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Welfare Gains from Financial Liberalization

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ABSTRACT

Financial liberalization has been a controversial issue, as empirical evidence for growth enhancing effects is mixed. Here, we find sizable welfare gains from liberalization (cost to repression), though the gain in economic growth is ambiguous. We take the view that financial liberalization is a government policy that alters the path of financial deepening, while financial deepening is endogenously chosen by agents given a policy and occurs in transition towards a distant steady state. This history-dependent view necessitates the use of simulation analysis based on a growth model. Our application is a specific episode: Thailand from 1976 to 1996.

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I. INTRODUCTION

Whether or not a developing country should liberalize its financial sector has been a controversial issue, and the current financial crisis appears to be refueling the debate.[2] One of the reasons is that there is mixed empirical support for positive effects of a financial liberalization on growth in savings, investment, or GDP. For example, Bandiera, et al. (2000) show, in a sample of eight developing countries, that financial liberalization is not associated with an increase in savings. Jayaratne and Strahan (1996) find that deregulation of intrastate bank branches in the United States raised the state-level GDP growth but did not increase bank lending. Based on cross-country panel data, Galindo, Micco, and Ordoñez (2002) find an industry-level growth enhancing effect, but Abiad and Mody (2004) report mixed evidence on both aggregate and industry-level growth effects from financial liberalization.

However, theories do not always predict positive growth effects of financial liberalization, even if the same theories predict Pareto improvement in household welfare. As such, it seems unwise to evaluate the success of a financial liberalization based on its effect on growth in savings, investment, and GDP. In McKinnon (1973) and Shaw (1973), the removal of the interest-rate ceiling was imagined to generate a higher interest rate, leading to higher savings and investment. But theoretically, the relative size of income and substitution effects from higher interest rates is ambiguous. Likewise, better insurance against future risks could bring higher growth, as this enables entrepreneurs to seek higher-risk, higher-return projects (Obstfeld 1994). However, better insurance arrangements may decrease the need for precautionary savings (Devereux and Smith 1994) and result in lower rates of investment and GDP growth. Theory may suggest unambiguous effects on other dimensions, for example, an increase in efficiency in allocating capital, which some papers support.[3] However, without a utility or overall objective function, it would be difficult to judge if these efficiency gains are large, small, or worth the political costs.

We propose to evaluate the success of a financial liberalization based on the associated welfare gains, which we compute using both theory and data. Indeed, the main contribution of this paper is to develop a welfare analysis of changes in the financial sector policy, accounting for dynamic general equilibrium effects associated with financial deepening and economic growth. For this purpose, the effects of financial liberalization need to be studied through the lens of an explicit model of financial deepening.

Although the distinction between financial liberalization and financial deepening is not often made in the literature, we think it is critical to do so.[4] Financial liberalization and repression refer to changes

[2]We focus on the liberalization of domestic financial activities, not capital account liberalization which allows international financial transactions. Note that, depending on the authors, financial liberalization refers to either or both liberalizations. We define it here as a reduction in the barriers preventing free domestic financial activities, as opposed to financial repression.

[3]Abiad, Oomes, and Ueda (2008) show in their panel regression analysis that efficiency in allocating capital increased with financial liberalization in five developing countries. Acharya, Imbs, and Sturgess (2006), using the U.S. bank branch deregulation episode, also show that the industry structure of each state moved towards the mean-variance efficiency frontier after the deregulation.

[4]There is broader literature in finance and growth. The main focus in this literature is the effect of financial deepening, which is typically measured by M2, private credit, and market capitalization, without explicitly considering financial liberalization. For example, King and Levine (1993) and Levine, Loayza, and Beck (2000) show in their regression

in government policies regarding the financial sector, something largely exogenous to economic agents, whereas financial deepening, measured for example by the ratio of private credit to GDP, market capitalization to GDP, or the percentage of households and firms using financial services, is the result of changes over time associated with endogenous choice by economic agents, given a government policy.[5] We include both aspects here.

We measure the welfare gains from a financial liberalization through its impact on financial deepening. A complex interaction emerges between financial sector policy and financial deepening in an otherwise simple growth model. Indeed, based on a model without any government intervention, Townsend and Ueda (2006) show that regressions may not reveal a true causal link between financial deepening and its effect. First, financial deepening is an endogenous variable. It is an aggregation of individual decisions as shown in much of the theoretical literature, for example, Greenwood and Jovanovic (1990), Greenwood and Smith (1997), and Acemoglu and Zillibotti (1997).[6] Second, in all these models, financial deepening occurs jointly with economic growth and is a transitional phenomenon, before convergence to a long-run steady state. Transitional dynamics means that the resulting macro data are neither stationary nor ergodic. This forces researchers to view the entire history as a one-sample draw. More generally, the models tell us how to think about realized data.

We use a canonical growth model, following Townsend and Ueda (2006), of an economy in transition with endogenous financial deepening, as a basis to compute welfare gains. In the model, the financial sector is endowed with two functions, risk sharing and an efficiency gain in production (via better project selection), as these are typically considered to be the key functions of banks and other financial intermediaries. The financial sector in the model requires both fixed costs for entry and variable costs for operations. These create endogenous movements into intermediation: as they save and invest successfully, households pass a key wealth threshold for participation in the financial system. Financial liberalization is layered on top of this and is defined as a reduction in a distortion, or effectively, in model terms, a decline in those fixed and variable costs.

Our motivation is similar in spirit to calculating the welfare cost of business cycle or the gains from removing the cycle (e.g., Lucas 1987). However, we tailor the financial liberalization to actual policy events on a transitional path, whereas the business cycle literature conducts a conceptual, on-off experiment in a steady state, comparing an economy with perfect smoothing of the business cycles to one without. If that were our analysis, we would answer the following question: what would happen if perfect financial arrangements were introduced suddenly? That question is extreme, if not unrealistic, as financial infrastructure is costly to build. Instead, in our model, financial activities exist both before and after the liberalization, consistent with an actual economy where a financial

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studies that financial depth is associated positively with subsequent economic growth. Beck, Levine, and Loayza (2000) find that financial deepening appears to affect growth primarily through an increase in total factor productivity.

[5]Governments have heavily intervened in the financial systems of the East Asian countries (Aoki, Kim, and Okuno-Fujiwara 1996) but those countries typically enjoy much higher levels of financial depth than Latin American countries, where the financial systems have been no less liberalized than East Asian countries (de la Torre and Schmukler 2007). Most advanced countries have by now both a fully liberalized financial system and highly matured credit and capital markets, although there are historical differences, for example, between the U.S. and continental Europe (Allen and Gale 2000).

[6]As such, financial deepening measures are ill-suited as regressors and thus instrumental variables are often used in regression studies. However, a typical instrument is a *de jure* financial liberalization measure, which should be distinguished from deepening. Another typical measure is lagged values of financial deepening, which could be valid instruments if the economy were in the steady state.

sector is present before liberalization and would hardly be perfect for everyone after liberalization. An important related aspect is that financial sector development can be occurring endogenously, whether or not the exogenous financial sector policies are implemented. Agents are forward-looking, with or without the policy changes, and they act accordingly.

We identify actual changes in financial sector policy in a calibration exercise for a key period, 1976 to 1996, in the history of Thailand, a country in a phase of rapid economic growth and financial deepening. In a closely related paper, Townsend and Ueda (2006) contribute a mainly methodological perspective: how to evaluate the fit of a growth model under transition, in particular with endogenous financial deepening, given the actual data. They show that while the model based on Greenwood and Jovanovic (1990) broadly traces the trend of actual Thai data, it has difficulty capturing a flat period followed by a dramatic upturn in growth and financial deepening, starting in mid-1980s. Apparently, there are ingredients missing from the model, and we argue here that one of them is financial sector policy.

Specifically, in this paper, we use the same preference and technology parameters as in Townsend and Ueda (2006), but introduce a government sector with costly distortions in the form of a financial sector policy. We then alter the financial sector policy. These policy changes are not *ad hoc*, but rather are taken to be consistent with the actual data and with historical regulatory material. We pick the government's share in new bank lending as a representative indicator that traces the degree of government intervention in financial activities. This measure features an acute repression that started in the early 1980s and ended with liberalization in 1987–89.

Change in financial sector policy turns out to be an important ingredient in understanding the mechanism of economic development. We incorporate policy distortions into the model and compare the simulated paths of the model under policies that alter these distortions over time. With the observed historical pattern of financial repression and liberalization, the model is capable of replicating the actual patterns of both GDP growth and financial deepening.

We then estimate welfare gains from a specific policy change, the financial liberalization episode of mid-1980s in Thailand. We simulate the model Thai economy with and without the financial liberalization and compare the results. The gain in economic growth turns out small and not robust—this is consistent with the empirical literature. However, we find sizable welfare gains. The welfare gains are different among households depending on their wealth—an interesting feature of the model. In other words, there is heterogeneity in gains.

Our estimates of the population-average welfare gain from this particular financial liberalization episode turns out to be sizable, from a 0.5 percent to a 28 percent increase in permanent consumption, though the impact on the aggregate economic growth is mixed, -0.3 to 0.7 percent in the subsequent ten-year term. Our estimates can be compared to those of an on-off experiment with the financial system in a domestic economy, quantified by a few papers in the literature so far. For example, Giné and Townsend (2004) show positive growth effects by eliminating credit constraints when individuals choose their occupations along the course of economic development and estimate welfare gains at 17 to 34 percent of income. Jeong and Townsend (2006) use a similar model to explain approximately 75 percent of the improvements in TFP. Greenwood, Sanchez, and Wang (2007) show that the world-wide improvements in project selection by banks, that is, movement towards the technological frontier, would cause about a 20 percent increase in world GDP.

Through sensitivity analysis, we also find that the welfare gains in the Thai episode are mostly from the risk-sharing function of banks rather than from the project-selection function. The large variation in our estimates of welfare gains reflects the two types of experiments regarding policy distortions, one through a one-time fixed cost to start using financial services and the other through a variable cost of financial services. Depending on the nature of distortions, growth and welfare gains can vary substantially. This is consistent with existing, mixed empirical evidence for the growth effects of financial liberalization. By looking at auxiliary variables, inequality and investment, we find that the 1987-89 Thai episode is more consistent with the variable-cost-reduction case, in which the growth effects are often positive and the welfare gains are closer to 28 percent, the upper-end of our range of estimates. Note, however, that the fixed-cost-reduction case may be a more appropriate description of episodes of other countries at a development stage similar to Thailand.

Regarding the welfare effects of risk sharing, the business cycle literature (e.g., Lucas 1987, reviewed by van Wincoop 1999 and Prasad, et al. 2003) reports welfare gains typically smaller than our findings here. Many papers in this risk sharing literature report less than a 0.5 percent increase in permanent consumption. Note again, however, that these papers examine the elimination of macro business cycles, possibly by international risk sharing.[7] Household-level income volatility is much higher than the aggregate volatility, the volatility of average income, and it is recognized even in the business cycle literature that developing countries with higher aggregate fluctuations benefit more from the smoothing GDP volatilities (Obstfeld 1995). But, to our knowledge, few calibration studies have examined the welfare gains from a domestic, within-country financial liberalization that helps to smooth household consumption against idiosyncratic income shocks.

Here, we focus on domestic financial liberalization, not capital account liberation nor trade liberalization. The latter along with monetary policy, coups (1976, 1981, 1991, and 2006), and natural disasters are viewed here through the lens of the model as shocks that, unlike domestic financial sector policy, do not affect domestic financial deepening directly, but rather indirectly as the realization of factors enhancing or retracting from growth. That is, these policy, military, or natural shocks are treated as exogenous to the model and fitted empirically. We evaluate the welfare effects of domestic financial liberalization given observed impact of these shocks. We also discuss the relationship between financial liberalization and crises occasionally throughout the paper. With a model describing how the financial sector links to economic development, we quantify the costs of institutionalized government intervention in the financial system, though we do not intend to downgrade benefits of temporary government interventions to stabilize financial system in a crisis.

The paper proceeds as follows. Section II describes Thai financial sector policy in the sample period. Section III describes the model, and Section IV explains how we conduct simulations. Section V reports results of the simulation exercise, and Section VI calculates welfare gains. Section VII conducts some sensitivity analysis, compares our results with business cycle literature, and investigates model implications in inequality and investments. Finally, Section VIII concludes.

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[7]There is a literature on the effects of capital account liberalizations looking at growth effects. There are also conflicting views. Some stress positive effects on growth rates (e.g., Bekaert, Harvey, and Lundblad 2005) and others stress negative effects, raising probability of crisis (e.g., Stiglitz 2000). Kaminsky and Schmukler (2003), using their composite index of both domestic and international deregulations, show that both views can coexist: liberalization may create crisis in the short-run but may be beneficial for the long-run growth (see also Tornell and Westermann 2005).

II. Thai Financial Sector Policy

Rapid economic growth and financial deepening characterize the Thai economy from 1976 to 1996. As Figure 1 shows, growth and financial deepening stalled somewhat between 1980 and 1986, and both then suddenly rose together in 1987.[8] Casual observation might suggest a positive link between financial deepening and growth as well as possible regime changes in financial sector policy in Thailand during the sample period.

Financial sector policies, repression and liberalization, are of course difficult to measure but we use the government's share in new bank lending as the best measure of policy distortions in Thailand for the period 1976 to 1996.[9] The solid line in Figure 2 shows that the share is around 10 percent from 1976 to 1980, then rises to around 30 percent, but eventually comes down to zero by the end of 1980s. Note that at 30 percent, if one were to deposit 100 Thai baht in a bank, only 70 baht might be fully invested in productive capital. If we assume the other 30 baht would be invested through government management with some distortions, say, with a modest 5 percent lower return, then the degree of financial repression, the implicit tax on savings, can be calculated as 1.5 percent. Similarly calculated distortions along the path are 0.5 percent from 1976 to 1980, rising to 1.5 percent around 1980, and down to zero by the end of 1980s. The transition to the final phase is what we define as the financial liberalization, eliminating the 1.5 percent implicit tax on savings. This is, by the way, consistent with a 1.5 percent decline of the spread between the deposit and loan rates from early to late 1980's. Below, we explain alternative measures of financial sector policy, such as interest rates, and compare them to our selected measure.

Financial laws and regulations do not seem to change much in the 1980s. The standard *de jure* documentation of financial liberalization consists of a chronology of changes in laws and regulations. The solid line of Figure 3 shows one of such *de jure* indices of financial liberalization by Abiad and Mody (2005) for Thailand.[10] Evidently, by this standard, Thailand liberalized monotonically but slowly, and there was no change in the middle of 1980s when GDP growth and financial deepening accelerated. We need to be cautious when using a *de jure* measure, however, as there is some discretion in precisely dating events: a Bank of Thailand document suggests changes may have begun as early as in 1986, including more liberalized bank branching. Also, Bekaert, Harvey, and Lundblad (2005) identify 1987 as the year that Thailand opened its equity market investments to foreigners.

Moreover, actual *de facto* deregulation may be distinct. For example, Berglöf and Claessens (2003) argue that laws and regulations regarding corporate governance may be implemented with lags. One can also create direct efficiency indicators from micro data and track improvements. For example,

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[8]Our financial deepening measure is the fraction of households that have a bank account.

[9]Based on the IMF's International Financial Statistics (IFS), the online version for the October 2006 issue, the government share in new bank lending is calculated as an increase in *claims on central government* and *claims on public nonfinancial corporations* divided by the increase in the sum of *claims on central government, claims on public nonfinancial corporations*, and *claims on private sector*. They are all components of domestic credit by banking institutions. The World Economic Outlook database provides the data for *gross capital formation* and *gross domestic product*.

[10]They create an index of *de jure* regulation out of six categories: interest rate controls, directed credit, entry restrictions, privatizations, international transactions, and prudential regulations. The index is normalized to one.

Abiad, Oomes, and Ueda (2008), using the Gini coefficient measure of dispersion of Tobin's Q, show that there were substantial improvements in allocating capital in Thailand dating from 1987 (see the dashed line in Figure 3). The dispersion of Tobin's Q is regarded as a good proxy for the dispersion of the expected marginal product of capital, especially after controlling for industry- and age-effects.[11] A market-based allocation is supposed to equate expected marginal products of capital across firms, while a pre-liberalization allocation by the government, often due to political considerations, seems less likely to do so.

It is important to note also that *de jure* changes and *de facto* changes need not move together. Hoshi and Kashyap (2000) argue that deregulation of the corporate bond market in Japan in the late 1980s, without deregulation of the banking sector, made banks lose their best client firms. Banks then expanded loans to relatively unknown clients, with more reliance on real estate as collateral, a source of the bubble and eventual problems of the 1990s.

On the other hand, there may be *de facto* financial repression even though laws and regulation do not change. Changes in economic conditions can cause a problem, sometimes exacerbated by subsequent policy change. By this standard, the degree of *de facto* financial repression in Thailand appears large for the early to mid 1980s. We use a study conducted by the International Monetary Fund (Robinson, et al. 1991), with additional data, to identify three main features that likely created a large cost of using financial services at that time, with few changes in laws and regulations.

First, from 1979 to 1981, as nominal interest rate controls remained in effect and inflation suddenly rose (due to an oil shock), the real (*ex post*) interest rate became negative—the nominal deposit rate was around 12 percent, while the inflation rate hit 20 percent (see Figure 4).[12] The negative real deposit rate seems to have deterred households from making new deposits. As Figure 5 shows, real growth of demand deposits was quite low from 1980 to 1985, often negative.[13] As for the loan side, note that low real loan rates would have allowed inefficient firms to continue.

Second in the chronology, evidently as a consequence of low deposit growth and the funding of inefficient firms, a financial crisis started in 1983. This spread eventually to one third of all financial institutions (a quarter of total financial assets).[14] The Bank of Thailand and the Ministry of Finance

[11]Their result holds with either unbalanced or balanced panel data. That is, the result is robust to any composition effects, for example, exit of privileged inefficient firms or entry of formerly credit-constrained productive firms.

[12]IFS provides data for various interest rates, namely, *deposit rate*, *government bond yield*, and *lending rate*, with which *lending-deposit spreads* are calculated. Inflation is calculated from the *consumer price index* in the World Economic Outlook database.

[13]IFS provides data for total deposits, which are the sum of *demand deposits* and *time, savings, and foreign currency deposits*. There are changes in statistical definitions for deposits and banks' claims in 1976, so that those numbers before and after 1976 are not perfectly comparable. Growth rates of deposits are adjusted for inflation. Total deposit growth was low only up to 1982 and then turned higher. This difference in movement between total deposits and demand deposits may reflect a differential change in the interest rates of two types of deposits, savings and checking accounts. Note, however, that the opening of new bank accounts should be more in line with the growth in the demand deposits, as the new customers are likely to be less wealthy and save relatively more in the demand deposit accounts than less liquid deposit accounts. Evidently, potential new depositors are more sensitive to negative interest rates.

[14]Thus, the financial crisis in Thailand in the 1980s appears to be caused by repressive financial sector regulations combined with inflationary shocks. This is in contrast to some recent studies (e.g., Kaminsky and Schmukler 2003 and Ranciere, Tornell, and Westermann 2006), which argue that financial liberalization, though beneficial in the long run, is a culprit in financial crises.

intervened, injecting capital into financial institutions, in some cases taking over management by acquiring shares (most shares were eventually sold off to the original owners by the end of 1980s).[15] Government-based allocation of capital is unlikely to be as efficient as market-based allocation. For example, with directed credit, increase in government control would expand politically-related inefficient lending—the indirect evidence appears in Gini of Tobin's Q reported by Abiad, Oomes, and Ueda (2008). We model this below. It is possible, of course, that if the government had not bailed out the banks, the Thai financial sector might have performed worse. Still, the main cause of the crisis appears to be interest rate controls combined with an oil shock. Thus, we regard subsequent bailout policies as an integral part of a *de facto* financial repression, even though it was unintentional.

Third, the distortion from tight regulations such as interest rate controls becomes worse with a higher level of government borrowing. In the period of 1980 to 1986, government borrowing increased and this was financed primarily by banks. This likely created further distortions in the financial system, almost surely unintentionally. For example, under maintained interest rate controls, an increase in government borrowing, either via purchase of government bonds by banks or direct loans from banks, brings to the banking sector a loss of profits, as banks are lending to the government at a low, distorted rate—indeed, deposit rates were higher in some years than the government bond yield (see Figure 4). This distortion is on top of any typical "crowding-out" argument, which assumes that government's deficit financing makes interest rates to go up, reducing private investment (and partially offsets deficit-financing demand boosts).

Note that the increase in government borrowing mostly came from structural fiscal adjustments and bailout costs, rather than business-cycle related automatic stabilizer effects and Keynesian policy (i.e., a more active public capital spending). Expenditures and tax revenues show only small short-run fluctuations along long-run trends (Figure 6). The capital-expenditures-to-GDP ratio (solid line) was almost flat at approximately 8 percent from 1977 to 1986.[16] The current expenditure, proxied by public-consumption-to-GDP ratio (dashed line), was steadily decreasing from near 20 percent in 1970 to around 10 percent in 1990, though it was more or less stable during the first half of 1980s. As for the revenue side, the tax-revenues-to-GDP ratio (dot-dashed line) was relatively stable, on an increasing trend from 15 percent to 18 percent over 1979 to 1990. Some bailout costs are not on the budget but affect gross government borrowing. For example, when the government purchases equity of a bank by issuing bonds, there is no effect on government budget flows but gross debt increases (and gross asset increases).[17] The difference appears sizable in some years between the government borrowing share in new bank lending (solid line) and the budget deficit share in new bank lending (dot-dashed line) in Figure 2, although government borrowing is also affected by the accounting treatment of redemptions and amortization of outstanding debt.[18]

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[15]Though little accounting information for exact intervention is available, financial institutions were bailed out through various government arms; namely, the central bank (Bank of Thailand), a state-owned bank (Krung Thai Bank), and a bailout fund (the Fund for the Rehabilitation and Development of Financial Institutions), and also directly by the government (Ministry of Finance).

[16]Robinson, et al. (1991) note that there were deliberate efforts at fiscal restraint that lowered capital expenditures in the later part of 1980s but nothing special in the earlier 1980s.

[17]The bailout costs should also include management costs of banks and firms. There was a suggestive evidence of increased management costs of firms, as net borrowings of nonfinancial public enterprises increased substantially—1.5 percent of GDP on average from 1980 to 1986, compared to an almost balanced budget for those enterprises on average from 1987 to 1990.

[18]The budget deficit in new bank lending (dot-dashed line) is the ratio of the domestically financed budget deficit to the

All in all, bank lending to the government increased from 10 percent to 30 percent of total new bank lending (again, see the solid line of Figure 2) around 1980. Then, after 1987, the government's share in new bank lending declined, to almost zero by 1990. Accordingly, private capital formation out of national savings was low from 1982 to 1987, after which it increased dramatically (see the dashed line in Figure 2).

In sum, *de facto* measures seem to capture Thai financial sector policies better than *de jure* measures. By any of the *de facto* measures, the broad implications look the same: inefficiency of the financial sector seems likely to have increased dramatically in the early 1980s with increased government involvement in banking, and then declined in the mid to late 1980s. Equivalently, the cost of intermediation in the financial sector increased and then decreased.

These *de facto* policy changes are difficult to quantify since they are of multiple dimensions and often complex. Thus, to make progress, we need to simplify: We pick the government's share in new bank lending as our *de facto* measure for calibration in the model simulation.[19] This measure shows clearly that savings were used more by the government for much of the 1980s. Likewise, we see some flaws in other measures. Reported interest rates might not reflect the true rates because, under controlled interest rates, nonprice competition may occur in various forms, such as gifts to depositors and bribes for loan officers. Deposit amounts are too closely linked to our (endogenous) financial deepening measure, the fraction of households having a bank account.

As we emphasized, financial sector policy is not the same as financial deepening. Typical measures of financial deepening, the private-credit-to-GDP ratio and the M2-to-GDP ratio, are not independent of economic growth, as the denominator is GDP itself. Hence, it would be difficult to disentangle economic growth and financial deepening if we were to use those measures. When financial liberalization induces a credit expansion that boosts GDP growth, there may be little change in the conventional measures. Likewise, there would be little change in those measures even when poor economic growth impedes financial deepening, for example, when there is a negative shock to GDP and credit contracts. Here, we select the fraction of households using a formal bank account, either savings or loans, as our measure of financial deepening. This is not normalized to GDP, but rather to population, and is closely related to our model described below.

III. THE MODEL

A. Setup

The model is a modified version of a simple, tractable growth model with a financial sector, the one used in Townsend and Ueda's (2006) calibration study, following the tradition of Greenwood and Jovanovic (1990) and Townsend (1983). Specifically, Townsend and Ueda (2006) conducted a

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increase in total bank claims. Specifically, the numerator are computed as the central government budget deficit net of central-bank and foreign finance. Note that, for much of 1980s, foreign finance is mainly bilateral and multilateral official borrowing (e.g., IMF, World Bank, and foreign governments). These data are from Robinson, et al. (1991).

[19]This *de facto* measure picks up not merely the changes in the degree of interest-rate distortion and inefficient lending, but also some effects of monetary policy or fiscal policy as we have discussed. If those government policies affect the real costs of participating financial system, then we define the overall effect as the *de facto* financial sector policy.

model-based simulation study of Thailand 1976–1996 and found evidence of transitions towards a long-run steady state and of a complex interlinkage among finance, inequality, and growth. However, they were unable to generate some of the more salient movements in Thai economy. Namely, financial sector participation flattened in the early 1980s and then surged suddenly in the middle to late 1980s together with an acceleration in economic growth. Here, we entertain seriously the premise that these relatively abrupt changes were the consequence of policy changes, exogenous to private agents. We therefore modify the model to include a government sector explicitly, and then calibrate its path.

There is a continuum of agents, consumer-cum-entrepreneurs, as if with names indexed on the interval $[0, 1]$. At the beginning of each period, they start with their assets k_t. After they consume c_t, they use savings s_t to engage in productive activities.

An individual can engage in two types of productive activities: a safe but low-return occupation (e.g., agriculture) and a high-risk, high-return business. Safe projects are assumed to return δ and risky businesses are assumed to return $\eta_t = \theta_t + \epsilon_t$, where $\theta_t \in \Theta$ is an aggregate shock, common to all businesses, something which clearly moves GDP growth, and $\epsilon_t \in \mathcal{E}$ is an idiosyncratic shock, different among risky businesses, with mean zero. The cumulative distribution functions are denoted by $F(\theta_t)$ for the aggregate shock, $G(\epsilon_t)$ for the idiosyncratic shock, and $H(\eta_t)$ for the sum of the two. An individual does not have to stick to the same projects over time, and she can choose a portion $\phi_t \in [0, 1]$ of her savings s_t to invest in high-risk, high-return projects.[20] Individual savings s_t is also endogenous. In summary, those who are not using financial services accumulate assets according to

$$k_{t+1} = (\phi_t(\theta_t + \epsilon_t) + (1 - \phi_t)\delta)s_t. \tag{1}$$

A financial institution provides two services to its customers in this simple model. First, a financial institution offers insurance for idiosyncratic shocks, essentially pooling returns as in a mutual fund. Second, a financial institution selects productive projects. Financial services, however, require a one-time cost $q > 0$ to start using them and a per-period cost $(1 - \gamma) \in [0, 1]$ proportional to the savings amount ($\gamma = 1$ implies no cost). These costs are intrinsic, so that no one can claim these resources once spent.[21]

Regarding efficiency gains, we assume that banks have an informational advantage in selecting projects, following Greenwood and Jovanovic (1990).[22] Specifically, when people apply for loans, banks gather information on the true aggregate shock and advise applicants as to whether they

[20] To allow simple analytical expressions for participants' value functions and welfare gains, defined later, the model assumes 100 percent depreciation of wealth, so that there is little distinction between income and wealth.

[21] Indeed, in the real world, banks need to offer extra services, which are not necessary in self-investment activities. Examples of variable costs include preparing accounting statements and printing deposit statements. Examples of fixed costs include building branches and checking credit history. Those costs must be charged to depositors as a result of competition, and the fee structure becomes optimal (see Townsend 1978 and 1983, and Greenwood and Jovanovic 1990). In addition, depositors themselves typically pay additional costs; for example, buying a motorbike and traveling for some time to visit a branch.

[22] This captures crudely and is in line with several theories of a bank's role in enhancing efficiency; for example, by preventing moral hazard (Diamond 1984) or internalizing an externality (Ueda 2006).

should stay in the relatively safe occupation or engage in the high-risk, high-return business.[23] To simplify the analysis, we assume that banks are able to infer the true underlying aggregate shock θ. As such, the return from a project for a household becomes $\theta_t + \epsilon_t$ if the risky project is chosen (i.e., when $\theta_t > \delta$) and δ if the safe project is chosen.

Regarding risk and insurance, we assume that a household puts all its money on deposit but then borrows money to finance a project and repays the loan conditionally on the returns from the project. In particular, when a household runs a risky business, repayments can vary with its idiosyncratic shock ϵ_t so that each household does not have to bear this risk.[24] Thus, after pooling, only aggregate shocks influence the overall return on savings, which we define as $R(\theta_t) \equiv \max\{\theta_t, \delta\}$. An alternative interpretation is that a financial institution is a mutual fund; that is, households buy shares in the mutual fund (savings), and the fund invests across projects to pool idiosyncratic risks, then pays off a return contingent on the aggregate shocks only. Theoretically, as Townsend (1978) and Greenwood and Jovanovic (1990) show, competition drives banks to provide insurance for idiosyncratic shocks using loan contracts with varying repayment obligations (e.g., defaults) conditional on realized idiosyncratic shocks.

However, the exact contract for each household depends on the total loans, which may be smaller than total deposits as banks also buy government bonds. A government runs and finances state-owned or state-managed firms in our model. Idiosyncratic shocks are again pooled by banks. The government also obtains advice from banks. Thus, returns from projects are almost the same as the private sector, less a key additional proportional cost z, due to bureaucratic inefficiency. The total return from the government-run or financed projects is thus $(1 - z)R(\theta_t)$, lower than the mean return of private firms. The assumption of an inefficient government does not tautologically create sizable welfare gains from financial liberalization. This inefficiency cannot be determined *a priori* and is possibly negligible. But in the calibration exercise below, we pin down z quantitatively by comparing the model predictions and the actual data.

To simplify the formula, we assume that the government borrows G_t from banks at a constant portion α of aggregate net-of-cost deposits D_t; that is, $G_t = \alpha D_t$. Parameter α characterizes the financial regime, meaning that α portion of the aggregate deposits will be invested in less profitable government securities or projects. Thus, under the mutual-fund interpretation, $(1 - \alpha z)R(\theta_t)$ is the per unit return from a bank for deposits D_t back to households. The return from deposits is the same when we alternatively interpret banks as savings-and-loan institutions (see Appendix I). The

[23] For example, when a Thai farmer in the countryside tries to start a rubber-making business and asks a bank to provide loans, the bank, headquartered in Bangkok, would gather information on potential demand and costs, including forecasts of the international rubber price. In a broader sense, several empirical papers support an efficiency-enhancing view of financial intermediation, as reported in the introduction.

[24] Perfect insurance for those who participate in the financial system may seem an extreme assumption. However, a theory is an abstraction from reality, and we think this assumption is not so far from reality. Townsend and Yaron (2001) describe the contingency repayment plan of the Thai Bank for Agriculture and Agricultural Cooperatives (BAAC) as an institutional mechanism which potentially insures income risks of farmers quite well. Indeed, Alem and Townsend (2007), using Thai household survey data collected by Townsend, et al. (1997), provide empirical evidence that the BAAC has effectively allowed households to smooth consumption, to reach the standard of the full risk sharing model. They also find that commercial banks are helpful not only in consumption but in protecting investment from cash flow fluctuations. As for project selection, there is less support for the assumption of selecting the risky project when its return is higher than the safe one. However, in general, talented fund managers actively select assets, beating the average market return, even in the well-developed U.S. financial sector. Indeed, a major strand of finance literature tries to measure those talents of fund managers (e.g., alpha in CAPM).

aggregate net-of-cost deposits D_t available for lending is smaller than the original savings amount, as the variable cost, $(1-\gamma)$ portion, is subtracted. Thus, the evolution of wealth of a participant with savings s_t can be expressed as:

$$k_{t+1} = (1-\alpha z)R(\theta_t)\gamma s_t. \tag{2}$$

The effective variable cost $1-\hat{\gamma} \equiv 1-(1-\alpha z)\gamma$ combines intrinsic transactions costs $1-\gamma$ and institutional impediments to a country's financial sector, summarized here as parameters α and z, the government share and its inefficiency. Naturally, the larger the size of government α and the larger the inefficiency in government-run business z, the higher the effective variable cost. We can also think of the fixed entry cost q as representing both intrinsic and institutional impediments, such as branch regulation.[25] Both these costs q and $\hat{\gamma}$ are a key part of the policy analysis which follows.

In addition, we assume that financial services remain attractive after marginal costs are paid. That is, net-of-cost intermediation provides an informational advantage over any portfolio returns without intermediation. We also assume that the risky asset is profitable enough to attract potentially some positive investment from risk-averse nonparticipants. In summary,

Assumption 1.

$$E[(1-\alpha z)\gamma R(\theta_t)] > E[\theta_t] > \delta. \tag{3}$$

An individual chooses at date t whether she uses financial services ($d_t = 1$) or not ($d_t = 0$), savings s_t, and portfolio share of risky projects ϕ_t to maximize her expected lifetime utility:

$$E_1\left[\sum_{t=1}^{\infty}\beta^{t-1}u(c_t)\right] \tag{4}$$

subject to the budget constraint

$$c_t = k_t - s_t - q\mathbf{1}_{d_t > d_{t-1}}, \tag{5}$$

where $\beta \in (0,1)$ denotes the consumers' discount rate and $\mathbf{1}_{d_t>d_{t-1}}$ denotes an indicator function, which takes value 1 if an individual joins the financial system at t (i.e., $d_t > d_{t-1}$) and takes value 0 otherwise. We use the log contemporaneous utility for most of this paper, but we also report a sensitivity analysis using a more general, constant relative risk aversion (CRRA) utility function $u(c_t) = c_t^{1-\sigma}/(1-\sigma)$, where $\sigma \geq 0$ denotes the degree of relative risk aversion.

Note that the production function represents a linear, essentially Ak-type, technology, which requires two conditions to limit the range of the life-time utility to be finite.[26] First, as participants' wealth grows at most at rate $\hat{\gamma}R(\theta_t)$, their consumption grows at most at the gross rate of $E[(\hat{\gamma}R(\theta_t))^{1-\sigma}]$. Here, we ensure that the lifetime utility does not explode.

Assumption 2.

$$\beta E[((1-\alpha z)\gamma R(\theta_t))^{1-\sigma}] < 1. \tag{6}$$

[25] By definition, a household can engage in a financial arrangement only upon the payment of the entry cost q. In other words, a household is assumed not to be able to borrow to pay for the entry cost.

[26] Please see Townsend and Ueda (2001) for detailed discussion.

Second, we focus on cases in which (almost) everyone's wealth grows forever, so that the lifetime utility does not decline to negative infinity. If a household can invest only in the safe project, it is easy to show that the optimal consumption growth rate would be $(\beta\delta)^{(1/\sigma)}$. As such, a sufficient condition for perpetual growth is

Assumption 3.

$$\beta\delta > 1. \tag{7}$$

B. Recursive Formulation

Because it is difficult to obtain analytic solutions that maximize lifetime utility (4) for nonparticipants, we use numerical methods based on dynamic programming, transforming the original maximization problem at the initial date to a recursive maximization problem conditional on two states, current assets and current participation status in the financial system.[27] Following the notation of Greenwood and Jovanovic (1990), we define $V(k_t)$ as the value for those who have already joined financial intermediaries today, and $W(k_t)$ as the value for those who have not joined today but have an opportunity to do so tomorrow.[28] Also, we introduce a pseudo $W_0(k_t)$ as the value for those who are restricted to never joining. These value functions are defined as follows.
For participants, where $d_t = 1$ already,

$$V(k_t) = \max_{s_t} u(k_t - s_t) + \beta \int V(k_{t+1}) dF(\theta_t) \tag{8}$$

subject to the wealth accumulation process (2);
for current nonparticipants thinking about joining next period, with current $d_t = 0$,

$$W(k_t) = \max_{s_t, \phi_t} u(k_t - s_t) + \beta \int \max_{d_t} \{W(k_{t+1}),\, V(k_{t+1} - q)\} dH(\eta_t) \tag{9}$$

subject to the wealth accumulation process (1); and
for never-joiners, who provide a counter-factual but useful benchmark,

$$W_0(k_t) = \max_{s_t, \phi_t} u(k_t - s_t) + \beta \int W_0(k_{t+1}) dH(\eta_t) \tag{10}$$

subject to the same wealth accumulation process (1).

We can write an equivalent formulation for nonparticipants in which the participation decision is made at the beginning of each period. It is simply defined as

$$Z(k_t) \equiv \max_{d_t \in \{0,1\}} \{W(k_t), V(k_t - q)\}, \tag{11}$$

where $V(k_t - q)$ represents the value for *new* participants today.

[27] With some additional technical assumptions, we can establish the equivalence of solutions between these two maximization problems. See proofs in Townsend and Ueda (2001).

[28] In practice, participation decision d_t will be zero for several periods and then jump to one and stay there. That is, no one will ever exit the financial sector in this transitional growth model (see proof in Greenwood and Jovanovic 1990).

For nonparticipants with value $Z(k)$, the savings s and the portfolio share ϕ are functions of wealth k and can be obtained numerically. Since the economy grows perpetually, we cannot apply a standard numerical algorithm, which requires an upper and lower bound of wealth level k. Fortunately, the participant's value $V(k)$ and the never-joiner's value $W_0(k)$ have closed-form solutions together with their associated optimal savings rates and portfolio shares. Those provide numerical approximation to nonparticipants' value $Z(k)$ for sufficiently high and low k, respectively. See Townsend and Ueda (2006) for detailed derivation of analytical and numerical solutions for those value functions, $Z(k)$, $V(k)$, and $W_0(k)$.

IV. Setup for Numerical Analysis

We analyze the quantitative properties of the model by comparing numerically simulated paths to the actual Thai data. Although each household's return is not affected by the choice of others, it does depend on each household's wealth. As a consequence, "macroeconomic" variables, such as income growth and financial deepening, vary with the entire wealth distribution of participants and nonparticipants. Further, the transitional evolution of all these variables should be viewed as one possible sample from the draw of an entire history of aggregate and idiosyncratic shocks, one draw among many.

The Thai economy experienced rapid economic growth and financial deepening prior to the financial crisis of 1997, and we calibrate the model against 20 years of data, from 1976 to 1996.[29] The basic parameter values are the same as those in Townsend and Ueda (2006), based on multiple sources of data. In particular, the initial wealth distribution and the initial number of households having formal sector bank accounts come from a nationally representative household survey, the *Socio-Economic Survey* (SES). The per capita real GDP growth rate is from the IMF World Economic Outlook database (originally from the Thai government).[30] In addition, the returns of safe and risky assets are from the Townsend-Thai data.[31]

Under these and other parameter values, Townsend and Ueda (2006) show that the model simulation follows reasonably well the overall trends of growth, financial deepening, and changing inequality in Thailand for the 1976 to 1996 period. The benchmark parameter values are summarized in Table 1.[32]

Computed value functions for the benchmark parameter values are shown in Figure 7. The nonparticipant's value $W(k)$ is always between the participant's $V(k)$ and the never-joiner's $W_0(k)$.

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[29] See discussions in the concluding remarks on the Asian crisis.

[30] The SES surveys were taken in 1976 and then biannually from 1980. The range of aggregate shocks is consistent with historical variations in the per capita real GDP growth rate. The mean of the aggregate shocks is picked by calibration, essentially by matching the expected growth rate in simulation to the average actual growth rate under simplifying assumptions (see Townsend and Ueda 2006). Note also that compact supports for distributions of shocks are used in the proof of existence of the optimal path for the perpetually growing economy (Townsend and Ueda 2001).

[31] The safe return is set at the median net return from capital investment in agriculture. The range of the uniform distribution of idiosyncratic shocks comes from the difference between top 1 and 99 percent of income-to-capital ratio for those nonagricultural businesses with no access to the formal financial system. Note that, with a small number of survey years, it is difficult to distinguish idiosyncratic shocks from common shocks. Detailed information on Townsend-Thai data is available in Townsend, et al. (1997), and also at the web page: http://dvn.iq.harvard.edu/dvn/dv/rtownsend.

[32] These benchmark parameter values are very close to the estimates made by Jeong and Townsend (2006).

As anticipated, it approaches $W_0(k)$ as k goes to zero and coincides with $V(k-q)$ for large k. The critical level of wealth to join the bank is $k^* = 15$, the minimum capital level such that $Z(k)$ and $V(k-q)$ coincide.

The savings rate of nonparticipants increases with their wealth level up to near the critical level of capital k^* that determines the entry decision (Figure 8).[33] This is because nonparticipants have an incentive to accumulate wealth faster to cover the cost of starting to utilize the financial services. In addition, before participation, they prepare for payment of the fixed fee to smooth consumption over time. Moreover, as discussed in the introduction, participants have less precautionary motives to save as their idiosyncratic shocks are insured. The higher savings rate of nonparticipants implies ironically that the economic growth rate may become lower with more financial participation.

The portfolio share of risky assets varies in Figure 8 as expected around the optimal level ϕ^{**} under $W_0(k)$, the value function of those who are never allowed to enter the bank. The share increases first and then decreases. It is, however, almost always *larger* than ϕ^{**} for $k < k^*$. That is, nonparticipants put their wealth in the risky assets as a natural lottery to convexify their lifetime utility (i.e., value function)—see Proposition 1 in Townsend and Ueda (2006). In other words, nonparticipants invest more in risky assets than never-joiners, hoping that they can enter the financial system earlier. Those chances are low for very poor people, and the figures show that their portfolio share and savings rate approach those of the never-joiners as wealth goes to zero. Note that the per unit return on savings is higher when more households join the financial system, as banks always select more profitable projects, when choosing between safe and risky ones. However, wealth growth also depends on savings rates, which again may be lower with more participants.

Using these numerically-obtained savings and portfolio share functions, we generate the evolution of the distribution of wealth (Figure 9) starting from the measured, benchmark 1976 distribution of wealth of the SES.[34] Then, we compute the model's prediction for aggregate growth and financial participation rates for each year from 1976 to 1996. Apart from the benchmark parameter values, the path of cost parameters $\hat{\gamma}$ and q and the path of aggregate shocks θ_t are specified in the next section.

Note that the initial fixed cost q is used as a scale parameter, on the assumption that future policy changes come as a surprise (that is, the agents assume that the initial fixed and marginal costs are forever constant). Given other parameter values, the initial fixed cost q determines the critical value of wealth under which people in the model join the financial system. The participation rate is six percent in 1976 in the data, with the other 94 percent not participating, and we take this as the initial condition; that is, in both model simulation and actual wealth data, we assume that all people with wealth below the critical level are not participating the financial system in 1976. We compare the critical capital level k^* in the model and 94th percentile of the 1976 wealth distribution—about 220,000 baht evaluated at the 1990 price level. Equating the two numbers pins down the "exchange rate" between the model unit and the Thai baht. This exchange rate varies with parameter values q. Under the benchmark parameter values with $q = 5$, the critical capital level in model unit is $k^* = 15$ and so the exchange rate of baht per model unit is $14,667 = 220,000/15$. If we were to use another

[33] It then decreases slightly for the wealth level larger than the critical value k^*. This is the region showing the off-the-equilibrium path, in which households should have participated in the financial system already. See Townsend and Ueda (2006) for a more detailed discussion.

[34] See Townsend and Ueda (2006) for technical details.

value for q, say 500, then the exchange rate would be 147. In this sense, the fixed cost q serves as a scale parameter only.

In the experiments with varying fixed costs, the exchange rate is kept constant in every period (at $14,667$ for the benchmark parameter case) but we vary the fixed cost q over time to investigate the effects. Similarly, we use the constant exchange rate in the experiments with changing effective variable costs $\hat{\gamma}$, although the critical capital level changes with variable costs.

V. CALIBRATION

Our aim is *not* to show how well the model explains the movements of GDP growth *but* to determine how large the effects of financial liberalization are on growth and welfare after allowing for aggregate shocks that make the model-generated data track the actual GDP growth rates well. To disentangle important domestic financial sector policy changes from these common aggregate shocks, we display simulated movements of the growth rate and financial deepening under various specifications. Specifically, assuming for now a constant entry cost, we compare and contrast three experiments: (i) aggregate shocks at their mean value with a constant zero variable cost, (ii) actual GDP growth rates fed in as the aggregate shocks but again with a constant zero variable cost, (iii) calibrated aggregate shocks with policy-induced cost movements based on the *de facto* policy changes. Essentially, we choose the aggregate shocks to match observed GDP growth rates, and then focus on how well the model tracks actual financial deepening under these shocks.[35]

Figure 10 shows the first experiment with aggregate shocks constant at their expected value each period and a constant zero variable cost. The evolutions of growth and financial sector participation in the Thai data are almost identical with the movements of the *average* of 1000 Monte Carlo simulations reported in Townsend and Ueda (2006). Figure 10 illustrates a salient feature of the model, two-way causation between financial deepening and economic development. As households become wealthier, more households participate in the financial system. As more households participate, the average growth rate rises. Apparently, however, the average evolution is too smooth to predict the observed flattening of financial sector participation in 1980–82, the observed upturn in financial sector participation in 1987–89, and the observed fluctuations and upturn in the growth rate in 1987.

Figure 11 shows the second specification with a specific guess for TFP shocks under which the simulated growth rates mimic the actual growth rates well. As a first guess for the aggregate shocks, we feed in actual growth rates, with a level adjustment, under the same constant cost.[36] Apparently,

[35]Though regression analysis may be an unwise strategy in identifying the effects of financial liberalization in a transition economy, if conducted, we would at least control for other factors affecting GDP growth rates: for example, trade openness, capital flows, exchange rates, year dummies for political turmoil, and so on. Here, in our simple model, aggregate shocks can stem from any of those potential factors. To identify the effects from financial liberalization, we control for those other factors by using specific aggregate shocks that make the model-generated data match well with the actual GDP growth rates.

[36] The model has two production technologies, and inputs are divided endogenously over time, depending on the evolution of wealth. As such, there is no stationary aggregate production function, except in the long-run steady state. Hence, Solow residuals cannot be computed using the structure of the model. Also, Solow residuals based on a typical neoclassical growth model, if computed, would not recover the TFP shocks in our model. Therefore, we guess and verify the shocks. Specifically, we start with actual GDP growth rates as the initial guess for TFP shocks, with level adjustment

the growth rate is well mimicked, though still a bit short on the upturn. Still, there is little variation in the participation rate from its average trend. In this sense, aggregate shocks alone fail to explain the movements in financial deepening. Although wealth growth does accelerate financial sector participation in the model, the quantitative effects of this are rather small. This is because specific realizations of income shocks alter neither expected benefits nor costs of joining the financial system. Something more is needed to explain the path of financial deepening, with its flattening and subsequent upturn, though evidently shocks can be selected to mimic all the observed GDP growth.[37]

We now experiment with changes in the financial sector policy. *De facto* measures appear to have been related to variable costs; they do not seem directly associated with bank entry or branch openings but rather with efficiency in allocating capital to profitable projects. Hence, we focus on movements in variable costs. But, later as a robustness check, we will also experiment with varying fixed costs of joining the financial system.

From the historical evidence pictured in Figure 2, we guess there were three regime changes. Average credits to the government, which correspond to α in the model, are 10.8 percent of total credit before 1980, 30.2 percent for the period between 1980 and 1986, 8.3 percent between 1987 and 1989, and -0.2 percent after 1989.[38] We fix the public sector inefficiency level z to be 0.05; that is, the investment rate of return is *always* 5 percent less if the government conducts business. Assuming no intrinsic costs ($\gamma = 1$), the effective variable costs $1 - \hat{\gamma} = 1 - (1 - \alpha z)\gamma = \alpha z$ for these four periods are estimated at 0.5, 1.5, 0.4, and 0 percent, respectively. The dashed line in the variable-cost plots of the bottom graph of Figure 12 shows government's share in new bank lending scaled with $z = 0.05$, and the solid line is our stylized characterization of the evolution of that policy. Note that though we choose government inefficiency z, we *do not* freely choose the timing and overall effect of government share in new bank lending. The timing is calibrated to the historical pattern and the impact is through the model. Also, note that we assume here that both size α and inefficiency z of the government are structural parameters and that households take a specific policy regime as given. The change in regime comes as a surprise.[39]

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implied by a typical savings rate and portfolio choice. The simulation with this first guess is reported in Figure 11. Moreover, we improve our guess in the simulations below. We simulate the GDP growth under the first guess and take the difference between the simulated growth rates and the actual growth rates. We then add the difference to the initial guess to improve our guess for TFP shocks. We iterate this process until the simulated growth rate mimics the actual growth rate well. We find that one or two iterations appear sufficient.

[37]This result is in line with Townsend and Ueda (2006). They have a different objective, that is, they look at the joint explanatory power in terms of growth, inequality, and financial deepening. Their best fit simulation is taken out of 1000 simulations with varying aggregate shocks drawn from a prespecified distribution, based on a covariance-normalized distance from actual growth, financial participation, and inequality data, simultaneously. The best fit path succeeded somewhat in replicating the GDP growth rate but did not deliver the dynamic changes from mid-1980s, especially in financial participation and inequality.

[38]The after-1989 number is the 1990–1996 average. The before-1980 number is the 1977–1979 average, as there was a change in statistical definition in 1976.

[39]In reality, a regime change might not come as a complete surprise. Effects of announcement or implementation delays could be mimicked by altering the year of the regime change to a year before or later. However, the movements of actual financial participation are well traced by simulation of the current model that assumes surprise changes in policy. This implies that announcement effects or implementation delays are less likely to be present. Recall that we select the *de facto* measure of financial liberalization because it creates fewer problems than the *de jure* measures in terms of announcement effects or implementation delays. More generally, the size and inefficiency of government intervention could be formulated as a stochastic process. In this case, households should anticipate a regime change with some

With this historical evolution of financial sector policy, simulated financial deepening traces the actual data well (see the middle panel of Figure 12). Though initial aggregate shocks are again based on actual GDP growth rates, subsequently forecast errors are added, and the result, after this one-step iteration, matches actual GDP growth well. Indeed, we could further iterate until we mimic the actual growth data almost perfectly. But, we report the results based on this one-step iteration alone, since there is a remarkable resemblance between the simulated and actual data in Figure 12.[40] Again, the focus should be on the success in matching financial deepening, which stagnates in the repression and surges in the liberalization.

Similarly, the calibration study can be carried out changing entry costs, keeping variable cost constant (at zero). Unlike the variable cost case, we do not have specific information on entry cost movements. We rely on trial-and-error estimates but keep the timing the same as in the variable cost case. Figure 13 displays the final results, analogous to Figure 12. For the simulated financial participation to trace the actual data, the entry cost needs to rise 40 percent (from 5 to 7) in 1980, decline to the original level in 1987, and then decline an additional 10 percent (from 5 to 4.5) in 1989. Again, we could iterate further on both TFP shocks and financial sector policy changes to deliver an even closer fit, but the match is already quite good.

Moreover, similar figures can be drawn for different parameter settings; for example, with a lower safe return ($\delta = 1.047$) in Figures 14 and 15 and with higher risk aversion ($\sigma = 1.5$) in Figures 16 and 17.[41] In the case of the lower safe return, the model simulation overpredicts the participation rate in the later years and, in the higher-risk-aversion case, the simulation underpredicts the participation in almost all the sample years.

Inefficiency parameter value $z = 0.05$ is not chosen in an *ad hoc* manner. Rather it is calibrated to the actual data so that the model prediction of financial participation rate performs well. With lower government inefficiency ($z = 0.02$), the kink in the participation rate rarely occurs (Figure 18). Apparently, this is not a good parameter choice. With higher government inefficiency ($z = 0.08$), the kink becomes steeper. The simulation underpredicts the participation rate in earlier years but overpredicts in later years (Figure 19). This parameter value is not a good choice either, as changes in other parameter values would not provide a remedy to the problem.

Note once again that the simulation results tracing the growth rates should *not* be interpreted as a model's success. Rather, we choose a sequence of aggregate shocks to match growth rates and then

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positive probability. Under the variable cost interpretation, however, realization of a specific policy regime would not matter much for participation decision, since households primarily weigh expected benefits and expected costs, not specific realizations. As such, a simulation would produce too smooth a path for financial deepening. Under the fixed cost interpretation, realization does matter. Households will join the financial system when a low fixed cost is realized, and otherwise will wait for a better, cheaper timing. Frequent policy changes would create volatile new participation flows, which we do not see in the data. With infrequent policy changes, however, the analysis would not be much different from what we now have under surprised regime shifts.

[40]The overall picture is quite similar if we use only actual GDP growth rates without the one-step-iteration. However, we prefer to use a better measure of aggregate shocks to mimic the actual GDP growth, so that we can evaluate the gains in growth and welfare more accurately in the next section. Note that identifying specific aggregate shocks is important in generating the actual growth pattern of Thailand. In the simulation with changing variable costs but with aggregate shocks constant at their expected mean value each period, the generated growth pattern is too smooth.

[41]With a higher risk aversion, we needed to iterate twice to find a sequence of aggregate shocks to mimic the actual GDP growth rate well.

focus on how well the model tracks actual financial deepening. But, as stressed above, we do not give ourselves perfect freedom in choosing the evolution of transaction costs. The evolution of the government's share in new bank lending follows the historical data. The simulations show that the model successfully replicates both GDP growth and financial deepening simultaneously when equipped with varying aggregate shocks and the observed historical evolution of the financial sector policy.

Is our assumption on shocks too specific? In addition to regime changes in financial sector policy, we could have assumed regime changes in productivity (e.g., lower returns from 1980 and higher returns from 1987). However, regime changes in productivity would barely affect relative advantages of financial services because the returns from underlying projects affect wealth growth for both participants and nonparticipants. Thus, assuming regime changes in productivity would not only be *ad hoc* but also unlikely to generate the drastic changes in financial participation.

A technical question still remains: are those aggregate shocks are *i.i.d.* as is assumed in the model? It might be natural to assume that shocks follow an AR process, since per capita real GDP growth has strong autocorrelation, about 0.77 with a *t-statistic* of 4.60 for 1976-1996 period.[42] However, the sequence of underlying aggregate shocks, which we picked in the algorithm for simulation to mimic the actual GDP growth rates by iteration, is not significantly autocorrelated. That is, the aggregate shock process used in the benchmark variable-cost reduction case has an AR(1) coefficient of 0.34 with an insignificant *t-statistic* of 1.49. Yet, our simulated GDP growth rates shows strong autocorrelation, almost identical with the actual data. Here, the autocorrelation of GDP growth rates does not stem from the autocorrelation in underlying shocks. Rather, household behavior, combined with persistent but varying policy regimes, creates strong endogenous autocorrelation in growth rates.

VI. Welfare Gains

As shown in the calibration exercises in the previous section, *de facto* financial repression was followed by *de facto* financial liberalization in 1987–89, associated with a reduction of the variable cost from 1.5 to 0 percent or reduction of the entry cost from 7 to 4.5. We now ask a new question: What would be the effects on growth and welfare of this financial liberalization compared to what would have happened if the repression had continued?

For simplicity, we compare a once-and-for-all liberalization in 1987 versus continued repression. Although four regimes are identified in the calibration exercise, we focus on financial liberalization only. Specifically, we simulate the economy as in the previous section using the same iterated shocks and policy path, but in 1987 we reduce the variable cost from 1.5 to 0 percent. As a comparison, we also simulate the counterfactual case that differs only in that the variable cost remains at 1.5 percent through 1996.

Table 2 shows that the gain in the annualized per capita GDP growth rate for the 1987–1996 period with variable-cost reduction is 0.59 percent; that is, 6.87 percent with the reduction and 6.28 without

[42]The coefficients are estimated by ordinary least squares and the *t-statistics* are based on moving block bootstrap estimates for heteroskedastic and autocorrelation consistent standard errors (Fitzenberger 1997) with 10,000 resampling of four-period blocks.

the reduction, both using the iterated sequence of aggregate shocks, the same one as in Figure 12. The gain with entry-cost reduction is -0.14 percent, from 7.48 without reduction to 7.34 percent with reduction, using the sequence of shocks that generated Figure 13. As a robustness check, though not specific to the Thai episode, we also report the results with the expected, mean value of shocks from 1987 onwards. The growth difference is estimated at 0.96 percent with the variable-cost reduction and -0.26 percent with the entry-cost reduction.

While movements in public debt financed by banks suggest that the *de facto* financial liberalization in Thailand in this period was more likely to be associated with a reduction in variable costs, episodes in other countries and other periods may be associated with a reduction in entry costs. As such, our results are consistent with the literature, which does not find decisive favorable evidence for enhanced growth associated with financial liberalizations.

Reductions in costs do not induce much growth over the subsequent 10 years of transition. The effects would be different in the long-run steady state in which everyone participates in the financial system—though steady-state growth would not be affected by the entry-cost reduction, it would be higher with the variable-cost reduction. But, in transition, there are opposing forces and their magnitude changes over time. On the one hand, there is a positive effect: the aggregate expected return on investment becomes higher as financial liberalization accelerates participation that enables households to enjoy higher expected return. On the other hand, there are negative effects: (i) an increase in endogenous entry-cost payments (and reduction in productive inputs) right after financial liberalization, as more households enter; and (ii) a drop in aggregate savings as participants have a lower savings rate than nonparticipants.

Still, a low growth effect does not preclude a high welfare gain. Household-level shocks are insured, and the expected return on savings is higher. More specifically, for participants, we have a closed-form solution from the value function. This makes clear the gains from a lower marginal cost, that is, an increase in the return $\hat{\gamma}R(\theta)$. Of course, there is no gain to participants from changes in the entry cost *ex post*, because they are already in the financial system.

For nonparticipants, there is no closed-form solution, so the welfare gains for them must be computed numerically. Specifically, we compare the value function $Z(k)$ of nonparticipants with and without liberalization. The value function with liberalization is reported as the higher solid line and the one without as the lower dashed line, both in the upper left quadrant of Figure 20. Nonparticipants' values $Z(k)$ are drawn for the wealth level below the critical value of wealth, around 320,000 baht associated with the 1.5 percent variable cost. Above 320,000 baht, the participants' values $V(k)$ are plotted.[43] The difference in the lifetime utility value from the reduction in the variable cost is reported in the lower left quadrant of Figure 20. Note that the utility compensation naturally depends on wealth. Low wealth households are so far from the date of entry

[43]In Figure 20, the critical value of capital such that an individual joins the financial system is around 200,000 baht (15 model units) and 320,000 baht (25 model units) for the zero and 1.5 percent variable costs, respectively. Households with wealth between 200,000 baht and 320,000 baht would have participated in the financial system and face the participant's value function $V(k)$ if the cost had always been zero. Right after the cost is reduced, households with wealth between 200,000 baht and 320,000 baht immediately join the financial system and face the value function of new participants $V(k-q)$, which comprises $Z(k)$. Note that the exchange rate between Thai baht and the model unit used in Figure 20 is about 13,000. The initial threshold is still the same 220,000 baht from the actual wealth data for 1976. But, in model units, the initial critical capital level is 17 under the 1976-1980 regime, in which we assume the variable cost is at 0.5 percent, higher than in the benchmark, zero-variable-cost case.

that the future utility gains are of little consequence. Nonparticipants' utility gains increase with wealth toward, though not converging to, those of participants.

We report the welfare gain in the monetary units as the corresponding wealth compensation—the amount of transfer one would have to give to an agent with wealth k under the repression in order to get her lifetime utility up to the value she would have under the liberalization.[44] Specifically, let $\hat{Z}$ denote the value function for nonparticipants after the reduction of variable cost (liberalization) and Z the previous value function (repression). The wealth compensation $\tau(k)$ is likely to vary with wealth k and is defined as follows:

$$\hat{Z}(k) = Z\left(k + \tau(k)\right). \tag{12}$$

The upper right quadrant of Figure 20 shows this wealth compensation, and the lower right quadrant shows this wealth compensation relative to the wealth levels in percentage terms.[45] Among all nonparticipants, those who are just below the threshold of participating in the financial system under the 1.5 percent cost, benefit most from the financial liberalization. That is, the gain is increasing with wealth and reaches 35.2 percent just before entry. However, the participants' gain from the reduction of variable cost is 43.7 percent, based on the closed-form solution (see Appendix II), so there is a discrete jump in the wealth compensation between nonparticipants and participants—due to the different curvatures of the value functions. Apparently, participants gain more than nonparticipants because participants benefit from a higher return immediately after the reduction of variable costs, while nonparticipants, especially the poorest, need to accumulate wealth before they start using the financial services. In other words, inequality in terms of welfare widens with financial liberalization.

Welfare gains from the reduction in the entry cost can be calculated similarly and are shown in Figure 21. The graphs share many qualitative features of the variable-cost version but lower welfare gains at all wealth levels. Moreover, unlike a reduction in the variable cost, the reduction in the entry cost does not benefit participants at all. So, the nonparticipants' gains do not approach the participants' gains (zero). Rather, the benefits are concentrated among the middle wealth households who are likely to join the financial sector in the near future. Also, note that somewhere between the two critical values of capital, 200,000 baht under the new, lower q and 300,000 baht under the original, higher q, welfare gains appear to decrease, from the peak of around 13 percent.[46] Once

[44]This concept corresponds to transfers used in Hicks compensation principle. A similar Kaldor compensation principle was used in Townsend and Ueda (2001), as well as in Epaulard and Pommeret (2003), for an on-off experiment. The Kaldor compensation is the amount of wealth that a consumer would be willing to give up after liberalization to take utility down to its previous value. We use Hicks compensation here, as it is computationally easier. Welfare gains from risk sharing vary with the choice of distribution of idiosyncratic shocks, as well as the utility function. As shown in Table 1, we have used the log utility and assumed the uniform distribution of idiosyncratic shocks with the range based on the Townsend-Thai data. A log normal, instead of uniform distribution, would possibly give us a lower welfare gain. But on the other hand, our benchmark assumption of at most ± 0.6 gross return is a conservative estimate of income variation. There would be no households anywhere near bankruptcy or a doubling of their wealth in one year, although these cases are found in the data.

[45]To smooth out the computational errors due to the discretized grid of wealth for the nonparticipant's case, a fitted value (solid line) is drawn based on a cubic regression.

[46]In Figure 21, the critical values of capital such that people join the financial system are around 200,000 baht (14 model units) and 300,000 baht (21 model units) for entry costs of 65,000 baht (4.5 model units) and 100,000 baht (7 model units), respectively. The exchange rate used in the simulation in Figure 21 is about 14,700. The initial 1976-1980 regime is assumed to be the same as in the benchmark case, which has a critical capital level of around 15, while again the actual

households start using the financial system, their gains from entry-cost reduction is zero. Hence, the benefits of a lower entry fee are restricted to wasting fewer resources on entry and starting to utilize the financial services earlier. The former effect, after discounting for expected periods left before joining, is always larger for richer nonparticipants. The latter effect depends on the change of the expected entry date. It is small for very poor households, who would join in a far away distant future under any regime, and also for very rich nonparticipants, who were close to the critical capital level and highly likely to join the financial system in the next period even under the repression. Overall, this complex relationship between welfare gains and wealth implies that the effect on inequality in terms of welfare is unclear, unlike the variable-cost-reduction case in which welfare gains are increasing with wealth.

To begin a comparison with the literature, we compute the "aggregate" welfare gains from the 1987–89 financial liberalization. To obtain one number, we need to integrate the wealth-dependent welfare gains using the wealth distribution in 1987, the date of liberalization. Specifically, we obtain the 1987 wealth distribution by simulating the economy under the specified parameter values, including regime changes in entry and variable costs as described, and a specific sequence of aggregate shocks up to 1987. Then, we compute total compensation for all households and divide it by aggregate wealth—we are *not* calculating a simple average or a wealth-weighted average of the wealth transfer. Our exercise simulates a policy experiment in which a central planner determines the total amount of transfers. Note again that the aggregate compensation varies with histories of costs and shocks, which determine the distribution of participation status at 1987.

Table 3 reports the result: the aggregate compensation is about 27 percent of the aggregate wealth for the case of a reduction in the variable cost. It is about 14 percent for nonparticipants and 44 percent for participants. Although the population shares are 89 percent versus 11 percent, respectively, the wealth shares are about the same for both groups, so that the overall welfare gains are close to the simple average of welfare gains for two groups.[47] As for the entry cost reduction, the welfare gain is about 2 percent. Because the entry cost reduction affects only nonparticipants, the participants' gain is zero. Nonparticipants' gain is about 4 percent. Nonparticipants make up 88 percent of the population but own only approximately half of the total wealth in the 1987 simulated economy.[48]

Most of the business-cycle literature expresses welfare gains in terms of changes in permanent consumption, not a one-time wealth transfer. Here, as all the important movements happen in transition, it is not fruitful to identify the gain in terms of steady-state permanent consumption. In

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threshold is 220,000. Note that wealth compensation is not really zero even at the low end—the plots contain approximation errors, especially in the low end, due to the cubic-regression based interpolation.

[47] As Townsend (1978) and Greenwood and Jovanovic (1990) show, it is a competitive equilibrium result, and Pareto optimal, to set the price of financial services at the true intrinsic costs. So, banks would not enjoy any rents nor gains under any government policies, as intrinsic costs are assumed to be real wastes. In another interpretation, intrinsic costs could be regarded as labor income of bankers. Although an increase (or a decrease) in costs associated with government inefficiency does not change intrinsic costs, bankers would earn more income with a lower level of government interventions that lead to a higher participation rate. However, the potential gains for bankers would be matched by an increased disutility of labor, otherwise competition would cut the wage. As such, the rents should be low, if any. Hence, the implication of the model would not be much different even if intrinsic costs reflected bankers' labor income. Of course, to predict the effects more precisely, it would be necessary to develop another formal model with a labor market.

[48] This 4 percent gain for nonparticipants is about a quarter of the variable-cost-reduction case, 14 percent. This lower gain stems partly from the shape of wealth-dependent welfare gains, as the peak gain, 13 percent, is more than a quarter of the variable-cost-reduction case, 44 percent.

addition, with the entry cost reduction, there is a wealth effect on savings, and thus we cannot pin down exactly the relationship between changes in levels and growth rates.

Still, as an approximate number, and for comparison, we can interpret our measure, the transfer as a percentage of the wealth level, as an increase in permanent consumption. This approximation is exact for the participants (and hypothetical never-joiners), as the growth rates of their wealth and consumption are constant thanks to the CRRA utility and a simple Ak type linear technology.[49] Thus, a one-time change in levels does not affect the growth rate. Specifically, a one-time 27 percent increase in wealth implies that, in any subsequent period, wealth and consumption levels are always 27 percent higher than the levels without such an income transfer.

We would like to remind the readers that our welfare-gain estimates are not likely to pick up the effects of other policy changes or exogenous productivity shocks, as we are using shocks calibrated to the actual growth experience. Our calibration study in the last section shows clearly that the financial deepening path is altered primarily through changes in financial intermediation costs.

VII. Discussion

A. Sensitivity Analysis

To check on sensitivity, we replicate our results using a safe return, $\delta = 1.047$, lower with respect to benchmark value 1.054 (see Figure 14 for the variable cost reduction case and Figure 15 for the entry cost reduction case). This corresponds to the lower bound of the risky return, so now all the savings of participants go to the risky asset, regardless of θ. Thus, there are no informational gains, and all the welfare gains from intermediation stem from risk insurance. Apparently, the direct benefits of joining the financial system become lower, but more complex dynamics are brought about by the process of financial deepening, especially prior to liberalization.

The aggregate growth effect and welfare gains (Tables 4 and 5) turn out to be virtually identical to the benchmark case.[50] In the breakdown though, there are some differences. Participants' welfare gains turned out to be the same as in the benchmark case. Even though the underlying mean return is different, the policy change is the same 1.5 percent reduction in the effective variable cost and this change brings welfare gains (see Appendix II again). As for nonparticipants, welfare gains turned out to be slightly lower than in the benchmark case, probably because larger idiosyncratic risks create higher incentives to participate in the financial system even under the repressed regime and thus a reduction of 1.5 percent in variable cost is less effective to increase extensive margin of participation than in the benchmark case. Indeed, more people participate in the financial system at 1987 in this simulation. This also makes overall growth and welfare gains slightly higher than in the benchmark case, as participants receive highest relative welfare gains and there are more of them.

[49] In particular, with the log utility and Ak technology and with a 100 percent depreciation rate, the savings rate is always equal to the discount rate β and the growth rates of wealth and consumption are βA. A similar linear growth rate can be obtained for CRRA utility functions with any values of σ.

[50] Note that in both variable-cost-reduction and entry-cost-reduction cases, the iterated shocks necessary to mimic the GDP growth data are almost identical to those in the benchmark case, as reported in the last rows of Tables 4 and 5.

Similarly, in the entry-cost-reduction case, gains in growth and welfare are only slightly magnified from the benchmark case—the aggregate welfare gains are higher even though the growth loss is larger. Interestingly, while there are no welfare gains for participants, welfare gains for nonparticipants are higher than in the benchmark case. The discounted advantage of sharing the larger idiosyncratic risks when they participate in the future (intensive margin) is not outweighed by a smaller increase in participation (extensive margin).

We also replicate the results using a higher relative risk aversion $\sigma = 1.5$ (see Figure 16 for the variable cost reduction case and Figure 17 for the entry cost reduction case).[51] With higher risk aversion, participants save less, and thus a change in net-of-cost return has a smaller effect on the lifetime utility.[52] As such, welfare gains for participants become lower, and so do those for nonparticipants, who expect to become participants in the future (Table 4). Overall, the gain is 18 percent of permanent consumption. Growth rates can be higher, 0.67 percent, under the iterated shocks or lower, -0.32 percent, under the mean shocks. The results of the entry-cost-reduction case relative to the benchmark case are similar qualitatively to those of the variable-cost-reduction case (Table 5).

Finally, we would like to look at the implication of imperfect risk sharing upon participation in the financial system. As the model would differ substantially, we instead experiment with a lower variation in idiosyncratic shock ϵ, which gives households less incentive to join the financial system for risk sharing purpose. With half of the variance in idiosyncratic shock, the overall welfare gains are 13.4 percent of permanent consumption, about half of the estimates under the benchmark case (Table 4). The growth rate is now negative, -0.12 percent, under the iterated shocks, although it is positive 0.32 percent under the mean shock. For the entry cost reduction case, reduction in the growth rate is quite high both for the iterated and the mean shocks (Table 5). More importantly, the welfare gains are 0.5 percent, only a quarter of the estimates under the benchmark case.

B. Comparison to Business Cycle Literature

Our exercise is different from the literature on the welfare gains from risk sharing in three dimensions. First, existing studies compare current volatility to no volatility (with and without domestic business cycles) or to perfect risk sharing among countries (international risk sharing). Apparently, any endogenous choice of risk-sharing activity is not typically taken into account in this literature. Second, in our model, not only risk sharing but also an informational advantage increase the welfare gain—though the effect of the latter may be small as shown in the previous section. Finally, our study focuses on domestic, individual-level volatility, which is quite high, rather than the volatility of macro variables, in which individual shocks are averaged out by construction.

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[51] The iterated shocks necessary to mimic the GDP growth data are much higher than those in the benchmark case, as reported in the last rows of Tables 4 and 5. This implies that the set of parameter values is less likely to generate the actual Thai data.

[52] With a log utility, the savings rate is constant at β regardless of returns. With a CRRA utility, the savings rate depends on the relative risk aversion parameter and the mean and variance of returns, $\mu^* = \{\beta E[(\hat{\gamma}R(\theta))^{1-\sigma}]\}^{1/\sigma}$ (see Townsend and Ueda (2006) for the derivation). This is because the reciprocal of parameter σ also represents the intertemporal elasticity of substitution. Higher σ means not only higher risk aversion but also lower elasticity, less preference towards future consumption, and hence lower savings.

The welfare gains of moving from autarky, $W_0(k)$, to perfect participation, $V(k)$, with no cost is similar to what the existing literature calculates, namely, exogenously turning off and on the advantages of financial system. Specifically, $V(k)$ is expressed as (see Townsend and Ueda 2006),

$$V(k) = \frac{1}{1-\beta}\ln(1-\beta) + \frac{\beta}{(1-\beta)^2}\ln\beta + \frac{\beta}{(1-\beta)^2}\int \ln \hat{\gamma}R(\theta)\, dF(\theta) + \frac{1}{1-\beta}\ln k. \tag{13}$$

$W_0(k)$ has a different third term but otherwise the same as $V(k)$. Thus, the utility difference of the third terms of $V(k)$ and $W_0(k)$ under the benchmark parameter values is,

$$\frac{\beta}{(1-\beta)^2}\left(\int \ln \hat{\gamma}R(\theta)dF(\theta) - \int \ln e^{**}(\eta)dH(\eta)\right) = 19.3, \tag{14}$$

where $e^{**}(\eta)$ is the optimized per unit return based on the optimal portfolio choice, which is 0.38 for the benchmark parameter values. The Hicks wealth compensation $\tau(k)$ should satisfy the following equation:[53]

$$V(k) = W_0(k+\tau(k)) = W_0(k) + \frac{1}{1-\beta}\ln\left(1+\frac{\tau(k)}{k}\right). \tag{15}$$

But, we already know the numerical value of the difference between $V(k)$ and $W_0(k)$ in equation (14),

$$19.3 = V(k) - W_0(k) = \frac{1}{1-\beta}\ln\left(1+\frac{\tau(k)}{k}\right). \tag{16}$$

Thus,

$$\frac{\tau(k)}{k} = \exp\left(19.3(1-\beta)\right) - 1 = 1.16. \tag{17}$$

That is, the welfare gains are always 116 percent of wealth for all values of k.[54]

This total gain from a regime change stems from two functions of the banking technology. One is sharing the risk of idiosyncratic shocks and the other is selecting projects. By avoiding low aggregate returns, banks offer higher expected returns as well as insurance against low aggregate shocks. To figure out the relative contribution of the two functions, we compute the utility gain as above but assume no idiosyncratic risks, that is, $\eta = \theta + \epsilon$ is replaced by θ, then,

$$\frac{\beta}{(1-\beta)^2}\left(\int \ln \hat{\gamma}R(\theta)dF(\theta) - \int \ln e(\theta)dF(\theta)\right) = 14.8, \tag{18}$$

with the same portfolio choice allocation (0.38 on risky assets) as used in (14). The compensating wealth transfer turns out 82 percent of wealth. This is the welfare gain from project selection. The remaining 34 percent, out of 116 percent, could be regarded as a pure risk sharing effect. This

[53]The last term of $W_0(k+\tau(k))$ can be expressed as:

$$\frac{1}{1-\beta}\ln\left(k+\tau(k)\right) = \frac{1}{1-\beta}\ln\left(\left(1+\frac{\tau(k)}{k}\right)k\right) = \frac{1}{1-\beta}\ln k + \frac{1}{1-\beta}\ln\left(1+\frac{\tau(k)}{k}\right).$$

[54]With higher risk aversion $\sigma = 1.5$, the wealth compensation is about 92 percent of wealth. This is smaller than the log utility case, partly because the savings rate (and thus wealth growth) becomes lower with better risk insurance and because the optimal portfolio under autarky is not so volatile with a higher weight in safe projects.

decomposition of the overall gain is not similar to the results under transition dynamics explained in the previous section, in which risk sharing provides almost all the total welfare gains.

However, the risk sharing effects can be much larger in the on-off experiment, too, because, without idiosyncratic shocks, the optimal portfolio selection of the risky assets is no longer 0.38 but rather 1.00 (under the benchmark parameter values). With this new portfolio share, individuals choose more higher-risk and higher-return projects. Put differently, if idiosyncratic risk insurance were to be provided to never-joiners, welfare gains from financial participation, just to take advantage of project selection, would be very low as shown in (19) below:

$$\frac{\beta}{(1-\beta)^2}\left(\int \ln \hat{\gamma} R(\theta) dF(\theta) - \int \ln e^{**}(\theta) dF(\theta)\right) = 0.14. \tag{19}$$

The compensating wealth transfer is virtually zero. This is because those never-joiners with risk insurance would invest happily in risky assets much more (1.00 v.s. 0.38) and enjoy a much higher autarkic return than those without risk insurance. Apparently then, the risk sharing function alone can create much of the welfare gains in total gains in (14). This is consistent with the previous result, almost all the welfare gains are from risk sharing when comparing the lower-safe-return case and the benchmark case, as households optimize their decisions in each case.

A critical departure from the business cycle literature is that our model incorporates high volatility at the household level. This creates large welfare gains from the on-off risk sharing in our model, even without any growth effects. This contrasts to the business cycle literature, which typically reports less than 0.5 percent welfare gains in permanent consumption from eliminating aggregate volatilities. If we also count growth effects from risk sharing, even larger welfare gains emerge. This again contrasts to typical studies of the welfare gains from eliminating business cycles, as they are based on simple exogenous endowment economies, without long-run growth effects.[55] However, large welfare gains due to growth effects is consistent with a recent business cycle study of Alvarez and Jermann (2004), who show that large welfare gains, more than 1000 percent, are possible by eliminating longer-term trend movements in GDP growth rates.[56]

The advantage of this on-off experiment is that it is directly comparable to the literature. We emphasize, however, that this on-off experiment does not correspond to the reality of financial liberalization. Provided that household decisions regarding participation in the financial system are endogenous and based on the costs and benefits of financial services, financial liberalization affects the household cost-benefit calculation and alters the aggregate path of financial deepening. Here, for us, transitional dynamics—and thereby the economy's initial position and history—are important,

[55] An exception is Epaulard and Pommeret (2003), a simulation study based on Obstfeld (1994), an Ak growth model with recursive utility. Their representative macro agent invests in higher-risk and higher-return projects when risks are insured; this creates higher growth and, more to the point, a higher welfare gain in terms of wealth compensation. They find potentially large welfare gains, but the range is quite wide, 0.03 percent to 34 percent. Note also that their model always predicts positive growth gains, which are not consistent with the empirical literature.

[56] The welfare gains could be larger if financial liberalization also induced improvements in project selection technology and thereby higher growth. For example, Greenwood, Sanchez, and Wang (2007) illustrate that world-wide improvements in the financial technology to the frontier would cause about a 20 percent increase in world GDP. On the other hand, a diminishing-return technology, not a linear one as assumed in this paper, may provide lower welfare gains, depending on whether the long-run productivity growth rate, not only the level, is affected by a better functioning financial system. While our model assumes so, a simple model with diminishing-return technology would not. A further quantitative study could distinguish growth or level effects of a better financial system.

much more so than in business cycle analysis.[57] For example, even if financial liberalization reduces costs and raises benefits, it would not affect overall welfare much if everyone were very poor. This is because the poor would enjoy benefits of the financial system only in distant future, after accumulating enough capital to make it worthwhile to utilize financial services. In contrast, a steady-state on-off comparison implicitly assumes that everyone starts using financial services immediately after a policy change. Somewhere in between those two extremes is the Thai episode, as the liberalization occurred in the middle of the financial deepening process, in which some households join the financial system immediately but the poor join much later. Also, transitional dynamics create more complex effects than in a simple on-off experiment. Our sensitivity analysis with higher risk aversion and lower variance of idiosyncratic shocks shows that changes in key parameter values bring nonlinear and somewhat counter-intuitive effects on gains in growth and welfare, unlike the more predictable effects in on-off experiments.

C. Pinning Down the Cost Structure

Given the large difference in welfare gain estimates, it is natural to ask which case, variable-cost reduction or entry-cost reduction, describes the Thai experience better. Although we believe that the reality of the Thai episode is a mixture of both cases, we may be able to pin this down further by looking at predictions for other variables. We pick two variables: the first one is the Theil measure of inequality and the second one is the investment-to-output ratio. The latter is defined in the actual data as gross private-fixed-capital formation divided by GDP (again from IMF's World Economic Outlook database) and in the model as the difference in aggregate savings divided by capital —since in our model savings s_t is used as the input to produce the output k_{t+1} and the aggregate of the difference $s_t - s_{t-1}$ is close to the notion of "capital formation" in the actual national accounts. Note that the simplifying assumption of a 100 percent depreciation rate makes the model difficult to match perfectly with the data conceptually.

Figure 22 shows simulation results and actual data for the evolution of inequality. The actual inequality measure (dashed line) increases almost steadily up to 1986, sharply increases right after the financial liberalization up to 1990, plateaus for a while, and then declines after 1993. The model cannot generate the decline after 1993, which is confirmed with more robustness checks in Townsend and Ueda (2006). However, qualitatively, compared with the dotted line that represents the no-reform case (but with the same aggregate shocks), both the variable-cost-reduction case (solid line) and the entry-cost-reduction case (dot-dash line) show a kink around 1987 and a sharp increase thereafter.[58] Unlike the entry-cost-reduction case or the no-reform case, however, the simulated path of income inequality for the variable-cost-reduction case fits the actual data better, at least until 1990. Participants' wealth increases less before the reduction, creating a lower inequality trajectory, while inequality is always too high in other cases.

Figure 23 shows simulation results and actual data for the evolution of the investment-to-output ratio. The left axis shows the unit for the actual data, while the right axis shows the unit for the model simulation. Note again that the conceptual mismatch between the model and data requires some unit adjustments in comparing the actual capital formation and the aggregates of the model

[57] We owe this point to a referee.

[58] Recall that variable-cost reduction makes inequality worsen in terms of welfare by bringing higher welfare gains for participants, while effects on inequality are less straightforward in the entry-cost-reduction case without simulations.

counterpart $s_t - s_{t-1}$. However, the shapes of the model simulations trace relatively well that of the actual data. This is somewhat surprising given the fact that a standard neoclassical growth model struggles to match relatively constant, if not increasing, investment-to-output ratio over the growth process, because a neoclassical growth model predicts larger investments due to higher returns at low income levels (see recent contributions, for example, Acemoglu and Guerrieri 2008 and Buera and Shin 2008). Since our model is based on a linear Ak growth model, it is relatively easy to generate a constant investment-to-output ratio over time. However, the actual Thai data (dashed line) show that a sudden rise in the investment-to-output ratio during 1987 to 1990 after a relatively stable period from 1976 to 1986. This movement can stem either from a regime change or transitory large positive shocks that induce higher overall savings (and thus capital formation). Indeed, both forces appear to play roles according to our model simulations. We again compare simulations of the no-reform case, the variable-cost-reduction case, and the entry-cost reduction case. In each case, there is too much of a hike around 1987 compared to the actual data. However, investments in the no-reform case overshoot the most. The model simulation of the variable-cost-reduction case fits the actual movements over the whole sample period better than the entry-cost-reduction case.

Overall, the variable-cost-reduction case is more successful in tracing both inequality and the investment-to-output ratio. We need to be cautious in interpreting the results, since the model is designed to be simple, to focus on GDP growth and financial deepening, and is not well equipped to predict movements in other variables. Nevertheless, given the simulation results for these additional two variables, we judge that welfare gains from the specific financial liberalization episode in Thailand in 1987-89 are likely to be near the 27 percent suggested by the variable-cost-reduction case, rather than around the 2 percent suggested by the entry-cost-reduction case.

VIII. Concluding Remarks

This paper contributes to a lively debate on financial liberalization. We report welfare gains based on an endogenous financial deepening model, calibrated to an actual financial liberalization episode. To the best of our knowledge, there is nothing quite like this in the literature. Financial repression and liberalization are represented as changes in variable and entry costs for financial services. Those changes in costs affect both financial deepening and economic growth. Based on historical events, we report on the *de facto* evolution of financial sector policy in Thailand from 1976 to 1996, in particular, a repression in 1980-1986 followed by a significant financial liberalization in 1987–1989. We evaluate this specific financial liberalization episode in terms of growth and welfare gains, allowing for other potential factors which might affect growth, using a sequence of aggregate shocks that makes the model trace the actual path of GDP growth.

We find sizable welfare gains, although the model predicts, consistent with the literature, ambiguous effects on growth. Specifically, we find population-average welfare gains as high as 0.5 to 28 percent of permanent consumption, while the effects on economic growth range from -0.3 to 0.7 percent on average for the subsequent 10 years. Note that those numbers would change for other countries depending on their income level and the degree of financial deepening, and more precisely, on the underlying historical evolution of wealth. At the household level, welfare gains are not distributed equally. For nonparticipants, the gains are larger for those who had relatively large wealth and were about to enter the financial system in the near future. Participants receive benefits only from the reduction of the variable cost, not the entry fee.

The seemingly large variations in population-average welfare gains reflect two different types of experiments regarding policy distortions, one through the reduction of the one-time fixed cost to start using financial services and the other through the reduction of the variable cost of financial services. By looking at implications in inequality and investment, we judge that the financial liberalization episode in Thailand 1987-89 is more consistent with the variable-cost-reduction case and the welfare gains must be near 28 percent, the upper-end of our estimates. Moreover, we show that some of the insights from on-off experiments on a steady-state economy do not carry over to the effects of financial liberalization in a developing economy during an endogenous financial deepening process. For example, the risk sharing role in the welfare gains can be much larger in transitions than an on-off experiment would suggest. The optimally-adjusted participation decision appears to absorb the return advantage given by financial services, while that advantage is important in an on-off experiment.

Of course, we regard this paper as a first step only. We are pleased and surprised by how well we do in tracking the actual data and in dating *de facto* repressions and liberalizations. There is a close match with the historical evidence. However, by focusing on financial deepening and growth based on a rather simple model, we recognize that we have neglected other factors through which finance may affect growth and the welfare calculations; for example, credit constraints to start new business and liquidity needs to continue business.

There is also a caveat on the specific years we selected. The Asian Crisis started in Thailand 1997, one year after our sample period ends. One of the triggers was a large percentage of nonperforming loans. Presumably this is associated with inefficient lending, in particular to real estate with foreign liabilities, in years prior to 1997. The point is that our assumption of an efficient allocation of capital by private banks in an essentially closed economy does not describe all key features of the Thai economy in mid 1990's, preceding the crisis. So, our estimates of welfare gains from liberalizations in the middle of 1980s appear to be overstated. There are, however, diversified views in the literature. Some criticize liberalization (e.g., Stiglitz 2000), others point to higher growth for liberalized countries even with occasional crises (e.g., Ranciere, Tornell, and Westermann 2006), and yet others take the middle ground and suggest reform was imperfect or needed to be complemented by good institutions such as corporate governance (e.g., Johnson, et al. 2000).

We would like to leave these debates on the causes of crises and relevant policy recommendations for future efforts. There are, however, two important lessons from our study of Thailand 1976 to 1996. First, financial repression sometimes causes a crisis, too, specifically due to nominal interest controls with ill-controlled inflation. A similar episode can be found in Japan in the late 1980s, when interest rate controls combined with the introduction of a corporate bond market created heightened financial repression. Second, a government may overreact to a crisis and create further distortions. In Thailand, the government started massive recapitalization in 1983 and took control of banks (and companies) until the late 1980s. This further heightened *de facto* financial repression, with capital allocation less efficient. Such over-reactions by government in the financial system after a crisis, with associated efficiency losses, are not unique to Thailand. In historical corporate finance studies, Kroszner and Rajan (1994) and Rajan and Zingales (2003) find that free and open financial systems were essentially gone after the 1920s—not revived until the 1980s—and that many countries that had increased government interventions did so with little economic basis. Indeed, these financial repressions may have caused productivity losses. In empirical studies based on general equilibrium models, Chari, Kehoe, and McGrattan (2007) hypothesize an efficiency loss brought on by an ill-functioning financial system during the Great Depression in the U.S., and Cole, Ohanian, and

Leung (2007) hypothesize that similar finance channels played a major role in the depressions of many countries in the 1930s. Note, however, that unlike these steady-state business-cycle models, transitional dynamics are important in emerging market countries such as Thailand 1976-1996, especially as financial repression and liberalization naturally change entire paths of financial deepening and economic growth.

In summary, a more realistic model with additional policy considerations would alter the welfare impacts but would not undercut our general point: an evaluation of financial repression and liberalization needs a model-based study, and policy changes are layered on top of endogenous financial deepening. Our study displays a clear picture of the mechanism under which financial sector policy affects the economy. In particular, we find that financial liberalizations may contribute little to growth but increase welfare substantially. We surmise that similar effects—but in the opposite direction—could become reality if governments in developing countries were to overregulate or directly manage banks for long periods in the wake of the current financial crisis.

REFERENCES

Abiad, Abdul, and Ashoka Mody, 2004, "Finance for Development: Access, Incentives, or Both?," (April). Unpublished Manuscript, IMF.

_____, and _____, 2005, "Financial Reform: What Shakes It? What Shapes It?," *American Economic Review*, Vol. 95, No. 1 (March), pp. 66–88.

_____, Nienke Oomes, and Kenichi Ueda, 2008, "The Quality Effect: Does Financial Liberalization Improve the Allocation of Capital?," *Journal of Development Economics*, Vol. 87, pp. 270–282.

Acemoglu, Daron, and Fabrizio Zilibotti, 1997, "Was Prometheus Unbound by Chance? Risk, Diversification, and Growth," *Journal of Political Economy*, Vol. 105, No. 4 (August), pp. 709–751.

_____, and Veronica Guerrieri, 2008, "Capital Deepening and Nonbalanced Economic Growth," *Journal of Political Economy*, Vol. 116, No. 3 (June), pp. 467–498.

Acharya, Viral V., Jean Imbs, and Jason Sturgess, 2006, "The Efficiency of Capital Allocation: Do Bank Regulations Matter?" Unpublished Manuscript, London Business School.

Alem, Mauro, and Robert M. Townsend, 2007, "An Evaluation of Safety Nets and Financial Institutions in Crisis and Growth." Unpublished Manuscript, University of Chicago.

Allen, Franklin, and Douglas Gale, 2000, *Comparing Financial Systems* (Cambridge: MIT Press).

Alvarez, Fernando, and Urban J. Jermann, 2004, "Using Asset Prices to Measure the Cost of Business Cycles," *Journal of Political Economy*, Vol. 112, No. 6, pp. 1223–1256.

Aoki, Masahiko, Hyung-Ki Kim, and Masahiro Okuno-Fujiwara, eds, 1996, *The Role of Government in East Asian Economic Development* (Oxford: Clarendon Press).

Bandiera, Oriana, Gerard Caprio, Patrick Hanohan, and Fabio Schiantarelli, 2000, "Does Financial Reform Raise or Reduce Saving?," *Review of Economics and Statistics*, Vol. 82, No. 2 (May), pp. 239–263.

Beck, Thorsten, Ross Levine, and Norman Loayza, 2000, "Finance and the Sources of Growth," *Journal of Financial Economics*, Vol. 58 (October/November), pp. 261–300.

Bekaert, Geert, Campbell Harvey, and Christian Lundblad, 2005, "Does Financial Liberalization Spur Growth?," *Journal of Financial Economics*, Vol. 77, pp. 3–55.

Berglöf, Erik, and Stijn Classens, 2003, "Enforcement and Good Corporate Governance in Developing Countries and Transition Economies," *The World Bank Research Observer*, Vol. 21, No. 1 (Spring), pp. 121–150.

Buera, Francisco J., and Yongseok Shin, 2008, "Financial Frictions and the Persistence of History." Unpublished Manuscript, Northwestern University.

Chari, V. V., Patrick J. Kehoe, and Ellen R. McGrattan, 2007, "Business Cycle Accounting," *Econometrica*, Vol. 75, No. 3, pp. 781–836.

Cole, Harold L., Lee E. Ohanian, and Ron Leung, 2007, "The International Great Depression: Deflation, Productivity and the Stock Market." Unpublished Manuscript.

de la Torre, Augusto, and Sergio L. Schmukler, 2007, *Emerging Capital Markets and Globalization: The Latin American Experience* (Palo Alto: Stanford University Press).

Devereux, Michael B., and Gregor W. Smith, 1994, "International Risk Sharing and Economic Growth," *International Economic Review*, Vol. 35 (August), pp. 535–550.

Diamond, Douglas W., 1984, "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, Vol. 51 (July), pp. 393–414.

Epaulard, Anne, and Aude Pommeret, 2003, "Recursive Utility, Endogenous Growth, and the Welfare Cost of Volatility," *Review of Economic Dynamics*, Vol. 6, pp. 672–684.

Fitzenberger, Bernd, 1997, "The Moving Blocks Bootstrap and Robust Inference for Linear Least Squares and Quantile Regressions," *Journal of Econometrics*, Vol. 82, pp. 235–287.

Galindo, Arturo, Alejandro Micco, and Guillermo Ordoñez, 2002, "Financial Liberalization: Does It Pay to Join the Party?," *Economia*, Vol. 3 (Fall), pp. 231–261.

Giné, Xavier, and Robert M. Townsend, 2004, "Evaluation of Financial Liberalization: A General Equilibrium Model with Constrained Occupation Choice," *Journal of Development Economics*, Vol. 74, pp. 269–307.

Greenwood, Jeremy, and Boyan Jovanovic, 1990, "Financial Development, Growth, and the Distribution of Income," *Journal of Political Economy*, Vol. 98, pp. 1076–1107.

_____, and Bruce D. Smith, 1997, "Financial Markets in Development, and the Development of Financial Markets," *Journal of Economic Dynamics and Control*, Vol. 21 (October), pp. 145–181.

_____, Juan M. Sanchez, and Cheng Wang, 2007, "Financing Development: The Role of Information Costs," *Economie d'Avant Garde Research Report*, No. 14.

Hoshi, Takeo, and Anil K. Kashyap, 2000, "The Japanese Banking Crisis: Where Did It Come from and How Will It End?," in Ben Bernanke, and Julio Rotemberg, eds., *NBER Macroeconomics Annual 1999*, (Cambridge: MIT Press), chapter 3, pp. 129–201.

Jayaratne, Jith, and Philip E. Strahan, 1996, "The Finance-Growth Nexus: Evidence from Bank Branch Deregulation," *Quarterly Journal of Economics*, Vol. 111, No. 3, pp. 639–670.

Jeong, Hyeok, and Robert M. Townsend, 2006, "Growth and Inequality: Model Evaluation Based on an Estimation-Calibration Strategy," *Macroeconomic Dynamics.* forthcoming.

Johnson, Simon, Peter Boone, Alasdair Breach, and Eric Friedman, 2000, "Corporate Governance in the Asian Financial Crisis," *Journal of Financial Economics*, Vol. 58, pp. 141–186.

Kaminsky, Graciela L., and Sergio L. Schmukler, 2003, "Short-Run Pain, Long-Run Gain: The Effects of Financial Liberalization," *IMF Working Paper*, No. 03/34.

King, Robert G., and Ross Levine, 1993, "Finance and Growth: Schumpeter Might be Right," *Quarterly Journal of Economics*, Vol. 108, No. 3 (August), pp. 717–737.

Kroszner, Randall S., and Raghuram G. Rajan, 1994, "Is the Glass-Steagall Act Justified? A Study of the U.S. Experience with Universal Banking Before 1933," *American Economic Review*, Vol. 84, No. 4 (September), pp. 810–832.

Levine, Ross, Norman Loayza, and Thorsten Beck, 2000, "Financial Intermediation and Growth: Causality and Causes," *Journal of Monetary Economics*, Vol. 46, No. 1 (August), pp. 31–77.

Lucas Jr., Robert E., 1987, *Models of Business Cycles* (Oxford: Basil Blackwell).

McKinnon, Ronald I., 1973, *Money and Capital in Economic Development* (Washington: Brookings Institution).

Obstfeld, Maurice, 1994, "Risk-Taking, Global Diversification, and Growth," *American Economic Review*, Vol. 84, No. 5, pp. 1310–1329.

_____, 1995, "International Capital Mobility in the 1990s," in Peter B. Kenen, ed., *Understanding Interdependence*, (Princeton: Princeton University Press), pp. 201–261.

Prasad, Eswar S., Kenneth Rogoff, Sahng-Jin Wei, and M. Ayhan Kose, 2003, *Effects of Financial Globalization on Developing Countries* (Washington: International Monetary Fund). IMF Occasional Paper 220.

Rajan, Raghuram G., and Luigi Zingales, 2003, "The Great Reversals: The Politics of Financial Development in the Twentieth Century," *Journal of Financial Economics*, Vol. 69, pp. 5–50.

Ranciere, Romain, Aaron Tornell, and Frank Westermann, 2006, "Decomposing the Effects of Financial Liberalization: Crises vs. Growth," *Journal of Banking and Finance*, Vol. 30, pp. 3331–3348.

Robinson, David, Yangho Byeon, Ranjit Teja, and Wanda Tseng, 1991, *Thailand: Adjusting to Success, Current Policy Issues* (Washington: International Monetary Fund). IMF Occasional Paper 85.

Shaw, Edward S., 1973, *Financial Deepening in Economic Development* (New York: Oxford University Press).

Stiglitz, Joseph E., 2000, "Capital Market Liberalization, Economic Growth, and Instability," *World Development*, Vol. 28, No. 6, pp. 1075-1086.

Tornell, Aaron, and Frank Westermann, 2005, *Boom-Bust Cycles and Financial Liberalization* (Cambridge: MIT Press).

Townsend, Robert M., 1978, "Intermediation with Costly Bilateral Exchange," *Review of Economic Studies*, Vol. 45 (October), pp. 417–425.

_____, 1983, "Theories of Intermediated Structures," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 18, pp. 221-272.

_____, and Jacob Yaron, 2001, "The Credit Risk–Contingency System of an Asian Development Bank," *Economic Perspectives*, Vol. Q3, pp. 31–48.

_____, and Kenichi Ueda, 2001, "Transitional Growth with Increasing Inequality and Financial Deepening," *IMF Working Paper*, No. 01/108.

_____, and _____, 2006, "Financial Deepening, Inequality, and Growth: A Model-Based Quantitative Evaluation," *Review of Economic Studies*, Vol. 73, No. 1 (January), pp. 251–293.

_____, Anna Paulson, Sombat Sakuntasathien, Tae Jeong Lee, and Mike Binford, 1997, "Questionnaire Design and Data Collection for NICHD Grant *Risk, Insurance and the Family*, and NSF Grants." Unpublished Manuscript, The University of Chicago.

Ueda, Kenichi, 2006, "Banks as Coordinators of Economic Growth," *IMF Working Paper*, No. 06/264.

Van Wincoop, Eric, 1999, "How Big are Potential Welfare Gains from International Risk Sharing?," *Journal of International Economics*, Vol. 47, No. 1, pp. 109–135.

Figure 1. Economic Growth and Financial Deepening (%)

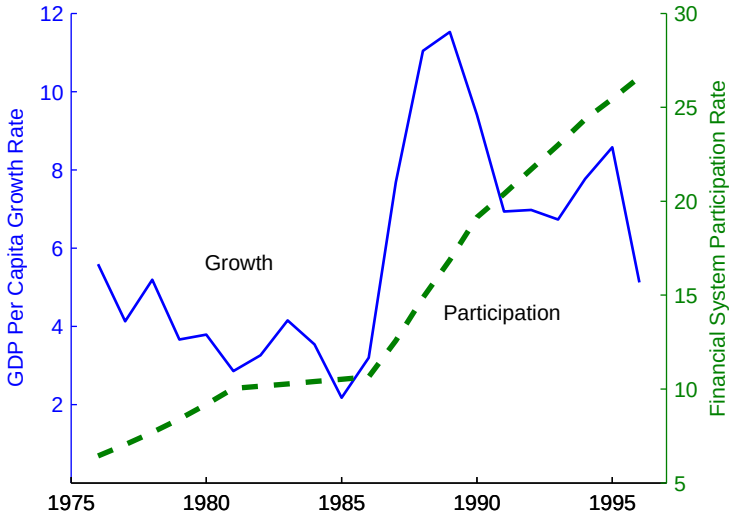

Figure 2. Use of Savings

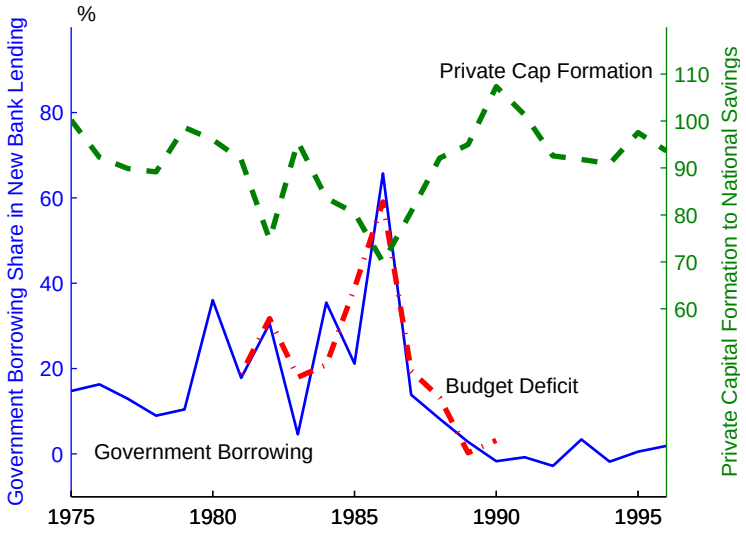

Figure 3. Financial Liberalization and Gini of Tobin's Q

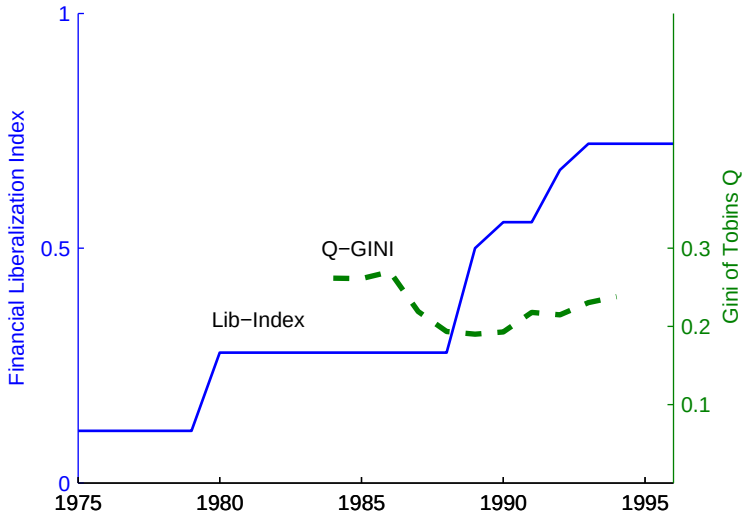

Figure 4. Inflation, Deposit Rate, and Spread

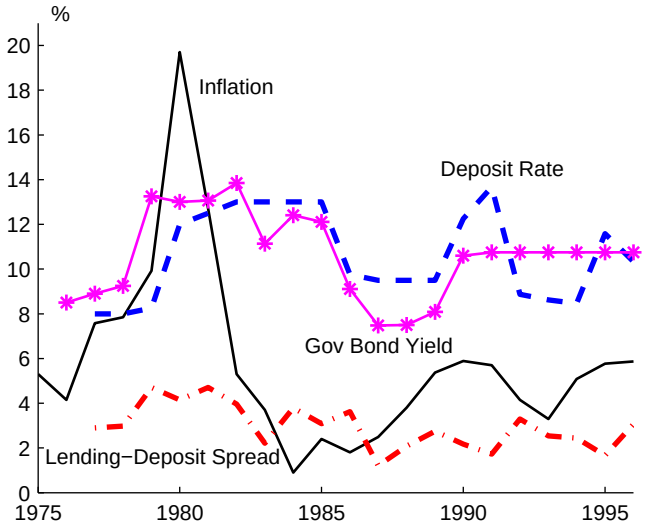

Figure 5. Real Growth of Deposits

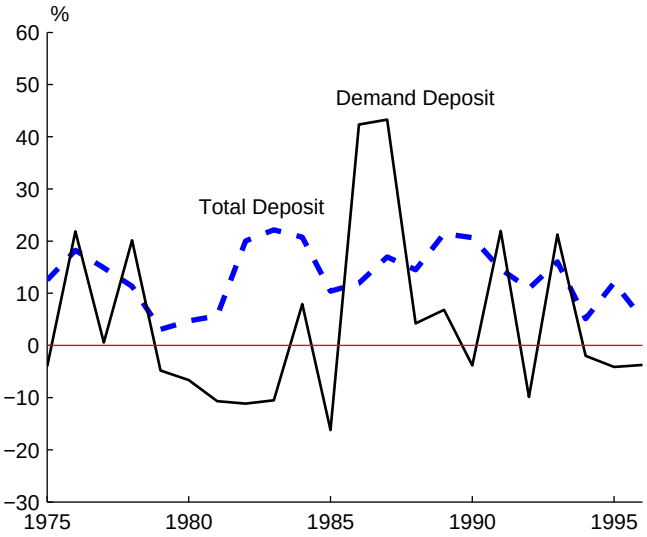

Figure 6. Government Revenues and Expenditures

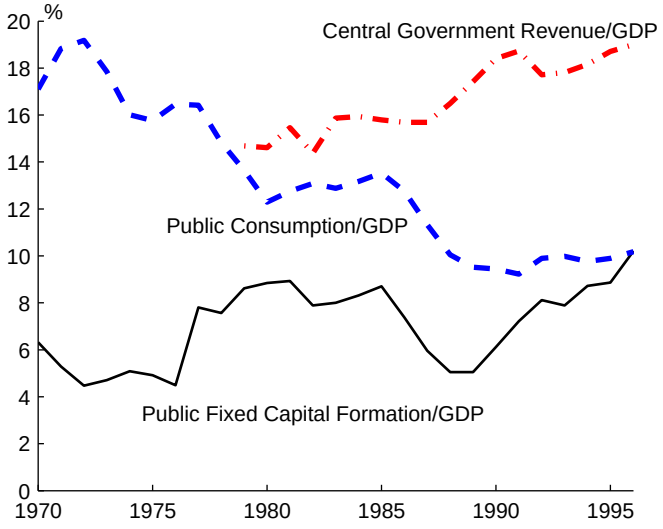

Figure 7. Value Functions

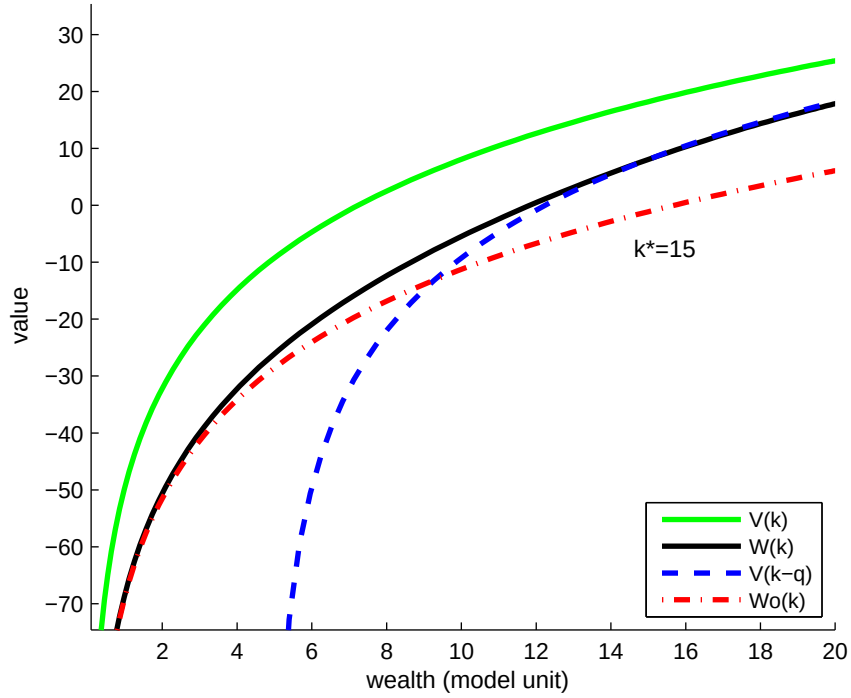

Figure 8. Policy Functions

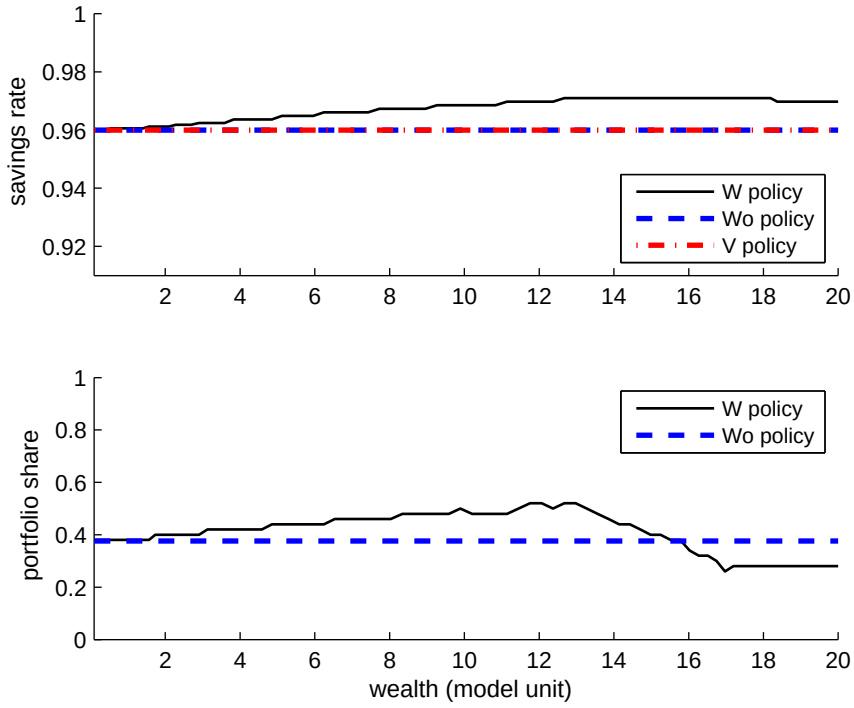

Figure 9. Wealth Evolution

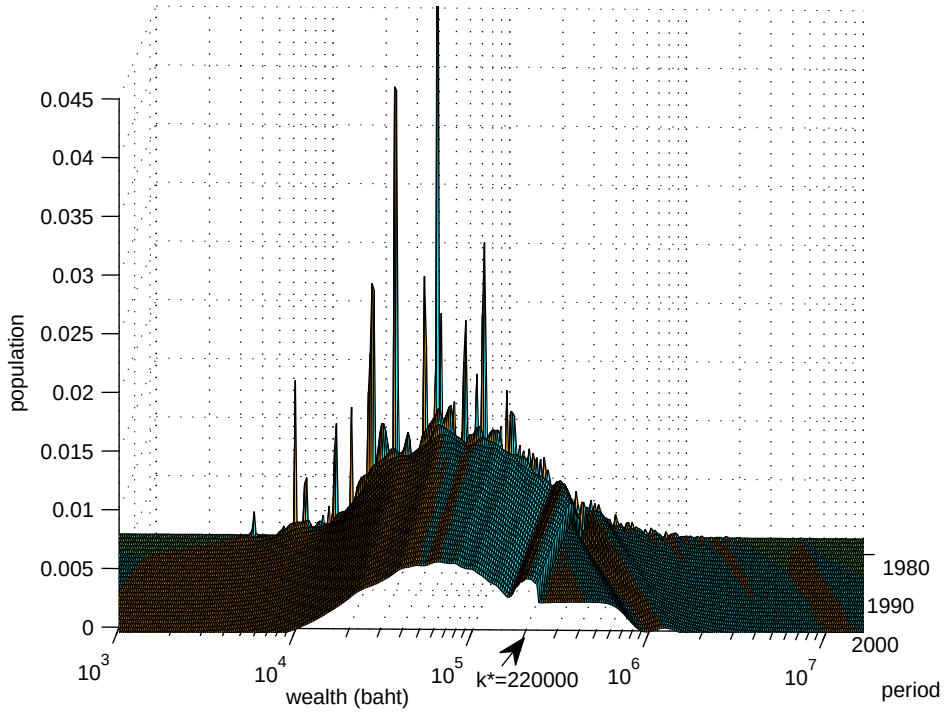

Figure 10. Benchmark

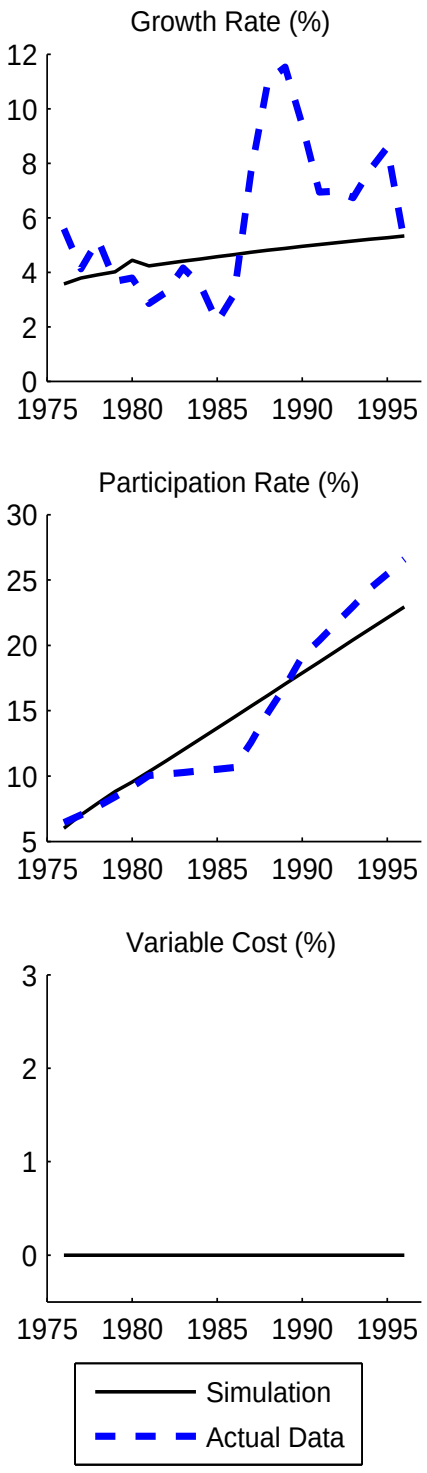

Figure 11. Guessed TFP Shocks

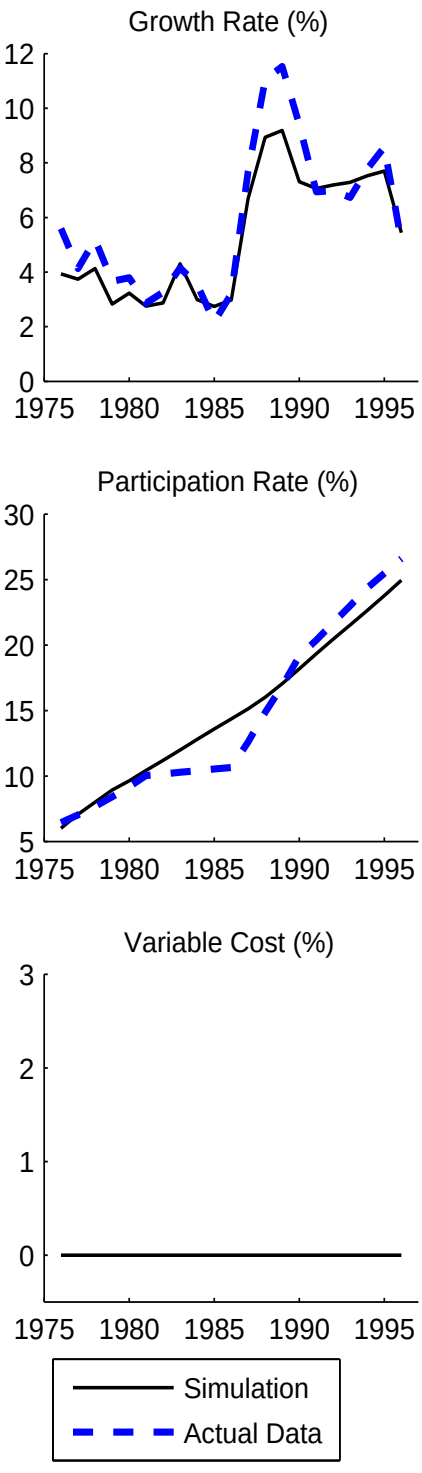

Figure 12. Changing Variable Costs

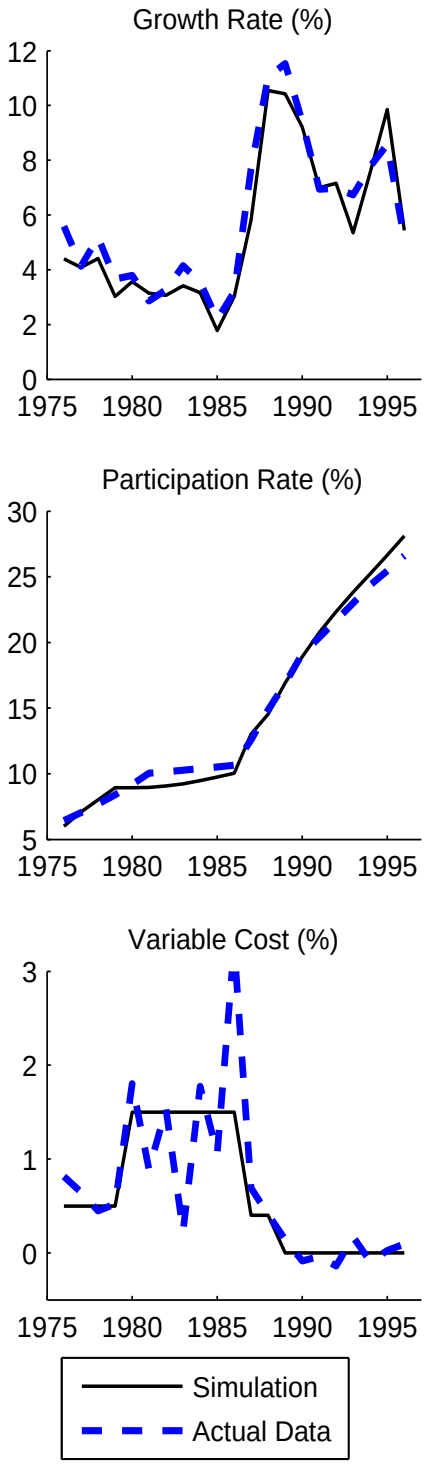

Figure 13. Changing Entry Costs

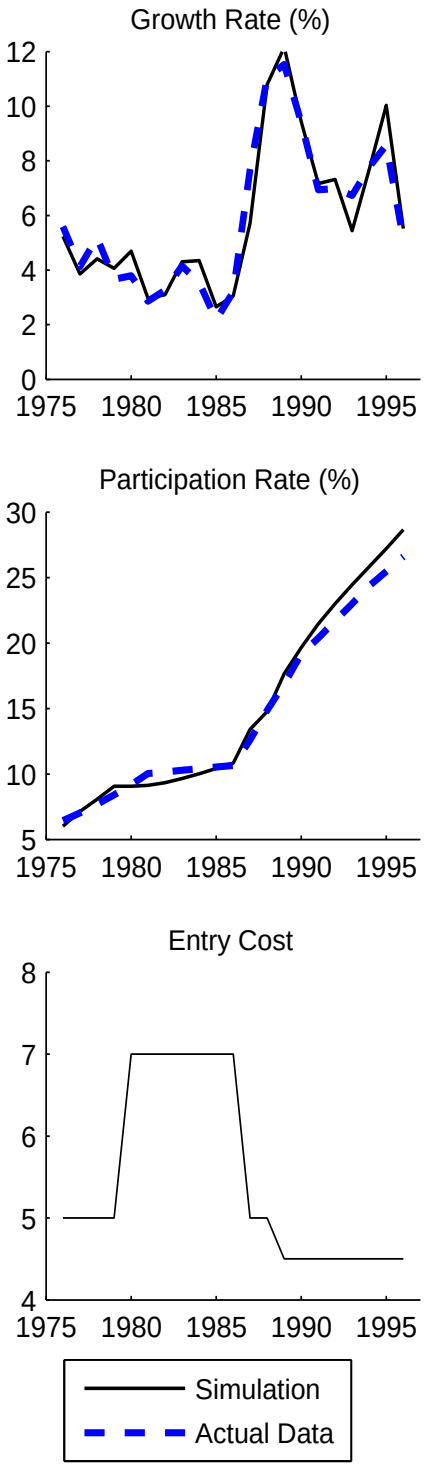

Figure 14. Lower Safe Return, Var Cost

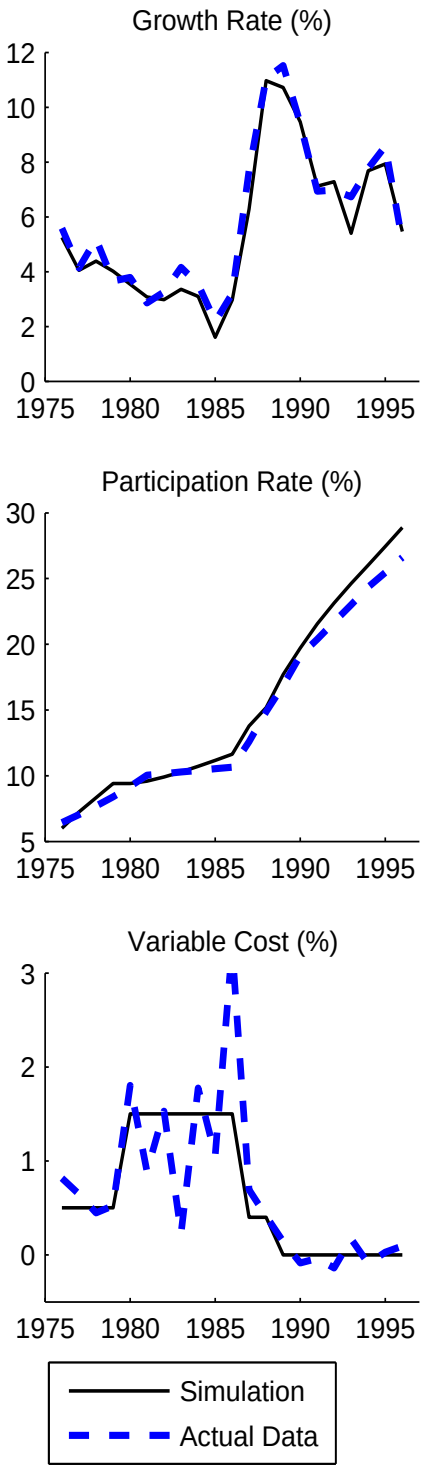

Figure 15. Lower Safe Return, Ent Cost

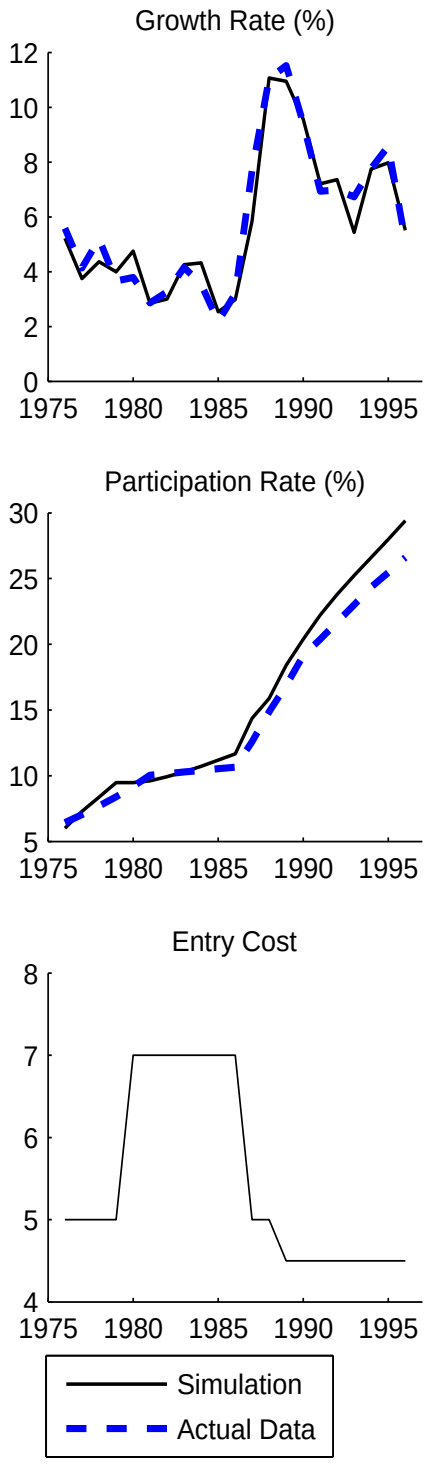

Figure 16. Higher Risk Aversion, Var Cost

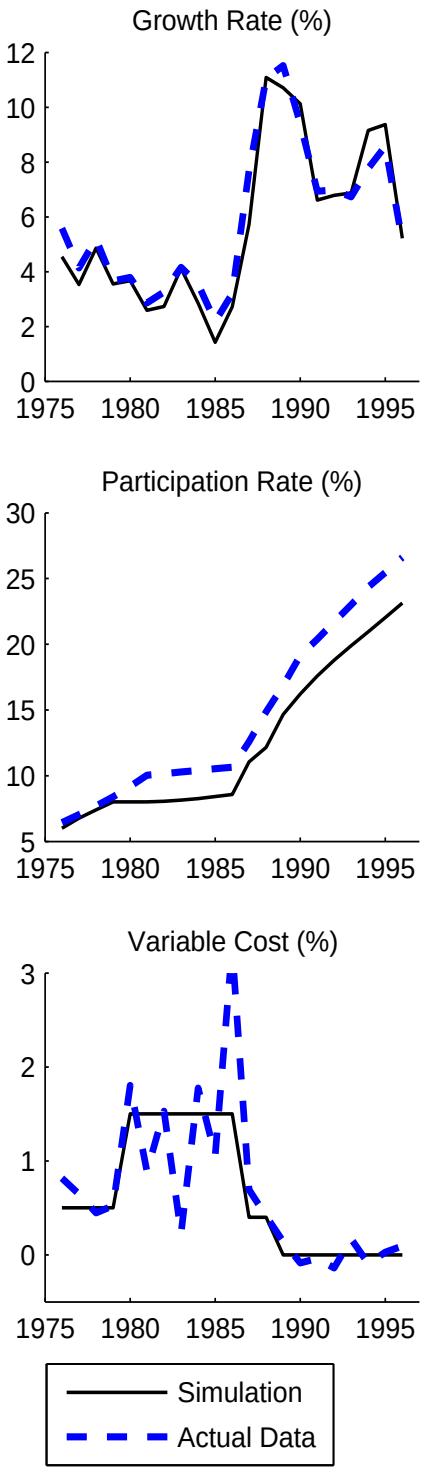

Figure 17. Higher Risk Aversion, Ent Cost

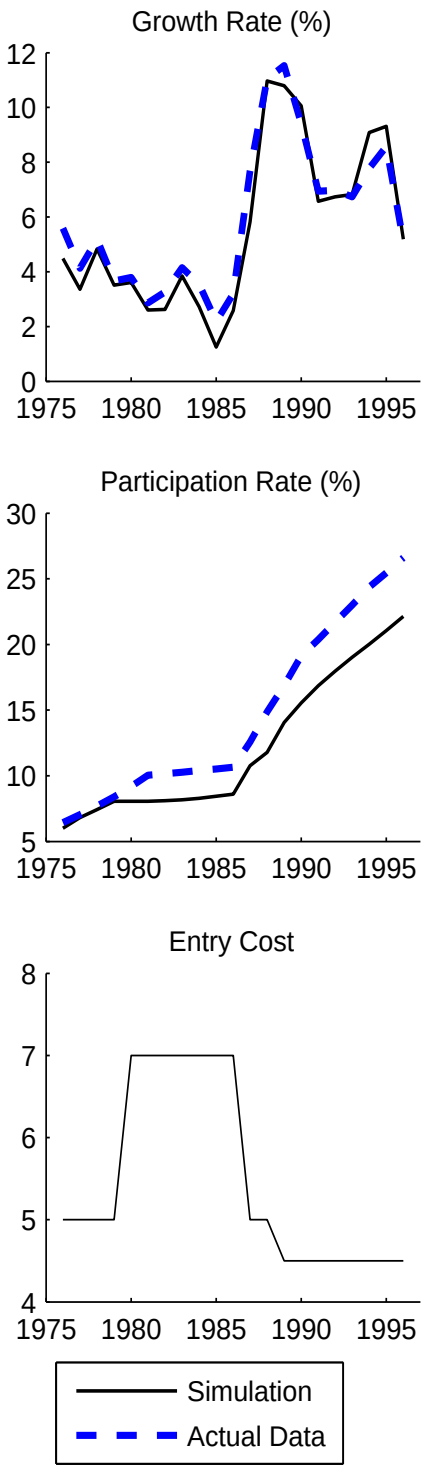

Figure 18. Lower Gov't Inefficiency

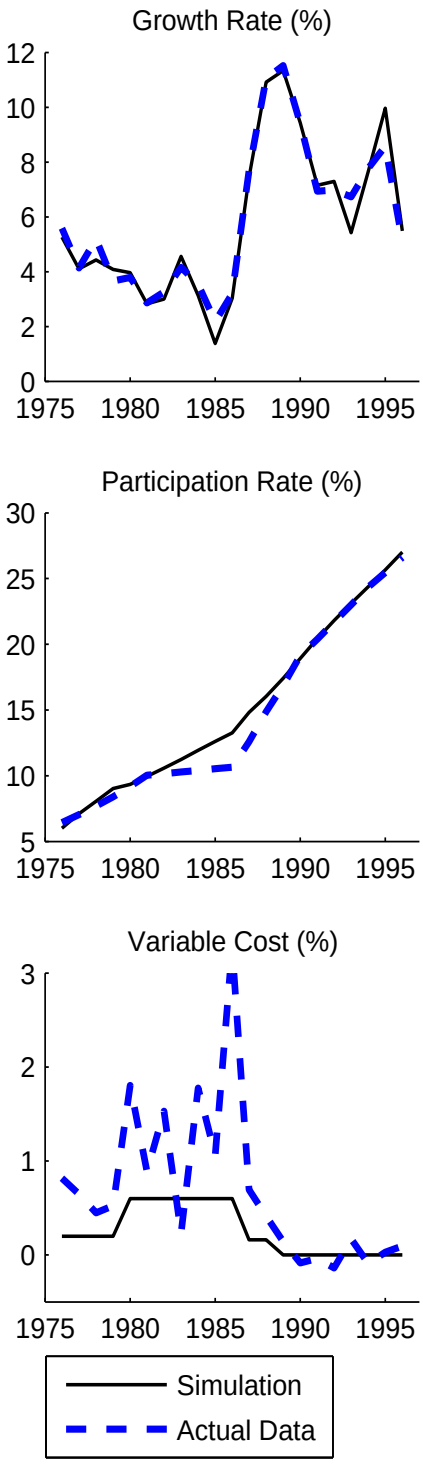

Figure 19. Higher Gov't Inefficiency

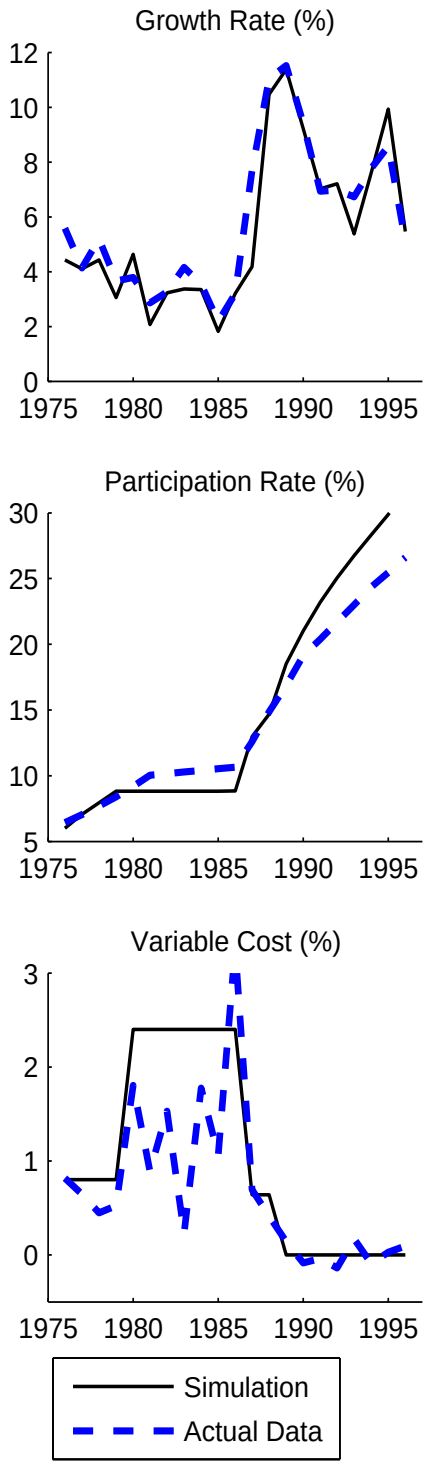

Figure 20. Welfare Gains from Eliminating 1.5% Variable Cost

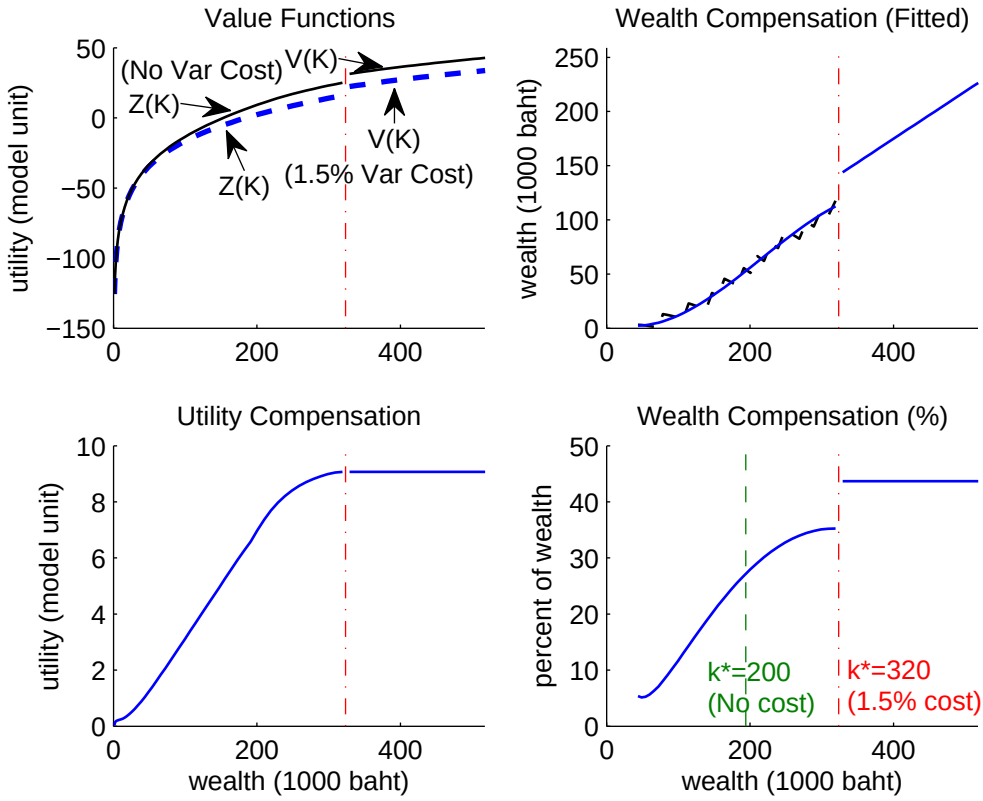

Figure 21. Welfare Gains from Reduction in Entry Cost, 100000 to 65000 baht (7 to 4.5 model unit)

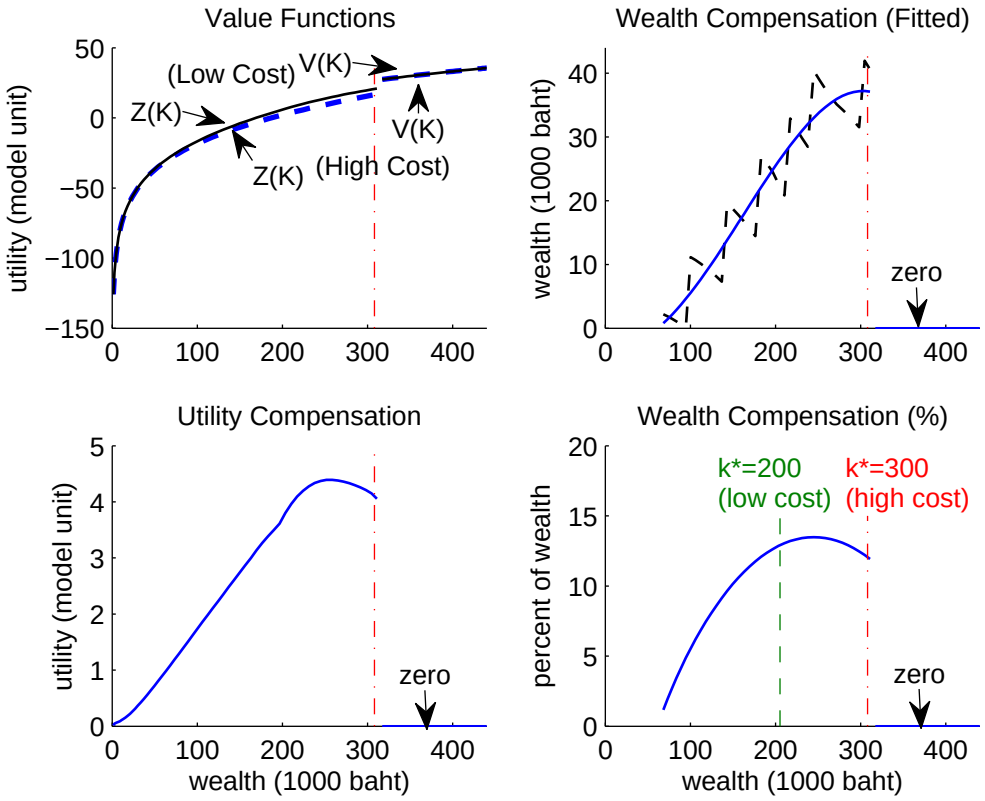

Figure 22. Theil Measure of Inequality

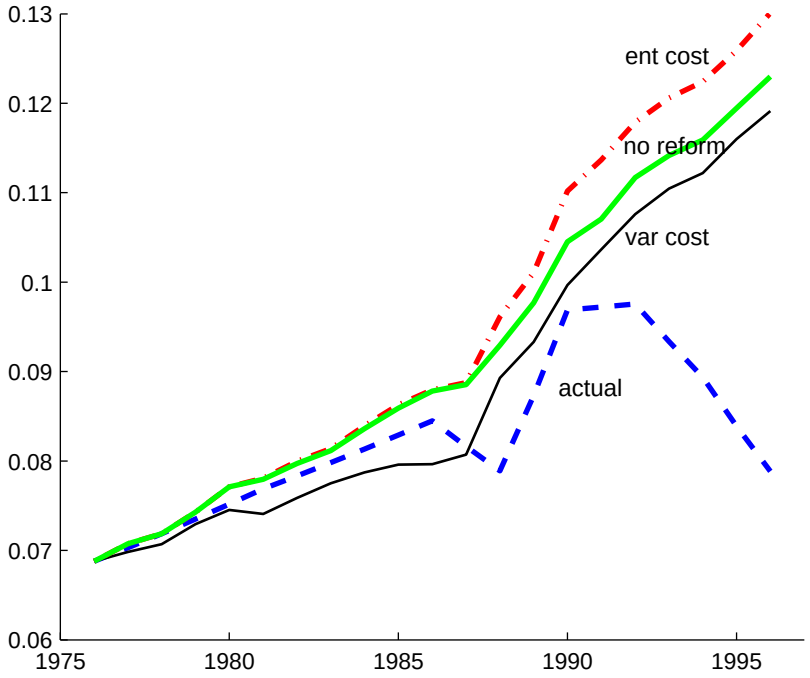

Figure 23. Investment-to-Output Ratio

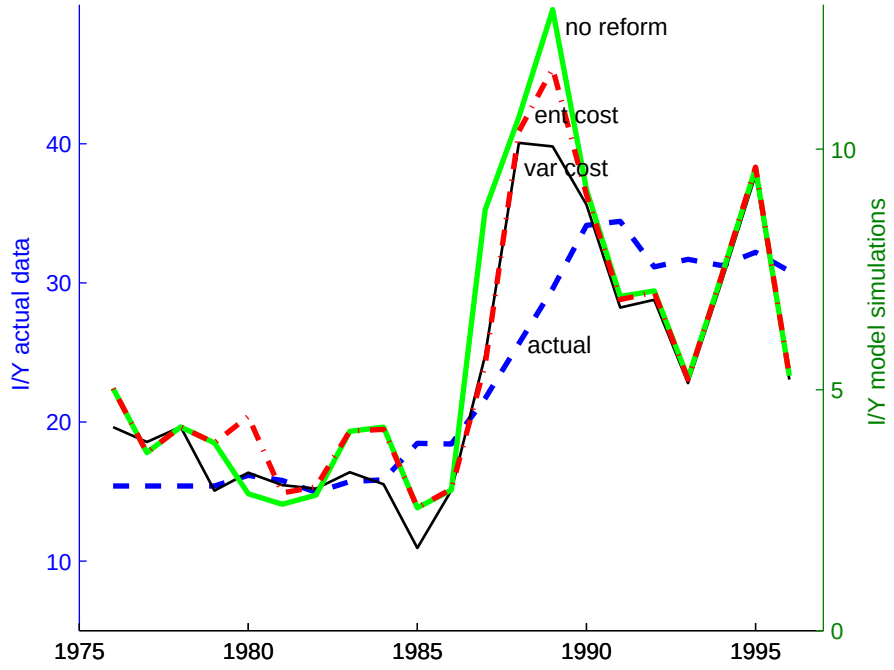

Table 1. Parameter Values

	Benchmark	Lower δ	Higher σ	Half Var(ϵ)	Changing α	Changing q
β	0.96					
σ	1		1.5			
δ	1.054	1.047				
$F(\theta)$	[1.047, 1.147]					
$G(\epsilon)$	[-0.6, 0.6]			$\left[-\frac{0.6}{\sqrt{2}}, \frac{0.6}{\sqrt{2}}\right]$		
γ	1					
z	0				0.05	0.05
α, 76-79	0				0.1	
α, 80-86	0				0.3	
α, 87-88	0				0.08	
α, 89-96	0				0	
q, 76-79	5					5
q, 80-86	5					7
q, 87-88	5					5
q, 89-96	5					4.5

Table 2. Growth Difference (%)

	1987-96 Growth Difference	Annualized Growth with Cost Reduction	Annualized Growth without Cost Reduction
Variable Cost Reduction in 1987 (1.5% to 0%)	0.59 [0.96]	6.87 [4.41]	6.28 [3.45]
Entry Cost Reduction in 1987 (7 to 4.5 model unit)	-0.14 [-0.26]	7.34 [4.48]	7.48 [4.74]

Note: Iterated shocks are used in the simulation. Numbers in brackets are the results of alternative simulation, using the expected value of shocks after 1987.

Table 3. Welfare Gains

	Aggregate Welfare Gains (% wealth)	Nonparticipants (population) [income share]	Participants (population) [income share]
Variable Cost Reduction in 1987 (1.5% to 0%)	27.1	14.2 (88.9) [56.3]	43.7 (11.1) [43.7]
Entry Cost Reduction in 1987 (7 to 4.5 model unit)	2.0	3.9 (88.0) [51.6]	0.0 (12.0) [48.4]

Table 4. Sensitivity Analysis: Variable Cost Reduction

	Benchmark Case	Lower Safe Return $\delta = 1.047$	Higher Risk Aversion $\sigma = 1.5$	Half Var(ϵ) $G(\epsilon) = \left[-\frac{0.6}{\sqrt{2}}, \frac{0.6}{\sqrt{2}}\right]$
Growth Difference (%)				
with iterated shocks	0.59	0.62	0.67	-0.12
[with mean shocks after 1987]	[0.96]	[1.06]	[-0.32]	[0.32]
Welfare Gains (% wealth)	27.1	27.9	18.0	13.4
(Nonparticipants)	(14.2)	(12.9)	(8.6)	(12.5)
[Participants]	[43.7]	[43.7]	[30.4]	[14.8]
Participation Rate in 1987 (%)	11.1	12.9	9.3	10.2
Average Magnitude of Agg. Shocks (%)	2.62	2.53	5.48	1.69

Note: Definition of growth difference and welfare gains are the same as in Table 2 and 3, respectively. All simulations use the same policy changes in the variable cost as in the benchmark case. Iterated shocks are used, but tailored to each simulation to mimic the actual GDP growth rate. The average magnitude of those shocks are reported in the last row.

Table 5. Sensitivity Analysis: Entry Cost Reduction

	Benchmark Case	Lower Safe Return $\delta = 1.047$	Higher Risk Aversion $\sigma = 1.5$	Half Var(ϵ) $G(\epsilon) = \left[-\frac{0.6}{\sqrt{2}}, \frac{0.6}{\sqrt{2}}\right]$
Growth Difference (%)				
with iterated shocks	-0.14	-0.17	-0.04	-0.34
[with mean shocks after 1987]	[-0.26]	[-0.24]	[-0.36]	[-0.33]
Welfare Gains (% wealth)	2.0	2.1	1.1	0.5
(Nonparticipants)	(3.9)	(4.2)	(2.0)	(1.0)
[Participants]	[0.0]	[0.0]	[0.0]	[0.0]
Participation Rate in 1987 (%)	12.0	13.0	9.3	13.9
Average Magnitude of Agg. Shocks (%)	0.75	0.74	3.55	1.31

Note: Definition of growth difference and welfare gains are the same as in Table 2 and 3, respectively. All simulations use the same policy changes in the entry cost as in the benchmark case. Iterated shocks are used, but tailored to each simulation to mimic the actual GDP growth rate. The average magnitude of those shocks are reported in the last row.

APPENDIX I. GOVERNMENT SECTOR UNDER THE SAVINGS-AND-LOANS INTERPRETATION

When we interpret banks as savings-and-loans institutions, modeling the government activity requires a little more detail, though there is no substantial difference.

Under financial repression, a government sets the deposit and loan rates, as well as government-bond yields. As a government has no intention of making profits, it sets the yield on government bonds equal to the return from government-run projects. To fulfill all its financing needs, a government also sets population-average loan rates equal to government-bond yields, thus preempting competition from the financial sector for loans—banks become indifferent between the government-bond holdings and the private-sector loans. In sum, the loan rate $r^L(\theta_t, \epsilon_t)$ is set at $(1-z)\theta_t + \epsilon_t$ when risky projects are chosen and $(1-z)\delta$ otherwise.[59] This contract embodies insurance for the idiosyncratic risk in risky projects, as a household with a good shock repays the temporary high profit to a bank, while a household with a bad shock repays less than the average. Note that the loan rate is lower than the return from the private business, which is $\theta_t + \epsilon_t$ when risky projects are chosen and δ otherwise. The difference $zR(\theta_t) = z\max(\theta_t, \delta)$ remains in hands of the consumer-cum-entrepreneurs as profit income.

As typically observed in financial repression, and from the evidence presented earlier, both deposit and loan rates are set by the government possibly with a generous spread, intended to provide banks with positive rents. However, an artificial spread would be easily dissipated as banks would engage in nonprice competition. When both loan and deposit rates are lower than the market equilibrium rate, there is a relative shortage of deposits; hence banks would engage in nonprice competition for depositors (e.g., gift giving), using all the artificial rents created by the government. As a result, the effective, net-of-cost, deposit rate $r^D(\theta_t)$ must be equal to $(1-z)R(\theta_t)$, the population average loan rate.

Through competition, loans are allocated among households proportionally to their deposits, and banks offer a package of deposit and loan contracts to each consumer-cum-entrepreneur.[60] Since loans l_t are doled out in proportion to deposits s_t for each household, consumer-cum-entrepreneurs will *internalize* the profit income, which they earn from their investment on their own projects, into their savings decision. Here, wealth of a participant evolves as

$$k_{t+1} = r^D(\theta_t)\gamma s_t + zR(\theta_t)l_t. \tag{A1}$$

The government borrows at a constant portion α of deposits, which are γs_t per participant after netting out the variable cost. The loan amount for each participant is equal to the rest of the

[59] Recall that z measures degree of inefficiency of government-run business.

[60] If profit income is not allocated in proportion to deposits, there would be cross-subsidization among households. This would be impossible in an equilibrium, as another bank would offer more profit income per deposit for those who contribute to funding the implicit subsidy.

net-of-cost deposits, $l_t = (1-\alpha)\gamma s_t$. Using the equilibrium deposit rate $r^D(\theta_t) = (1-z)R(\theta_t)$, wealth evolution of participants (A1) can be expressed as

$$k_{t+1} = (1-z)R(\theta_t)\gamma s_t + zR(\theta_t)(1-\alpha)\gamma s_t = (1-\alpha z)R(\theta_t)\gamma s_t. \tag{A2}$$

This is the same as in the mutual-fund interpretation, equation (2).

Note that if households needed to offer some profits to loan officers or government officers to obtain or approve loans, the savings decision would be distorted and dead-weight loss on the economy would be even greater.[61] However, this should affect participation decision. In our calibration exercise, we pin down the changes in effective variable cost $\hat{\gamma}$ in the variable-cost-reduction case and the entry cost q in the entry-cost-reduction case by essentially matching simulated evolution of financial deepening to the actual one. As they reflect *de facto* financial repression and liberalization, those calibrated costs—or a deeper, inefficiency parameter z—may already include the dead-weight loss from the rent seeking behavior.

APPENDIX II. CLOSED-FORM SOLUTIONS OF WELFARE GAINS FOR PARTICIPANTS FROM A REDUCTION IN THE EFFECTIVE VARIABLE COST

We are interested in finding the compensation $\tau(k)$ that equates the value under the reduced variable cost to the value under the high cost but with the compensation, that is, $\hat{V}(k) = V(k+\tau(k))$. Below we show two different formulas depending on the period-utility function, either log utility or more general CRRA utility, because the associated value functions have different closed-form expressions.[62] However, in both log and general CRRA utility cases, the welfare gains for participants from reduction in the variable cost turn out to be constant fraction of the wealth.

For the case with a log utility function, it is easy to find a closed-form expression for $\tau(k)$. Under the reduced effective variable cost, the return would be higher, and let Δ denote the difference of expected log returns. Here, we use $E\left[\ln \hat{\gamma} R(\theta)\right]$ for log returns under financial repression (e.g., 1.5 percent effective variable cost in the benchmark case) and use $E\left[\ln \hat{\gamma} R(\theta)\right] + \Delta$ for log returns under liberalized financial system (e.g., no effective variable cost in the benchmark case). Note that those returns can be numerically computed with specific parameter values. Using the definition of the value function, we can find a closed-form expression for $\tau(k)$.

$$\begin{aligned}
\hat{V}(k) &= \frac{1}{1-\beta}\ln(1-\beta) + \frac{\beta}{(1-\beta)^2}\ln\beta + \frac{\beta}{(1-\beta)^2}\left(E\left[\ln\hat{\gamma}R(\theta)\right] + \Delta\right) + \frac{1}{1-\beta}\ln k, \\
&= \frac{1}{1-\beta}\ln(1-\beta) + \frac{\beta}{(1-\beta)^2}\ln\beta + \frac{\beta}{(1-\beta)^2}E\left[\ln\hat{\gamma}R(\theta)\right] + \frac{1}{1-\beta}\left(\ln k + \frac{\beta\Delta}{1-\beta}\right), \\
&= \frac{1}{1-\beta}\ln(1-\beta) + \frac{\beta}{(1-\beta)^2}\ln\beta + \frac{\beta}{(1-\beta)^2}E\left[\ln\hat{\gamma}R(\theta)\right] + \frac{1}{1-\beta}\left(\ln k \exp\left[\frac{\beta\Delta}{1-\beta}\right]\right).
\end{aligned}$$

[61] We owe this point to a referee.

[62] See the derivation of the participant's value and policy functions in Townsend and Ueda (2006).

Therefore,

$$\tau(k) = \left(\exp\left[\frac{\beta\Delta}{1-\beta}\right] - 1\right) k. \tag{A1}$$

Similarly, for the case with a more general CRRA utility function, we can also find a closed-form expression for $\tau(k)$. Note that the participant's value function is $V(k) = (1-\mu^*)^{-\sigma} k^{1-\sigma}/(1-\sigma)$, where μ^* is the optimal savings rate and equals $\{\beta E[(\hat{\gamma}R(\theta))^{1-\sigma}]\}^{1/\sigma}$. Let ζ denote the difference in the log propensity to consume under the reduced cost regime. Here, we use $\ln(1-\mu^*)$ for log propensity to consume under financial repression (e.g., 1.5 percent effective variable cost in the benchmark case) and use $\ln(1-\mu^*)+\zeta$ for log propensity to consume under liberalized financial system (e.g., no effective variable cost in the benchmark case). Note that the size of ζ is a nontrivial function of a change in return $\hat{\gamma}R(\theta)$ but we can obtain it numerically given specific parameter values. Again, using the definition of the value function, we can find a closed-form expression for $\tau(k)$.

$$\begin{aligned}
\ln \hat{V}(k) &= -\sigma\left(\ln(1-\mu^*) + \zeta\right) + (1-\sigma)\ln k - (1-\sigma), \\
&= -\sigma \ln(1-\mu^*) + (1-\sigma)\left(\ln k + \frac{\sigma\zeta}{\sigma-1}\right) - (1-\sigma), \\
&= -\sigma \ln(1-\mu^*) + (1-\sigma)\left(\ln k \exp\left[\frac{\sigma\zeta}{\sigma-1}\right]\right) - (1-\sigma).
\end{aligned}$$

Therefore,

$$\tau(k) = \left(\exp\left[\frac{\sigma\zeta}{\sigma-1}\right] - 1\right) k. \tag{A2}$$