mobilized in the developed and liberalized financial market scenario and the smaller volume of reserves held make it possible for the banks to loan larger amounts of credit to both types of firms, while the reduction in frictions allows them to make those loans at lower interest rates. As a result, both types of firms enjoy, in this scenario, higher amounts of credit per unit of effective labor and can pay higher wages than in a financially repressed economy. Since the reduction in frictions has not been uniform across the two segments of the credit market, wages increase faster in the informal sector and the wage rates in the two sectors tend to converge.
Thus, in the first scenario, wages for the low-skilled workers, of 0.2542 per unit of effective labor, are lower than the wages of high-skilled workers, of 0.2951 per unit of effective labor. In the second scenario, however, the difference in the wages of the low-skilled and high-skilled households is minor. High-skilled workers earn 0.3370 in wages, while low-skilled workers earn wages equal to 0.3330 per unit of effective labor. With minimal differences in frictions across the two types of credit markets, the differences in the amount of credit per effective unit of labor across the two types of firms are smaller. Hence, the wage differences are almost negligible.

Nevertheless, the incomes from labor for the high-skilled households are still higher than the incomes from labor for the low-skilled households, because the former own three times more units of effective labor than the latter, when the differences in labor productivity are taken into account. These differences in household wage incomes, in reflection both of productivity differences (units of effective labor per household) and wage rate differences, are reflected in the functional distribution of the total wage bill in the economy across the two segments of the population (namely, low-skilled labor and the owners of human capital).

These trends for the wage incomes of the two types of households have important consequences on the inequality of the distribution of wage incomes. The Gini coefficient from the distribution of labor income is 18 percent in the first scenario and 6 percent in the second one (Table 3). Thus, the combined process of financial deepening and human capital accumulation improves the distribution of household income in the economy, but the analysis must take into account intermediate stages between these extreme cases.
<table>
<thead>
<tr>
<th>Description</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Wage Income Share (Low-Skilled)</th>
<th>Wage Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>0.0763</td>
<td>0.0295</td>
<td>0.1058</td>
<td>72.10</td>
<td>27.90</td>
<td>17.90</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>0.0111</td>
<td>0.3033</td>
<td>0.3144</td>
<td>3.53</td>
<td>96.47</td>
<td>6.47</td>
</tr>
</tbody>
</table>

Table 3: Wage Earnings, Shares, and Inequality of Wage Income. Alternative Scenarios

There are two forces driving this evolution of inequality in the functional distribution of household labor incomes. One is the change in the structure of the labor force (given by the increase of the proportion of high-skilled households, in reflection of a process of human capital accumulation) and the second one is the reduction in the relative wage differences between the two types of workers, due to pro-informal-biased (pro-poor) changes in the financial regime in place.

In effect, in the first scenario there are much financial shallowing and repression (which hurt informal firms disproportionately) and an abundance of low-skilled workers, who earn relatively low wage incomes. Because of their comparatively large numbers, however, their share in total wage income is greater than the share of high-skilled households (Table 3). The inequality of the distribution of labor income thus has the potential to rise even more, as the structural shift in the labor force takes place. However, in the second scenario, when a large proportion of the households have already shifted from a low-paying sector to a high-rewarding sector, the inequality of the distribution of labor income has already declined significantly.
With financial development accompanying the structural shift in the labor force, the wage difference between the two types of workers becomes smaller. So, the low inequality of the distribution of income in these two extreme scenarios raises the possibility of the existence of a non-linear inverted U-shaped relationship (Kuznets curve) reflecting both the structural movement of labor from the informal to the formal sector and the consequences of the gradual improvement in the financial regime. This possibility of a nonlinear relationship between development and distribution is explored in detail in section 5.3.

Apart from wage incomes, both types of households also earn interest income on their deposit holdings. However, under the assumptions about parameter values used for both scenarios, this interest income constitutes a small proportion of total household income, given by wage income plus interest income. This outcome about the sources of household income is consistent with reality in developing countries, where the share of interest payments on deposits in total income is typically in the single digits. While in scenario 1, the added interest income earned by both types of households is 2 percent of total aggregate income, in scenario 2 this proportion is 6 percent of total aggregate income. This is particularly the case in the model, because in it households hold deposits only to insure against adverse labor productivity and production shocks to the firms, but do not have options to invest for higher returns. Thus, the inclusion of interest income does not add much to the analysis of income inequality performed by using wage incomes alone.
Table 4 shows that there are minute changes in the Gini coefficient computed for total household income as compared to the Gini coefficient computed for wage incomes (Table 3). The Gini for total income is 18.2 percent and 6.6 percent, for scenarios 1 and scenario 2, respectively, while, the Gini for wage income is 17.9 percent and 6.5 percent, respectively. Therefore, interest income can be ignored in the analysis of income inequality. It is interesting to note, though, that financial development reduces the inequality of the distribution of total income more when interest earnings are included in total income than when they are not.

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Income (Low-Skilled)</th>
<th>Total Income (High-Skilled)</th>
<th>Total Household Income</th>
<th>Income Share (Low-Skilled) (%)</th>
<th>Income Share (High-Skilled) (%)</th>
<th>Gini of Total Income (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>0.0775</td>
<td>0.0305</td>
<td>0.1080</td>
<td>71.77</td>
<td>28.23</td>
<td>18.23</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>0.0114</td>
<td>0.3232</td>
<td>0.3345</td>
<td>3.40</td>
<td>96.60</td>
<td>6.60</td>
</tr>
</tbody>
</table>

Table 4: Total Income Shares and Inequality of Total Income. Alternative Scenarios

There are significant differences in the levels of output produced by the economy and the associated financial deepening indicators, in the two extreme scenarios considered here. In terms of the GDP, the economy in scenario 2 is three times as large as the economy in scenario 1 (Table 5). The two fundamental reasons for this growth in output are: (a) the structural shift in the labor force from low-skilled to high-skilled households and (b) the increased availability of credit in the economy, due to a reduction in financial frictions.
As the size of the labor force in the more productive formal sector increases in the transition to scenario 2, aggregate output increases as well. In turn, the reduction in financial frictions in the transition to scenario 2 allows the banks to charge lower interest rates on their loan portfolio. As the interest rates on loans to both sectors decline and the volume of credit increases, firms in both sectors can purchase larger amounts of non-human inputs. With credit per effective unit of labor increasing in both sectors, there is an overall increase in aggregate output.

The economy also shows a greater extent of financial deepening in scenario 2 than in scenario 1 (Table 5). An economy with a low level of the human capital stock and acute financial repression has shallow financial depth in scenario 1, as the credit to the GDP ratio is only 19 percentage points. In scenario 2, however, the credit to the GDP ratio has increased to 30 percentage points. This higher level of financial deepening and the accompanying reduction of the fragmentation of the economy increase the productivity of the available endowment of resources. Similarly, the deposit to the GDP ratio increases from 27 percentage points in scenario 1 to 30 percentage points in scenario 2, indicating an increase in the relative importance of financial wealth (Shaw 1973).

<table>
<thead>
<tr>
<th>Description</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>0.1627</td>
<td>19.05</td>
<td>27.16</td>
<td>8.11</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>0.4837</td>
<td>29.50</td>
<td>30.31</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Table 5: Indicators of Financial Deepening. Alternative Scenarios
Figure 11: Steady-State Cumulative Distribution Functions \((F_0)\) and \((F_1)\). Scenario 1

Figure 12: Steady-State Cumulative Distribution Functions \((F_0)\) and \((F_1)\). Scenario 2
Moreover, in scenario 1, under financial repression, an important proportion of the wealth (at least 30 percent of the deposits), equivalent to 8 percentage points of the GDP, is taxed away as idle reserves by the authorities or is wasted in transaction costs. This implies a significant loss of welfare, as these resources are not employed for productive purposes. In contrast, in scenario 2, with limited financial repression, the reserves to the GDP ratio is only 0.8 percentage points, indicating a higher degree of financial intermediation and of the accompanying gains in productivity and welfare.

Regarding the levels of financial wealth, the aggregate amount of deposits held by the two types of households, in either scenario, are shown in Table 6, and the steady-state cumulative distribution functions of low-skilled and high-skilled households over these deposits, in each scenario, are depicted in Figure 11 and Figure 12.

The two cumulative distributions shown in Figure 11, for scenario 1, highlight the critical differences in the holdings of deposits by the two types of households in the model. In the case of the low-skilled households, a large proportion (54.56 percent of all the households and 60.62 percent of the low-skilled households) has zero deposit holdings. Their initial deposits and wage incomes are too low to allow savings. The remainder of the low-skilled households holds positive amounts of deposits, up to a maximum amount of 0.4205. In contrast, all high-skilled households hold a positive amount of deposits, with sizes that range between a minimum of 0.1590 and a maximum of 0.5364, which is larger than the maximum deposit amount for low-skilled households.
A similar outcome is depicted for scenario 2 in Figure 12. In this scenario, 13.50 percent of the low-skilled households (which represent 1.35 percent of all the households) hold no deposits, while all high-skilled households hold deposits. The range for the sizes of these deposits has shrunk (minimum of 0.0169 and maximum of 0.0654 for high-skilled households), however, as the probability of suffering an adverse productivity shock has declined with the transition towards a more developed economy.

The resulting Gini coefficient for the distribution of wealth, of 74 percent, indicates a high level of inequality in the first scenario; while the Gini coefficient of 24 percent indicates a low level of wealth inequality in the second scenario (Table 5). In this stylized economy, at a nascent stage of development, in scenario 1, poverty levels and the inequality of the distribution of wealth are high, because there are very few high-skilled workers. The few richer households have, however, strong motivations to save and hold wealth (deposits) over time, given a high probability (1 – N) that, in future periods, they may suffer an adverse labor productivity shock (or the firm where they work may suffer a production shock) and they may not be able to sustain their current levels of consumption.

<table>
<thead>
<tr>
<th>Description</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposit to Wage Income Ratio (Low-Skilled)</th>
<th>Deposit to Wage Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>0.0247</td>
<td>0.0195</td>
<td>32.44</td>
<td>65.92</td>
<td>73.84</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>0.0020</td>
<td>0.1446</td>
<td>18.19</td>
<td>47.67</td>
<td>24.39</td>
</tr>
</tbody>
</table>

Table 6: Deposit Mobilization and Inequality of Wealth. Alternative Scenarios
In order to protect—in the future— their consumption at its currently high level (given by their higher wage incomes), the high-skilled households build—through saving—a desired (“target”) stock of deposits, as a precautionary reserve to be used if the adverse shock occurs in any future period (Deaton 1990 and 1991, (Alderman and Paxson 1992, Besley 1995, Jalan and Ravallion 2001, Conning and Udry 2007, Gomez-Soto and Gonzalez-Vega 2007, Gomez-Soto 2007, Carroll 2009).

Depending on their policy function and on the level of the deposits carried over from the previous period, the households will save or dissave, in order to approach their target level of deposits. Once they reach this level, their current savings will be zero and the size of the deposit will remain constant from one period to the next, until a shock changes their skill status.

Low-skilled households also build some reserves, given the probability that a production shock to the firm where they work may leave them without wages as well as given potential changes in wage rates as a result of changes in the availability of credit to the firms, but they do not fear an adverse shift from high to low skills. Their target level of deposits would be, therefore, lower than for high-skilled households.

Because the deposit opportunities available to the households have a one-period maturity, at the end of each period they receive from the banks the funds deposited in the earlier period (and the corresponding interest earnings) and, once they have reached their target level of precautionary reserves, they redeposit the same amount that they had at the start of the period.
Therefore, in the steady state of scenario 1, the wealthier high-skilled households keep a high ratio of their deposits (reserves) to their income, at 66 percent of their wage earnings, and, while their share in the population of households is only 10 percent, their share in total deposits is 44 percent. This contributes to a high degree of concentration in the distribution of wealth.

At the same time, a large number of poor, low-skilled households are less willing or are even unwilling to save and sacrifice current consumption because, if at all, their status might improve in the future, if a favorable shock shifted them from low to high skills. Therefore, in scenario 1 they keep a lower ratio of their deposits (reserves) to income, at 32 percent of their wage earnings. While they represent 90 percent of the population of households, their share in total deposits is only 56 percent, and a sizeable proportion of them hold a zero level of deposits (Figure 11).

As financial and economic development take place, however, the number of poor, low-skilled households declines, the number of richer, high-skilled households rises, the stock of wealth grows, and the inequality in the distribution of wealth falls, as larger and larger numbers of depositors are added to the economy and as the differences in deposit sizes shrinks. So, with the structural transformation of the economy, the inequality of wealth seems to monotonically decline. While in the less fragmented and less risky economy that is emerging, the desired (target) ratio of reserves to wage incomes may decline, because the risk of adverse productivity shocks is declining, the numbers of high-skilled depositors and their wage earnings are increasing and this leads to improvements in the distribution of wealth.
These changes in the distribution of wealth are apparent in Figure 13, where the Lorenz curves for the model economy, in each scenario, are drawn. In the first case, around 50 percent of the households (the poorest) hold only 0.5 percent of the wealth but, in the second case, 0.5 percent of the wealth is held by just around 7 percent of the households. The poorest 50 percent of the households hold a much larger proportion of wealth in this second scenario (32 percent). The share of the poorest in the distribution of wealth has thus improved and the Lorenz curve has moved towards the diagonal.
Similarly, there is significant improvement at the top end of the distribution of wealth. In the first scenario, the wealthiest 5 percent of the households hold around 29 percent of the deposits. In contrast, in the second scenario, the richest 5 percent of the households hold only 8 percent of the wealth. Thus, the improvement in the distribution of wealth is quite apparent. Most of this improvement comes from the accumulation of human capital, while the role of financial development is to improve the rewards to depositors and offer additional incentives for households to hold deposits and accumulate financial wealth.

5.2 Policy Analyses: Financial Policies, Financial Development and Inequality

The two extreme scenarios assessed in the first section of this chapter suggest that, apart from the structure of the labor force, the level of financial development has an effect on the mobilization of deposits, the availability of credit, the level of output, the accumulation of wealth, the rate of growth of wages, and the degree of inequality in the distributions of income and wealth.

In this section, the focus of the simulations is to further explore the distributional impacts of changes in the financial policies that affect the extent of frictions in financial markets. In addition, as a sensitivity analysis, these policy simulations are performed at various stages of human capital formation. The augmented Kuznetsian analysis of financial deepening and human capital formation jointly influencing the distribution of income is carried out in the next section.
The most direct financial policy intervention, in order to decrease the wedge between the lending and deposit interest rates, is to lower the required reserve ratio. Apart from such direct policy interventions, however, the authorities can improve the performance of financial markets by indirectly influencing the environment for the operation of those markets.

Policies such as new bank/branch licensing rules, loan-loss reserves norms, penalties or fines for regulatory breaches, establishing credit bureaus for a better risk profiling of the borrowers, bringing improvements in legal services to settle disputes, setting accounting standards, establishing property registries, and the like have an impact on the costs associated with screening and monitoring borrowers.

Similarly, a greater availability of risk-management tools, the development of insurance markets, the provision of safety nets and disaster relief as well as the development of a better physical infrastructure would help reduce loan defaults. Moreover, promoting new lending technologies, which introduce new ways of ascertaining creditworthiness (like microfinance), can improve the operations of financial markets and also reduce the gap between the lending and deposits interest rates. The impact of all of these policies is proxied, in the following simulations, by changes in the corresponding parameters.

To start the analysis, I take as a reference the first scenario, with a high degree of financial repression and a small stock of human capital. Throughout, I keep all other parameters the same as in this reference point, including the proportion of high-skilled workers at 10 percent of the number of households.
I then carry out a set of policy simulations, in which the required reserve ratio, $\eta$, the rate of default from firms in the informal sector, $p_0$, and the costs of lending to the informal sector, $a_0$ and $b_0$, are gradually reduced in each simulation, separately. The evolution of these parameters thus depicts a process of financial liberalization and of financial deepening, which reduce the frictions encountered in financial markets.

The corresponding three sets of simulations are then repeated at an intermediate stage of structural transformation and evolution of the labor force, for an economy with a larger stock of high-skilled workers, namely when $N$ equals 50 percent, and when some reduction in the default rate of the informal sector firms has taken place.

<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Description</th>
<th>Default</th>
<th>Cost Parameters</th>
<th>Required Reserve Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N=0.10$</td>
<td>Initial Case Simulation</td>
<td>$p_0$ 0.20</td>
<td>$p_1$ 0.01</td>
<td>$a_0$ 0.10</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>0.20-0.08</td>
<td>-</td>
<td>0.10-0.04</td>
</tr>
<tr>
<td>$N=0.50$</td>
<td>Initial Case Simulation</td>
<td>$p_0$ 0.16</td>
<td>$p_1$ 0.01</td>
<td>$a_0$ 0.10</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>0.16-0.04</td>
<td>-</td>
<td>0.10-0.04</td>
</tr>
<tr>
<td>$N=0.70$</td>
<td>Initial Case Simulation</td>
<td>$p_0$ 0.12</td>
<td>$p_1$ 0.01</td>
<td>$a_0$ 0.09</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>0.12-0.06</td>
<td>-</td>
<td>0.09-0.03</td>
</tr>
</tbody>
</table>

NOTE: Values of non-financial parameters, discount factor $\delta$, risk aversion $\gamma$, labor productivity $\bar{l}$, labor time $\bar{h}$ and share of loans in production $\alpha$ do not change in any simulation and they remain the same as in the alternate scenarios given in Table 1.

Table 7: Financial Parameter Values and their Range in Simulations
Finally, the same set of three simulations is carried out when the economy is at an advanced stage of human capital development, when $N$ equals 70 percent of the households, and when an important degree of financial development has already taken place. However, I do not change any of the non-financial parameters, like the discount factor, risk aversion coefficient, labor productivity differentials, and the share of loans in the production function, in any of the simulations, at either stage.

The purpose is to observe the effectiveness of direct and indirect financial policies in influencing the distributions of income and wealth at various stages of economic development. Table 7 reports the values of the parameters and the range used in the simulations carried out at the three levels of structural transformation assumed as alternative scenarios.

As policies bring improvements in the financial regime, I expect that the wedge between the interest rates on deposits and on loans would shrink, the levels of output and asset accumulation would increase, and the economy would achieve greater financial depth (Beck, Levine and Loayza 2000, Levine 2004). In the economy of the model, all households have access to financial services (deposit facilities) and they earn a uniform interest rate on their deposits. Also, both the formal and informal sector firms can borrow from the banks, for production purposes, at interest rates determined by conditions prevailing in the respective segments of the market. Thus, any direct or indirect policy intervention would have an impact on the interest rate paid on deposits and the interest rates charged on the two types of loans, thereby leading to an expansion of finance at the intensive (rather than the extensive) margin.
So, policy measures that increase the volume of loanable funds (such as a reduction in the required reserve ratio, thereby lowering the level of wealth held as idle reserves) or plug the leakages of resources due to market imperfections or to incomplete institutions (resulting in a reduction in default rates and a reduction in the costs of lending) would reduce the gap between interest rates on loans and deposits.

The availability of credit has a direct impact on the level of output, because the level of non-labor inputs to be combined with the labor force depends on the firms’ access to credit. With greater financial development, the firms would be able to borrow more, at lower interest rates, and the households would earn better returns on their deposits. Hence, production and asset accumulation would rise. Because asset accumulation would take place more rapidly than the growth of output, this would also lead to increasing financial deepening (represented by the ratio of financial wealth to output).

The impact of these improved financial policies on inequality is difficult to assess \textit{a priori}. In the case of a direct intervention in financial markets (such as a reduction in the required reserve ratio $\eta$), more loanable funds would be available to the banks and the supply of credit to both the high-risk and low-risk firms would increase. Since the labor supply in the economy remains constant, the demand for credit remains unaltered in both the informal and formal sectors. The interest rates charged on loans would decline and the amount of credit would increase.
In these circumstances, an increase in the volume of loans would result in an increase in output and in wages across all firms, because the amount of credit per effective unit of labor would increase in both types of firms. The inequality of wage incomes may, however, rise, decline or remain constant, depending upon the relative increase in wages for the two types of households. If the wage incomes of all households in the economy increased by a similar proportion, the impact on the inequality of the distribution of income would be neutral.

If, however, the labor income of the low-skilled households increased faster than the labor income of the high-skilled households, then the inequality of the distribution of income would decline. In contrast, if the labor income of the high-skilled households increased more rapidly, then the inequality of the distribution of income would rise. The relative differences in the rates of wage increases would depend, in turn, upon the differences in the rates of change of the amounts of credit that the two types of firms receive.

These differences in the rates of credit expansion depend, in turn, upon the differences in the (slopes of the) marginal cost of lending functions for the bank and the differences in the (slopes of the) demand for credit from the two types of firms. Since I have assumed that the production function has the same Cobb-Douglas shape in the two sectors and, therefore, the schedule for the marginal product of effective labor (and, as a consequence, the slope of the demand function) is the same in both sectors, these differences in the rates of credit expansion would depend on differences in the cost of lending functions for the banks.
The inequality of the distribution of wealth, apart from the influence of differential wages (in reflection of labor productivity differences), also depends upon the levels of the initial deposits, the level of the interest rate paid on deposits, and the different motivations that the two types of households have to accumulate precautionary reserves. Given the greater risk of an adverse productivity shock, high-skilled households have a stronger motivation (“willingness”) and their incomes give them a greater “ability” to hold larger amounts of deposits (wealth).

Direct policy interventions would influence the distribution of wealth through changes in the interest rates earned on deposits—given the initial levels of these deposits, which have resulted from the history of shocks suffered by the households (driven by a Markov process)—and through the relative strength of the income and substitution effects of the interest rate changes for the two types of households as well as through differential changes in wage incomes, as a result of the non-uniform process of credit deepening. In particular, through these channels, financial development would influence the policy functions of the two types of households and the target levels of precautionary reserves (deposits) that they would want to hold. In turn, changes in their levels of deposits would then affect the distribution of wealth across households.

In the case of (pro-informal sector biased) indirect interventions in the environment for the operation of financial markets, policy interventions are expected to lead to a reduction in the default rate in the informal sector, \( p_0 \), and in the costs associated with lending to the informal sector, \( a_0 \) and \( b_0 \).
When this is the case, the banks are expected to expand lending faster to the informal sector, because the risks and marginal costs of lending for the bank would have declined just for this sector. The levels of output as well as the wages paid by informal sector firms are then expected to increase, with the increase in credit per unit of effective labor in this sector.

There would also be changes, however, in the credit conditions for the formal sector firms, as the banks reorganize their portfolio in the presence of the new financial market conditions, but the smaller relative changes in credit amounts to formal firms would lead to smaller changes in the production levels and the wages paid by these firms.

As the wages of the low-skilled households increase more rapidly than the wages of the high-skilled workers, the share of the former in total wage income increases but, depending upon the stage of human capital development and the distribution of skills in the economy, the inequality of the distribution of income may decline or rise.

As in the case of direct policy interventions, the changes in the inequality of the distribution of wealth would depend upon the proportion of high-skilled households in the economy and on how the two types of households react to the changes in the interest rate on deposits and in wages. The structural process associated with the distribution of skills in the population would dominate this process, with changes in financial policies augmenting or dampening these structural processes, through their impact on household incomes from deposit holdings and wages.
In summary, the impact of financial policies on inequality would depend upon the choice of policy intervention, the magnitude of the change in the policy parameter, the initial conditions of the economy, and the behavior of heterogeneous agents. Below, I present the results of each of the three policy simulations, separately.

<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Required Reserve Ratio</th>
<th>Deposits</th>
<th>Loans</th>
<th>Deposit Interest Rate</th>
<th>Loan Interest Rates</th>
<th>Wage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$D$</td>
<td>$L_0$</td>
<td>$L_1$</td>
<td>$\tau_D$ (%)</td>
<td>$\tau_{L0}$ (%)</td>
</tr>
<tr>
<td>0.10</td>
<td>0.30</td>
<td>0.0205</td>
<td>0.0105</td>
<td>5.05</td>
<td>100.50</td>
<td>51.71</td>
</tr>
<tr>
<td></td>
<td>0.22</td>
<td>0.0240</td>
<td>0.0124</td>
<td>4.92</td>
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</tr>
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<td>0.16</td>
<td>0.0277</td>
<td>0.0144</td>
<td>4.78</td>
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<td>23.20</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.0314</td>
<td>0.0166</td>
<td>4.67</td>
<td>52.32</td>
<td>12.61</td>
</tr>
<tr>
<td>0.30</td>
<td>0.0983</td>
<td>0.0130</td>
<td>0.0558</td>
<td>0.81</td>
<td>83.60</td>
<td>45.69</td>
</tr>
<tr>
<td></td>
<td>0.22</td>
<td>0.0152</td>
<td>0.0660</td>
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<td>65.93</td>
<td>30.68</td>
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<td>0.16</td>
<td>0.0175</td>
<td>0.0768</td>
<td>0.65</td>
<td>51.56</td>
<td>18.47</td>
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<td>0.08</td>
<td>0.0199</td>
<td>0.0882</td>
<td>0.54</td>
<td>39.62</td>
<td>8.32</td>
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<td>0.50</td>
<td>0.1233</td>
<td>0.0096</td>
<td>0.0892</td>
<td>5.75</td>
<td>60.53</td>
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</tr>
<tr>
<td></td>
<td>0.1273</td>
<td>0.0105</td>
<td>0.0980</td>
<td>5.72</td>
<td>51.65</td>
<td>25.84</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td>0.0114</td>
<td>0.1071</td>
<td>5.68</td>
<td>43.76</td>
<td>18.83</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td>0.0123</td>
<td>0.1164</td>
<td>5.64</td>
<td>36.70</td>
<td>12.57</td>
</tr>
</tbody>
</table>

Table 8: Deposit and Loan Amounts, Interest Rates, and Wages, for Policy Simulations Performed with the Required Reserve Ratio, at Different Levels of the Stock of Human Capital
5.2.1 Changes in the Required Reserve Ratio and the Inequality of Income and Wealth

For the first case of these policy simulations, undertaken at three stages of human capital development ($N=0.10$, $N =0.50$ and $N =0.70$), the improvements in the financial regime are brought about by a direct policy intervention (namely, a reduction in the required reserve ratio) that reduces the gap between the interest rates on deposits and on loans. This intervention increases the level of output, through a greater degree of financial deepening, but it worsens the distribution of wage incomes and it deteriorates the distribution of wealth, in all three of the simulations implemented at different levels of the stock of human capital. Several dimensions of the impacts of financial liberalization are shown in Tables 8 through Table 11.

The decline in the required reserve ratio, $\eta$, makes extra resources available (a volume effect) for the banks to lend (as a lower proportion than before, of the deposits mobilized, has to be held as idle reserves) and also, it uniformly (given the fungibility of liquid funds, because household depositors do not distinguish across the banks’ asset choices), decreases the marginal cost of lending (a price effect) for the banks, in both the formal and informal credit markets, because it reduces the opportunity cost of the idle resources mobilized from the households and kept as reserves and it, therefore, reduces the effective cost of funds ($\frac{R_D}{1-\eta}$) for the banks (Table 8). The supply of loans to the two types of firms thereby increases and the interest rates on these loans decline. If the demand for credit is relatively elastic, then the additional supply of funds would be taken up with little change in the interest rate on loans. If, however, the demand for credit is relatively inelastic, the interest rate on loans will decrease faster.
The credit portfolio of the banks increases, both because the proportion of any amount of deposits that is available for lending increases and because the volume of deposits itself increases (Table 8). The change in the volume of deposits is, however, the outcome of a complex general equilibrium interaction, where households respond both to endogenous changes in the interest rates paid on deposits (in reflection of income and substitution effects) and to endogenous changes in wage earnings.
That is, apart from the interest rate to be earned, the household supply of deposits also depends upon wage incomes, which are endogenously determined in the model, as well as on discount factors and rates of risk aversion, which are exogenous. Indeed, the reduction in the reserve requirement ratio would not only change the interest rate that the banks are willing to pay on deposits (pushing this rate upwards), but it would also change the wage incomes of the households (which would push this rate downwards), because it would alter the amount of credit supplied to the two types of firms and it would change the amount of output produced by them. Thus, while isolating the changes in the supply of deposits due to changes in the interest rates is difficult, both the changes in interest rates and in wages and, therefore, the full net change in the volume of deposits mobilized would be attributable to the process of financial liberalization. With the impact of the increase in the wage incomes of the high-skilled households, which are the primary savers in the economy, dominating the final outcome, the supply of deposits is expected to increase (shift outwards).

As reflected in Table 8, after the change in the required reserve ratio, the interest rate on deposits declines in all simulations (actually, a total of 7.8 percent, when N equals 0.10), but there is a more than proportional rise in the volume of aggregate deposits (a total of 14.1 percent, in the same simulation). Thus, the reduction in the interest rate and increase in total deposits could actually only happen if there has been a shift (increase) in the supply function for deposits, due mostly to the increase in the wage incomes of the (high-skilled) households.
<table>
<thead>
<tr>
<th>Human Capital Stock Stock</th>
<th>Required Reserve Ratio</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>η</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.10</td>
<td>0.30</td>
<td>0.1627</td>
<td>19.05</td>
<td>27.16</td>
<td>8.11</td>
</tr>
<tr>
<td></td>
<td>0.22</td>
<td>0.1721</td>
<td>21.16</td>
<td>27.05</td>
<td>5.89</td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.1810</td>
<td>23.25</td>
<td>26.95</td>
<td>3.69</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.1895</td>
<td>25.33</td>
<td>26.83</td>
<td>1.51</td>
</tr>
<tr>
<td>0.50</td>
<td>0.30</td>
<td>0.3004</td>
<td>22.92</td>
<td>32.72</td>
<td>9.81</td>
</tr>
<tr>
<td></td>
<td>0.22</td>
<td>0.3183</td>
<td>25.52</td>
<td>32.70</td>
<td>7.18</td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.3353</td>
<td>28.13</td>
<td>32.69</td>
<td>4.56</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.3516</td>
<td>30.74</td>
<td>32.67</td>
<td>1.94</td>
</tr>
<tr>
<td>0.70</td>
<td>0.20</td>
<td>0.3844</td>
<td>25.71</td>
<td>32.07</td>
<td>6.37</td>
</tr>
<tr>
<td></td>
<td>0.15</td>
<td>0.3972</td>
<td>27.31</td>
<td>32.06</td>
<td>4.75</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td>0.4096</td>
<td>28.92</td>
<td>32.05</td>
<td>3.13</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td>0.4216</td>
<td>30.53</td>
<td>32.04</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Table 10: Indicators of Financial Deepening for Policy Simulations Performed with the Required Reserve Ratio, at Different Levels of the Stock of Human Capital

In turn, for a constant amount of labor inputs at each level of the stock of human capital, the demands for credit, in the formal and informal sectors, appear to be fairly inelastic. Thus, the changes in the interest rates are substantial (Table 8). Actually, the interest rates on both formal and informal loans decline markedly, with the increase in the supply of credit resulting from the reduction in the required reserve ratio.
There are two consequences of these changes in interest rates. On the one hand, even though the reduction in the required reserve ratio is not biased in favor of any particular sector, the differences in the (slopes of the) marginal cost of lending functions for the banks lead to a more pronounced decline of the interest rate on informal loans (a total of 48.2 percentage points, when $N$ equals 0.10) than the decline of the interest rate on formal loans (a total of 39.1 percentage points in the same simulation, as reflected in the data reported in Table 8). Therefore, the differences in the cost of loans for the two types of firms are reduced even in the case of this apparently neutral direct intervention. On the other hand, the overall wedge between the lending and deposit interest rates (used as a proxy for financial development) declines in the simulations, as financial liberalization takes place, despite a slight decrease in the interest rate paid on deposits.

The changes in the credit portfolio lead to changes at the firm level and in the wage rates the two types of firms pay. Wages, $W_0$ for the low-skilled households and $W_1$ for the high-skilled households, increase in all the simulations performed, at the three different levels of human capital formation (Table 8). Financial liberalization, therefore, increases the marginal product of labor across the board. Thus, there is an absolute increase in wages across both sectors. However, the wages of the high-skilled households increase more rapidly than the wages of the low-skilled households (because the amount of credit received increases proportionately more for the formal than for the informal firms, given the differences in the marginal costs of lending). This non-uniform increase in wages has adverse consequences for the distribution of wage incomes.
Thus, the changes in the distribution of income result from the differential credit deepening triggered by the direct policy intervention.
Given the parameter values used in the simulations, Figure 14 and column 8 of Table 9 show that the inequality of wage incomes increases with the direct policy intervention in financial markets (a reduction in the required reserve ratio), for each one of the three levels of human capital formation, although the magnitude of the impact decreases as the process of structural transformation proceeds. This deterioration of the (functional) distribution of wage incomes is reflected by a reduction of the share of the low-skilled households in the total wage bill, in all simulations (column 6, Table 9). In contrast, the share of the high-skilled households in the total wage bill increases (column 7, Table 9).
However, as the structural transformation takes place and the skills composition of the labor force changes, the impact of the direct intervention in financial markets on the inequality of income becomes less pronounced. In all cases, moreover, the adverse changes in the Gini coefficient for the distribution of wage incomes are very small. So, whatever the deterioration of the distribution as a consequence of financial liberalization is, it is very minor.

It would be incorrect to infer, moreover, that the tools of financial repression, such as a movement of the required reserve ratio in the opposite direction (that is, an increase in the requirement) might be good policy tools to seek improvements in the distribution of income. To understand why this would not be the case, one must consider the resource allocation costs, in terms of reduced output (GDP) and lower wages (and presumably, lower welfare), associated with such policy interventions.

Indeed, in the simulations, as the required reserve ratio is reduced by 22 percentage points in the first (when N equals 0.10) and the second (when N equals 0.50) sets of simulations and by 15 percentage points in the third (when N equals 0.70) set of simulations, the GDP increases 16 percent, 17 percent, and 10 percent, respectively (Table 10). Thus, a tiny improvement in the distribution of income (measured by small fractions of one percentage point of the Gini coefficient, as shown in Table 9 and Figure 14), achieved with this instrument of financial repression, would have been obtained at the cost of substantial losses of total output and the accompanying reductions in the marginal product of labor and in wages (Table 8).
The improvements in the productivity of the economy from this policy of financial liberalization (proxied by the reduction of the required reserve ratio) are due, in turn, to the greater role of financial intermediation in the allocation of resources. This is reflected in the increases in the ratios of credit to the GDP and deposits to the GDP and, particularly, in the reduction of the reserves to the GDP ratio, which indicates a declining leakage of resources from productive activities into idle reserves (Table 10). With the reduction in the leakage into reserves, the indicators of financial deepening, credit to the GDP and deposits to the GDP tend to converge. After financial liberalization, the majority of the deposits mobilized are thus returned to the flows of intermediation and transformed into a productive credit portfolio.

The evolution of the aggregate levels deposits (wealth) held by the two types of households, as the required reserve ratio is reduced, is shown in Table 11. In all cases, the volume of deposits increases with the liberalization of financial markets, for both types of households and at all stages of the structural transformation of the labor force. Thus, the growth of the loan portfolios of the banks emerges both from a greater availability of deposits and a larger proportion of those deposits being available for lending. In a general equilibrium framework, this direct policy intervention influences the holdings of deposits through the complex interaction among changes in the interest rates earned on deposits, the initial levels of these deposits, the relative strength of the income and substitution effects of the interest rate changes, and the changes in the wage incomes of the households, as a result of the process of credit deepening triggered by the liberalization policies.
The increases in the holdings of deposits are not, however, uniform for both types of households. The deposit holdings of the high-skilled household increase faster, as the process of financial liberalization proceeds and, except in the most advanced stage of the structural transformation, their share in aggregate wealth (deposits) increases with financial liberalization. This reflects the more rapid growth in the wages of the high-skilled households and their greater propensity to accumulate reserves, in order to insure against adverse labor productivity shocks (Table 11).

Thus, the steady-state ratio of deposit holdings to wage incomes is higher for the high-skilled than for the low-skilled households. The difference between these ratios declines, however, with the process of structural transformation, as the probability of suffering an adverse productivity shock declines for the high-skilled households with the declining proportion of low-skilled households in the labor force (Table 11).

The consequences of these non-uniform changes in the holdings of deposits on the inequality of the distribution of wealth depend on the stage of development of the economy. At an early stage, the process of financial liberalization worsens inequality, as shown by a minor increase in the Gini coefficient of the distribution of wealth. This is due to the more rapid increase in wealth of a small number of high-skilled households (Table 11 and Figure 15). However, at an intermediate level of human capital formation ($N$ equals 0.50) and at an advanced level ($N$ equals 0.70), the impact of financial liberalization on the distribution of wealth becomes almost insubstantial or it may even slightly reduce inequality, given the larger proportion of high-skilled households in the population.
In summary, direct policy interventions in financial markets may slightly increase the inequality of the distributions of income and wealth, but this adverse impact gradually subsides, as the structural transformation of the labor force takes place. In contrast, the impact of liberalization on financial deepening, on the levels of output and on wages is strongly positive, at all the stages of human capital formation. Direct financial policy interventions, proxied by changes in the required reserve ratio, may thus lead to a trade-off between improving these distributions and suffering a loss of output and lower wages.
Therefore, with direct interventions in financial markets, the authorities might bring about small improvements in the distributions of income and wealth, but only at a huge loss in output and in financial deepening. Therefore, the required reserve ratio (and similar interventions) is not a useful tool to influence the distributions of income and wealth. Governments interested in reducing inequality should look for other, less sub-optimal instruments to achieve their goals (Gonzalez-Vega, 2003). The following sections explore the extent to which indirect policy interventions in financial markets, to lower risks and transaction costs by improving the environment for the operation of markets, may have desirable impacts on the reduction of inequality.

5.2.2 Changes in the Default Rate in the Informal Sector and the Inequality of Income and Wealth

When there are (pro-informal, pro-poor biased) indirect interventions in the environment for the operation of financial markets that lower the default rate of firms in the informal sector, the simulations, undertaken at three stages of the process of human capital formation ($N=0.10$, $N=0.50$ and $N=0.70$), show that the wedge between the interest rate on deposits and the interest rate on loans to informal sector firms declines and that the distribution of wage incomes improves at all three stages of development. However, the impacts on the level of output and on financial deepening as well as on the distribution of wealth are sensitive to the stage of human capital formation (Table 12 through Table 15).
## Table 12: Deposit and Loan Amounts, Interest Rates and Wages for Policy Simulations Performed with Changes in the Default Rate of Informal Sector Firms, at Different Levels of the Stock of Human Capital

<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Default Rate</th>
<th>Deposits</th>
<th>Loans</th>
<th>Deposit Interest Rate</th>
<th>Loan Interest Rates</th>
<th>Wage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$p_0$</td>
<td>$D$</td>
<td>$L_0$</td>
<td>$L_1$</td>
<td>$r_{D}$ (%)</td>
<td>$r_{L_0}$ (%)</td>
</tr>
<tr>
<td>0.10</td>
<td>0.20</td>
<td>0.0442</td>
<td>0.0205</td>
<td>0.0105</td>
<td>5.05</td>
<td>100.50</td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.0456</td>
<td>0.0217</td>
<td>0.0103</td>
<td>6.38</td>
<td>93.24</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>0.0471</td>
<td>0.0229</td>
<td>0.0101</td>
<td>7.67</td>
<td>86.57</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.0486</td>
<td>0.0242</td>
<td>0.0099</td>
<td>8.81</td>
<td>80.24</td>
</tr>
<tr>
<td>0.50</td>
<td>0.16</td>
<td>0.0983</td>
<td>0.0130</td>
<td>0.0558</td>
<td>0.81</td>
<td>83.60</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>0.0980</td>
<td>0.0138</td>
<td>0.0548</td>
<td>1.97</td>
<td>77.16</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.0976</td>
<td>0.0145</td>
<td>0.0538</td>
<td>3.19</td>
<td>71.36</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td>0.0973</td>
<td>0.0152</td>
<td>0.0529</td>
<td>4.39</td>
<td>66.01</td>
</tr>
<tr>
<td>0.70</td>
<td>0.12</td>
<td>0.1233</td>
<td>0.0096</td>
<td>0.0892</td>
<td>5.75</td>
<td>60.53</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td>0.1229</td>
<td>0.0099</td>
<td>0.0886</td>
<td>6.24</td>
<td>57.64</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.1225</td>
<td>0.0102</td>
<td>0.0881</td>
<td>6.66</td>
<td>54.79</td>
</tr>
<tr>
<td></td>
<td>0.06</td>
<td>0.1222</td>
<td>0.0104</td>
<td>0.0875</td>
<td>7.08</td>
<td>52.06</td>
</tr>
</tbody>
</table>

The decline in the default rate of informal sector firms, $p_0$, lowers the marginal cost of lending to the informal sector. This would make the banks more profitable, so they transfer some of these gains to the depositors, in the form of a better interest rate on their deposits, depending on the relevant elasticities. Thus, the interest rate on deposits increases in all the simulations (Table 12).
Some of the gains from the lower lending costs are also transferred to the informal sector firms, in all cases, through lower interest rates on loans, $r_{L_0}$, and through a larger amount of credit, $L_0$, due to a supply shift. Thus, the dispersion between the two loan interest rates (a source of fragmentation) and the wedge between the deposit interest rates and the interest rates on loans to the informal firms also declines.

Because of the change in the relative profitability of loans to the two sectors, the interest rate on loans to the formal sector firms, $r_{L_1}$, increases and the volume of loans to the formal sector firms, $L_1$, declines. This is because, with no change in the riskiness of loans to the formal sector firms, the supply of loans to this sector becomes relatively less attractive for the bank.

Despite the increase of the interest rate on loans to firms in the formal sector, the overall fragmentation of the economy (reflected by the interest rate wedge) declines, in two ways. On the one hand, the difference between the interest rates charged on loans to formal and to informal firms’ declines. This improves the allocation of the credit portfolio across sectors and reduces the relative disadvantage of informal sector firms and, thereby, of the low-skilled households hired by them.

On the other hand, the wedge between the interest rate paid on deposits and the average interest rate earned on the loan portfolio (weighted by the shares of the two types of loans in the total amount of credit) declines. For example, at the initial stage of development (when $N$ equals 0.10), the reduction in the riskiness of the informal sector firms leads to a reduction of the weighted average interest rate earned on the total portfolio, from 84.0 percent to 72.6 percent (computed from the data in Table 12).
<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Default Rate</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Wage Income Share (Low-Skilled)</th>
<th>Wage Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.20</td>
<td>0.0763</td>
<td>0.0295</td>
<td>0.1058</td>
<td>72.10</td>
<td>27.90</td>
<td>17.90</td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.0778</td>
<td>0.0293</td>
<td>0.1071</td>
<td>72.63</td>
<td>27.37</td>
<td>17.37</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>0.0793</td>
<td>0.0291</td>
<td>0.1084</td>
<td>73.14</td>
<td>26.86</td>
<td>16.86</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.0808</td>
<td>0.0290</td>
<td>0.1097</td>
<td>73.61</td>
<td>26.39</td>
<td>16.39</td>
</tr>
<tr>
<td>0.50</td>
<td>0.16</td>
<td>0.0444</td>
<td>0.1509</td>
<td>0.1953</td>
<td>22.74</td>
<td>77.26</td>
<td>27.26</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>0.0453</td>
<td>0.1499</td>
<td>0.1952</td>
<td>23.19</td>
<td>76.81</td>
<td>26.81</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.0461</td>
<td>0.1490</td>
<td>0.1951</td>
<td>23.63</td>
<td>76.37</td>
<td>26.37</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td>0.0469</td>
<td>0.1481</td>
<td>0.1949</td>
<td>24.05</td>
<td>75.95</td>
<td>25.95</td>
</tr>
<tr>
<td>0.70</td>
<td>0.12</td>
<td>0.0286</td>
<td>0.2212</td>
<td>0.2499</td>
<td>11.46</td>
<td>88.54</td>
<td>18.54</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td>0.0289</td>
<td>0.2207</td>
<td>0.2496</td>
<td>11.58</td>
<td>88.42</td>
<td>18.42</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.0292</td>
<td>0.2202</td>
<td>0.2494</td>
<td>11.71</td>
<td>88.29</td>
<td>18.29</td>
</tr>
<tr>
<td></td>
<td>0.06</td>
<td>0.0295</td>
<td>0.2198</td>
<td>0.2492</td>
<td>11.83</td>
<td>88.17</td>
<td>18.17</td>
</tr>
</tbody>
</table>

Table 13: Inequality of Wage Incomes for Policy Simulations Performed with Changes in the Default Rate of Informal Sector Firms, at Different Levels of the Stock of Human Capital

This reduction in the average loan interest rate, combined with the increase in the interest rate paid on deposits, shrinks the wedge that reflects the extent of frictions in financial markets. Thus, even though the intervention considered in these simulations is pro-informal sector biased, the overall efficiency of the financial market improves, with particular gains for depositors and informal sector firms and poor households.
<table>
<thead>
<tr>
<th>Human Capital Stock Stock $N$</th>
<th>Default Rate $p_0$</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.20</td>
<td>0.1627</td>
<td>19.05</td>
<td>27.16</td>
<td>8.11</td>
</tr>
<tr>
<td></td>
<td>0.16</td>
<td>0.1648</td>
<td>19.42</td>
<td>27.68</td>
<td>8.26</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>0.1668</td>
<td>19.80</td>
<td>28.22</td>
<td>8.42</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.1688</td>
<td>20.21</td>
<td>28.79</td>
<td>8.59</td>
</tr>
<tr>
<td>0.50</td>
<td>0.16</td>
<td>0.3004</td>
<td>22.92</td>
<td>32.72</td>
<td>9.81</td>
</tr>
<tr>
<td></td>
<td>0.12</td>
<td>0.3003</td>
<td>22.84</td>
<td>32.62</td>
<td>9.78</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.3001</td>
<td>22.77</td>
<td>32.52</td>
<td>9.74</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td>0.2999</td>
<td>22.71</td>
<td>32.43</td>
<td>9.72</td>
</tr>
<tr>
<td>0.70</td>
<td>0.12</td>
<td>0.3844</td>
<td>25.71</td>
<td>32.07</td>
<td>6.37</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td>0.3840</td>
<td>25.64</td>
<td>31.99</td>
<td>6.35</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>0.3837</td>
<td>25.59</td>
<td>31.93</td>
<td>6.34</td>
</tr>
<tr>
<td></td>
<td>0.06</td>
<td>0.3835</td>
<td>25.55</td>
<td>31.88</td>
<td>6.33</td>
</tr>
</tbody>
</table>

Table 14: Indicators of Financial Deepening for Policy Simulations Performed with Changes in the Default Rate of Informal Sector Firms, at Different Levels of the Stock of Human Capital

With a greater availability of loans to purchase non-labor inputs, output in the informal sector firms rises. At the same time, output in the formal sector firms declines, due to the decline in the availability of loans in this sector. So, the wages, $W_0$, of the low-skilled households increase and the wages of the high-skilled households, $W_1$, decrease, with implications for the distribution of wage incomes.
Table 15: Deposit Mobilization and Inequality of Wealth for Policy Simulations Performed with Changes in the Default Rate of Informal Sector Firms at Different Levels of the Stock of Human Capital

These non-uniform changes in wages lead to a decline in the inequality of the distribution of total wage incomes in all the simulations (Table 13 and Figure 16). In this case, they reflect the informal-sector bias of the improvement of financial markets.
As was the case with the direct policy intervention, however, the magnitude of the impact of this indirect intervention declines as the economy develops. The Gini coefficient that measures the inequality of the distribution of wage incomes declines by 1.51, 1.31 and 0.37 percentage points at the low, intermediate, and advanced stages of human capital formation, respectively. At the advanced levels of development ($N = 0.50$ and $N = 0.70$), some degree of improvement in the environment for the operation of financial markets had already taken place ($p_0 = 0.16$ and $p_0 = 12$) to begin with and there is less room to further improve it.

In contrast to the case of a direct intervention in financial markets (a reduction in the required reserve ratio), the indirect intervention to improve the environment for the operations of financial markets (a reduction in the default rate of the informal sector firms) not only reduces the inequality of the distribution of income, but also the improvements in the distribution are stronger.

As the default rate of the firms in the informal sector declines, at low levels of the human capital stock the volume of deposits rises, but at higher levels it falls (Table 12). These changes in the aggregate volume of deposits are the net result, however, of differential changes in deposit holdings, which increase for the low-income households and decline for the high-income households (Table 15). In the case of the low-income households, this increase in their financial wealth reflects mostly the higher wages made possible by the expansion of the supply of credit to the informal sector firms but also the influence on their saving behavior of the higher interest rates paid on deposits.
In turn, the declining deposit holdings of the high-skilled households in part reflect their declining wage earnings as well as their responses to the higher interest rates paid on deposits. In this model, the reason for the households to save and to hold deposits is their fear of the risk of getting an adverse labor productivity shock that would lower their future consumption below current levels. This is particularly true for the high-skilled households (currently in the good state). Given their policy functions, these households seek to hold a higher “target” ratio of their deposit holdings to their income flows (in reflection of the willingness to save) and their lower incomes would give them a lower ability to save.

With lower wage incomes and with higher interest rates paid on their deposits, high-skilled households can reach this target ratio by holding a smaller amount of deposits as before the indirect policy intervention. Even if their target level of deposits were constant, a higher interest rate would allow them to reach it by saving smaller amounts each period. With lower wage incomes, however, the target amount of the deposit declines.

Moreover, as the structural transformation of the labor force proceeds ($N=0.50$ or $N=0.70$), the probability of being in a bad state (by suffering an adverse labor productivity shock) is declining (to 50 percent or 30 percent, rather than 90 percent). Therefore, the high-skilled households have less motivation to save and their target ratio of deposits to wage income declines at higher levels of development, because the probability of receiving a bad shock is lower.
A similarly ambiguous (non-linear) outcome reflects the impact of the indirect policy intervention on the level of output (GDP in Table 14). The GDP increases with the informal-biased reduction in the default rate, at the initial level of human capital formation, but it declines at higher levels of the human capital stock. This is a direct consequence of the reduction in the volume of deposits mobilized, given the asymmetric incentives to save of the two types of households. With a reduction in the volume of deposits, at the more advanced stages of structural transformation, there is a reduction in the total credit portfolio and in the GDP. The effect is small, because the marginal product of a loan is higher in the informal sector than in the formal sector, which enjoys more credit per worker, due to lower lending costs to this sector.
The same set of circumstances explain the non-linear evolution of the indicators of financial deepening, which also follow a similar pattern, as the credit to the GDP and the deposits to the GDP ratios improve, with the indirect policy intervention, at the early stage of development, but they are hurt by this intervention at more advanced stages of the structural transformation (Table 14). Because of the decline in the deposits to the GDP ratio and with a given required reserve ratio, the proportion of idle reserves to the GDP also declines.

The informal-biased intervention reduces the inequality of the distribution of wage incomes, as reflected by the Gini coefficient of the distribution (Figure 17). The relationship is stronger at the early stage of development, given the large magnitude of the financial frictions present at that stage (Table 14 and Figure 17). Indeed, as the default rate of informal firms, $p_0$, declines, the wages of the low-skilled workers increase (because the volume of credit to the informal firms increases) and the wages of the high-skilled workers decline (because the volume of credit to the formal firms declines). This contributes to a reduction of the inequality in the functional distribution of wage incomes.

Given the opposite changes in their wage incomes and their different motivations to save, the deposit holdings of the low-skilled and high-skilled households move in opposite directions, except at the initial stage of human capital formation, when the indirect policy interventions increases the amounts of credit granted to both types of firms.
At the initial stage of development, the target deposit to wage income ratio of the low-skilled households increases by 3.83 percentage points, in contrast to an increase of 0.77 percentage points for the ratio, for the high-skilled households (Table 15). As a consequence of these opposite movements, the difference in wealth levels (deposit holdings) between the two types of household declines and the inequality in the distribution of wealth declines as well. At intermediate and advanced levels of structural transformation, however, some financial development has already taken place (the default rates are already low to begin with), and further reductions in the default rate have a more limited effect in reducing the inequality of wealth.
From the above discussion, it can be concluded that pro-informal, pro-poor biased indirect policy interventions have a positive and relatively stronger impact on reducing the inequality of the distributions of income and wealth especially at the early stages of development. At more advanced stages of development, however, there may be a trade-off between improving the distributions and reducing the levels of output and the rate of accumulation of wealth. Therefore, sector-specific indirect policy interventions to improve the environment for the operation of informal credit markets are a better tool to improve the distributions of income and wealth, without a loss of output, when the economy is at an early stage of economic progress and financial market frictions are particularly acute in the informal sector.

5.2.3 Changes in the Cost of Lending to the Informal Sector and the Inequality of Income and Wealth

Policy simulations for a second type of (pro-informal, pro-poor biased) indirect interventions in the environment for the operation of financial markets are performed by decreasing the costs of lending to the informal sector, at the three stages of human capital formation ($N=0.10$, $N=0.50$ and $N=0.70$). The gap between the interest rates on deposits and on loans to informal sector firms shrinks, the distribution of wage incomes improves, output grows and financial deepening increases, at the three levels of human capital development. The impact on the distribution of wealth, however, shows mixed results, depending on the stage of human capital development (Table 16 through Table 19).
As with the two previous sets of simulations, the magnitude of the impacts of this indirect policy intervention declines as the economy develops. Thus, as expected, there are diminishing marginal effects to all types of improvements in the efficiency of financial markets. At the start, when there is acute financial repression, liberalization and improvements in the environment for the operation of markets can have substantial impacts, particularly on output, wages (and, potentially, welfare) and, although less pronounced, greater impacts on the distributions of income and wealth than at later stages. When, in contrast, market frictions have already been substantially reduced, additional policy interventions would have less powerful effects.

The gap between the interest rate charged on loans to the informal sector firms and the deposit interest rate shrinks, as the costs of lending to the informal sector firms, $a_0$ and $b_0$, decline. On the one hand, the reduction in the marginal cost of lending, in this segment of the credit market, would make, ceteris paribus, the banks more profitable and, therefore, they do transfer a portion of these gains to the depositors. They do this, by increasing the interest rate paid on deposits. Indeed, the interest rate paid on deposits increases in all the simulations (Table 16).

On the other hand, given the corresponding outward shift of the supply of credit in this segment of the market, the banks also transfer part of these gains by lowering the interest rates charged on loans to the informal sector firms, $r_{L_0}$, and by increasing the volume of loans in this sector, $L_0$. These impacts are shown, for all the simulations, in Table 16.
<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Cost of Lending</th>
<th>Deposits</th>
<th>Loans</th>
<th>Deposit Interest Rates</th>
<th>Loan Interest Rates</th>
<th>Wage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$a_0/b_0$</td>
<td>$D$</td>
<td>$L_0$</td>
<td>$L_1$</td>
<td>$r_D$ (%)</td>
<td>$r_{L_0}$ (%)</td>
</tr>
<tr>
<td>0.10</td>
<td>0.10/0.080</td>
<td>0.0442</td>
<td>0.0205</td>
<td>0.0105</td>
<td>5.05</td>
<td>100.50</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.0446</td>
<td>0.0209</td>
<td>0.0104</td>
<td>5.30</td>
<td>98.42</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.0451</td>
<td>0.0212</td>
<td>0.0104</td>
<td>5.50</td>
<td>96.27</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.0455</td>
<td>0.0216</td>
<td>0.0104</td>
<td>5.70</td>
<td>94.11</td>
</tr>
<tr>
<td>0.50</td>
<td>0.10/0.080</td>
<td>0.0983</td>
<td>0.0130</td>
<td>0.0558</td>
<td>0.81</td>
<td>83.60</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.0985</td>
<td>0.0133</td>
<td>0.0557</td>
<td>0.97</td>
<td>81.47</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.0986</td>
<td>0.0135</td>
<td>0.0555</td>
<td>1.14</td>
<td>79.38</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.0988</td>
<td>0.0138</td>
<td>0.0554</td>
<td>1.29</td>
<td>77.24</td>
</tr>
<tr>
<td>0.70</td>
<td>0.09/0.040</td>
<td>0.1233</td>
<td>0.0096</td>
<td>0.0892</td>
<td>5.75</td>
<td>60.53</td>
</tr>
<tr>
<td></td>
<td>0.07/0.035</td>
<td>0.1233</td>
<td>0.0098</td>
<td>0.0890</td>
<td>5.93</td>
<td>58.49</td>
</tr>
<tr>
<td></td>
<td>0.05/0.030</td>
<td>0.1233</td>
<td>0.0100</td>
<td>0.0888</td>
<td>6.04</td>
<td>56.37</td>
</tr>
<tr>
<td></td>
<td>0.03/0.020</td>
<td>0.1234</td>
<td>0.0102</td>
<td>0.0887</td>
<td>6.15</td>
<td>54.25</td>
</tr>
</tbody>
</table>

Table 16: Deposit and Loan Amounts, Interest Rates, and Wages for Policy Simulations Performed with Changes in the Cost of Lending to Informal Sector Firms, at Different Levels of the Stock of Human Capital.

While credit becomes more affordable for the informal sector firms, the opposite is true, however, for those in the formal sector. As in the simulation with changes in the default rate, the interest rate charged on loans to the formal sector firms, $r_{L_1}$, increases and there is a reduction in the volume of loans to formal sector firms, $L_1$, as the supply of loans shifts, when this segment of the market becomes comparatively less attractive.
<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Cost of Lending</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Wage Income Share (Low-Skilled)</th>
<th>Wage Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>(a_0/b_0)</td>
<td>(W_0 * H_0)</td>
<td>(W_1 * H_1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>0.10/0.080</td>
<td>0.0763</td>
<td>0.0295</td>
<td>0.1058</td>
<td>72.10</td>
<td>27.90</td>
<td>17.90</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.0767</td>
<td>0.0295</td>
<td>0.1062</td>
<td>72.24</td>
<td>27.76</td>
<td>17.76</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.0771</td>
<td>0.0294</td>
<td>0.1066</td>
<td>72.38</td>
<td>27.62</td>
<td>17.62</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.0776</td>
<td>0.0294</td>
<td>0.1070</td>
<td>72.51</td>
<td>27.49</td>
<td>17.49</td>
</tr>
<tr>
<td>0.50</td>
<td>(a_0/b_0)</td>
<td>(W_0 * H_0)</td>
<td>(W_1 * H_1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>0.10/0.080</td>
<td>0.0444</td>
<td>0.1509</td>
<td>0.1953</td>
<td>22.74</td>
<td>77.26</td>
<td>27.26</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.0447</td>
<td>0.1507</td>
<td>0.1954</td>
<td>22.87</td>
<td>77.13</td>
<td>27.13</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.0450</td>
<td>0.1506</td>
<td>0.1956</td>
<td>22.99</td>
<td>77.01</td>
<td>27.01</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.0453</td>
<td>0.1505</td>
<td>0.1957</td>
<td>23.12</td>
<td>76.88</td>
<td>26.88</td>
</tr>
<tr>
<td>0.70</td>
<td>(a_0/b_0)</td>
<td>(W_0 * H_0)</td>
<td>(W_1 * H_1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>0.09/0.040</td>
<td>0.0286</td>
<td>0.2212</td>
<td>0.2499</td>
<td>11.46</td>
<td>88.54</td>
<td>18.54</td>
</tr>
<tr>
<td></td>
<td>0.07/0.035</td>
<td>0.0288</td>
<td>0.2211</td>
<td>0.2499</td>
<td>11.54</td>
<td>88.46</td>
<td>18.46</td>
</tr>
<tr>
<td></td>
<td>0.05/0.030</td>
<td>0.0290</td>
<td>0.2209</td>
<td>0.2500</td>
<td>11.62</td>
<td>88.38</td>
<td>18.38</td>
</tr>
<tr>
<td></td>
<td>0.03/0.020</td>
<td>0.0293</td>
<td>0.2208</td>
<td>0.2501</td>
<td>11.70</td>
<td>88.30</td>
<td>18.30</td>
</tr>
</tbody>
</table>

Table 17: Inequality of Wage Incomes for Policy Simulations Performed with Changes in the Costs of Lending to the Informal Sector Firms, at Different Levels of the Stock of Human Capital

Despite this increase of the interest rate on loans to the firms in the formal sector, the overall fragmentation of the economy again declines. On the one hand, the difference between the interest rates charged on loans to the formal and the informal sector firms’ declines. This smaller dispersion in interest rates reduces the relative disadvantage of informal sector firms and, thereby, of the low-skilled households hired by them.
On the other hand, the wedge between the interest rate paid on deposits and the average interest rate earned by the banks on their loan portfolio (weighted by the shares of the two types of loans in the total amount of credit) declines. For example, at the initial stage of development (when N equals 0.10), the reduction in the costs of lending to the informal sector firms leads to a reduction of the weighted average interest rate earned on the total portfolio, from 84.0 percent to 64.2 percent (computed from the data in Table 16), reflecting an even larger reduction in the frictions observed in the market than in the case of the simulations with changes in default rates. These differences depend on the parameter values used for the simulations (particularly, on the change of slope of the marginal cost schedule). Thus, the dispersion between the two loan interest rates (a source of fragmentation) and the wedge between the deposit interest rate and the average interest rates on loans (an indicator of the extent of frictions) both decline.

The opposite evolution of the amounts of credit in the two sectors has consequences for the distribution of household wage incomes. Actually, the inequality of the distribution of income declines in all the simulations (Table 17 and Figure 18). As the availability of credit to purchase non-labor inputs increases in the informal sector, production and hence wages in the informal sector rise. In contrast, production and wages in the formal sector decline, due to the decline in the availability of loans. The share of the low-skilled households—as a group—in total wage income increases and the share of the high-skilled households falls (Table 17). These changes lead to a reduction of the inequality of the functional distribution of wage incomes, as shown by the changes in the corresponding Gini coefficient (Table 17).
<table>
<thead>
<tr>
<th>Human Capital Stock $N$</th>
<th>Cost of Lending $\alpha_0/\beta_0$</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.10/0.080</td>
<td>0.1627</td>
<td>19.05</td>
<td>27.16</td>
<td>8.11</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.1633</td>
<td>19.16</td>
<td>27.31</td>
<td>8.16</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.1640</td>
<td>19.28</td>
<td>27.49</td>
<td>8.21</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.1646</td>
<td>19.40</td>
<td>27.66</td>
<td>8.26</td>
</tr>
<tr>
<td>0.50</td>
<td>0.10/0.080</td>
<td>0.3004</td>
<td>22.92</td>
<td>32.72</td>
<td>9.81</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.3007</td>
<td>22.93</td>
<td>32.75</td>
<td>9.82</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.3009</td>
<td>22.95</td>
<td>32.77</td>
<td>9.82</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.3011</td>
<td>22.97</td>
<td>32.80</td>
<td>9.83</td>
</tr>
<tr>
<td>0.70</td>
<td>0.09/0.040</td>
<td>0.3844</td>
<td>25.71</td>
<td>32.07</td>
<td>6.37</td>
</tr>
<tr>
<td></td>
<td>0.07/0.035</td>
<td>0.3844</td>
<td>25.70</td>
<td>32.06</td>
<td>6.36</td>
</tr>
<tr>
<td></td>
<td>0.05/0.030</td>
<td>0.3846</td>
<td>25.70</td>
<td>32.07</td>
<td>6.37</td>
</tr>
<tr>
<td></td>
<td>0.03/0.020</td>
<td>0.3847</td>
<td>25.71</td>
<td>32.08</td>
<td>6.37</td>
</tr>
</tbody>
</table>

Table 18: Indicators of Financial Deepening for Policy Simulations Performed with Changes in the Costs of Lending to the Informal Sector Firms, at Different Levels of the Stock of Human Capital

However, these reductions in the inequality of the distribution of wage incomes are not as large as they were in the case of the simulations with changes in default rates, given the parameter values used in each case. The Gini coefficient for the distribution of wage incomes now declines by 0.41, 0.38 and 0.24 percentage points, for the low, intermediate and advanced levels of human capital formation, respectively.
<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Cost of Lending</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposit to Wage Income Ratio (Low-Skilled)</th>
<th>Deposit to Wage Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.10/0.080</td>
<td>0.0247</td>
<td>0.0195</td>
<td>32.44</td>
<td>65.92</td>
<td>73.843</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.0251</td>
<td>0.0195</td>
<td>32.76</td>
<td>66.12</td>
<td>73.676</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.0255</td>
<td>0.0195</td>
<td>33.10</td>
<td>66.36</td>
<td>73.478</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.0259</td>
<td>0.0196</td>
<td>33.38</td>
<td>66.78</td>
<td>73.348</td>
</tr>
<tr>
<td>0.50</td>
<td>0.10/0.080</td>
<td>0.0166</td>
<td>0.0817</td>
<td>37.36</td>
<td>54.17</td>
<td>46.519</td>
</tr>
<tr>
<td></td>
<td>0.08/0.075</td>
<td>0.0167</td>
<td>0.0818</td>
<td>37.32</td>
<td>54.26</td>
<td>46.517</td>
</tr>
<tr>
<td></td>
<td>0.06/0.070</td>
<td>0.0168</td>
<td>0.0818</td>
<td>37.29</td>
<td>54.33</td>
<td>46.517</td>
</tr>
<tr>
<td></td>
<td>0.04/0.065</td>
<td>0.0169</td>
<td>0.0819</td>
<td>37.25</td>
<td>54.43</td>
<td>46.464</td>
</tr>
<tr>
<td>0.70</td>
<td>0.09/0.040</td>
<td>0.0093</td>
<td>0.1140</td>
<td>32.54</td>
<td>51.52</td>
<td>36.435</td>
</tr>
<tr>
<td></td>
<td>0.07/0.035</td>
<td>0.0093</td>
<td>0.1140</td>
<td>32.09</td>
<td>51.57</td>
<td>36.762</td>
</tr>
<tr>
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<td>0.05/0.030</td>
<td>0.0093</td>
<td>0.1140</td>
<td>31.98</td>
<td>51.62</td>
<td>36.758</td>
</tr>
<tr>
<td></td>
<td>0.03/0.020</td>
<td>0.0093</td>
<td>0.1141</td>
<td>31.89</td>
<td>51.67</td>
<td>36.747</td>
</tr>
</tbody>
</table>

Table 19: Inequality of Wealth for Policy Simulations Performed with Changes in the Costs of Lending to the Informal Sector Firms, at Different Levels of the Stock of Human Capital.

Also, given the parameter values used for this simulation, the results with respect to the accumulation of financial wealth and the level of output differ from those obtained by changing the default rate for the informal sector firms, in the earlier simulation.
In effect, neither the aggregate volume of deposits nor output decline in any of the simulations, at any stage of human capital formation (Table 16 and Table 18). The reason is that the simulations associated with this second indirect intervention lead to smaller changes in the supply of credit to the formal and informal sectors which, in turn, are associated with smaller changes in output and wages. Further, while —under the assumptions of the model— the change in the default rate shifts only the intercept, both the intercept and slope of the marginal cost curve change in this second case, leading to different relative changes in the level of loans.

Figure 18: Changes in the Costs of Lending to the Informal Sector Firms ($a_0$ and $b_0$) and the Inequality of Wage Income (Gini-I)
The interest rate charged on loans to firms in the formal sector increases, at the three levels of the human capital stock, as the banks’ supply of credit in this —now comparatively less attractive— segment of the market declines (Table 16). This is associated with a reduction in the volume of loans to firms in this sector and, thereby, to a reduction in the wages of high-skills households, as the amount of credit per unit of effective labor and hence output decline in that sector. However, the reduction in wages is very small (Table 20).

At the same time, the interest rate paid on deposits increases, as the banks pass on some of the gains from their lower costs to the depositors. In the simulations, it appears that the interest rate on deposits increases enough so as to compensate the effect of the small decline in the wage incomes of the high-skilled households. This may explain, in part, the tiny but positive increases in aggregate deposits observed.

Similarly, with a reduction in the costs of lending, the GDP increases, particularly at the initial stage of human capital development, but the pace of the improvement slows down at the intermediate and advanced levels, as the weight of the formal sector —not favored by this improvement in the environment for the operation of financial markets— increases in the economy (Table 18). The indicators of financial deepening follow a similar pattern, as the credit to the GDP and deposits to the GDP ratios improve at the early stage of development but remain basically unchanged at the intermediate and advanced stages of development (Table 18).
When the simulations are performed by changing the costs of lending to the informal sector, $a_0$ and $b_0$, at three stages of human capital formation, the inequality of the distribution of wealth depicts a non-linear relationship with this indirect policy intervention. Inequality declines at the initial stage, remains almost unaltered at the intermediate stage, and increases at the advanced stage (Table 19).

The inequality of the distribution of wealth declines at the initial stage of development, in part, because, as the costs of lending to the informal sector decline, the wages of the low-skilled workers increase (because the volume of credit to the informal firms increases) and the wages of the high-skilled workers decline (because the volume of credit to the formal firms declines).

These relative wage income changes, combined with the different responses of both types of households to the changes in the interest rate paid on deposits (given differences in the marginal utility of current and future consumption, at different levels of income) and given changes in their target deposit-to-income ratios leads to a more rapid increase in the amount of deposits held by the low-skilled than by the high-skilled households. In effect, the desired deposit-to-income ratio increases more rapidly for the low-skilled households, as their relative conditions improve, in contrast to the high-income households. Therefore, the inequality of the distribution of wealth, reflected in the corresponding Gini coefficient, declines at the initial stage of development.

At the intermediate stage, the relative changes in wage incomes and in the desired ratios of deposits to income are smaller and this leads to minute changes in the inequality of the distribution of wealth, except with major reduction in costs.
At the advanced stage, however, while the target ratio of deposits to income of the low-skilled households declines, this ratio increases for the high-skilled households (Table 19). It appears that, at this stage, the interest rate effects dominate the wage income effects in influencing the saving behavior of the two types of households. This leads to an increase in the inequality of the distribution of wealth (Gini coefficient).
<table>
<thead>
<tr>
<th>Human Capital</th>
<th>Simulation 1 ((\eta))</th>
<th>Simulation 2 ((p_0))</th>
<th>Simulation 3 ((a_0) and (b_0))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(W_0)</td>
<td>(W_1)</td>
<td>(W_0)</td>
</tr>
<tr>
<td>(N=0.10)</td>
<td>5.66</td>
<td>6.07</td>
<td>2.01</td>
</tr>
<tr>
<td></td>
<td>5.06</td>
<td>5.47</td>
<td>1.92</td>
</tr>
<tr>
<td></td>
<td>4.56</td>
<td>4.96</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(L_0)</td>
<td>(L_1)</td>
<td>(L_0)</td>
</tr>
<tr>
<td>(N=0.10)</td>
<td>17.04</td>
<td>18.34</td>
<td>5.85</td>
</tr>
<tr>
<td></td>
<td>15.16</td>
<td>16.42</td>
<td>5.57</td>
</tr>
<tr>
<td></td>
<td>13.60</td>
<td>14.84</td>
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</tr>
<tr>
<td>(N=0.50)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(L_0)</td>
<td>(L_1)</td>
<td>(L_0)</td>
</tr>
<tr>
<td>(N=0.50)</td>
<td>16.92</td>
<td>18.25</td>
<td>5.66</td>
</tr>
<tr>
<td></td>
<td>15.04</td>
<td>16.34</td>
<td>5.27</td>
</tr>
<tr>
<td></td>
<td>13.55</td>
<td>14.83</td>
<td>5.01</td>
</tr>
<tr>
<td>(N=0.70)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(L_0)</td>
<td>(L_1)</td>
<td>(L_0)</td>
</tr>
<tr>
<td>(N=0.70)</td>
<td>9.16</td>
<td>9.83</td>
<td>2.83</td>
</tr>
<tr>
<td></td>
<td>8.58</td>
<td>9.25</td>
<td>2.85</td>
</tr>
<tr>
<td></td>
<td>8.07</td>
<td>8.73</td>
<td>2.78</td>
</tr>
</tbody>
</table>

Table 20: Growth Rates of Wages and of Loan Amounts in Three Sets of Simulations
In summary, the pro-informal, pro-poor biased indirect policy intervention that reduces the costs of lending to the informal sector has a positive impact in reducing the inequality of the distribution of income and in increasing output and financial deepening, especially at the early stages of development. At more advanced stages of development, however, the impact gets smaller and smaller. Thus, such indirect policy intervention to improve the environment for the operation of financial markets is a better tool to improve the distribution of income as well as increase output when the economy is at an early stage of economic development. However, the impact of this cost-reducing indirect policy intervention, on the inequality of the distribution of wealth, is mixed. Nevertheless, at an early stage of development, the inequality of the distribution of wealth also declines with an indirect intervention of this type.

Table 20 summarizes the impact of the three types of policy interventions on the rates of growth of wages and on the rates of growth of the credit portfolios, in each segment of the market. In all cases, financial liberalization (a reduction of the required reserve ratio) increases wage rates for the two types of households. The rate of increase of wages declines, however, with additional doses of the intervention and at more advanced stages of human capital formation. The rate of increase of wages is also always higher for the high-skilled than for the low-skilled households, which leads to an increase in inequality in the distribution of household wage incomes. This deterioration is compensated by the strong and more than proportional output and wage-augmenting effects discussed earlier. Throughout, loan portfolios increase faster than wages.
In turn, depending on the dose of the intervention, indirect policies that improve the environment for the operation of financial markets in a pro-informal, pro-poor biased way (either through a reduction of the riskiness of the firms that hire low-skilled households or through a reduction of the costs of lending to these informal sector firms), tend to increase the volumes of credit and wage rates in the informal sector and to lower the volumes of credit and wage rates in the formal sector firms. These changes get less pronounced as the dose of the intervention increases and at more advanced stages of human capital development. Given the parameter values used in the simulations, the changes shown in Table 20 are more pronounced for reductions in riskiness than for reductions in costs, but this is not inevitably the case.

The movements of the wage rates in opposite directions correct the adverse effect of financial market frictions—which more severely hurt firms in the informal sector—on relative wages. Wage rates per unit of effective labor depend on the marginal product of labor in each sector. Given identical, Cobb-Douglas production functions in the two sectors, differences in this marginal product only reflect differences in the amount of non-human inputs that are combined with one unit of effective labor in each sector, a function of the available amount of credit per unit of effective labor in the corresponding sector. With no financial market frictions, the amount of credit per unit of effective labor should be the same in each sector and the wage rates should be equal. The high-skilled households would be richer only because they own more units of effective labor than the low-skilled households. Thus, without financial market frictions, differences in household incomes would reflect only differences in labor productivity.
Asymmetric financial market frictions are thus a source of inequalities in the distribution of income, additional to differences in labor productivity. To the extent to which the dispersion of frictions in the two segments of the market (that is, when the extent of fragmentation) is reduced, and risks and costs in the two segments converge, the disadvantage of low-skilled households that comes from this source of inequality would be reduced and the distribution of household incomes should improve. Indeed, the results in Table 20 show the channels through which reductions in the asymmetries generated by those frictions improve the distribution of income.

5.3 Financial Development, Human Capital Formation, and Inequality

In this section, the Kuznetsian relationship between inequality in the distribution of wage incomes and human capital formation is analyzed in two different ways. First, I examine the simple (pure) relationship between inequality and human capital formation. Second, I explore how this relationship is modified by the evolution of frictions in financial markets. The Kuznetsian story is then “augmented” by simultaneously considering human and financial development. The expectation is that the combined effort further reduces inequality.

The original Kuznets (1955) story did not mention the role of finance in the development process. His hypothesis suggested that the structural transformation of the labor force was the source driving the inverted U-shaped relationship between economic development and the inequality in the distribution of income. This hypothesis is first evaluated in the context of the model developed in this dissertation.
Thus, keeping values of the parameters associated with the availability of credit in the economy constant (to ignore, for the moment, the influence of financial development), I look at the evolution of the distribution of household wage incomes, as the proportion of high-skilled households in the labor force increases in the model. I expect that this should generate an inverted-U relationship, as predicted by Kuznets.

Finance would modify the resulting Kuznetsian story in two different ways. The first one, not modeled explicitly in this dissertation, is the extent to which the process of human capital formation is influenced, itself, by the process of financial development. Recent research has suggested that finance matters for the accumulation of human capital, by eliminating liquidity constraints, lengthening horizons for investment, improving the management of risk, and assisting in consumption smoothing (Galor and Zeira 1993, Maldonado and Gonzalez-Vega 2008). As more people get education and training, the number of high-skilled households tends to rise in the economy. The role of finance, in this case, would be to accelerate the rate at which the structural transformation takes place and the economy moves along the Kuznetsian path, to levels of the human capital stock where additional development also improves the distribution of income.

The second influence of finance is the extent to which, for a given level of the stock of human capital, financial development affects the distribution of household incomes, as examined with the simulations above. A comparative analysis would then generate the “marginal” influence of financial development on the Kuznetsian relationship, beyond the impacts associated with the “original” Kuznetsian story. That is, I generate a Kuznets curve with and without financial development accompanying it.
<table>
<thead>
<tr>
<th>Description</th>
<th>Parameters</th>
<th>Initial Simulation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor</td>
<td>( \delta )</td>
<td>0.85</td>
<td>-</td>
</tr>
<tr>
<td>Risk aversion</td>
<td>( \gamma )</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>Labor productivity</td>
<td>( \bar{l}_0, \bar{l}_1 )</td>
<td>1, 3</td>
<td>-</td>
</tr>
<tr>
<td>Labor time</td>
<td>( \bar{h} )</td>
<td>1/3</td>
<td>-</td>
</tr>
<tr>
<td>Proportion of high-skilled workers</td>
<td>( N )</td>
<td>0.10</td>
<td>0.10-0.60</td>
</tr>
<tr>
<td>Share of loans in production</td>
<td>( \alpha )</td>
<td>0.35</td>
<td>-</td>
</tr>
<tr>
<td>Default rates</td>
<td>( p_0, p_1 )</td>
<td>0.20, 0.01</td>
<td>-</td>
</tr>
<tr>
<td>Cost parameters</td>
<td>( a_0, a_1 )</td>
<td>0.10, 0.001</td>
<td>-</td>
</tr>
<tr>
<td>Required reserve ratio</td>
<td>( \eta )</td>
<td>0.30</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 21: Parameter Values and their Range for the Original Kuznetsian Analysis.

In general, the inequality of the distribution of household wage incomes is expected to be lower in the second scenario, where financial development accompanies human capital development, than in the first scenario, where only human capital development takes place, at each level of the human capital stock.

Starting with the parameters values considered in scenario 1 of section 5.1, the steady-state proportion of high-skilled households \( N \) is allowed to rise from 10 percent to 60 percent, in five steps. The values from the solution are re-computed at each step. The purpose is to assess the “original” impact of human capital development on inequality, given the same repressive financial regime considered in scenario 1 of section 5.1 (Table 21).
Next, the financial regime is allowed to improve along with the structural shift in the labor force. In this case, starting with the same reference point of scenario 1 of section 5.1 and ending at scenario 2 of section 5.1, the steady-state proportion of high-skilled households $N$ is allowed to rise from 10 percent to 90 percent in five steps. At each step, however, the financial regime is also allowed to improve, by lowering the required reserve ratio, the riskiness of informal sector firms, and the costs of lending to these firms. The values of the parameters and their range used in the simulations are given in Table 22.

The results of the simulations for the original Kuznetsian analysis and for the augmented Kuznetsian analysis are shown in Tables 23 to 26 and Tables 27 to 30, respectively.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Scenario-1</th>
<th>Simulation 1</th>
<th>Simulation 2</th>
<th>Simulation 3</th>
<th>Simulation 4</th>
<th>Simulation 5</th>
<th>Scenario-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta$</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>$\bar{t}_0, \bar{t}_1$</td>
<td>1, 3</td>
<td>1, 3</td>
<td>1, 3</td>
<td>1, 3</td>
<td>1, 3</td>
<td>1, 3</td>
<td>1, 3</td>
</tr>
<tr>
<td>$\bar{h}$</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>$N$</td>
<td>0.10</td>
<td>0.20</td>
<td>0.40</td>
<td>0.50</td>
<td>0.60</td>
<td>0.80</td>
<td>0.90</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>$p_0, p_1$</td>
<td>0.20, 0.01</td>
<td>0.18, 0.01</td>
<td>0.15, 0.01</td>
<td>0.10, 0.01</td>
<td>0.07, 0.01</td>
<td>0.05, 0.01</td>
<td>0.02, 0.01</td>
</tr>
<tr>
<td>$a_0, a_1$</td>
<td>0.10, 0.001</td>
<td>0.08, 0.001</td>
<td>0.07, 0.001</td>
<td>0.06, 0.001</td>
<td>0.04, 0.001</td>
<td>0.005, 0.001</td>
<td>0.003, 0.001</td>
</tr>
<tr>
<td>$b_0, b_1$</td>
<td>0.08, 0.01</td>
<td>0.05, 0.01</td>
<td>0.04, 0.01</td>
<td>0.03, 0.01</td>
<td>0.02, 0.01</td>
<td>0.02, 0.01</td>
<td>0.02, 0.01</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.30</td>
<td>0.25</td>
<td>0.20</td>
<td>0.15</td>
<td>0.10</td>
<td>0.05</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Table 22: Parameter Values and their Range for the Augmented Kuznetsian Analysis
<table>
<thead>
<tr>
<th>Human Capital</th>
<th>Deposits</th>
<th>Loans</th>
<th>Deposit Interest Rate</th>
<th>Loan Interest Rates</th>
<th>Wage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>$D$</td>
<td>$L_0$</td>
<td>$L_1$</td>
<td>$r_D$ (%)</td>
</tr>
<tr>
<td>0.10</td>
<td>0.0442</td>
<td>0.0205</td>
<td>0.0105</td>
<td>5.05</td>
<td>100.50</td>
</tr>
<tr>
<td>0.20</td>
<td>0.0599</td>
<td>0.0195</td>
<td>0.0225</td>
<td>0.29</td>
<td>91.98</td>
</tr>
<tr>
<td>0.30</td>
<td>0.0744</td>
<td>0.0175</td>
<td>0.0347</td>
<td>-1.42</td>
<td>88.89</td>
</tr>
<tr>
<td>0.40</td>
<td>0.0873</td>
<td>0.0150</td>
<td>0.0462</td>
<td>-1.35</td>
<td>88.97</td>
</tr>
<tr>
<td>0.50</td>
<td>0.0989</td>
<td>0.0123</td>
<td>0.0569</td>
<td>-0.49</td>
<td>90.44</td>
</tr>
<tr>
<td>0.60</td>
<td>0.1086</td>
<td>0.0096</td>
<td>0.0665</td>
<td>1.25</td>
<td>93.49</td>
</tr>
</tbody>
</table>

Table 23: Loan and Deposit Amounts, Interest Rates, and Wages. Original Kuznetsian Analysis, without Financial Development.

<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Wage Income Share (Low-Skilled)</th>
<th>Wage Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>$W_0 \cdot H_0$</td>
<td>$W_1 \cdot H_1$</td>
<td>$\psi_0$ (%)</td>
<td>$\psi_1$ (%)</td>
<td>Gini-I (%)</td>
</tr>
<tr>
<td>0.10</td>
<td>0.0763</td>
<td>0.0295</td>
<td>0.1058</td>
<td>72.10</td>
<td>27.90</td>
<td>17.90</td>
</tr>
<tr>
<td>0.20</td>
<td>0.0694</td>
<td>0.0605</td>
<td>0.1299</td>
<td>53.42</td>
<td>46.58</td>
<td>26.58</td>
</tr>
<tr>
<td>0.30</td>
<td>0.0612</td>
<td>0.0916</td>
<td>0.1529</td>
<td>40.07</td>
<td>59.93</td>
<td>29.93</td>
</tr>
<tr>
<td>0.40</td>
<td>0.0525</td>
<td>0.1221</td>
<td>0.1746</td>
<td>30.06</td>
<td>69.94</td>
<td>29.94</td>
</tr>
<tr>
<td>0.50</td>
<td>0.0435</td>
<td>0.1519</td>
<td>0.1955</td>
<td>22.28</td>
<td>77.72</td>
<td>27.72</td>
</tr>
<tr>
<td>0.60</td>
<td>0.0345</td>
<td>0.1806</td>
<td>0.2151</td>
<td>16.05</td>
<td>83.95</td>
<td>23.95</td>
</tr>
</tbody>
</table>

Table 24: Inequality of Household Wage Incomes. Original Kuznetsian Analysis, without Financial Development.
<table>
<thead>
<tr>
<th>Human Capital Stock $N$</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.1627</td>
<td>19.05</td>
<td>27.16</td>
<td>8.11</td>
</tr>
<tr>
<td>0.20</td>
<td>0.1999</td>
<td>21.02</td>
<td>29.98</td>
<td>8.96</td>
</tr>
<tr>
<td>0.30</td>
<td>0.2352</td>
<td>22.17</td>
<td>31.65</td>
<td>9.47</td>
</tr>
<tr>
<td>0.40</td>
<td>0.2686</td>
<td>22.76</td>
<td>32.49</td>
<td>9.73</td>
</tr>
<tr>
<td>0.50</td>
<td>0.3007</td>
<td>23.03</td>
<td>32.89</td>
<td>9.86</td>
</tr>
<tr>
<td>0.60</td>
<td>0.3310</td>
<td>23.00</td>
<td>32.82</td>
<td>9.82</td>
</tr>
</tbody>
</table>

Table 25: Indicators of Financial Deepening. Original Kuznetsian Analysis, without Financial Development.

<table>
<thead>
<tr>
<th>Human Capital Stock $N$</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposit to Wage Income Ratio (Low-Skilled)</th>
<th>Deposit to Wage Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.0247</td>
<td>0.0195</td>
<td>32.44</td>
<td>65.92</td>
<td>73.843</td>
</tr>
<tr>
<td>0.20</td>
<td>0.0237</td>
<td>0.0362</td>
<td>34.21</td>
<td>59.78</td>
<td>65.291</td>
</tr>
<tr>
<td>0.30</td>
<td>0.0221</td>
<td>0.0523</td>
<td>36.16</td>
<td>57.06</td>
<td>58.119</td>
</tr>
<tr>
<td>0.40</td>
<td>0.0196</td>
<td>0.0677</td>
<td>37.39</td>
<td>55.41</td>
<td>52.123</td>
</tr>
<tr>
<td>0.50</td>
<td>0.0164</td>
<td>0.0825</td>
<td>37.65</td>
<td>54.31</td>
<td>46.419</td>
</tr>
<tr>
<td>0.60</td>
<td>0.0126</td>
<td>0.0960</td>
<td>36.46</td>
<td>53.18</td>
<td>41.161</td>
</tr>
</tbody>
</table>

Table 26: Deposit Mobilization and the Inequality of Wealth. Original Kuznetsian Analysis, without Financial Development.
Without any change in the financial structure of the economy, as the structural transformation of the labor force takes place, the interest rate paid on deposits and the interest rates charged on loans initially decline but then they increase again (Table 23). These changes reflect evolving circumstances for both the supply of deposits and the demand for credit. On the one hand, at the beginning of the process of structural transformation, with the increase in the proportion of high-skilled households, the number of depositors in the economy increases and more deposits are available for the banks to lend. This exerts downward pressures on the interest rates.

On the other hand, as the number of low-skilled workers drops and the demand for credit in the informal sector declines, loan interest rates decline in this sector more rapidly than in the formal sector. The demand for credit increases in the formal sector but, given lower lending costs (in particular, a less steep slope of the marginal cost schedule), this increase in demand is not sufficient to compensate the downward pressures on interest rates from the other two sources.

As the proportion of high-skilled households increases, however, their fear of suffering an adverse labor productivity shock declines (as the probability of the shock depends on the proportion of low-skilled households in the labor force). This lowers the target deposits-to-income ratio of high-skilled households (while this target ratio does not increase as much for the low-skilled households) and, thereby, it reduces the supply of deposits. This exerts upward pressures on all interest rates, not compensated by changes in demands for credit that move in opposite directions and are larger for formal firms.
The non-linear evolution of all interest rates (approaching something of a U-shaped path) evokes the inverted-U shape that characterizes the relationship between the process of human capital accumulation and the inequality of the distribution of wage incomes. Nevertheless, despite this non-linear evolution of interest rates and without any direct and indirect interventions in the operation of financial markets, the accumulation of human capital leads to a steady process of financial development. Thus, from this perspective, economic development (resulting from human capital accumulation) actually favors financial development.

Several indicators highlight this induced process of steady financial development. A reduction of the influence of financial market frictions, as the process of structural transformation takes place, is reflected in a monotonically decreasing wedge between the deposit interest rate and the weighted average interest rate on loans. The weighted average interest rate on loans declines from 84.0 percent, at the earliest stage (that is, when $N = 0.10$) to 52.1 percent (when $N = 0.50$) and it then slightly increases. Given the changes in the deposit interest rate, however, the wedge between these two rates (on deposits and the loan portfolio) declines monotonically, from 78.9 percentage points (for $N=0.10$) to 51.0 percentage points (for $N = 0.60$), as can be computed from the data in Table 23.

This is accompanied, in turn, by a process of financial deepening, with the ratio of credit to the GDP increasing from 19 percent to 23 percent and the ratio of deposits to the GDP increasing from 27 percent to 33 percent, as the proportion of high-skilled workers goes from 10 percent to 60 percent of the population of households (Table 25).
### Table 27: Loan and Deposit Amounts, Interest Rates and Wages. Augmented Kuznetsian Analysis, with Combined Human Capital and Financial Development

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Deposits</th>
<th>Loans</th>
<th>Deposit Interest Rate</th>
<th>Loan Interest Rates</th>
<th>Wage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$D$</td>
<td>$L_0$</td>
<td>$L_1$</td>
<td>$r_D$ (%)</td>
<td>$r_{L_0}$ (%)</td>
</tr>
<tr>
<td>1</td>
<td>0.0442</td>
<td>0.0205</td>
<td>0.0105</td>
<td>5.05</td>
<td>100.50</td>
</tr>
<tr>
<td>2</td>
<td>0.0628</td>
<td>0.0225</td>
<td>0.0246</td>
<td>1.33</td>
<td>74.80</td>
</tr>
<tr>
<td>3</td>
<td>0.0937</td>
<td>0.0200</td>
<td>0.0550</td>
<td>0.59</td>
<td>56.35</td>
</tr>
<tr>
<td>4</td>
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<td>0.0195</td>
<td>0.0729</td>
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<td>41.23</td>
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<td>0.1222</td>
<td>0.0177</td>
<td>0.0924</td>
<td>5.10</td>
<td>29.94</td>
</tr>
<tr>
<td>6</td>
<td>0.1407</td>
<td>0.0097</td>
<td>0.1244</td>
<td>10.28</td>
<td>22.76</td>
</tr>
<tr>
<td>7</td>
<td>0.1466</td>
<td>0.0049</td>
<td>0.1378</td>
<td>13.74</td>
<td>21.21</td>
</tr>
</tbody>
</table>

### Table 28: Inequality of Wage Incomes. Augmented Kuznetsian Analysis, with Combined Human Capital and Financial Development

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Wage Income Share (Low-Skilled)</th>
<th>Wage Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$W_0 \times H_0$</td>
<td>$W_1 \times H_1$</td>
<td>$\psi_0$ (%)</td>
<td>$\psi_1$ (%)</td>
<td>Gini-I (%)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.0763</td>
<td>0.0295</td>
<td>0.1058</td>
<td>72.10</td>
<td>27.90</td>
<td>17.90</td>
</tr>
<tr>
<td>2</td>
<td>0.0730</td>
<td>0.0625</td>
<td>0.1354</td>
<td>53.88</td>
<td>46.12</td>
<td>26.12</td>
</tr>
<tr>
<td>3</td>
<td>0.0581</td>
<td>0.1298</td>
<td>0.1879</td>
<td>30.92</td>
<td>69.08</td>
<td>29.08</td>
</tr>
<tr>
<td>4</td>
<td>0.0511</td>
<td>0.1657</td>
<td>0.2168</td>
<td>23.59</td>
<td>76.41</td>
<td>26.41</td>
</tr>
<tr>
<td>5</td>
<td>0.0428</td>
<td>0.2027</td>
<td>0.2454</td>
<td>17.43</td>
<td>82.57</td>
<td>22.57</td>
</tr>
<tr>
<td>6</td>
<td>0.0221</td>
<td>0.2711</td>
<td>0.2931</td>
<td>7.52</td>
<td>92.48</td>
<td>12.48</td>
</tr>
<tr>
<td>7</td>
<td>0.0111</td>
<td>0.3033</td>
<td>0.3144</td>
<td>3.53</td>
<td>96.47</td>
<td>6.47</td>
</tr>
<tr>
<td>S. No.</td>
<td>Output (GDP)</td>
<td>Credit to GDP (%)</td>
<td>Deposits to GDP (%)</td>
<td>Reserves to GDP (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>--------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
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<td>27.16</td>
<td>8.11</td>
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<td>2</td>
<td>0.2083</td>
<td>22.62</td>
<td>30.13</td>
<td>7.51</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>0.2891</td>
<td>25.95</td>
<td>32.42</td>
<td>6.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.3336</td>
<td>27.72</td>
<td>32.60</td>
<td>4.88</td>
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<td>0.3776</td>
<td>29.18</td>
<td>32.35</td>
<td>3.18</td>
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<tr>
<td>6</td>
<td>0.4509</td>
<td>29.73</td>
<td>31.19</td>
<td>1.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.4837</td>
<td>29.50</td>
<td>30.31</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 29: Indicators of Financial Deepening. Augmented Kuznetsian Analysis, with Combined Human Capital and Financial Development

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposit to Wage Income Ratio (Low-Skilled)</th>
<th>Deposit to Wage Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$D_0$</td>
<td>$D_1$</td>
<td>$\frac{D_0}{W_0H_0} \times 100$</td>
<td>$\frac{D_1}{W_1H_1} \times 100$</td>
<td>Gini-W (%)</td>
</tr>
<tr>
<td>1</td>
<td>0.0247</td>
<td>0.0195</td>
<td>32.44</td>
<td>65.92</td>
<td>73.843</td>
</tr>
<tr>
<td>2</td>
<td>0.0253</td>
<td>0.0375</td>
<td>34.70</td>
<td>59.97</td>
<td>65.117</td>
</tr>
<tr>
<td>3</td>
<td>0.0217</td>
<td>0.0721</td>
<td>37.32</td>
<td>55.50</td>
<td>52.064</td>
</tr>
<tr>
<td>4</td>
<td>0.0191</td>
<td>0.0897</td>
<td>37.29</td>
<td>54.12</td>
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</tr>
<tr>
<td>5</td>
<td>0.0152</td>
<td>0.1069</td>
<td>35.63</td>
<td>52.76</td>
<td>41.370</td>
</tr>
<tr>
<td>6</td>
<td>0.0059</td>
<td>0.1348</td>
<td>26.66</td>
<td>49.73</td>
<td>31.625</td>
</tr>
<tr>
<td>7</td>
<td>0.0020</td>
<td>0.1446</td>
<td>18.19</td>
<td>47.67</td>
<td>24.393</td>
</tr>
</tbody>
</table>

Table 30: Inequality of Wealth. Augmented Kuznetsian Analysis, with Combined Human Capital and Financial Development
When the structural transformation of the labor force is accompanied by financial development, the interest rate on deposits again follows a U-shaped path, where it initially declines but it then rises again. This path reflects the conflicting influences on the supply of deposits from: (a) the growing number of depositors, as the stock of human capital grows, and (b) the changing target levels of the ratio of deposits to income among the high-skilled households, as the probability of an adverse labor productivity shock declines. The levels of the interest rate paid on deposits are higher than in the original Kuznetsian case, particularly at the more advanced stages of development, as depositors enjoy some of the fruits of financial deepening (in particular, the reduction of the required reserve ratio). In turn, the volume of deposits mobilized is greater than in the original Kuznetsian case (Table 23 and Table 27).

However, the interest rates charged on loans to both the informal and formal sector firms declines steadily throughout the process of structural transformation, due to a persistent improvement in the financial regime. Thus, the combined effects on interest rates lead to a monotonic and more substantial reduction in the wedge that reflects the extent of frictions in the financial market. Financial deepening also proceeds at a quicker pace. The ratio of credit to the GDP increases from 19 percent to 29.5 percent, while the ratio of deposits to the GDP increases from 27 percent to 30.3 percent, and the proportion of GDP represented by idle reserves drastically declines (Table 29). Combined, the direct and indirect interventions in the operations of financial markets and the structural transformation of the labor force, as indicative of the aggregate process of economic development, lead to greater financial deepening.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Growth Rate of Wage Rates (%)</th>
<th>Growth Rate of Loan Amounts (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$W_0$</td>
<td>$W_1$</td>
</tr>
<tr>
<td>1</td>
<td>2.37</td>
<td>2.53</td>
</tr>
<tr>
<td>2</td>
<td>0.87</td>
<td>0.93</td>
</tr>
<tr>
<td>3</td>
<td>-0.03</td>
<td>-0.04</td>
</tr>
<tr>
<td>4</td>
<td>-0.43</td>
<td>-0.46</td>
</tr>
<tr>
<td>5</td>
<td>-0.87</td>
<td>-0.93</td>
</tr>
</tbody>
</table>

Table 31: Growth Rate of Wages and Loan Amounts. Kuznetsian Analysis, without Financial Development

The wage rates in both sectors also show a similar pattern of increasing initially and then falling, as the labor force shifts from a low-skilled to a high-skilled status, with just the accumulation of human capital, in the original Kuznetsian story. This reflects the steady decline in the equilibrium level of loans to the informal sector and steady rise in the equilibrium level of loans to the formal sector (Table 23 and Table 31), which, combined with the evolution of the labor force as it moves from the informal to the formal sector, first increases the amount of credit per unit of effective labor in both sectors, keeping wage rates growing, but then eventually reduces it, bringing down wage rates.

Financial development prevents, however, this decline of wage rates at the more advanced stages of the structural transformation. Table 27 and Table 32 show that, when financial deepening is combined with human capital accumulation, wages do not decline, although the rate of growth in wage rates still declines as the transformation takes place.
Along with the changes in the composition of the labor force, the resulting changes in the wage rates have a major impact on the distribution of household wage incomes, in both the original and the augmented Kuznetsian structural transformation (Table 24 and Table 28). As reflected by the evolution of the Gini coefficient of the distribution of household wage incomes, inequality initially rises, as the labor force shifts from being low-skilled to being high-skilled, and it eventually falls. Thus, an inverted U-shaped relationship between the structural transformation of the labor force and the inequality of wage income is present in both cases (Figure 20 and Figure 21).

However, when the structural shift in the labor force is augmented by financial development, at every stage of human capital formation, the Gini coefficient is lower, indicating a lesser degree of inequality in the distribution of wage incomes. Thus, financial development contributes to a reduction of inequality along the Kuznetsian path.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Growth Rate of Wage Rates (%)</th>
<th>Growth Rate of Loan Amounts (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$W_0$</td>
<td>$W_1$</td>
</tr>
<tr>
<td>1</td>
<td>7.64</td>
<td>5.81</td>
</tr>
<tr>
<td>2</td>
<td>6.17</td>
<td>3.94</td>
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<tr>
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<td>2.10</td>
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<tr>
<td>4</td>
<td>4.57</td>
<td>1.92</td>
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<tr>
<td>5</td>
<td>3.09</td>
<td>0.32</td>
</tr>
<tr>
<td>6</td>
<td>0.68</td>
<td>-0.54</td>
</tr>
</tbody>
</table>

Table 32: Growth Rate of Wages and Loan Amounts. Augmented Kuznetsian Analysis, with Combined Financial Development and Human Capital Accumulation
Figure 20: Human Capital Formation and the Inequality of Household Wage Incomes (Gini Coefficient). Original Kuznetsian Analysis

Moreover, when human capital formation is augmented by financial development, the peak value of the Gini coefficient (that is, the moment of greatest inequality) is lower and takes place at an earlier stage in the structural transformation than the peak value of the Gini coefficient for the original Kuznetsian relationship between development and inequality (Figure 22). Indeed, in the original Kuznetsian case, the Gini coefficient increases from 18 (when N = 0.10) to 30 (when N = 0.40) and it then declines to 24 (when N = 0.60). In the augmented case, the Gini coefficient increases to 29 and it then declines to 6.5, a much lower value. Further, these differences in inequality increase as the structural transformation proceeds (the gap widens).
This divergence is due to the reductions in the three types of financial frictions, at each stage of the structural shift of labor force, brought about by direct and indirect interventions in financial markets, which not only improve the wage incomes of all households in absolute terms, but they also reduce the relative differences in wage incomes between the two types of households (Figure 22).
The differences between the two types of Kuznetsian analysis are also apparent with respect to the accumulation of deposits, the level of aggregate output and the indicators of financial deepening (Table 25 and Table 29). In all cases, the combination of human capital formation and financial development improves these indicators of financial and economic development.
Wealth, in the form of deposits, is accumulated along with the shift of the labor force from low-productivity to more productive households, which earn higher incomes (and thus have a greater ability to save) and possess stronger incentives to accumulate a precautionary reserve to sustain consumption in the case of an adverse labor productivity shock (have a greater willingness to save). There is, however, a deceleration of the process of wealth accumulation, as the threat of the adverse shock declines, the rate of growth of wages declines, and the share of the population still in the low-skill category gets smaller and smaller. When financial development accompanies human capital formation, however, at every stage of the structural transformation, the volume of deposits held (amount of wealth accumulated) is much larger (Table 23, Table 27 and Figure 23).

Further, because of the steady rise in the amount of loans and of high-skilled labor provided to the formal sector firms, aggregate output (GDP) increases. This increase in GDP is more substantial when financial development is combined with human capital formation than in the original Kuznetsian hypothesis (Table 25 and Table 29).

The indicators of financial deepening improve in both cases and improve more when the two dimensions of economic development are combined. The credit to GDP, deposits to GDP, and reserves to GDP all show noteworthy improvements, even with no changes in the financial regime but, particularly, as interventions in the environment for the operation of financial markets reduce the extent of frictions.
Particularly important is the role of policies that reduce the extent of financial repression in the economy. The ratio of required reserves to the GDP declines from 8 percent, at an early stage of the transformation, to 0.8 percent, at advanced stage (Table 29). This reduction in the leakage of resources into idle reserves is responsible for an important share of the improvements discussed above.
Figure 24: Inequality of Wealth (Gini Coefficient). Comparison of Original and Augmented Kuznetsian Analyses

The Gini coefficient for the distribution of wealth declines steadily in both cases (Table 26 and Table 30). The process of wealth accumulation in the economy mainly depends upon the number of high-skilled households. Thus, wealth accumulates (albeit at a declining rate) as a result of the structural shift in labor force, and the share of high-skilled household in total wealth increases.
In summary, direct and indirect policies that reduce frictions in financial markets and promote financial development, along with human capital formation (which also depends, in part, on financial development), not only bring about improvements in the level of output, the accumulation of wealth, and the level of wages, but they also eventually reduce inequality in the distribution of household wage incomes. Further, they do not generate adverse consequences for the distribution of wealth.
Chapter 6: Financial Policies and Inequality in Pakistan. A Case Study

In this chapter, I take the model to the data for Pakistan, in order to test its implications for a developing country. The purposes of the chapter are not to match the endogenously determined values from the solution of the model to any corresponding macroeconomic indicators of the economy of Pakistan or to use those results to explain the actual historical evolution of this economy.

Rather, by adopting values for the parameters relevant for Pakistan, the solution of the model and the associated policy simulations are evaluated and offered as a guidance for the authorities in Pakistan and in similar developing countries, regarding the extent to which financial development—brought about by direct and indirect policy interventions in the operation of financial markets—along with a process of human capital formation—which, in turn, may also depend on the breadth and depth of outreach of financial development—may have significant consequences for the inequality of the distributions of income and wealth.

In particular, the focus of the chapter is to present an augmented Kuznetsian scenario, using parameter values based on data from Pakistan, which may be useful in identifying the sequence of government policies that, if pursued, would eventually lead to more egalitarian distributions of income and wealth in this country.
6.1 Overview of the Economy of Pakistan

I begin with a few stylized facts about this economy, which may help place the analysis in this country’s context. Pakistan is classified by The World Bank as a lower middle-income country, with a per capita income of US$ 1,120, as per the Atlas method, in the year 2011. This level is well below the level of per capita income of US$ 1,760, for the entire group of middle-income countries. The total GDP for Pakistan was equivalent to US$ 211 billion in 2011, and the real growth rate of GDP, for the same year, was 2.4 percent. Historically, however, in Pakistan the real GDP has been growing faster (Figure 25). The average (geometric) real GDP growth rate was 4.9 percent, over the 1960-2010 period (State Bank of Pakistan 2010).

Considering the average (geometric) population growth rate of 2.7 percent for the 1960-2010 period, the growth rate of GDP has not been encouraging. The average (geometric) real per capita GDP growth rate was 2.0 percent for that period and it showed a lot of volatility. For some years, as recent as in 2009, the per capita GDP actually shrunk (Figure 25). Thus, the economy of Pakistan has not been growing at a rate that would allow its burgeoning population, of more than 176 million, the opportunity to enjoy rapidly growing standards of living.

Pakistan had historically been an agricultural country, where the share of agriculture in the value added to the GDP was 46 percent in 1960. At that time, the manufacturing and the services sectors contributed 15 percent and 39 percent of the GDP, respectively. However, over the years, the share of agriculture has declined and there has been some structural transformation.
The size of the services sector grew rapidly, and its share in value added had increased to 55 percent by 2010. There has been some industrialization, and the share of manufacturing in the GDP had risen to 24 percent in the same year. At the same time, the share of agriculture had declined to 21 percent. Despite these structural shifts in the composition of output, its overall rate of increase has been disappointing. This may be due mostly to the rudimentary production technologies employed and the dearth of high-skilled labor. Indeed, the size of the labor force increased from 32 percent of the population in 1961 to 46 percent of the population in 2009, with no equivalent increase in per capita output (State Bank of Pakistan 2010). An increase in the number of low-skilled workers has thus mainly contributed to this increase in the labor force.
There has been some migration from the rural to the urban areas, but the majority of the population of Pakistan still lives in the rural areas. In effect, 65 percent of the population lived in the rural areas and 35 percent lived in the urban areas by 2008. Back in 1961, 77 percent of the population had lived in the rural areas.

Pakistan may be considered a relatively closed economy. Over the 1990-2011 period, the average imports (mostly petroleum and chemical products and machinery) to the GDP ratio was 19 percent, the exports (mostly agricultural goods and textiles) to the GDP ratio was 15 percent, and the remittances to the GDP ratio was 3.5 percent (World Bank 2011).

The financial sector of Pakistan has seen a number of changes over the years. The private commercial banks existing at the time of independence, in 1947, and those newly established after independence were all nationalized in the 1970s. They were again privatized starting in the early 1990s. As of 2012, the banking sector consists of six types of financial institutions, namely: (a) public sector commercial banks, (b) domestic private banks, (c) foreign banks, (d) specialized banks, (e) Islamic banks, and (f) development finance institutions (State Bank of Pakistan 2012).

All these financial institutions are regulated by the central bank and, apart from the foreign banks, most commercial banks have a presence in both the urban and the rural areas. Access to financial services, however, is still very limited. The number of bank branches per 100,000 people increased slowly, from 7.6 in 2004 to 8.8 in 2010 (World Bank 2011).
So, despite the financial reforms undertaken since the early 1990s, with the removal of credit controls, privatization of publicly-owned banks, liberalization of the exchange rate regime, and granting of licenses for the establishment of private commercial banks, the expansion of the supply of financial services to the underprivileged population, especially those living in the rural areas, is still a challenge.

The system is dominated by the domestic private banks. As of March 31, 2012, they held 75 percent of the total outstanding loans and 78 percent of the deposits of all commercial banks (State Bank of Pakistan 2012). The public sector commercial banks accounted, in turn, for 20 percent of the outstanding loans and 19 percent of the deposits. Foreign banks held only 2 percent of the outstanding loans and 3 percent of the deposits. The specialized banks, which mainly include agricultural banks and microfinance banks, held 3 percent of the loans and only 0.2 percent of the deposits.

There are very large differences in the default rates experienced by the various types of banks. The specialized banks show the highest ratio of non-performing to total loans, of 37 percent, for the 2004-2010 period. They are followed by the public sector banks, with a ratio of non-performing to total loans of 14 percent. The private commercial banks and the foreign banks have non-performing to total loans ratios of 8 percent and 4 percent, respectively. Thus, there is a broad range of non-performing portfolios, including some very high default rates. The specialized banks face the highest and the foreign banks the lowest default rates in the system.
The specialized banks also show, on average, high administrative costs to income ratios, of 56 percent over the 2004-2010 period (State Bank of Pakistan 2012). They also show a high administrative costs to the loan portfolio ratio of 2.6 percent, as of March 31, 2012. They are followed by the domestic private banks and the public sector commercial banks, with administrative costs to income ratios of 49 percent and 39 percent over the 2004-2010 period, respectively, and administrative costs to loans ratios of 1.7 percent and 1.4 percent as of March 31, 2012, respectively. The foreign banks had earlier had low administrative costs to income ratios, but these ratios increased to an average of 58 percent over the 2004-2010 period. As of March 31, 2012 they also show a high administrative costs to loan ratio of 3.8 percent. This is because, in recent years, the foreign banks have shifted the composition of their asset portfolio from higher yielding but risky loans to lower yielding but safe investments in government bonds. Indeed, the loans to deposits ratio of 80 percent for the foreign banks in 2006 declined to 48 percent in 2010 (State Bank of Pakistan 2012).

<table>
<thead>
<tr>
<th>Period</th>
<th>Required Reserve Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948 to July 29 1963</td>
<td>5.00 #</td>
</tr>
<tr>
<td>July 30 1963 to March 31 1965</td>
<td>5.00</td>
</tr>
<tr>
<td>April 1965</td>
<td>6.25</td>
</tr>
<tr>
<td>May 1 1965 to August 20 1965</td>
<td>7.50</td>
</tr>
<tr>
<td>August 21 1965 to September 16 1965</td>
<td>6.00</td>
</tr>
<tr>
<td>September 17 1965 to June 15 1967</td>
<td>5.00</td>
</tr>
<tr>
<td>June 16 1967 to January 18 1968</td>
<td>6.25</td>
</tr>
<tr>
<td>January 19 1968 to October 6 2000</td>
<td>5.00</td>
</tr>
<tr>
<td>October 7 2000 to December 14 2000</td>
<td>7.00</td>
</tr>
<tr>
<td>December 15 2000 to December 31 2010</td>
<td>5.00</td>
</tr>
</tbody>
</table>

# Represents the required reserve ratio for demand deposits only.

Table 33: Statutory Reserve Requirements for Pakistan over the 1948-2010 period
The regulatory environment for the financial sector has become more enabling, especially in the 1990s and 2000s. The required reserve ratio, a classical tool of financial repression, has been kept at relatively low levels throughout these years (Table 33), though inflation has been quite high at times (Figure 27). Thus, at least the policy-induced frictions that emerge from reserve requirements have been comparatively low.

The banking sector had shown some vibrancy between 2001 and 2008, when the domestic credit to the GDP ratio increased from 21.8 percent in 2001 to 29.8 percent in 2008, while the ratio of non-performing loans to the total gross portfolio declined from 21.3 percent in 2001 to 10.5 percent in 2008 (World Bank 2011). Recently, however, these favorable trends have been reversed. The gross credit to the GDP ratio dropped to 18.3 percent and the non-performing loans to the total gross portfolio ratio increased to 15.4 percent in 2011. These ratios reflect a very low degree of financial deepening, even compared to similar developing countries, and a high level of delinquency in the credit portfolios of Pakistan’s financial system.

Moreover, in the decade since 2001, the spread between the nominal loan interest rates and the nominal deposit interest rates has remained high. The difference between the weighted average nominal interest rates on all loans and the weighted average nominal interest rates on all deposits, of 8.73 percentage points in 2001, had declined to 6.85 percentage points in 2004, but it crept back up to 9.35 percentage points in 2010 (State Bank of Pakistan 2010). In the presence of comparatively low required reserve ratios, this high interest rate margin reflects high administrative costs, a high proportion of non-performing loans in the portfolio and, potentially, monopoly profits.
If borrower and depositor transaction costs, which seem to be quite high and broadly dispersed in Pakistan, were added to this interest rate wedge, the extent of frictions in financial markets in this country is possibly quite considerable. This would explain the comparatively low level of financial deepening observed.

Moreover, substantial volatility of the real interest rates on all deposits and loans over the 1960-2010 period may in good part reflect the variability of inflation rates. Further, the real interest rates on deposits have typically been negative, even in recent years (Figure 26). This reflects a high degree of financial repression in the economy, where the depositors are being taxed for their savings holdings (McKinnon 1973, Shaw 1973).
There is still much room, therefore, for direct and, particularly, indirect policy interventions, to improve the performance of financial markets in Pakistan. In addition to the control of inflation, this may include better tools and incentives for reducing portfolio delinquency and for lowering transaction costs for all market participants.

Poverty and inequality are rife in Pakistan. Around 21 percent of the population lived below US$ 1.25 per person per day in 2008, and the poverty head count ratio would increase to 60 percent if the metric were increased from US$ 1.25 per day to US$ 2.00 per day (World Bank 2011).

In turn, the reported extent of inequality in Pakistan, based on consumption and household surveys, was reflected in a Gini coefficient of 30 percent in 2005 and 29 percent in 2007 (Ministry of Finance, Government of Pakistan 2011). These are comparatively low levels of the Gini coefficient, by international standards, but they likely underestimate the true extent of income and wealth inequality in the country.

Thus, Pakistan is a typical developing country, with a slow rate of economic progress, especially in recent years. It has a large population, and the majority lives in the rural areas. It also has a large work force, but skill levels are low. There have been some improvements in the policy regime for the financial sector, but the outreach of financial services, especially to the underprivileged, is not adequate. Thus, the environment for the operation of financial markets must be strengthened. Therefore, the economy of Pakistan represents a somewhat similar picture to the stylized economy reflected by scenario 1 of section 5.1 of the previous chapter.
Next, I calibrate the model with data from Pakistan. Some generalizations and simplifications are needed for the calibration, as the model focuses on only a few key features of the economy and the availability of data for Pakistan is limited. The main purpose of the exercise is to generate a hypothetical augmented Kuznets curve for Pakistan and describe its key features.

6.2 Calibration and Estimation

There are a total of 14 parameters in the model, which need to be either calibrated or estimated with data from Pakistan. On the household side, the two important parameters are the discount factor, \( \delta \), and the risk aversion coefficient, \( \gamma \). Since no heterogeneity is assumed with respect to the discount factor and the relative rate of risk aversion, following Hansen and Singleton (1982), uniform values may be estimated by applying the generalized method of moments (GMM) technique, using the Euler equation for the deterministic representative-agent economy as follows:

\[
u'(C_t) = \delta E[u'(C_{t+1})(1 + r_{t+1}^D)]\]

(45)

which, after applying the CRRA utility function, can be restated as

\[
1 = \delta E \left\{ \left( \frac{C_{t+1}}{C_t} \right)^{-\gamma} (1 + r_{t+1}^D) \right\}
\]

(46)

The estimable form of the above Equation (46) for the GMM is then:

---

1 The GMM methodology has been widely used in the asset pricing literature, to estimate the discount factor and relative risk aversion parameters in the Euler equation. The methodology has been presented in detail in econometric and finance textbooks, such as Greene (2008) and Cochrane (2005). Hansen and Singleton (1982) is a seminal source.
\[ 1 - \delta E \left( \left( \frac{C_{t+1}}{C_t} \right)^{-\gamma} (1 + r_{t+1}^D) \right) = 0 \] (47)

where \( \frac{C_{t+1}}{C_t} \) is the consumption growth rate and \( r_{t+1}^D \) is the interest rate on deposits to be paid in the next period.

Using an iterative generalized method of moments (IGMM), Ahmed, Haider and Iqbal (2012) have estimated, for Pakistan, the discount factor and relative risk aversion parameters. The underlying assets assumed in their estimation were either the 3-month treasury bills or long-term government bonds with maturities of three years and above.

Since the model under consideration in this dissertation clearly specifies the underlying assets in the households’ problem to be deposits upon which interest is earned in the following period, the discount factor and relative risk aversion are then re-estimated. For this purposes, I use the IGMM and annual data for the weighted-average yearly rates of return on deposits with three-year and five-year maturities and for the per capita private consumption growth rates (as there is no public consumption in the model), for the 1960-2010 period.

Before the estimation, nominal values for the interest rates were converted to real values, using the GDP deflator, because the model assumes real values without any inflation. The GDP deflator is preferred over other measures of inflation like the Consumer Price Index (CPI) or the Whole-Sale Price Index (WPI), because it is not based on a fixed basket of goods and services, which would require adjustments from time to time, as the GDP covers the entire array of goods and services produced in the economy in a particular year.
The GDP deflator then combines the experience about inflation by all agents (businesses, consumers, government) in the economy, in line with a model economy in which all agents face similar interest rates and prices. Further, in Pakistan the differences between the CPI and the GDP deflator are small, for the period under consideration (Figure 27). The GDP deflator has been used earlier in the literature for similar analyses (Hansen and Singleton 1982).

The stationarity assumption for the growth of consumption and the interest rate was confirmed by applying the Augmented Dicky-Fuller (ADF) unit root test to both the series. Real per capita consumption growth and real interest rates were stationary as per the ADF test statistics shown in Table 34.

Figure 27: GDP Deflator and CPI in Pakistan over the 1960-2010 Period
<table>
<thead>
<tr>
<th>Variables</th>
<th>Test Statistics</th>
<th>p-values</th>
<th>1% Critical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption Growth</td>
<td>-6.980</td>
<td>0.000</td>
<td>-3.587</td>
</tr>
<tr>
<td>Interest Rate 3-Years</td>
<td>-3.793</td>
<td>0.003</td>
<td>-3.580</td>
</tr>
<tr>
<td>Interest Rate 5-Years</td>
<td>-3.437</td>
<td>0.010</td>
<td>-3.580</td>
</tr>
</tbody>
</table>

Table 34: Augmented Dicky-Fuller Unit-Root Test Results

The estimation was carried out using yearly interest rates on deposits of 3-year and 5-year maturity. Because of the time series nature of the estimation, autocorrelation was suspected and the AR (1) type regression over residuals of the GMM estimation (with a yearly interest rate on 3-year maturity deposits) indicated an autocorrelation coefficient equal to 0.54, with t-value of 4.35. Therefore, it was deemed appropriate to obtain Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors for the estimation.

In small samples, like the one under consideration, the choice of bandwidth and kernel in the HAC has implications for the validity of the tests of significance (Stock and Watson 2008, Greene 2008). The literature usually suggests using a lag equal to $T^{\frac{1}{5}}$ for Bartlett Kernel or $T^{\frac{1}{4}}$ for Quadratic Spectral or Parzen Kernels (where $T$ is the total number of observations) in the HAC estimation (Baum, Schaffer and Stillman 2007). However, if autocorrelation is strong, as is the case here, some authors suggest using longer lags (Stock and Watson 2008, Sun, Phillips and Jin 2008). Moreover, Kiefer and Vogelsang (2002, 2005) have developed an alternative asymptotic theory in which the bandwidth (lags) for the kernel can equal the sample size.
<table>
<thead>
<tr>
<th></th>
<th>HAC (Bandwidth = 4)</th>
<th></th>
<th>HAC (Bandwidth = 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-Year</td>
<td>5-Year</td>
<td>3-Year</td>
</tr>
<tr>
<td>Coef. t-value</td>
<td>Coef. t-value</td>
<td>Coef. t-value</td>
<td>Coef. t-value</td>
</tr>
<tr>
<td></td>
<td>δ</td>
<td>γ</td>
<td>δ</td>
</tr>
<tr>
<td>0.9975</td>
<td>0.9875</td>
<td>0.9987</td>
<td>0.9987</td>
</tr>
<tr>
<td>79.96</td>
<td>70.05</td>
<td>124.28</td>
<td>3.35</td>
</tr>
<tr>
<td>0.4094</td>
<td>0.5205</td>
<td>0.4527</td>
<td>0.5649</td>
</tr>
<tr>
<td>1.05</td>
<td>1.15</td>
<td>1.63</td>
<td>1.71</td>
</tr>
<tr>
<td>Hansen’s J-statistics@</td>
<td>3.07</td>
<td>3.31</td>
<td>2.45</td>
</tr>
<tr>
<td>p-values</td>
<td>0.3806</td>
<td>0.3467</td>
<td>0.4836</td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

Notes: The instruments used to estimate the GMM coefficients were lagged values of real consumption growth rate and real interest rates. Let $\bar{c}_t = \frac{c_{t+1}}{c_t}$ be the growth rate of consumption and $r^D_{t+1}$ the interest rate on deposits, used in the Euler equation. Then, the instruments were: $\bar{c}_{t-1}$, $\bar{c}_{t-2}$, $r^D_t$, $r^L_{t-1}$ and a constant.

# KV critical values for $t^*_b$, where $b = 0.25$ are for the 99 and 90 percent confidence levels, for the discount factor and risk aversion coefficient, respectively, and are obtained through interpolation (Kiefer and Vogelsang 2005).

@ The Hansen’s J-statistics is obtained with 3 degrees of freedom in both regressions.

Table 35: Iterative Generalized Method of Moment Estimation Results

These alternatives have been developed because, in finite samples, HAC robust tests have a tendency to over-reject under the null hypothesis (Kiefer and Vogelsang 2005). Therefore, the model was estimated with the HAC adjustment using the Bartlett Kernel and with a lag length equal to 4 and 12. The results of the IGMM estimation, test statistics for over-identifying restrictions (Hansen’s J-statistics), and KV critical t-values for higher bandwidth are reported in Table 35. The estimated values for the discount factor, $\delta$, and relative risk aversion rate, $\gamma$, are 0.9987 or 0.9856 and 0.4527 or 0.5649, depending upon the yearly interest rate used for the 3-year and 5-year maturity deposits, respectively. These values are in line with earlier work.
The values obtained for the risk aversion rate, of less than unity, mean that the inter-temporal elasticity of substitution is high. This suggests that the households are sensitive to changes in the interest rates and wage income in their deposit choices.

Moreover, the Hansen’s J-statistics shows that the moment conditions used are valid and that the null-hypothesis of correct specification of the model cannot be rejected.

The proportions of high-skilled and low-skilled workers were determined by using the distribution of employed persons by major occupational groups, reported in the Labor Force Surveys for the years 2001-02, 2005-06 and 2007-08 (Table 14, Pakistan Bureau of Statistics 2002, 2006, 2008). Workers in the top three earnings categories, i.e., legislators, senior officials and managers, professionals and technicians, and associate professionals, comprising 13.6 percent, 13.7 percent, and 14.2 percent of the labor force, in the years 2001-02, 2005-06 and 2007-08, respectively, were treated as high-skilled. The remaining 86.4 percent, 86.4 percent and 85.8 percent were treated as low-skilled. The resulting average shares of high-skilled and low-skilled workers in the labor force are 13.8 percent and 86.2 percent, respectively.

The differences in labor productivity between the two types of households $\bar{I}_l$ can be estimated from the empirical distribution of hourly wages (Heer and Maussner 2005). However, hourly wage data are not readily available in the labor force surveys used to classify the labor force according to skill levels. Therefore, the difference in monthly wage rates was used as a proxy for the difference in labor productivity.
To establish this difference in labor productivity, the monthly income corresponding to the three categories of workers selected as high-skilled was determined from Table 10 of the Household Integrated Economic Survey (HIES), implemented by the Pakistan Bureau of Statistics for the years 2005-06, 2007-08 and 2010-11. The combined simple average monthly wage rate for the three categories of workers, for the three years, is Rs 16,312, and the combined simple average monthly wage rate for the workers in the rest of the categories is Rs 7,343. This wage difference of 2.22 times was taken to be the difference in labor productivity.

Further, the labor time supplied by the two types of workers $\bar{h}$ was then calibrated to be one-third of their available time so as to correspond to 8 hours of work per day. According to the Pakistan Bureau of Statistics (2012), over 86 percent of the labor force worked for more than 35 hours per week or around one-third of their time.

As, in the model, both the high-risk and the low-risk firms use a similar production technology, with differences in output emerging only from differences in the productivity per worker, to estimate the loan share, $\alpha$, in the Cobb-Douglas production function, I used as a proxy the average private credit to the GDP ratio of 24.7 percent, for the 1990-2011 period (World Bank 2011). Because the private credit to the GDP ratio indicates the extent of financial deepening, it has been widely used by researchers as an indicator for financial development (Beck, Demirgüc-Kunt and Levine 2004, Clarke, Xu and Zou 2006). However, this ratio is used here as an indicator for the extent of non-labor inputs purchased or hired, by using credit in the production process.
To calibrate the average probability of default, $p_0$ and $p_1$, in the informal and formal sector firms, the non-performing loans (NPLs) to total loans ratio may be used as a proxy. However, sector-wide data on non-performing loans (NPLs) is not publicly available. To circumvent this difficulty, the NPLs to loans ratio of the foreign banks is treated as the default rate for the low-risk firms and the NPLs to loans ratio of the specialized banks is treated as the default rate of the high-risk firms. The foreign banks usually lend to well-established corporate sector firms. In turn, the specialized banks, comprising cooperatives, agricultural and small and microenterprise banks, lend to traditional firms. The average NPLs to loans ratio of all foreign banks operating in Pakistan for the 2004-2010 period was 3.54 percent, while the NPLs to total loan ratio for the specialized banks was 36.60 percent.

The parameters of the two cost functions, $a_j$ and $b_j$, are difficult to estimate. Their estimation requires a long series of data about credit volumes and the costs of administering a portfolio of loans to formal and informal sector firms. Unfortunately, such bifurcation of the data is not publicly available, at least for a sufficiently long period of time. An attempt was made, however, to estimate these parameters with banking data for Pakistan. To accomplish this, I implemented an ordinary least squares (OLS) regression, using data for banks incorporated in Pakistan and for banks incorporated outside Pakistan but operating in this country, during the 2001-2011 period. This effort made available only 11 yearly observations to estimate these parameters.
Table 36: Parameter values for the Pakistan (PAK) Model

The dependent variable used in the regression was the total amount of administrative costs, while the independent variables were the volume of loans and the square of the volume of loans. The estimated values were 0.0300097 (2.76) and 0.1708093 (6.44) for the parameters of the linear terms $a_0$ and $a_1$, and 8.08e-09 (2.13) and -8.04e-07 (-4.10) for the parameters on the quadratic terms $b_0$ and $b_1$, respectively.

The residuals of the two regressions reveal a high degree of autocorrelation, pointing to the non-stationarity of the data series. Indeed, when the two types of series were checked for stationarity, they failed the Augmented Dicky-Fuller unit root test. Moreover, the R-square of the two regressions was very high, at 0.98 and 0.92, indicating a spurious regression.
Therefore, because of the non-availability of data for a longer period of time and the resulting inconsistencies in the estimation, the cost parameters were instead calibrated as per the values selected in the previous chapter.

Finally, the required reserve ratio \( \eta \) was set equal to the average ratio of 6 percent maintained by the central bank over the 1963-2010 period (State Bank of Pakistan 2010). The parameters with their estimated/calibrated values are shown in Table 36.

6.3 Results of the Model for Pakistan

The solution of the model using parameter values relevant for Pakistan generates results similar to those obtained for the original model and described in Chapter 5. The convergence of the interest rate on deposits, \( r_D \), and of aggregate deposits, \( D \), is shown in Figure 28 and Figure 29. The solver starts with an initial value of the interest rate on deposits as negative 3 percent, but it converges to an even lower value of negative 5 percent. Given the zero-profit condition for the banks, under competitive equilibrium, and the specification in the model of the deposit contract as a profit-sharing arrangement, the non-positive interest rate paid on deposits reflects that the banks experience losses and pass on these losses to the depositors, who are willing to save even at these negative rates. This result of a negative interest rate on deposits is not, however, unusual, if one considers that the real interest rate paid on deposits in Pakistan was non-positive for several years in the sample (Figure 26). This indicates a high level of financial repression and financial shallowing in the model economy for Pakistan (McKinnon 1973, Shaw 1973, Edwards and Khan 1985, Edwards 1996).
Figure 28: Convergence of the Interest Rate on Deposits ($r_D$). PAK Model

Figure 29: Convergence of Aggregate Deposits ($D$). PAK Model
The amounts of aggregate deposits in the inner and the outer loops start at different levels, but then they slowly converge to the single value of 0.0384, as the interest rate paid on deposits converges. The initially higher values for aggregate deposits in the inner loop—compared to those in the outer loop—reflect an excess supply of deposits, given a lower demand for funds by the banks, at the initial interest rate. In response, the interest rate declines even further (into negative territory), until the households’ supply of deposits and the banks’ demand for funds are equated. The large extent of the frictions observed in this economy (namely, severe riskiness, particularly of the firms in the informal sector, and high costs of lending) chip away at the returns earned by depositing households and, as a consequence, it leads to a comparatively small size of the financial sector.

Figure 30 reports the optimal policy functions for the low-skilled and high-skilled households. The low-skilled households use a portion of the deposits that they have kept from the previous period, in order to sustain their current consumption (shown by a policy function always below the 45° line). That is, they withdraw a portion of their initial deposit and, therefore, dissave and carry a smaller deposit into the next period. Some of the low-skilled households, with levels of wealth close to the lower bound (of zero, as they do not have access to credit), have no initial deposits at all and, therefore, neither save nor dissave (which results in a kink in the policy function). For these households, at subsistence levels of wealth, the marginal utility of current consumption is so high and the interest rates paid on deposits so comparatively unattractive that they do not sacrifice current consumption for the future.
In contrast, high-skilled households, with more wealth and a lower marginal utility of consumption at that level of wealth and, particularly, with a fear of suffering a labor productivity shock that may shift their status from high to low skills and force their consumption to levels much lower than their current consumption, save and keep adding to their deposit holdings, until they reach their optimum level of wealth or “target deposit level” of 0.60 (shown by the intersection with the 45° line). Notice that this target level of wealth is lower than that obtained in the base model of Chapter 5. Moreover, once their wealth levels are above this target, the high-skilled households withdraw a portion of their deposits, to reinforce current consumption.
<table>
<thead>
<tr>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rates (%)</td>
<td></td>
</tr>
<tr>
<td>$r_D$</td>
<td>-5.38</td>
</tr>
<tr>
<td>$r_{L_0}$</td>
<td>70.08</td>
</tr>
<tr>
<td>$r_{L_1}$</td>
<td>10.66</td>
</tr>
<tr>
<td>Wage Rates</td>
<td></td>
</tr>
<tr>
<td>$W_0$</td>
<td>0.4008</td>
</tr>
<tr>
<td>$W_1$</td>
<td>0.4612</td>
</tr>
<tr>
<td>Deposits</td>
<td></td>
</tr>
<tr>
<td>$D$</td>
<td>0.0384</td>
</tr>
<tr>
<td>Loans</td>
<td></td>
</tr>
<tr>
<td>$L_0$</td>
<td>0.0222</td>
</tr>
<tr>
<td>$L_1$</td>
<td>0.0140</td>
</tr>
<tr>
<td>Reserves</td>
<td></td>
</tr>
<tr>
<td>$\eta D$</td>
<td>0.0023</td>
</tr>
</tbody>
</table>

Table 37: Interest Rates, Wages, Deposits and Loans. PAK Model

Table 37 shows the steady-state values of the interest rate on deposits, interest rates on loans for the high-risk and low-risk firms, aggregate deposits, loan volumes in the two segments of the market, amount of reserves, and wage rates for the low-skilled and high-skilled households. Due to the policy-induced frictions, $\eta$, as well as the market imperfections and incomplete institutions reflected by the threat of default rates, $p_j$, and the costs of lending $a_j$ and $b_j$, a large wedge between the loan and deposit interest rates emerges. The uniform interest rate on deposits is a negative 5 percent, while the interest rates charged on loans to the high-risk and low-risk firms are 70 percent and 11 percent, respectively. The firms in the informal sector (where 86.2 percent of the households work) capture 61.3 percent of the loan portfolio of the banks, while the formal sector firms receive 38.7 percent. Thus, the weighted average interest rate on the loan portfolio of the banks is 47.1 percent and the overall wedge is 52 percentage points.
The availability of deposits (even at negative interest rates) makes it possible for the banks to lend to both types of firms. In addition to the demand for loans from each sector (which depends upon the relative availability and productivity differentials of the two types of labor), the differential default rates and costs of lending determine the interest rates at which credit is disbursed to the two types of firms. Since the interest rate charged on loans is higher for the informal sector firms and the amount of credit per unit of effective labor in this sector is lower, so are wage rates in this sector. In turn, loan interest rates are lower and credit per unit of effective labor is higher in the formal sector firms, resulting in a higher marginal product of labor and higher wage rates for high-skilled workers in the formal sector firms. Therefore, the wage rates of the low-skilled workers of 0.4008 per unit of effective labor are lower than the wage rates of 0.4612 per unit of effective labor of the high-skilled households.

These differences in wage rates lead to starker differences in wage earnings, when one considers that the high-skilled workers own more than twice the units of effective labor than the low-skilled workers, when the differences in labor productivity are taken into account. The resulting differences in household wage incomes, in reflection both of productivity differences (units of effective labor per household) and wage rate differences, are reflected in the functional distribution of the total wage bill in the economy, across the two segments of the population (namely, low-skilled labor and the owners of human capital). Through these channels, the extent of the frictions observed in financial markets influences the distribution of household wage incomes.
Thus, low-skill households, which represent 86.2 percent of the total, earn only 70.9 percent of the total wage bill, while high-skilled households (13.8 percent of the households) earn 29.1 percent of the total wage bill. The corresponding Gini coefficient from the distribution of labor income is 15 percent in the base model (Table 38).

The shallowness of financial deepening is apparent from the indicators shown in Table 39. The credit to the GDP ratio is only 17 percent and the deposit to the GDP ratio is 18 percent. Since, in representation of policy-induced frictions, the required reserve ratio has been kept comparatively low at 6 percent of aggregate deposits, the resulting reserves to the GDP ratio is low, at 1 percent. This represents a relatively modest leakage of resources into idle holdings.
The aggregate level of deposits held by the two types of households is shown in Table 40. As was the case in scenario 1 of section 5.1 of the previous chapter, there are few richer households who have a stronger motivation to save and hold wealth (deposits) over time, particularly because they face a high probability (1 − N = 86.2 percent) that, in future periods, they may suffer an adverse labor productivity shock and may not be able to sustain their current levels of consumption. Thus, while the high-skilled workers represent only 13.8 percent of the total number of households, they hold 61 percent of the total wealth (deposits) in the economy.

Under steady-state, the target level of deposits of high-skilled households is almost 50 percent of their wage income. In contrast, the target level of deposits is only 13 percent of their wage income in the case of the low-skilled households. These poor, low-skilled households are unwilling to save and sacrifice current consumption because, if at all, their status might improve in the future and their only fear is to end up working in a firm that defaults on the payment of loans and wages. A sizeable proportion of them even hold a zero level of deposits. Therefore, the Gini coefficient for the distribution of wealth is 75 percent, which indicates a high level of inequality of wealth.

<table>
<thead>
<tr>
<th>Description</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposit to Wage Income Ratio (Low-Skilled)</th>
<th>Deposit to Wage Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAK Model</td>
<td>0.0150</td>
<td>0.0234</td>
<td>13.04</td>
<td>49.56</td>
<td>74.99</td>
</tr>
</tbody>
</table>

Table 40: Deposit Mobilization and Inequality of Wealth. PAK Model
In effect, the Lorenz curve for the distribution of wealth in the model for the Pakistan economy (Figure 31) shows that around 53 percent of the households (the poorest) hold only 0.04 percent of the wealth. At the other end of the distribution, the wealthiest 5 percent of the households hold around 33 percent of the deposits. This high level of inequality reflects both high degrees of financial repression and financial shallowing as well as the very low level of the stock of human capital and the high levels of risk in this economy. As the performance of the financial sector improves and human capital is accumulated, it is expected that the distribution of wealth would eventually improve.
6.4 Financial and Human Capital Development in Pakistan

In this section, I analyze the Kuznetsian relationship between economic growth and development, represented here by a process of human capital formation (exogenously incorporated through a series of alternative solutions of the model), and the evolution of the inequality of the distribution of (wage) incomes, for the case of the model economy for Pakistan. The analysis proceeds in two sequential ways.

First, I evaluate a simple version of the original Kuznetsian hypothesis, by exploring the relationship between human capital formation and inequality in the distributions of income and wealth. Second, I examine the same relationship between human capital and inequality—but with the analysis augmented by also incorporating financial development in the process of economic development—and establishing, as a first approximation, the additional influence of financial deepening on inequality.

The stylized story that lies behind the exercise describes the process of economic development as the combined outcome of inter-related: (a) investments in human capital (facilitated, in part, by increased household access to financial services, a dimension not explicitly incorporated in the model), and (b) financial development, which results both from an increased household ability and willingness to deposit—due to the transition of the labor force—and an enhancement of the environment for the operation of financial markets (through the adoption of both direct and indirect government interventions), which improves the management of risk and increases the efficiency in the allocation of resources in the evolving economy.
By reducing the frictions in financial markets that contribute to the fragmentation of the economy, in its early stages, and by reducing the leakage of resources into transaction costs and idle reserves, financial development increases the productivity of the available resource endowment. The larger levels of output that emerge, however, do not immediately lead to a more egalitarian distribution of income and wealth.

Indeed, the resulting evolution of: (a) the composition (by skills) of the labor force, (b) changes in the command over resources by formal and informal sector firms, as a consequence of the evolution of bank credit portfolios in each segment of the economy (as the corresponding demands for credit and the availability of deposits are modified by the structural transformation of the labor force and as the extent of market frictions declines), (c) the increasing level of output, and (d) differential wage rates and household earnings all jointly determine the path for the evolution of the distributions of income and wealth, along this combined process of economic and financial development.

As was the case of the simulations in Chapter 5, it is expected that the volume of credit to the formal sector firms would increase and the volume of credit to the informal sector firms would decrease. In effect, the structural shift in the composition of the labor force would lead to an increase in the demand for credit in the formal sector—brought about by an increase in the proportion of high-skilled workers—and a decrease in the demand for credit in the informal sector, brought about by a decrease in the proportion of low-skilled workers. The increase in the demand for credit in the formal sector—each time that a household’s skills are upgraded—would be proportionately greater than the decline of the demand in the informal sector, given the differences in labor productivity.
Because of the extent of the long-term process of structural transformation assumed in the exercise, these relative changes in the demands for credit in each sector would dominate the accompanying changes in the corresponding supplies of credit, brought about by reductions in default risks and lending costs that are (pro-poor) biased, in favor of the informal sector firms. Net changes in the volumes of credit would be due, therefore, to non-uniform increases in the supply of credit in both sectors and to movements of the demands for credit in opposite directions.

In turn, these (absolute and relative) changes in credit volumes would modify the amounts of non-labor inputs available per unit of labor, the marginal product of labor, wage rates, and labor earnings in each of the two sectors. Starting from a very low proportion of high-skilled households, at an early stage of development, these shifts would first worsen the distribution of household income but, as the proportion of high-skilled households in the economy increased further, the distribution would improve. The inequality of the distribution of income would, therefore, initially rise, although at a declining rate, and eventually fall. So, an inverted U-shaped relationship is expected to link the structural shift in the labor force that occurs with economic development and the inequality of the distribution of income.

Since the labor force in Pakistan still mainly consists of low-skilled workers, investments in education and training that would lead to human capital formation would accelerate this structural transformation. If this were the case, the simulations implemented in this section would describe potential consequences of this transformation on the distribution of income.
In order to obtain the augmented Kuznetsian analysis, I assume that direct and indirect financial policies can remove frictions in financial markets and increase the relative size of the financial system (that is, financial deepening would increase both the volume of deposits mobilized and the availability of credit). Household income would be higher, at each level of the human capital stock, because the amount of credit per unit of effective labor would rise in both types of firms (with the outward shift of the credit supplies), compared to a situation without financial deepening. Also, with the informal sector (pro-poor) biased improvements in the environment for the operation of financial markets, the original differences in the availability of credit per unit of effective labor between the two types of firms would decline.

With financial development, the non-uniform reduction in default rates and the costs of lending would then imply a decline in the wage rate differences across the two types of households. This would lead to less inequality in the distribution of income in the augmented scenario, where financial development accompanies human capital development, than in the simple scenario, where only human capital development takes place. This reduction in the inequality of the income distribution (that is, the extent of the improvement, compared to a scenario without financial development) would be greater: (a) the more rapidly the process of financial development takes place, accompanying the structural transformation of the labor force, as a result of direct policy interventions (which reduce financial repression) and indirect policy interventions (which lower risks of default and transaction costs) and (b) the extent of the (pro-poor), informal sector bias of the improvements (such as those related to microfinance).
For the first exercise, in this sequential analysis, while starting with the parameter values considered in the base model for Pakistan of the previous section, I allow the steady-state proportion of high-skilled households $N$ to rise from 14 percent to 64 percent, in five steps. The values for the solution of the model are re-computed at each step. The purpose of the exercise is to assess the impact of human capital formation on the inequality of the distribution of household wage incomes, given the same repressive financial regime as in the base case. The values of the parameters used in the simulations are shown in Table 41. The results from this exercise would indicate changes due only to the structural transformation of the labor force.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Base Model</th>
<th>Simulation 1</th>
<th>Simulation 2</th>
<th>Simulation 3</th>
<th>Simulation 4</th>
<th>Simulation 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta$</td>
<td>0.9856</td>
<td>0.9856</td>
<td>0.9856</td>
<td>0.9856</td>
<td>0.9856</td>
<td>0.9856</td>
</tr>
<tr>
<td>$\gamma$</td>
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<td>0.5649</td>
<td>0.5649</td>
<td>0.5649</td>
<td>0.5649</td>
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</tr>
<tr>
<td>$\bar{t}_0, \bar{t}_1$</td>
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<td>1.0, 2.22</td>
<td>1.0, 2.22</td>
<td>1.0, 2.22</td>
<td>1.0, 2.22</td>
<td>1.0, 2.22</td>
</tr>
<tr>
<td>$\bar{h}$</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
</tr>
<tr>
<td>$N$</td>
<td>0.14</td>
<td>0.24</td>
<td>0.34</td>
<td>0.44</td>
<td>0.54</td>
<td>0.64</td>
</tr>
<tr>
<td>$\alpha$</td>
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<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>$p_0, p_1$</td>
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<td>0.31, 0.04</td>
<td>0.24, 0.04</td>
<td>0.17, 0.04</td>
<td>0.10, 0.03</td>
<td>0.03, 0.01</td>
</tr>
<tr>
<td>$a_0, a_1$</td>
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<td>0.06, 0.05</td>
<td>0.05, 0.04</td>
<td>0.04, 0.03</td>
<td>0.03, 0.02</td>
<td>0.02, 0.01</td>
</tr>
<tr>
<td>$b_0, b_1$</td>
<td>0.04, 0.03</td>
<td>0.03, 0.02</td>
<td>0.02, 0.01</td>
<td>0.02, 0.01</td>
<td>0.01, 0.005</td>
<td>0.01, 0.005</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.06</td>
<td>0.055</td>
<td>0.050</td>
<td>0.045</td>
<td>0.040</td>
<td>0.035</td>
</tr>
</tbody>
</table>

Table 42: Parameter Values and their Range. Augmented Kuznetsian Analysis for Pakistan

Next, in the second exercise of this sequential analysis, the financial regime is allowed to improve, along with the structural shift of the labor force. In this case, starting with the same reference value of the base model, the steady-state proportion of high-skilled households $N$ is again allowed to rise from 14 to 64 percent, in five steps. At each step, however, the financial regime is also allowed to improve. The default rate from firms in the informal sector is allowed to decline, from 37 to 2 percent, but it is allowed to decline only from 3.5 to 1 percent in the case of the formal sector firms. The parameters of the cost of lending function are also allowed to decline, although at a slower rate. The required reserve ratio, $\eta$, is allowed to decrease from 6 percent to 3.5 percent. The parameter values and their ranges are shown in Table 42.
Table 43: Deposit and Loan Amounts, Interest Rates, and Wages. Kuznetsian Analysis for Pakistan

In the first exercise in this sequence, without any change in the financial structure of the model economy, the non-positive interest rate paid on deposits and the interest rates charged on both types of loans initially decline but, at higher levels of human capital formation, they increase again (Table 43). Similarly, using the data from Table 43 for the computations, the weighted average interest rate earned by the banks on their loan portfolio declines from 47.1 percent (when $N=0.14$) to 16.5 percent (when $N=0.44$) and it then moderately increases to 18.0 percent (when $N=0.64$).

In turn, the critical wedge between the average loan interest rate and the interest rate paid on deposits at first dramatically declines, from 52.5 percentage points (for $N=0.14$) to 19.6 points (for $N=0.54$), and then it moderately increases to 23.8 percentage points (when $N=0.64$). This non-linear evolution of all interest rates in the system is the result of the complex interaction between changing demands for credit (due to changes in skills, as $N$ evolves) and changing supplies of credit, along the transformation.
The demand for credit by firms in the informal sector declines, with the reduction in the number of low-skilled households. Simultaneously, the demand for credit by firms in the formal sector increases (more than proportionately), due to the increase in the number of high-skilled households and to the greater amount of effective labor that they supply. These relative demand changes exert upward pressures on the loan interest rates. The accompanying changes in the composition, by sectors, of bank credit portfolios reduce, however, both the banks’ overall risk of default and costs of lending, as the safer and less costly (formal) portion of their portfolio increases. This portfolio shift exerts downward pressures on interest rates, even though sectoral risks and costs have not changed. Moreover, the cost of funds (given by the uniform interest rate paid on deposits) declines, as the number of strong savers (namely, high-skilled households) increases.

The reduction in the interest rate paid on deposits and the interest rates charged on loans observed in the initial stages of the structural transformation is eventually reversed. As the number of high-skilled households increases, the probability that they will suffer an adverse shift in their labor productivity status declines. This reduces the motivation that the increasing number of high-skilled households has to accumulate deposits. The reduction in the target ratio of deposits to income and the lower wage rates—when the amount of credit per effective unit of labor declines—make funds scarcer for the banks and all interest rates rise. In particular, the interest rate paid on deposits increases, to induce households to save more out of their lower wage incomes. Thus, the gap between the interest rates charged on loans and the interest rate paid on deposits first declines, but it then increases, as the structural transformation advances.
<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Wage Income Share (Low-Skilled)</th>
<th>Wage Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>( W_0 * H_0 )</td>
<td>( W_1 * H_1 )</td>
<td>( \psi_0 ) (%)</td>
<td>( \psi_1 ) (%)</td>
<td>Gini-I (%)</td>
<td></td>
</tr>
<tr>
<td>0.14</td>
<td>0.1151</td>
<td>0.0472</td>
<td>0.1623</td>
<td>70.94</td>
<td>29.06</td>
<td>15.24</td>
</tr>
<tr>
<td>0.24</td>
<td>0.1024</td>
<td>0.0818</td>
<td>0.1842</td>
<td>55.59</td>
<td>44.41</td>
<td>20.59</td>
</tr>
<tr>
<td>0.34</td>
<td>0.0892</td>
<td>0.1164</td>
<td>0.2056</td>
<td>43.37</td>
<td>56.63</td>
<td>22.81</td>
</tr>
<tr>
<td>0.44</td>
<td>0.0757</td>
<td>0.1508</td>
<td>0.2264</td>
<td>33.42</td>
<td>66.58</td>
<td>22.76</td>
</tr>
<tr>
<td>0.54</td>
<td>0.0620</td>
<td>0.1846</td>
<td>0.2466</td>
<td>25.14</td>
<td>74.86</td>
<td>21.04</td>
</tr>
<tr>
<td>0.64</td>
<td>0.0484</td>
<td>0.2181</td>
<td>0.2665</td>
<td>18.16</td>
<td>81.84</td>
<td>18.02</td>
</tr>
</tbody>
</table>

Table 44: Wage Earnings and Shares and the Inequality of Wage Incomes (Gini Coefficient). Kuznetsian Analysis for Pakistan

<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.14</td>
<td>0.2154</td>
<td>16.78</td>
<td>17.82</td>
<td>1.05</td>
</tr>
<tr>
<td>0.24</td>
<td>0.2445</td>
<td>18.33</td>
<td>19.48</td>
<td>1.15</td>
</tr>
<tr>
<td>0.34</td>
<td>0.2729</td>
<td>19.44</td>
<td>20.66</td>
<td>1.23</td>
</tr>
<tr>
<td>0.44</td>
<td>0.3005</td>
<td>20.19</td>
<td>21.47</td>
<td>1.28</td>
</tr>
<tr>
<td>0.54</td>
<td>0.3273</td>
<td>20.67</td>
<td>21.91</td>
<td>1.24</td>
</tr>
<tr>
<td>0.64</td>
<td>0.3536</td>
<td>20.97</td>
<td>22.21</td>
<td>1.24</td>
</tr>
</tbody>
</table>

Table 45: Indicators of Financial Deepening. Kuznetsian Analysis for Pakistan
### Table 46: Aggregate Deposits and Inequality of Wealth. Kuznetsian Analysis for Pakistan

<table>
<thead>
<tr>
<th>Human Capital Stock</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposit to Income Ratio (Low-Skilled)</th>
<th>Deposit to Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$N$</td>
<td>$D_0$</td>
<td>$D_1$</td>
<td>$\frac{D_0}{W_0H_0} \times 100$</td>
<td>$\frac{D_1}{W_1H_1} \times 100$</td>
</tr>
<tr>
<td>0.14</td>
<td>0.0150</td>
<td>0.0234</td>
<td>13.04</td>
<td>49.56</td>
<td>74.99</td>
</tr>
<tr>
<td>0.24</td>
<td>0.0122</td>
<td>0.0354</td>
<td>11.93</td>
<td>43.27</td>
<td>67.66</td>
</tr>
<tr>
<td>0.34</td>
<td>0.0099</td>
<td>0.0465</td>
<td>11.14</td>
<td>39.90</td>
<td>61.00</td>
</tr>
<tr>
<td>0.44</td>
<td>0.0078</td>
<td>0.0567</td>
<td>10.29</td>
<td>37.62</td>
<td>54.89</td>
</tr>
<tr>
<td>0.54</td>
<td>0.0054</td>
<td>0.0664</td>
<td>8.64</td>
<td>35.94</td>
<td>49.90</td>
</tr>
<tr>
<td>0.64</td>
<td>0.0034</td>
<td>0.0752</td>
<td>6.97</td>
<td>34.47</td>
<td>43.88</td>
</tr>
</tbody>
</table>

In contrast, in the second exercise, where the structural transformation of the labor force is accompanied by financial development, the wedge between the interest rate paid on deposits and the weighted average interest rate charged on loans declines monotonically. On the one hand, while still being negative, the interest rate paid on deposits increases throughout the structural transformation, as the improvements in financial markets—which allow the banks to offer a better reward to savers—more than compensate the reduction in the target ratios of deposits to income, as the probability of an adverse labor productivity shock and the need for precautionary reserves decline (Table 47). Thus, some of the gains from financial deepening are transferred to the depositors and, as the proportion of high-skilled workers in the labor force increases, this should bring about an improvement in the distribution of income sooner.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Deposits</th>
<th>Loans</th>
<th>Deposit Interest Rate</th>
<th>Loan Interest Rates</th>
<th>Wage Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$D$</td>
<td>$L_0$</td>
<td>$L_1$</td>
<td>$r_D$ (%)</td>
<td>$r_{L_0}$ (%)</td>
</tr>
<tr>
<td>1</td>
<td>0.0384</td>
<td>0.0222</td>
<td>0.0140</td>
<td>-5.384</td>
<td>70.083</td>
</tr>
<tr>
<td>2</td>
<td>0.0504</td>
<td>0.0230</td>
<td>0.0246</td>
<td>-5.643</td>
<td>50.549</td>
</tr>
<tr>
<td>3</td>
<td>0.0611</td>
<td>0.0229</td>
<td>0.0352</td>
<td>-4.767</td>
<td>36.093</td>
</tr>
<tr>
<td>4</td>
<td>0.0708</td>
<td>0.0219</td>
<td>0.0458</td>
<td>-3.608</td>
<td>24.433</td>
</tr>
<tr>
<td>5</td>
<td>0.0804</td>
<td>0.0201</td>
<td>0.0572</td>
<td>-2.413</td>
<td>14.543</td>
</tr>
<tr>
<td>6</td>
<td>0.0907</td>
<td>0.0174</td>
<td>0.0702</td>
<td>-1.425</td>
<td>5.880</td>
</tr>
</tbody>
</table>

Table 47: Deposit and Loan Amounts, Interest Rates and Wages. Augmented Kuznetsian Analysis for Pakistan

On the other hand, the interest rates charged on loans to both the informal and formal sector firms decline steadily throughout the simulations, due to the persistent improvement in the financial regime, although the reduction is considerably larger in the case of the informal sector firms (Table 47). The weighted average interest rate earned by the banks on their credit portfolio declines monotonically, from the base case rate of 47.1 percent (when $N=0.14$) to 4.2 percent (when $N=0.64$), a much lower level than the rate of 18.0 percent reached for the same stage of the human capital stock but without the improvements in the financial regime.

In turn, the wedge—which represents the magnitude of the frictions in financial markets assumed in this exercise—declines from 52.5 percentage points (when $N=0.14$) to 1.4 percentage points (when $N=0.64$), well below the 23.8 percentage point difference reached, at the same level of the human capital stock, when the structural transformation of the labor force was not accompanied by financial development.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Wage Earnings (Low-Skilled)</th>
<th>Wage Earnings (High-Skilled)</th>
<th>Total Wage Bill</th>
<th>Income Share (Low-Skilled)</th>
<th>Income Share (High-Skilled)</th>
<th>Gini of Wage Income Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.1151</td>
<td>0.0472</td>
<td>0.1623</td>
<td>70.94</td>
<td>29.06</td>
<td>15.24</td>
</tr>
<tr>
<td>2</td>
<td>0.1059</td>
<td>0.0817</td>
<td>0.1876</td>
<td>56.44</td>
<td>43.56</td>
<td>19.74</td>
</tr>
<tr>
<td>3</td>
<td>0.0951</td>
<td>0.1163</td>
<td>0.2114</td>
<td>44.98</td>
<td>55.02</td>
<td>21.20</td>
</tr>
<tr>
<td>4</td>
<td>0.0831</td>
<td>0.1508</td>
<td>0.2339</td>
<td>35.53</td>
<td>64.47</td>
<td>20.65</td>
</tr>
<tr>
<td>5</td>
<td>0.0702</td>
<td>0.1860</td>
<td>0.2562</td>
<td>27.39</td>
<td>72.61</td>
<td>18.79</td>
</tr>
<tr>
<td>6</td>
<td>0.0564</td>
<td>0.2224</td>
<td>0.2788</td>
<td>20.23</td>
<td>79.77</td>
<td>15.95</td>
</tr>
</tbody>
</table>

Table 48: Wage Earnings and Functional Shares and the Inequality of Wage Incomes (Gini Coefficient). Augmented Kuznetsian Analysis for Pakistan

In the first exercise of this sequence, in both sectors, the evolution of the wage rates shows a similar pattern of increasing initially and then falling, as the labor force shifts from a low-skilled to a high-skilled status. Along this structural transformation, the decline in the volume of loans to the informal sector, where the labor force is shrinking, accelerates and is eventually faster than the labor force reduction, while the increase in the volume of loans to the formal sector, where the labor force is expanding, decelerates, as shown in Table 51. As a result, the amount of credit per unit of effective labor, which initially grows in both sectors, thereby allowing wage rates to keep rising in both types of firms, eventually drops, bringing down wages. Table 51 confirms that, initially, wages grow but they then decline, almost at the same pace in both sectors, given the values of the parameters used in the simulations.
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Output (GDP)</th>
<th>Credit to GDP (%)</th>
<th>Deposits to GDP (%)</th>
<th>Reserves to GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2154</td>
<td>16.78</td>
<td>17.82</td>
<td>1.05</td>
</tr>
<tr>
<td>2</td>
<td>0.2490</td>
<td>19.13</td>
<td>20.23</td>
<td>1.10</td>
</tr>
<tr>
<td>3</td>
<td>0.2805</td>
<td>20.70</td>
<td>21.78</td>
<td>1.08</td>
</tr>
<tr>
<td>4</td>
<td>0.3104</td>
<td>21.79</td>
<td>22.81</td>
<td>1.02</td>
</tr>
<tr>
<td>5</td>
<td>0.3404</td>
<td>22.73</td>
<td>23.66</td>
<td>0.93</td>
</tr>
<tr>
<td>6</td>
<td>0.3700</td>
<td>23.67</td>
<td>24.51</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Table 49: Indicators of Financial Deepening. Augmented Kuznetsian Analysis for Pakistan

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Aggregate Deposits (Low-Skilled)</th>
<th>Aggregate Deposits (High-Skilled)</th>
<th>Deposits to Wage Income Ratio (Low-Skilled)</th>
<th>Deposits to Wage Income Ratio (High-Skilled)</th>
<th>Gini of Wealth Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$D_0$</td>
<td>$D_1$</td>
<td>$\frac{D_0}{W_0H_0^*}$ 100</td>
<td>$\frac{D_1}{W_1H_1^*}$ 100</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.0150</td>
<td>0.0234</td>
<td>13.04</td>
<td>49.56</td>
<td>74.99</td>
</tr>
<tr>
<td>2</td>
<td>0.0142</td>
<td>0.0361</td>
<td>13.43</td>
<td>44.22</td>
<td>66.42</td>
</tr>
<tr>
<td>3</td>
<td>0.0133</td>
<td>0.0478</td>
<td>13.96</td>
<td>41.14</td>
<td>59.13</td>
</tr>
<tr>
<td>4</td>
<td>0.0116</td>
<td>0.0592</td>
<td>13.93</td>
<td>39.28</td>
<td>52.98</td>
</tr>
<tr>
<td>5</td>
<td>0.0096</td>
<td>0.0708</td>
<td>13.72</td>
<td>38.07</td>
<td>47.88</td>
</tr>
<tr>
<td>6</td>
<td>0.0077</td>
<td>0.0830</td>
<td>13.67</td>
<td>37.32</td>
<td>42.23</td>
</tr>
</tbody>
</table>

Table 50: Aggregate Deposits and Inequality of Wealth (Gini Coefficient). Augmented Kuznetsian Analysis for Pakistan
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Growth Rate of Wage Rates (%)</th>
<th>Growth Rate of Loan Amounts (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( W_0 )</td>
<td>( W_1 )</td>
</tr>
<tr>
<td>1</td>
<td>0.64</td>
<td>0.65</td>
</tr>
<tr>
<td>2</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>3</td>
<td>-0.07</td>
<td>-0.07</td>
</tr>
<tr>
<td>4</td>
<td>-0.28</td>
<td>-0.28</td>
</tr>
<tr>
<td>5</td>
<td>-0.39</td>
<td>-0.39</td>
</tr>
</tbody>
</table>

Table 51: Growth Rate of Wages and Loan Amounts. Kuznetsian Analysis for Pakistan

In the second exercise, however, wage rates steadily rise in both sectors of the economy (Table 47), although the rate of increase is much faster in the informal than in the formal sector firms (Table 52), as a consequence of the pro-poor, informal sector bias of financial development.

In the informal sector firms, nevertheless, the rise in wage rates decelerates throughout the structural transformation while, in the formal sector firms, the increase in wage rates first decelerates and then accelerates. Thus, in the early stages (as the stock of human capital goes from \( N=0.14 \) to \( N=0.24 \)), the rate of increase of informal sector wage rates is 7.3 times faster than the rate of increase of formal sector wage rates (as computed from Table 52). This difference in rates of growth of wage rates increases to 29.7 times faster (when the stock of human capital goes from \( N=0.34 \) to \( N=0.44 \)). Eventually, however, the difference in these rates of growth declines and informal wage rates increase only 3.1 times more rapidly than formal wage rates (as the stock of human capital goes from \( N=0.54 \) to \( N=0.64 \)).
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Growth Rate of Wage Rates (%)</th>
<th>Growth Rate of Loan Amounts (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$W_0$</td>
<td>$W_1$</td>
</tr>
<tr>
<td>1</td>
<td>4.06</td>
<td>0.56</td>
</tr>
<tr>
<td>2</td>
<td>3.34</td>
<td>0.19</td>
</tr>
<tr>
<td>3</td>
<td>2.97</td>
<td>0.10</td>
</tr>
<tr>
<td>4</td>
<td>2.73</td>
<td>0.43</td>
</tr>
<tr>
<td>5</td>
<td>2.60</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table 52: Growth Rate of Wages and Loan Amounts. Augmented Kuznetsian Analysis for Pakistan

Thus, in this second exercise, despite the divergent evolution of the demands for credit, due to the structural transformation of the labor force, the improvements in the financial regime sustain the supply of credit at sufficiently high levels for all wages to increase steadily, although at varying rates. Therefore, enough financial development generates gains for wage earning households (through their wage rates, in addition to the gains through the interest rates earned on deposits) in both sectors of the economy.

The combined process of: (a) changes in the skills of the labor force (human capital formation), (b) changes in the volumes of deposits mobilized and of credit offered to formal and informal firms (financial development), and (c) the accompanying changes in wage rates and in the wage earnings (given by both the wage rates and differences in labor productivity) of different types of households has complex and substantial influences on the (functional) distribution of wage incomes. The changes in wage rates are shown in Table 44, for the simple Kuznetsian exercise, and in Table 48, for the augmented exercise, which adds financial development to human capital formation.
In the case of both exercises (representative of different patterns of development), the inequality of the distribution of wage incomes initially rises, as the labor force shifts from the low-skilled to the high-skilled status. In this first stage (of deterioration of the distribution), the share in total income received by the high-skilled households increases, and, in particular, this share in income increases more rapidly than the share of high-skilled households in the labor force. As a consequence, in the beginning, the growing number of high-skill households enjoys more than proportional increases in their share of total income and the distribution of total income worsens.

In effect, in the simple Kuznetsian case of the first exercise, when the proportion of high-skilled households increases 10 percentage points (from $N=0.14$ to $N=0.24$), their share in total wage income increases 15.3 percentage points (from 29.1 percent to 44.4 percent, per Table 44). In turn, in the augmented case of the second exercise, when the proportion of high-skilled households increases 10 percentage points (from $N=0.14$ to $N=0.24$), their share in total wage income increases 14.5 percentage points (from 29.1 percent to 43.6 percent, per Table 48). That the latter increase is smaller than in the simple Kuznetsian case has important implications, to be derived below.

In both cases, therefore, at first the share in wage incomes of the high-skilled households increases more rapidly than their numbers. This is, among other things, a consequence of their higher labor productivity (because they contribute more units of effective labor than the low-skilled households that they are replacing in the population) and of the re-composition of the credit portfolios of the banks, towards the formal sector, where risks and costs are lower.
Eventually, however, in a second stage (of improvement of the distribution), the share of total income earned by the high-skilled workers grows less rapidly than the proportion that they represent among the population of households. At this stage, high-skilled households are becoming increasingly abundant, while the supply of low-skilled labor is declining. When this happens, the distribution of wage incomes begins to improve.
Thus, an inverted U-shaped relationship between the structural transformation of the labor force (both a cause and a consequence of the process of economic development) and the inequality of wage income is present in both exercises and the model reproduces the Kuznetsian hypothesis (Figure 32).

A key result of this dissertation is, nevertheless, that, when the structural shift in the labor force is augmented by financial development—as in the second exercise—not only is the Kuznetsian story revalidated (in this case, when using parameter values relevant for Pakistan), but that the extent of income inequality is lower—at every stage of the process of human capital formation—when the financial regime is improved. Moreover, the peak values of the Gini coefficient (highest levels of inequality) are much lower than the peak values in the simple Kuznetsian case (Figure 32).

In effect, the reductions of the three types of frictions in financial markets (financial repression, unmitigated risk of default, and transaction costs), which are brought about by direct and indirect interventions in financial markets and which occur in parallel and at each stage of the structural shift of the labor force, not only increase the wage incomes of both types of households they also reduce the relative differences in wage incomes among the population.

This result has very important policy implications. In pursuit of these dual public policy objectives, the combination of two instruments (policies that promote human capital formation and policies that promote financial development) makes it possible to achieve both higher household incomes (that is, greater efficiency) and a less unequal distribution of those incomes (that is, greater equity).
Each one of these two sets of policy instruments, by itself, would likely not be sufficient to reach the combined achievement of both objectives (efficiency and equity) as rapidly and as effectively. This is apparent when the results of the simple Kuznetsian exercise (with human capital formation but without financial development) are contrasted with those emerging from the augmented version of the hypothesis.

While the reverse exercise is not explored here, it is also likely that financial development by itself, without human capital formation, would not as effectively achieve the same dual results. If, in addition, financial development matters for the accumulation of human capital, improvements in the financial regime would allow an economy to reach the “virtuous” stage of growth with an improving distribution more rapidly. Financial development and human capital formation are, thus, complementary.

Moreover, Figure 32 also shows that the aggregate impact of financial development, represented by the differences between the two series of Gini coefficients, grows with the reductions in the frictions in financial markets, along with the structural transformation of labor force.

A combination of the two strategies also has important consequences for the productivity of the country’s resource endowment. Aggregate output (GDP) increases more in the second exercise, for the augmented Kuznetsian case, where the structural transformation of the labor force is accompanied by financial development, than in the first case, of the original Kuznetsian analysis. In effect, a GDP in the second exercise of 0.37 (Table 49) is 5 percent higher than GDP in the first one, not an insignificant difference (Table 45).
The reduction in all three types of financial frictions makes it possible for the volumes of credit to be higher, in the second exercise than in the first one (Table 43 and Table 47). This is reflected, as well, in all indicators of financial deepening, as the credit to the GDP, deposits to the GDP, and reserves to the GDP all show noteworthy improvements in the overall environment for the operation of financial markets, especially in the second exercise (Table 45 and Table 49).

The credit to the GDP ratio increases from 17 percent, at an early stage of development, to 21 percent, at an advanced stage, while the deposits to the GDP ratio increases from 18 percent to 22 percent, over the same process, in the simple Kuznetsian case (Table 45). In turn, the credit to the GDP ratio increases from 17 percent, in the early stage, to 24 percent, at advanced stage, while the deposits to GDP ratio increases from 18 percent to 25 percent, in the second exercise (Table 49).

The accumulation of deposits presents a similar picture, where it steadily increases, in both cases (Table 43 and Table 47). One of the reasons for the increase in the volume of deposits is the increasing relative abundance of high-skilled households, who are the primary savers in the economy. However, the rise in aggregate deposits decelerates more quickly in the first exercise (simple Kuznetsian case), as the structural transformation proceeds, because the wage rates decline in this case, but they do not drop in the second case. The accumulation of deposits in the second case, where financial development accompanies human capital development, is larger, at every stage of the structural transformation, because there is less wastage of resources due to a reduction in the frictions in financial markets.
As shown in Figure 33, not only is the amount of aggregate deposits larger in the second case, but its rate of growth declines more slowly.

Moreover, in contrast to the results of the previous chapter, the inequality of wealth is lower at each level of the structural shift of the labor force, in the second case of the augmented Kuznetsian analysis than in the first case of original Kuznetsian analysis (Table 50, Table 46 and Figure 34).
In this model, with parameter values relevant for Pakistan, although households are still risk averse, yet they have a higher elasticity of inter-temporal substitution, as the coefficient of relative risk aversion is less than unity ($\gamma < 1$). Also, households are more patient, because they show a higher discount factor. In general, these attributes suggest that households would save more for the future.
The accumulation of wealth in the economy depends upon the number of high-skilled households and, as their number increases—due to the structural shift in the labor force—their share in total wealth increases. This share increases less rapidly, however, than the share of high-skilled households in the labor force, and the distribution of wealth improves. Moreover, the rise in the share in total deposits of the high-skilled households is slower in the second exercise than in the first one, because the target ratio of deposits to wage incomes of the low-skilled households does not decline much in the second exercise (Table 50).

The wages of the low-skilled households, in contrast to the first exercise, actually increase in the second case (Table 51 and Table 52). With more income available to save, the total deposits held by the low-skilled households increase. Therefore, the inequality of wealth is lower in the second case and a gap between the two Gini series for wealth emerges (Figure 34).

The results of this dissertation suggest that, in a case such as Pakistan, the improvements in the environment for the operations of financial markets matter more than direct policy interventions in these markets, in bringing down inequality. There is a need to improve the infrastructure (both financial and physical), provide safety nets to the firms and households, improve dispute settlements and foreclosure laws, and reduce the regulatory costs for the operations of the banks, among other interventions more likely to lead to growth without inequality.
Chapter 7: Conclusion

In this dissertation, I explore a few aspects of the chain of impacts of financial policies on several dimensions of a developing economy. I particularly focus on the distributive (rather than the growth or stability) consequences of financial deepening. I adopt the perspective that financial intermediation, carried out by banks between depositors and borrowers, is the basic framework through which financial policies, directly or indirectly, exert their influence on the economy’s rate of growth and level of output and on the distributions of income and wealth.

To understand the complex relationships between financial policies and income and wealth inequality and to identify some of the direct and indirect channels of their influence, in this dissertation I develop a dynamic, stochastic, general equilibrium model with financial intermediation. In the model: (a) households are heterogeneous in terms of their skills (that is, their endowments of human capital) and are vulnerable to random labor productivity shocks, (b) firms are different in terms of their production technologies (they either work in the informal or the formal sector) and are subject to random shocks to their production levels, and (c) banks operate in an environment beset with market frictions due to repressive financial policies, market imperfections, and incomplete institutions.
The basic instruments to hold wealth in the model are bank deposits, where the savings of the households are kept to be used in the next period. Household holdings of deposits, influenced by wage earnings and interest rates, are also motivated by patience, risk aversion, and consumption smoothing concerns — associated with the individual household’s labor productivity state and the likelihood of shocks to this state and of production shocks to the firms.

Firms in the informal sector employ only low-skilled labor and firms in the formal sector employ only high-skilled labor. They demand credit to purchase non-labor inputs for production and to pay wages to their workers. The banks mobilize deposits from households, evaluate credit risk, and convert the command over resources entrusted to them into loans for the firms.

Influenced by policy-induced frictions (such as a required reserve ratio on deposits) as well as incomplete institutions and market imperfections (which result in different expected default rates, in each of the two production sectors, and in different costs associated with lending to firms in each sector), a bank’s decision (given the firms’ demand for loans) about which firms should receive how much credit is crucial in the determination of the interest rates, levels of production, and wage rates in each sector.

As wage and interest rates respond to the magnitude of these frictions in financial markets (which are, in turn, subject to influence by policies), the households adjust their consumption and savings behavior. These changes, at the individual and the aggregate levels, contribute in generating a measurable impact on the accumulation of wealth and on the dispersion of wage incomes and wealth across households.

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To highlight the differences in the outcomes generated by the model, I first obtain a numerical solution—for the steady-state equilibrium—for two extreme scenarios. Scenario 1 represents an economy at an early stage of development with acute financial repression, high degrees of institutional incompleteness and market imperfections, and few high-skilled workers. In contrast, scenario 2 represents an economy at an advanced stage of development, characterized by a high degree of financial liberalization (supported by strong institutions), a large stock of human capital (that is, a large number of high-skilled households), and low levels of frictions in financial markets.

Then, I separately implement simulations to identify and compare the impacts of two types of policies: (a) direct interventions in financial markets (e.g., manipulations of the required reserve ratio) and (b) indirect interventions that improve the environment for the operation of these markets (e.g., actions that reduce expected default rates and the costs of lending). The sensitivity of the results is gauged by performing these simulations at initial \((N = 0.10)\), intermediate \((N = 0.50)\), and advanced \((N = 0.70)\) levels of human capital formation.

I study the evolution of the inequality of the distributions of income and wealth, along the path of economic development, next. The simple relationship between human capital formation and inequality is examined first, and then the original Kuznetsian story is “augmented” by simultaneously considering human capital formation and financial development. The expectation is that the combined (policy-induced) effort would further reduce inequality.
To strengthen the argument and to highlight the importance of financial development, in the end, I carry out, again, the augmented Kuznetsian analysis by calibrating the model with data from a developing country, Pakistan.

First, the simulation results, in the case of the two alternative and extreme scenarios, show considerable impacts of policies that promote human capital formation and improvements in the financial regime. In particular, as the magnitude of the three types of frictions in financial markets declines, the wedge between the interest rate paid on deposits and the interest rate charged on loans (used as a proxy for financial development) is smaller in scenario 2. In response, the size of the financial sector becomes substantially (three times) larger in scenario 2 than in scenario 1. Because the size of the financial sector grows more rapidly than the GDP, all indicators of financial deepening—given as ratios of finance to the GDP—improve.

In turn, the shift in the labor force from low-skilled to high-skilled households also contributes to financial deepening. Because the high-skilled households have a greater ability—due to their higher wage earnings—and a greater willingness—due to their fear of an adverse labor productivity shock—to save, the supply of deposits to the banks increases. This is accentuated when wage rates increase, in part as a consequence of financial deepening. At the same time, the accumulation of human capital, as the proportion of high-skilled households in the population increases, augments the endowment of effective labor units in the economy, and this labor augmentation shifts the demand for credit outwards, thereby leading not only to higher deposits to the GDP but also higher credit to the GDP ratios.
With frictions at their minimum levels, in response to these growing demands for credit, the banks are able to provide larger amounts of loans, at more attractive interest rates, in scenario 2. This increases the amount of credit per unit of effective labor across both types of firms. There is, thereby, an increase in production, and workers receive better wages. Thus, independently of any distributional impacts, standards of living improve for the population at large. Moreover, the combined process of financial deepening and human capital accumulation leads to a less unequal distribution of household wage incomes although, as hypothesized by the Kuznetsian story, this may not be true at intermediate steps in the transition, not considered in these extreme scenarios.

In turn, the inequality of the distribution of wealth is high, in scenario 1, and low, in scenario 2. This is because, in scenario 1, high-skilled households are fewer in numbers and have a higher target level of deposits (given the fear of an adverse labor productivity shock) than low-skilled households. A stock of deposits mostly concentrated in a few hands results in a high value of the Gini coefficient. In contrast, in scenario 2, the risk of ending up in the bad state (low-skill level) is minimal and there are large numbers of high-skilled households. So, not only are wealth levels much higher in scenario 2 but, due to the abundance of strong depositors (high-skilled households), the Gini coefficient for the distribution of wealth is lower.

Second, the results of the policy simulations highlight important differences between government strategies focused on direct interventions in financial markets versus indirect interventions that, such as better infrastructure and institutions, improve the environment for the operation of financial markets.
The simulations that explore the influence of direct policy interventions, namely cutbacks in the required reserve ratio, show a reduction in the wedge between loan and deposit interest rates. Moreover, the cutbacks make extra resources available (volume effect) for the banks to lend (because less resources are kept as idle reserves), besides lowering their marginal costs of lending (price effect).

There is an outward shift in the supply function of deposits, in response to the higher wage incomes of the high-skilled households, and the interest rate paid on deposits falls slightly. The supply of loans by the banks, to both types of firms, rises and the interest rate charged on these loans declines even faster. Thus, the difference between the lending and deposit interest rates declines, despite the reduction of the interest rate paid on deposits.

Even though reductions of the required reserve ratio are an apparently neutral intervention, the decline of the interest rate charged on loans to the informal sector is more pronounced than the decline of the interest rate charged on loans to the formal sector, due to the differences in the marginal cost of lending functions. As the size of the credit portfolio increases, marginal costs of lending increase more rapidly in the informal than in the formal sector.

In turn, as the required reserve ratio is reduced, the wage rates and wage earnings of all households increase, due to an increase in the amount of credit per unit of effective labor across firms. However, the wages of high-skilled households increase more rapidly than the wages of low-skilled households. This leads to a minor deterioration in the distribution of wage incomes.
Similarly, the deposit holdings of high-skilled households increase faster than the deposit holdings of low-skilled households, which results in an increase in the inequality of the distribution of wealth. This is due to the faster increase in the wages of the high-skilled households and their greater propensity to accumulate precautionary reserves. This impact on the distribution gradually subsides, though, as the economy moves from an initial to an advanced level of human capital formation. In any case, however, the impact of this direct policy intervention (a reduction in the required reserve ratio) on the levels of output and financial deepening is not only positive but also strong, at all stages of human capital formation.

Thus, a direct policy intervention—proxied by changes in the required reserve ratio (and other similar tools)—leads to a trade-off between improving the distributions of income and wealth and, at the same time, deteriorating output levels and financial deepening, when the reserve requirement is raised. Using this kind of policy tool, the authorities may bring about small improvements in the distribution of income, but at a huge loss in output and financial deepening. Therefore, the required reserve ratio is not recommended for achieving the goal of lowering the inequality in the distributions of income and wealth.

Third, the simulations that explore the influence of a first type of pro-informal, pro-poor biased indirect interventions in the environment for the operation of financial markets, which lower the default rate of firms in the informal sector, lead to a reduction in the interest rate charged on loans and a larger volume of credit to the firms in the informal sector.
In turn, the volume of loans to the formal sector firms declines, while the interest rate charged on these loans rises. The interest rate paid on deposits also rises, because the banks become more profitable, due to a decline in the marginal cost of lending to the informal sector, and they transfer some of these gains to the depositors.

Despite the opposite effects on loan interest rates and credit volumes, the overall fragmentation of financial markets declines, in two ways. First, the difference between the interest rates charged by the banks to the formal and informal sector firms declines. Second, the difference between the interest rate paid on deposits and the average interest rate earned by the banks on loans declines. So, although the intervention is pro-informal sector biased, the overall efficiency of the financial sector improves.

Moreover, the level of output declines in the formal sector and rises in the informal sector, as a consequence of the changes in the relative availability of credit. This leads to a decline in the wage rates and wage earnings of the high-skilled households and a rise in the wage rates and wage earnings of the low-skilled households. As a result, the inequality of the distribution of wage incomes declines, in contrast to what was found in the case of a direct intervention in financial markets. The impact is, however, stronger at initial levels of human capital formation than at advanced levels.

The overall level of deposits increases at initial levels of human capital formation but declines at higher levels. This is a consequence of the differential impact of this indirect intervention on the wage rates earned by the two types of households and their differential reactions to changes in wages and in the interest rate paid on deposits.
Low-skilled households save more in deposits than before, when the environment for the operation of financial markets improves, due to the increase in their wages and more attractive (higher) interest rate paid on deposits. High-skilled households, on the contrary, save less, due to the decline in their wages and because their target level of the deposit-to-wage income ratio also declines. Moreover, a higher interest rate earned on deposits means that they can achieve the lower level of target deposits with fewer savings. At higher levels of human capital formation, the high-skilled households save even less, because the probability of suffering a bad shock declines. As a result, the difference in wealth levels of the two types of households declines and the inequality in the distribution of wealth declines as well. At advanced stages of development, however, further reductions in the default rate of the informal sector firms have limited effects in reducing inequality.

Following the similar non-linear pattern of deposits, the level of the GDP and the indicators of financial deepening also rise at initial levels of human capital formation, but they decline somewhat at advanced stages.

Thus, compared to direct policy interventions, these pro-informal, pro-poor biased indirect policy interventions have a positive and relatively stronger impact in reducing the inequality of the distributions of income and wealth, especially at the early stages of development. At more advanced stages of development, however, there may be a trade-off between using these tools for improving these distributions, at the cost of some reduction in the levels of output and the rate of accumulation of wealth.
Therefore, sector-specific indirect policy interventions to improve the environment for the operation of informal credit markets are a better tool to improve the distributions of income and wealth, without a loss of output, when the economy is at an early stage of economic progress and when financial market frictions are particularly acute in the informal sector.

Fourth, the simulations that explore the influence of a second type of (pro-informal, pro-poor biased) indirect interventions in the environment for the operation of financial markets, performed by decreasing the costs of lending to the informal sector, have similar implications. They also reduce the interest rate charged on loans and increase the volume of credit to the informal sector firms, increase the interest rate charged on loans and reduce the volume of credit to the formal sector firms, and increase the interest rate paid on deposits.

As was the case in the simulation with changes in the default rate, the overall fragmentation of the economy declines. The differences between the loan interest rates for the formal and informal sector firms as well as the differences between the deposit interest rate and the average interest rate charged on loans decline.

Due to the evolution of credit volumes in the two sectors, their output and, hence, wages for the low-skilled and high-skilled households move in opposing directions. Wages of the low-skilled households rise while wages of the high-skilled households fall. Thus, the inequality of the distribution of wage incomes declines in all simulations. Given the parameter values used, these reductions are not as large as they were in the case of the simulations with the default rate.
In this case, however, neither aggregate deposits nor output (GDP) decline in any of the simulations, at any stage of human capital formation. This is because the reduction in costs changes both the intercept and the slope of the marginal cost curve and the simulation results in small changes in the supply of credit to the two types of firms. However, GDP grows faster at initial levels of economic development and the pace declines at intermediate and advanced levels of development. The indicators of financial deepening follow a similar pattern.

The inequality of the distribution of wealth (Gini coefficient) declines at initial stages, remains almost unaltered at intermediate stages, and increases at advanced stages of human capital formation. These movements are attributable to the extent and direction of changes in the households’ wage incomes and the deposit-to-income ratios desired by the two types of households at different stages of the structural transformation.

Hence, the pro-informal, pro-poor biased indirect policy interventions that reduce the costs of lending to the informal sector are a better tool to improve the distribution of income as well as an increase in aggregate output, when the economy is at an early stage of economic development. However, the impact of this cost-reducing indirect policy intervention, on the inequality of the distribution of wealth, is mixed. Nevertheless, at an early stage of development, the inequality of the distribution of wealth also declines with an indirect intervention of this type.

Fifth, a Kuznetsian type inverted U-shaped relationship between the inequality of the distribution of wage incomes and the transformation of the labor force from low-skilled to high-skilled households emerges in the analysis.
This result is mainly due to changes in the shares in total income of the low-skilled and high-skilled households—brought about by changes in the composition of the labor force and by changes in the composition of bank credit portfolios, by sector of production—in comparison to changes in their respective shares in the labor force.

There are, however, important differences between the results for the original Kuznetsian relationship and the results for the analysis augmented—by including financial development—along with a process of human capital formation.

First, the evolution of all interest rates in the original Kuznetsian analysis follows a non-linear (approaching something of a U-shaped) path which, in the augmented Kuznetsian case, is followed only by the interest rate paid on deposits. Interest rates first decline and then rise, as just the structural shift in the labor force takes place. These changes are mainly due to evolving circumstances for both the supply of deposits (as the number of depositors increase and their target ratios of deposit-to-income change) and the demand for credit changes (as the proportion of low-skilled households declines and the proportion of high-skilled households rises).

Second, the level of the interest rate paid on deposits is higher and the interest rate charged on loans is lower, especially at advanced stages of development, when the structural transformation is accompanied by a reduction in financial frictions.

Third, the combined effect of the structural transformation of the labor force and financial liberalization leads to a monotonic and a more substantial reduction in the wedge between the interest rate charged on loans and the interest rate paid on deposits than when financial development is absent.

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Fourth, the volume of deposits, when financial development accompanies human capital formation, is much larger, at every stage of the structural transformation, because fewer resources are wasted, either as idle reserves or in transaction costs, due to a reduction of the frictions in financial markets.

Fifth, because of a steady rise in the amounts of loans and high-skilled labor provided, particularly to the formal sector firms, aggregate output increases. This increase in GDP is more significant in the augmented Kuznetsian scenario.

Sixth, the indicators of financial deepening improve at a quicker pace in the case when direct and indirect policies, besides human capital accumulation, reduce the extent of financial repression and financial shallowing in the economy.

Seventh, when financial development is combined with human capital formation, the rate of growth of household wage rates declines as the transformation takes place. In contrast, in the original Kuznetsian analysis, wage rates initially increase but then fall, as the labor force shifts according to skills.

Eighth, the inequality of the distribution of wage incomes is lower at every stage of human capital formation when it is accompanied by financial development than in the corresponding case with no financial development.

Ninth, the peak values of income inequality are much lower in the augmented Kuznetsian case than the peak values in the original Kuznetsian case. Also, the economy reaches these peak values at an earlier stage in the development process and the distribution of income improves thereafter.
These differences in the inequality of income between the two scenarios emerge because the reduction in the three types of frictions in financial markets, at each stage of the structural shift in the labor force, reduce the relative differences in wage incomes. Further, the differences between the two scenarios grow as additional financial development, along with the structural transformation of the labor force, takes place.

In the case of the inequality of wealth, however, the Gini coefficient for the distribution of wealth does not show any discernible difference between the two cases of Kuznetsian analyses. This Gini coefficient steadily declines in both cases. This is because the accumulation of wealth in the economy mainly depends upon the number of high-skilled households in the population. So, wealth accumulates (albeit, at a declining rate) as a result of the structural shift in the labor force, while the share of wealth held by high-skilled households increases less rapidly than their share in the population of households and the distribution of wealth improves.

Finally, when the model is taken to the data for a developing country, Pakistan, it portrays a low level of inequality in the functional distribution of income but a high level of inequality in the distribution of wealth. These results are similar to the results for the scenario 1 discussed in the comparison between the two extreme cases undertaken early in the analysis.

The inequality in the distribution of wealth, however, declines and it declines faster when financial development accompanies the transformation of the labor force. Moreover, most of the results obtained for the augmented Kuznetsian case are also confirmed by the results obtained for Pakistan.
This summary of the results obtained in the policy simulations suggests that the answer to the question I raised in the first sentence of this dissertation, about whether financial policies can influence the inequality of the distributions of income and wealth, is not straightforward. In some instances, financial policies might reduce inequality and in others they might worsen it.

The impact of financial development on inequality thus depends upon the initial conditions, reflecting the structure of labor markets and the riskiness of different sectors of economic activity, the choice of the (direct and indirect) policy instruments used, the magnitude of the changes in the policy parameters, the nature of the production technologies, the extent of human capital formation, and the determinants of the behavior of all agents (firms, banks, and households). Moreover, policies can affect inequality differently, depending on the extent of existing frictions in the financial sector, another important initial condition.

The inequality of the distributions of income and wealth predominantly emerges from non-financial circumstances, in particular from those differences in wage incomes associated with differences in household skill endowments and in labor productivity. In the process of development, financial deepening may have important consequences on the (differential) accumulation of human capital, but this link between finance and inequality is taken as exogenous in the analysis of this dissertation. Given heterogeneous endowments of skills, however, financial development influences the extent to which those skills are employed in the production process, through the differential access to credit governed by the extent of frictions in financial markets.
When frictions in financial markets disproportionately constrain the supply of credit to firms in the informal sector, where the low-skilled labor supply of poor households is employed, they substantially contribute to inequality in the distributions of income and wealth. Policies that promote financial development, particularly if they are informal sector biased, tend to correct for this asymmetry and improve the distribution of income. In this task, informal interventions that improve the environment for the operation of financial markets seem to achieve this objective at none or lower opportunity costs in terms of output growth than direct interferences with market outcomes.

On the one hand, the results also suggest that the non-linear relationship between human capital formation and the inequality of the distribution of income, by itself and when supplemented by financial development, is robust. When accompanied by financial development, however, improvements in the distribution occur earlier and are larger.

On the other hand, the results emphasize the importance of pursuing policies that bring improvements in the operation of financial markets in developing countries like Pakistan. Specifically, the combination of two instruments (policies that promote human capital formation and policies that promote financial development) may make it possible to achieve higher incomes with a less unequal distribution of those incomes, particularly in the early stages of development.

Such a combination of the two sets of policy instruments would make it possible to achieve two—at times conflicting—goals of public policy: greater efficiency, as reflected in higher levels of output, and greater equity, as reflected in more egalitarian distributions of income and wealth.
The scope of the model developed in this dissertation could be broadened in several directions. First, the labor supply decision of the households has been treated as exogenous. An extension of the model could make the household labor supply a choice variable, responsive to changes in wage rates and to different regimes for the labor productivity shocks. Similarly, unemployment could be introduced in the model. To introduce unemployment exogenously, the labor productivity states may be increased from two to three or even more. Also, as individual productivity states increase, so can the heterogeneity of the production sector. In fact, in a full blown model, there could be as many production sectors and individual labor productivity states as in the labor force surveys.

Second, households have been assumed to hold wealth only as bank deposits. An extension of the model could make the supply of household deposits dependent on portfolio choices, between holding precautionary reserves in financial or non-financial assets. Different combinations of risks and returns may be associated with these portfolio choices. Also, it has been assumed that households do not have access to credit. Creating the possibility of borrowing to smooth consumption would change the household supply of deposits and offer the opportunity to analyze another influence of financial development on the relevant variables. Similar consequences may be associated with the introduction of insurance in the model. Still another extension would link access to finance to household decisions about human capital formation.

Third, an extension of the model can consider differences in the production functions for different types of firms and the impact of finance on technology adoption.
Fourth, the assumption of a competitive equilibrium has not allowed the exploration of two additional issues. One is the impact of bank market power on the frictions present in financial markets and the role of policies in promoting competition. The other one is the possibility of non-interest credit rationing. Improvements in the environment for the operation of financial markets should reduce the extent of credit rationing and strengthen the results obtained in this dissertation. A potential extension is to explicitly model asymmetric information, incentive incompatibilities, and shortcomings of contract enforcement and explore the role of policies in reducing the resulting frictions.

Fifth, the assumption of a single banking sector can be relaxed so as to have two or more types of banks. Different types of financial intermediaries would be associated with different lending technologies, based on different abilities to evaluate risks of default and different cost of lending functions. For example, one may distinguish between microfinance banks, which cater to the low-skilled households and informal sector firms, and commercial banks, which cater to the high-skilled households and formal sector firms. Different types of policy interventions in financial markets would then have different consequences on the level of output and the distributions of income and wealth. These and other issues would be taken up in future research.
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Appendix A: Additional Algorithms

A.1.1 Newton Root Finding Algorithm 1

In order to compute the aggregate level of loans, $L_0$ and $L_1$, to the informal and formal sector firms, respectively, equations (27) and (28) can be used. Since, the two equations are very similar, except for the parameters, I present below the Newton Algorithm that can be applied to both the equations. This algorithm has been coded in MATLAB.

1. Given the initial value of interest rate on deposits $r_D$, initialize the loan amount to be computed say, $L$. This amount would then equal $L_0$ if computing loans to the informal sector firm and $L_1$ if computing the loans to the formal sector firm, respectively.

2. Restate equation (27) or (28) as a root finding problem in $L$ as:

$$M = \alpha L^{\alpha-1}H^{1-\alpha} - \frac{1}{(1-p)}\left[\alpha + 2bL + \frac{(1 + r_D)}{(1 - \eta)}\right]$$

(1)

Given the initial value of $L$, compute the residual value, $M$.

3. Compute the derivative of the above equation (1) with respect to $L$ as

$$G = \frac{\partial M}{\partial L} = \alpha(\alpha - 1)L^{\alpha-2}H^{1-\alpha} - \frac{2b}{(1-p)}$$

(2)

and compute the value $G$. 

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(4) Compute the Newton step, \( b = -\frac{M}{G} \).

(5) Re-compute the value of \( L \) by applying the Newton step, \( L = L + b \).

(6) If change in Newton step, \( b \), is small then stop. Otherwise go to step-2.

A.1.2 Newton Root Finding Algorithm 1(a)

The Newton root finding algorithm A.1.1 can be slightly modified to compute the interest rate on deposits \( r_D \) given the value of loans \( L_0 \) or \( L_1 \). The modified algorithm is as follows:

(1) Given the initial value of loan amount \( L \), initialize the interest rate on deposits \( r_D \).

(2) Restate equation (27) or (28) as a root finding problem in \( r_D \) as:

\[
M = \alpha L^{a-1}H^{1-a} - \frac{1}{(1-p)} \left[ a + 2bL + \frac{(1 + r_D)}{(1 - \eta)} \right]
\]  

(1)

Given the initial value of \( r_D \), compute the residual value \( M \).

(3) Compute the derivative of the above equation (1) with respect to \( r_D \) as

\[
G = \frac{\partial M}{\partial r_D} = -\frac{1}{(1-p)(1-\eta)}
\]  

and compute the value \( G \).

(4) Compute the Newton step, \( b = -\frac{M}{G} \).

(5) Re-compute the value of \( r_D \) by applying the Newton step, \( r_D = r_D + b \).

(6) If change in Newton step, \( b \), is small then stop. Otherwise go to step-2.
A.2 Algorithm to Compute the Gini Coefficient

To measure the Gini coefficient, first the area, $B$, under the “Lorenz Curve” is approximated, then the area, $A$, between the line of equality ($45^\circ$ line) and Lorenz Curve is computed and in the end Gini coefficient is computed as $G = 2A$, where $A = 0.5 - B$ and $B = \int_0^1 L(t) dt$. The following algorithm, adopted from (Khan, Quantitative Methods for Dynamic Models in Aggregative Economies 2011), uses the two distributions of wealth (deposits) $F_0(d)$ and $F_1(d)$ to compute the Lorenz curve and Gini coefficient:

1. Compute the measure (probability) of households, using the two distribution functions $F_i(d)$, between each of the two adjacent nodes in the discretized state space. Then, compute the sum of fraction of low and high skilled households for each level of deposits:

$$
\mu = \begin{cases} 
\sum_i F_i(dd_k), & k = 1 \\
\sum_i (F_i(dd_k) - F_i(dd_{k-1})), & k = 2, \ldots, m
\end{cases}
$$

Where $m$ is the total number of grid points used to approximate the distributions of wealth.

2. Compute the corresponding midpoint of wealth, between each of the two adjacent nodes, for the entire state space of deposits:

$$
dd = \begin{cases} 
d_k, & k = 1 \\
\frac{d_k + d_{k-1}}{2}, & k = 2, \ldots, m
\end{cases}
$$

3. Compute the wealth held by all households:
4. Compute the wealth held by group/proportion of households:

\[ b1 = \text{cumsum}(a1) \]  
\[ b1 = b1/b1(\text{end}) \]  

Where “\text{cumsum}” is a MATLAB routine to compute cumulative sums.

5. Compute the cumulative proportion of households:

\[ c1 = \text{cumsum}(\mu) \]  

6. Lorenz curve is then \((c1, b1)\), where \(x\)-axis represents the cumulative proportion of households and \(y\)-axis represents cumulative fraction of wealth.

7. Compute the area, \(B\), under the Lorenz curve using the following numerical integral steps:

\[ dc = c1(2: \text{end} - 1) - c1(1: \text{end} - 1) \]  
\[ db = (b1(1: \text{end} - 1) + b1(2: \text{end})) / 2 \]  
\[ B = \text{sum}(dc.*db) \]  

8. Compute the Gini as, \(Gini = 2 * A\), where \(A = 0.5 - B\).
Appendix B: Additional Results

In chapter 5, the stationary distribution of assets is approximated by using the cumulative distribution function. Another method to compute the steady-state distribution of assets is using the probability density function. In this appendix, some selected results for scenario 1 of section 5.1 are reported in which the distribution of assets is computed using the probability density function. The results using both methodologies are similar.

Figure 35: Convergence of Aggregate Deposits using Probability Density Function. Scenario 1
Figure 36: Lorenz Curve for the Distribution of Wealth using Probability Density Function. Scenario 1

<table>
<thead>
<tr>
<th>Description</th>
<th>CDF</th>
<th>PDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gini-I</td>
<td>17.90</td>
<td>17.90</td>
</tr>
<tr>
<td>Gini-W</td>
<td>73.84</td>
<td>74.45</td>
</tr>
</tbody>
</table>

Table 53: Comparative Results of Inequality of Income and Wealth using Cumulative Distribution Function (CDF) or Probability Density Function (PDF) for Scenario 1