“Occupational Choice, Financial Frictions, and Trade across Thai Villages”

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Abstract

We disentangle the impacts of real factors (relative prices) and financial factors (interest rates and credit/asset ratios) on households running farm/business projects or providing wage labor in diverse, small village economies that are open to trade and capital flows. To do so we construct a two-sector occupation choice/trade/financially-constrained open economy model; estimate/calibrate key parameters and initial conditions of the model in diverse regions; simulate and judge model performance against the data; and run some counterfactual exercises, namely, freezing real or financial factors at their initial values and comparing to the baseline simulations, or more radically, making the economies closed with respect to trade, to capital flows, or to both. We find through these counterfactual model-based exercises that the impact of real and financial factors can be heterogeneous and large, generating both gains and losses and non-monotone impact across wealth classes and occupations (even allowing for occupation shifts).
1.1 Townsend Thai Data

The data used in this paper comes from the monthly household-level panel survey, which is a part of the Townsend Thai project. The monthly survey is being conducted in two provinces in the Central region, Chachoengsao and Lop Buri, and in two provinces in the Northeast region, Buri Ram and Si Sa Ket. In each province, four villages in the rural and semi-urban areas are randomly picked. Then, approximately 45 households per village are sampled. The survey began in August 1998 with the baseline survey, which collects the data on the status of the sampled household, including household’s composition, wealth, and the occupations of its members. Then, in the monthly resurvey, the same households are being interviewed for any activities within the household, including changes in its wealth, inputs, outputs, and any income received during the past month. The resurvey was started in September 1998 and is still being conducted, making this one of the longest household-level panel survey. The results reported in this paper are drawn from 84-month period (months 5-88). This period covers from January 1999 to December 2005.

At the beginning of the survey, there are approximately 45 households per village. However, during the 88-month period covered in our survey, the migration of village resident is unavoidable. For every household in our survey that moves out of the village, a replacement household is added. However, for the purpose of constructing the village accounts, we decide to use the balanced panel data and consider only households that stay for the entire 88-month period.

1.2 Overview of the Thai Economy

Since the financial crisis in 1997, Thailand went through a considerable change in its financial environment, from the devaluation of Thai baht in 1997, to the decision to change from the Monetary Targeting framework to the Inflation Targeting framework in 2000, to
the introduction of one-million-baht village funds in 2001, which is one of the largest microfinance program in the world.\footnote{As reported in Kaboski and Townsend (2011), the size of the initial funds of this program is about 1.5 percent of the Thai GDP in 2001.} Over the same period, trade costs and other trade barriers, both domestic and international, have been significantly decreasing. The combined value of export and import have been increased from 95% of GDP in 1997 to 140% of GDP in 2016. The average travel time to district office has decreased by roughly 20% between 1996 and 2005.\footnote{Community Development Department (CDD).}

Traditional international trade models predict that, with decreasing trade costs, the ratios of factor prices across economies should converge. However, in the Townsend Thai data, the differences in the ratios of wage rates and interest rates across provinces have become bigger over time. Therefore, in this research, we develop an occupational-choice trade model with financial frictions in an attempt to capture these factor-price convergences and to explain the development in the patterns of trade and production in these villages over time.

1.3 Research Overview

We disentangle the impacts of real factors (movement in sectoral relative prices) and financial factors (lower interest rates, more liberal credit/asset ratios) on households running farm/business projects or providing wage labor in diverse, small village economies that are open to trade and capital flows. We follow much of the literature and create an occupational choice, wage-earner vs. enterprise model (see for example, Lloyd-Ellis and Bernhardt, 1999; and its empirical implementation in Giné and Townsend, 2003; Jeong and Townsend, 2008; as well as a growing influential literature such as Buera et al., 2011; Buera and Kaboski, 2012; and Song et al., 2011) but with two sectors, for production of the agricultural and manufactured good, respectively. The model is simplified in having myopic savings rates for end of period wealth (not forward-looking), but the within-period wealth distribution plays a key role, not only in the determination of interest income but also through household-varying borrowing limits (the usual indebtedness or collateral ratios). Wealth evolution is determined by within-period
earnings and (exogenous end-of-period) savings rates. Labor endowments are fixed and
common over households and time, and the wage rate is determined by the local demand
and supply for labor. Local economies are entirely open to capital and can borrow and
lend at outside-determined interest rates. In sum, in this model, borrowing limits and
relative prices determine jointly the occupational choices and equilibrium wage rates.

To calibrate the model, we act as if interest rates are accurately measured and
taken as given (small open economy). We do not believe we see accurate measures of
either local relative prices or borrowing limits, so these two variables are calibrated, to
match agricultural/manufacturing profit shares and the wage rate, respectively. This is
true as well for initial conditions though we have as well a matched/centered two
parameter version of the observed distribution of wealth (capital). We are able to match
perfectly the wage rate and profit shares.

We run some counterfactual exercises, namely, freezing real (relative prices) and
then financial factors (interest rates and borrowing limits) at their initial values, with the
other variables (financial and then real, respectively) free, comparing in turn to the
baseline simulations where both real and financial factors are allowed to vary to match the
wage and profit shares we see in the data. When either only financial factors or only
relative prices are varied in Buri Ram, for example, the wage rate is higher than in the
baseline scenario.

In a more austere counterfactual we make the economies closed with respect to
trade, to capital flows, or to both at the same time. When closed with respect to trade, the
local demand for each type of good must be equal to the local supply, changing relative
prices. So it matters if the economy was initially exporting labor-intensive (or capital-
intensive) good. This can cause the wage to drop (increase), if for example, the price of
the labor-intensive good is lowered (raised). When closed with respect to external finance,
the local demand for capital must equal the local supply. The latter can cause large
downward (upward) movements in the interest rate if the economy had been exporting
savings (or borrowing from abroad), so to speak. Thus, wage earners and/or owners of
capital suffer large losses. But on occasion, as with shutting down both real and financial,
some in the population gain; sometimes it is the middle wealth segment, the middle class
so to speak, that is hit the hardest. Finally, endogenous wealth accumulation can mitigate
losses over time and radically change the pictures of winners and losers by occupational and sectoral shifts.
Chapter 2
Literature Review

We have a lot in common with the widely cited, seminal review of Goldberg and Pavcnik (2007), not only in the topic we study but also in the overall conclusions. Goldberg and Pavcnik study the impact of reductions in tariff barriers, arguing for a causal link between trade openness and changes in inequality. But they also believe that by the 1990’s increased capital flows from financial liberalization were playing a co-determining role. They found this worrisome, as one is no longer look at the impact of trade alone. We thus emphasize our attempt to disentangle (through measurement and the model) real trade factors from financial factors. We also study the impact on particular regional economies over a period of time, one region at a time, rather than cross sectional comparisons. We do have the panel data from a continuously implemented survey to do this. Goldberg and Pavcnik also abstract from the growth channel and macro dynamics. We in contrast do have some endogenous wealth dynamics and hence time-varying impacts, but on the other hand, we abstract from TFP growth, and variation in TFP across firms and regions, though there is some evidence those things do play a role (indeed a lead role in many other models). One way to look at what we do is to try to see how far we can get without TFP shocks, focusing instead on the endogenous dynamics related to the interaction of real and financial factors. Finally we do identify several, diverse channels through which trade and financial openness can have impact. As Goldberg and Pavcnik (2007) and Feenstra (2008) emphasize the popular notion that relatively abundant factors in a country would be aided by exports and the consequent increase in factor prices turned out to be naïve and the standard Heckscher–Ohlin predictions turn out to be naïve in the context of our model, and data, as well. Their conclusion, and ours, is that attempts to understand, anticipate or alleviate the distributional effects of within-country openness need to be grounded in a careful study of regional circumstances. We document this extensively.
More recent papers continue to try to exploit exogenous policy variation in conjunction with theory. Brambilla et al. (2012) study exports, export destinations, and skill utilization by firms. Using the exogenous changes in exports and export destinations brought about by an Argentine 1999 devaluation, they find that Argentine firms exporting to high-income countries hired a higher proportion of skilled workers and paid higher average wages than other exporters (to non high-income countries) and domestic firms. We too are using exogenous policy variation, in particular variation in credit in the data associated with a government financial intervention (though other things were happening at the same time, and we use our model to sort this out).

On the other hand, unlike Brambilla et al. (2012) we do not focus at all on skills variation within the labor sector, heterogeneity among firms in a given sector in terms of exporting or not, nor the source of demand for those exports. There is of course a large and growing literature emphasizing this kind of heterogeneity, for example, Bustos (2011), Melitz (2003), and Verhoogen (2008). Indeed, as reviewed by Harrison et al. (2011), the poor performance of the Stolper–Samuelson mechanism, has led Feenstra and Hanson (1996), Helpman et al. (2011), Frías et al. (2012), and Burstein et al. (2014) to study different channels through which trade effects the distribution of earnings: outsourcing, labor market frictions, quality upgrading, or capital-skill complementarity. Here we take a different tact and incorporate financing frictions into a 2x2 HO model. This is another way to overturns the Stolper–Samuelson mechanism, a point made rather dramatically in Antrás and Caballero (2009) in their model of North-South trade and globalization, though their study was not empirical.

In emphasizing local within-country impacts associated with initial conditions, our paper shares much in common with Autor et al. (2013). They find impacts on local labor markets from rising Chinese import substitutes (unemployment, lower labor force participation, and reduced wages), and account for up to one quarter of declines in manufacturing employment. We too find impacts on factor prices and occupation, for us from changes in relative prices arguably associated with international and interregional trade. Related is McLaren and Hakobyan (2010), who find using US Census data for 1990-2000 at a quite disaggregated level the NAFTA-induced effects on US wages by industry.
and by geography, measuring each industry’s vulnerability to Mexican imports and each locality’s dependence on vulnerable industries. They find large distributional effects (larger than aggregate welfare effects estimated by other authors). Related in turn are the earlier papers of Topalova (2007), who constructed an employment-weighted average tariff for each Indian district to identify the differential effects of local labor-market shocks on different locations. Kovak (2010) uses a similar technique for Brazil. These studies indicate significant location-specific effects of trade shocks on wages, which of course implies mobility costs of some sort for workers that prevent them from arbitraging wage differences across locations. We too make these explicit assumptions about the local labor market, and we too document effects on wages. We go beyond these papers in taking an explicitly structural approach, which in turn allows us to conduct a number of counterfactual exercises. Though we stop short of introducing heterogeneity in labor skills, the matching of labor to task and worker-specific capital, or costs of adjustment, we find nevertheless enormous heterogeneity in impact.

As in the recent paper Fajgelbaum and Khandelwal (2013), we complement a literature which views the distributional impact of international trade as one of the central tasks to be pursued by international economists. Fajgelbaum and Khandelwal find that trade has relatively adverse effects for low-income consumers in more than half of the countries that they consider and that the distributional effects of trade are often large relative to the aggregate effects. They focus on the demand side and heterogeneity in demand elasticities. We shut down that mechanism entirely by assuming Cobb-Douglas, aggregable consumer and focus instead on the distribution of welfare gains and losses associated with factor endowments, varying factor intensities across sectors, and household-specific credit constraints related to wealth. As with a labor mobility literature, we find that occupation shifts can play a role in mitigating adverse impact, or facilitating gains, but the distribution of gains and losses even with this mechanism can be heterogeneous and large.
Consider a two-good two-factor trade model with financial friction. The two factors of production are labor and capital. And there are two production sectors, which differ in their factor intensity. Let $A$ denote the labor-intensive sector and let $B$ denote the capital-intensive sector. In this economy, there is a continuum of infinitesimal agents who are different in their wealth level and in their “entrepreneurial ability”. In each period, agents choose to be a wage worker or choose to run a business as an entrepreneur in one of the two sectors. An entrepreneur utilizes the factors of production and produces consumption goods. A worker provides inelastic labor supply $L$ at the market wage rate $w_t$. We assume that workers can move freely across sectors but cannot move across regions.

### 3.1 Preference, Entrepreneurial Ability, and Technology

In each period, agents save a fraction $s$ of their income and consume the rest. Agent $i$ derives the utility from consuming goods $A$ and $B$ through the instantaneous utility function

$$U_{it} = \left( \frac{C^A_{it}}{\mu} \right)^\mu \left( \frac{C^B_{it}}{1 - \mu} \right)^{1-\mu},$$

where $U_{it}$ is the utility of agent $i$ in period $t$, $C^A_{it}$ is agent $i$’s consumption of good $A$ in period $t$, and $C^B_{it}$ is agent $i$’s consumption of good $B$ in period $t$.

Agents accumulate their wealth by holding capital, which is produced by combining goods $A$ and $B$ according to the production function

$$\Delta K_{it} = \left( \frac{I^A_{it}}{\mu} \right)^\mu \left( \frac{I^B_{it}}{1 - \mu} \right)^{1-\mu},$$

where $\Delta K_{it}$ is the new capital produced, $I^A_{it}$ is agent $i$’s investment of good $A$ in period $t$, and $I^B_{it}$ is agent $i$’s investment of good $B$ in period $t$. The price of capital $q$ is therefore equal to

$$q = (p_A)^\mu (p_B)^{1-\mu},$$

where $p_A$ is the price of good $A$ and $p_B$ is the price of good $B$. The capital will be use as the numéraire and therefore $q = 1$.

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3 The estimated wage elasticities in the data are quite low (see Bonhomme et al., 2012).
In this model, agents are endowed with different “entrepreneurial ability”, which affect each agent’s output as an entrepreneur. If agent $i$ chooses to become an entrepreneur in sector $A$, he produces good $A$ using the following technology:

$$Y_{it}^A = A_i K_{it}^{\alpha_K} L_{it}^{\alpha_L}$$

where $Y_{it}^A$ is the level of good $A$ produced by agent $i$, $A_i$ is the total factor productivity (TFP) of agent $i$ in sector $A$, $K_{it}$ is the level of capital used, and $L_{it}$ is the level of labor employed.

Similarly, if agent $i$ chooses to become an entrepreneur in sector $B$, the technology available to him is

$$Y_{it}^B = B_i K_{it}^{\beta_K} L_{it}^{\beta_L}$$

where $Y_{it}^B$ is the level of good $B$ produced by agent $i$ and $B_i$ is the TFP of agent $i$ in sector $B$.

I assume that sector $A$ is relatively labor-intensive, i.e.,

$$\alpha_K/\alpha_L < \beta_K/\beta_L.$$ 

The TFPs of agent $i$ depend on the sector-average TFP and agent $i$’s entrepreneurial ability, $z_i$. That is

$$\ln(A_i) \equiv a_i = \bar{a} + z_i$$

and

$$\ln(B_i) \equiv b_i = \bar{b} + z_i$$

where $\bar{A}$ and $\bar{B}$ are the averages of log TFP for sectors $A$ and $B$, respectively.

### 3.2 Borrowing Limits

Due to an imperfect financial market, the amount of capital than an entrepreneur can utilize depend on his wealth level. We assume that the maximum level of capital that an entrepreneur $i$ with wealth $W_{it}$ can use in period $t$ is $C_t W_{it}$. In other words, we assume that an entrepreneur $i$ can borrow at most $(C_t - 1)$ times of his wealth level.
3.3 Occupational Choice

An entrepreneur $i$ in sector $A$ with wealth $W_{it}$ and ability $z_i$ solves the following maximization problem:

$$\max_{(k_{it}, l_{it})} p_A A_t K_{it}^\alpha L_{it}^\beta - r_t K_{it} - w_t L_{it}$$

subject to the borrowing constraint

$$K_{it} \leq C_t W_{it}.$$ 

Let $\pi^A_t(W_{it}, z_i)$ denote the net profit of an entrepreneur $i$ in sector $A$ with wealth $W_{it}$ and ability $z_i$ in period $t$. Similarly, an entrepreneur $i$ in sector $B$ with wealth $W_{it}$ and ability $z_i$ solves the following maximization problem:

$$\max_{(k_{it}, l_{it})} p_B B_t K_{it}^{\beta K} L_{it}^{\beta L} - r_t K_{it} - w_t L_{it}$$

subject to the borrowing constraint

$$K_{it} \leq C_t W_{it}.$$ 

And let $\pi^B_t(W_{it}, z_i)$ denote the net profit of an entrepreneur $i$ in sector $B$ with wealth $W_{it}$ and ability $z_i$ in period $t$.

Therefore, we can summarize the within-period income of agents in each group as follows:

$$\pi_t(W_{it}, z_i) = \begin{cases} 
  w_t \bar{L} + r_t W_{it} & \text{for a worker} \\
  \pi^A_t(W_{it}, z_i) + r_t W_{it} & \text{for an entrepreneur in sector } A \\
  \pi^B_t(W_{it}, z_i) + r_t W_{it} & \text{for an entrepreneur in sector } B 
\end{cases} \quad (3.1)$$

3.4 Markets for Capital and Labor

In this model, we assume that the market for capital is completely open and the market for labor is completely closed. In equilibrium, the wage rate $w_t$ adjusts so that the local demand for labor equals the local supply of labor. This assumption might seem extreme at first. However, it is not unreasonable in practice. In the data, interest rates are closer across provinces than wage rates.

3.5 Mechanics of the Model

Borrowing limits and relative prices will jointly determine the occupational choices and the equilibrium wage rate. An increase in borrowing limit will increase the demand for capital and labor for the constrained entrepreneur. This will, in turn, increase the real wage rate.
The effect of increasing the borrowing limit on the number of workers vs. entrepreneurs is less obvious. On the one hand, an increase in borrowing limit increases the size and the profits of the constrained entrepreneurs. On the other hand, increasing wage rate makes being a worker become more attractive. An increase in borrowing limit also benefits the entrepreneurs in sector $B$ (capital-intensive) more than the entrepreneurs in sector $A$ (labor-intensive).
4.1 Production Function Estimation

In Townsend Thai data, households’ production activities can be classified as one of the four sectors: business, cultivation, fish and shrimp, or livestock. We estimate the production function of each sector using the following specification:

\[
\ln(Y_{it}) = \delta_K \ln(K_{it}) + \delta_L \ln(L_{it}) + \epsilon_{it} \tag{4.1}
\]

where the error term \(\epsilon_{it}\) captures the household \(i\)’s specific productivity in period \(t\).

If the households in our data expand their production size when they observe positive productivity shocks, the levels of capital and labor might be correlated with the error term and the OLS estimators could be biased. Therefore, we use the estimation method in Levinsohn and Petrin (2003) to obtain the consistent estimators and use the level of intermediate input as a proxy variable. Table 4.1 reports the estimation results.

Cultivation activity is the most labor-intensive, while fish and shrimp activity is the least labor-intensive.

In the data, fish and shrimp activity basically appears only in Chachoengsao and later years in Si Sa Ket. Similarly, livestock activity appears primarily in Lop Buri and Si Sa Ket. Therefore, we use the factor shares of cultivation activity for sector \(A\) and use the factor shares of business activity for sector \(B\) in our calibration exercises.
Table 4.1 – Estimation of Production Functions

<table>
<thead>
<tr>
<th></th>
<th>Cultivation</th>
<th>Business</th>
<th>Livestock</th>
<th>Fish &amp; Shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta_K$</td>
<td>0.2313</td>
<td>0.3061</td>
<td>0.3099</td>
<td>0.5306</td>
</tr>
<tr>
<td></td>
<td>(0.0390)</td>
<td>(0.0975)</td>
<td>(0.1967)</td>
<td>(0.1892)</td>
</tr>
<tr>
<td>$\delta_L$</td>
<td>0.4564</td>
<td>0.3922</td>
<td>0.2260</td>
<td>0.0660</td>
</tr>
<tr>
<td></td>
<td>(0.0375)</td>
<td>(0.0873)</td>
<td>(0.1052)</td>
<td>(0.0963)</td>
</tr>
</tbody>
</table>

Note: Standard errors are in parentheses.

To estimate sector-average TFP and household’s entrepreneurial ability, we start by estimating household-specific TFP from the regression residual as follows:

$$a_i = \frac{1}{T} \sum_{t=1}^{T} \epsilon_{it} \quad (4.2)$$

where $a_i$ denotes the log TFP of household $i$. Then, we decompose the household-specific TFP into the sector-average TFP and the household’s entrepreneurial ability, i.e.,

$$a_i = \bar{a} + z_i \quad (4.3)$$

where $z_i$ is assume to have a normal distribution with mean zero and standard deviation $\sigma_z$. Table 4.2 reports the sector-average TFP and $\sigma_z$ for each activity.

Table 4.2 – Estimated Sector-Average TFP and Ability Dispersion

<table>
<thead>
<tr>
<th></th>
<th>Cultivation</th>
<th>Business</th>
<th>Livestock</th>
<th>Fish &amp; Shrimp</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\bar{a}$</td>
<td>4.1244</td>
<td>3.7464</td>
<td>4.6071</td>
<td>3.1648</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>0.8409</td>
<td>0.9644</td>
<td>1.4057</td>
<td>1.8448</td>
</tr>
</tbody>
</table>

4.2 Assumptions

4.2.1 Saving Rate

In the model, all of the savings is invested in capital. We assume that every household saves 10% of its income in each period based on the Thai macro data (9.3% saving rate). However, recent literatures (e.g., Buera and Shin, 2013) show that, the productive entrepreneurs with low wealth tend to have higher saving rate. One advantage for us is
that the occupational choice is determined in an almost static sense which helps us disentangle the impact of trade and financial restrictions.

4.2.2 Labor Endowment

We assume that each household is endowed with 3,461 units of labor per year. This number comes from the Townsend Thai data, in which the median number of household members whose age above 15 is 2.4, and from Thai macro data, in which 69.34% of population aged 15 or above work full-time.

4.2.3 Capital Endowment

Households have different levels of capital endowment. The distribution of household’s capital is assumed to follow Gamma distribution:

\[ f(x; k, \theta) = x^{k-1} \frac{e^{-x/\theta}}{\theta^k \Gamma(k)} \]  

(4.4)

where \( \Gamma(\cdot) \) is the Gamma function.

4.3 Calibration Exercises

As we envisioned this model as a trade model with occupational choice subject to financial constraints, the obvious exogenous variables are the interest rate, the relative price of goods, and the borrowing limit. For the interest rate, we believe we have a good measure of the interest rate in the data, the observed value. For the relative price and the borrowing limit, we don’t think we have very good measures of them, so we calibrate these two variables. Therefore, we need two endogenous variables against which to calibrate. The model suggests that the relative price should be calibrated against the profit share from each sector, and that the borrowing limit should be calibrated against the wage rate.

There are other endogenous variables (i.e., wealth dynamics, BOP, income/asset levels) as the measures of model performance and don’t calibrate or vary parameters to fit them. We have thought about doing otherwise, but at this point here is our thinking: For saving rate, the logical thing to do is to use the saving rate in the data. But since many households have negative income or income close to zero, the measure of saving rate (savings/income ratio) in the data is blown up. Therefore, we decided to use the saving
rate from Thai macro data instead. That is, we assume that the household saves 10 percent of its income.

For utility function, we could use the detailed information about the composition of household consumption in the data to determine consumption shares, but this remains to be completed. Currently, we assume that $\mu = 0.5$. The assumption does not affect the equilibrium prices and outcomes of the model except for the size of exports and imports. Our current parameter specification could affect the size of gains/losses in the counterfactual exercises as it has to do with demand elasticities (see Arkolakis, Costinot, and Rodríguez-Clare, 2010).

4.3.1 Initial Conditions

We calibrate the initial wealth distribution, the borrowing limit, and the relative price to match the real wage rate and profits share in the first year. Also, we use the wealth distribution in the data to get further moments of that distribution.

4.3.2 Calibration Procedure

In subsequent years, we adjust the borrowing limit and the relative price jointly to match (i) the real wage rate observed in the data, and (ii) the share of entrepreneurial profits from sector $A$ and sector $B$.

\footnote{In the model, we use cultivation for labor-intensive sector and we use for livestock, fish and shrimp, and business for capital-intensive sector. When we look at consumption data, we have the consumption of food and non-food, which includes the spending on gas, electricity, clothing, etc. Therefore, we need to decide what to do with the consumption of goods which are not related to the village’s production.}
4.4 Calibration Result for Buri Ram

Figure 4.1 compares the actual distribution of household’s fixed assets in Buri Ram data and the calibrated distribution in the model. The calibrated values for $k$ and $\theta$ are 1.3 and 0.08, respectively.

(a) Actual Distribution

(b) Calibrated Distribution

Figure 4.1 – Comparison between the actual and the calibrated distributions of household’s fixed assets.
Figure 4.2 shows the real interest rates in Buri Ram, which we take as given when calibrating the model. Figures 4.3 and 4.4 show the comparisons of real wage rate and the comparison of the share of profits from the capital-intensive sector in the data and in the calibrated model for Buri Ram. The model can match the real wage rate and the profit share with those in the data. The calibrated borrowing limit and the calibrated relative price in Buri Ram are shown in Figures 4.5 and 4.6, respectively. The results suggest that the borrowing limit declined sharply in 2000 and has not recovered since.
Figure 4.4 – Profit share from sector B in Buri Ram

Figure 4.5 – Calibrated borrowing limits in Buri Ram
Figure 4.7 shows the occupational choices from the calibrated model in Buri Ram in 1999. The horizontal axis represents the initial wealth of the household, while the vertical axis represents the household’s entrepreneurial ability. The model predicts that the households with medium-to-low ability will choose to be workers regardless of their wealth level. The households with high ability will be entrepreneurs. The household’s choice on sector is determined by the household’s ability rather than the household’s wealth level.

Figure 4.8 shows the occupational choices from the calibrated model in Buri Ram in 2005. Again, the households with medium-to-low ability will choose to be workers regardless of their wealth level. However, for the households with high ability, their wealth will determine the sector in which they choose to be entrepreneurs. The households with low wealth will choose the labor-intensive sector $A$, while the households with high wealth will choose the capital-intensive sector $B$. 
Figure 4.7 – Occupational choices in Buri Ram in year 1999

Figure 4.8 – Occupational choices in Buri Ram in year 2005
4.5 Calibration Results for Lop Buri

Figure 4.9 compares the actual initial distribution of household’s fixed assets in Lop Buri data and the calibrated distribution in the model. The calibrated values for $k$ and $\theta$ are 3.5 and 0.07, respectively.

![Actual Distribution](image1)

![Calibrated Distribution](image2)

Figure 4.9 – The actual distribution vs. the calibrated distribution of household’s fixed asset in Lop Buri in 1999
Figure 4.10 shows the actual real interest rates in Lop Buri. Figures 4.11 and 4.12 compare the real wage rates and the shares of profits from the capital-intensive sector in Lop Buri data and in the calibrated model. The model can match the real wage rates and the profit shares with those in the data. The calibrated borrowing limits and the calibrated relative prices in Lop Buri are shown in Figures 4.13 and 4.14, respectively.
Figure 4.12 – Profit share from sector $B$ in Lop Buri

Figure 4.13 – Calibrated borrowing limit in Lop Buri
Figure 4.15 shows the occupational choices from the calibrated model in Lop Buri in 1999. As in Buri Ram, households with medium-to-low ability will choose to be workers regardless of their wealth level. Households with high ability and high wealth level will choose to be entrepreneurs in sector $B$, while households with very high ability will choose to be entrepreneurs in sector $A$.

Figure 4.16 shows the occupational choices from the calibrated model in Lop Buri in 2005. Also similar to Buri Ram in 2005, the households with medium-to-low ability will choose to be workers regardless of their wealth level. And, for the households with high ability, their wealth will determine the sector in which they choose to be entrepreneurs. The households with low wealth will choose the labor-intensive sector $A$, while the households with high wealth will choose the capital-intensive sector $B$. 
Figure 4.15 – Occupational Choices in Lop Buri in Year 1999

Figure 4.16 – Occupational Choices in Lop Buri in Year 2005
4.6 Evaluating the Model’s Performance

In this section, we evaluate the performance of our model by looking at the household’s level. We compare the model’s prediction on households’ occupation, income, and wealth with those in the data.

4.6.1 Household A

We start by considering a household which is relatively high ability and relatively wealthy. First, we compare the occupational choices made by this household with those predicted in the model. The model predicts that this household would choose to be an entrepreneur in sector A in the first two years and choose to be an entrepreneur in sector $B$ in the last five years (Table 4.3). In the data, wages income represents income from being workers, cultivation income represents income from being entrepreneurs in the labor-intensive sector, and business income, fish income, and livestock income represent income from being entrepreneurs in the capital-intensive sector. If we define the household’s occupation by the main source of income, the model can correctly predict the occupation of this household in five out of seven years (Table 4.3).

Table 4.3 – The composition of household A’s income and the model’s prediction of occupational choices

<table>
<thead>
<tr>
<th>Year</th>
<th>Wages</th>
<th>Cultivation</th>
<th>Business</th>
<th>Fish &amp; Shrimp</th>
<th>Livestock</th>
<th>Occupation Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>0</td>
<td>7,732</td>
<td>0</td>
<td>0</td>
<td>-6,440</td>
<td>Labor-intensive</td>
</tr>
<tr>
<td>2000</td>
<td>1,650</td>
<td>12,500</td>
<td>0</td>
<td>0</td>
<td>-5,474</td>
<td>Labor-intensive</td>
</tr>
<tr>
<td>2001</td>
<td>7,700</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,084</td>
<td>Capital-intensive</td>
</tr>
<tr>
<td>2002</td>
<td>271,500</td>
<td>17,881</td>
<td>-31,516</td>
<td>0</td>
<td>8,158</td>
<td>Capital-intensive</td>
</tr>
<tr>
<td>2003</td>
<td>10,870</td>
<td>26,272</td>
<td>1,089,609</td>
<td>0</td>
<td>5,859</td>
<td>Capital-intensive</td>
</tr>
<tr>
<td>2004</td>
<td>13,950</td>
<td>47,510</td>
<td>398,820</td>
<td>300</td>
<td>1,226</td>
<td>Capital-intensive</td>
</tr>
<tr>
<td>2005</td>
<td>38,320</td>
<td>47,350</td>
<td>255,027</td>
<td>1,360</td>
<td>1,163</td>
<td>Capital-intensive</td>
</tr>
</tbody>
</table>

Next, we look at how well the model predicts the level of income and assets holding of this household. As seen in Figure 4.17, the model can predict the average level of income
for this household quite well (307,287 versus 362,911). However, the model cannot capture the year-by-year fluctuation of this household’s income, which is not surprising since there is neither aggregate shock nor idiosyncratic shock in this model. On the other hand, the model tends to underestimate the level of fixed assets of this household (Figure 4.18). One explanation is that this particular household saves at a higher rate than the rate assumed in the model.

Figure 4.17 – Comparison between the actual net income from production of household A and the predicted income from the model
4.6.2 Household B

Next, we consider a household with intermediate ability and intermediate wealth level. Table 4.4 reports the income composition of this household and the model’s prediction of occupation. Comparing to the case of household A, the model performs worse in this case. The model can correctly predict the occupational choice of this household in only two years out of seven years. The predictions overestimate the probability that this household chooses to become a wage earners.

Next, we compare the actual and the predicted level of household B’s income and wealth level in Figures 4.19 and 4.20, respectively. On average, the model can predict the income level reasonably well (79,278 vs. 92,925). However, similar to the previous example, the model fails to capture the trend. Also, the model underestimates the change in the wealth level of this household.
Table 4.4 – The composition of household B’s income and the model’s prediction of occupational choices

<table>
<thead>
<tr>
<th>Year</th>
<th>Wages</th>
<th>Cultivation</th>
<th>Business</th>
<th>Fish &amp; Shrimp</th>
<th>Livestock</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>7,230</td>
<td>-4,822</td>
<td>3,300</td>
<td>0</td>
<td>-4,541</td>
<td>Worker</td>
</tr>
<tr>
<td>2000</td>
<td>7,420</td>
<td>39,972</td>
<td>0</td>
<td>0</td>
<td>-5,538</td>
<td>Worker</td>
</tr>
<tr>
<td>2001</td>
<td>37,948</td>
<td>14,619</td>
<td>0</td>
<td>0</td>
<td>-1,897</td>
<td>Worker</td>
</tr>
<tr>
<td>2002</td>
<td>36,598</td>
<td>32,744</td>
<td>0</td>
<td>0</td>
<td>-2,374</td>
<td>Worker</td>
</tr>
<tr>
<td>2003</td>
<td>19,250</td>
<td>38,468</td>
<td>19,185</td>
<td>0</td>
<td>946</td>
<td>Capital-intensive</td>
</tr>
<tr>
<td>2004</td>
<td>29,740</td>
<td>55,397</td>
<td>171,090</td>
<td>600</td>
<td>4,872</td>
<td>Worker</td>
</tr>
<tr>
<td>2005</td>
<td>11,600</td>
<td>19,040</td>
<td>60,547</td>
<td>700</td>
<td>1,713</td>
<td>Worker</td>
</tr>
</tbody>
</table>

Figure 4.19 – Comparison between the actual net income from production of household B and the predicted income from the model
4.6.3 Household C

As a final example, we consider a household with low ability and intermediate wealth level. The model can predict the occupational choices of this household quite well. That is, it can correctly predict the household’s occupation in five out of seven years (Table 4.5). However, as seen in Figure 4.21, the model tends to over-predict the income of this household (75,175 vs. 102,501). And, similar to the previous two examples, the model tends to under-predict the household’s wealth level (Figure 4.22).
Table 4.5 – The composition of household C’s income and the model's prediction of occupational choices

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Income from the Data</th>
<th>Occupation Prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wages</td>
<td>Cultivation</td>
</tr>
<tr>
<td>1999</td>
<td>42,850</td>
<td>6,460</td>
</tr>
<tr>
<td>2000</td>
<td>36,960</td>
<td>4,660</td>
</tr>
<tr>
<td>2001</td>
<td>24,105</td>
<td>3,976</td>
</tr>
<tr>
<td>2002</td>
<td>82,600</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>32,600</td>
<td>0</td>
</tr>
<tr>
<td>2004</td>
<td>15,760</td>
<td>4,526</td>
</tr>
<tr>
<td>2005</td>
<td>85,750</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 4.21 – Comparison between the actual net income from production of household C and the predicted income from the model
Figure 4.22 – Comparison between the actual value of fixed assets of household C and the predicted value from the model.
Chapter 5  
Counterfactual Exercises

5.1 Introduction

In this chapter, we consider two counterfactual exercises. In the first exercise, we try to distinguish the effects of real and financial factors by keeping one factor at the initial level and varying another factor. In the second exercise, we consider the effects of shutting down the trade market, the financial market, or both.

5.2 Disentangling Real and Financial Factors

In this exercise, we freeze the relative price at the initial 1999 level and vary the financial variables (i.e., the interest rate and the borrowing limit) using the calibrated values from the baseline scenario. Then, we freeze the financial variables at the initial 1999 levels and vary the relative price instead. Hence, we are disentangling real and financial forces behind the movement over time through the lens of the model.

5.2.1 Buri Ram

In Buri Ram, both interest rate and borrowing limit decrease over time (see Figures 4.2 and 4.5). These changes have opposing effects on wage rate. On the one hand, the lower interest rate raises the marginal product of labor. Thus, wage rate should be higher. On the other hand, the lower borrowing limit lowers the demand for labor, and wage rate as well. Figure 5.1 shows the effects of financial factors on wage rate in Buri Ram. The black line shows the wage rate in baseline scenario, where both real and financial factors are in effect. The grey line shows the wage rate in the counterfactual scenario where only the real factor (i.e., relative price) is considered. Thus, the difference between the black line and the grey line shows the effect of financial factors (i.e., interest rate and borrowing limit). The result suggests that the effect of the borrowing limit dominates since the wage rate is lower in the baseline scenario (which includes the effect of financial factors) than in the “Real-only” counterfactual exercise (which excludes the effect of financial factors).
Changes in interest rate and borrowing limit also have opposing effects on the share of profits from each sector. On the one hand, the decreasing interest rate benefits the capital-intensive sector $B$ more than the labor-intensive sector $A$. Therefore, the share of profits from sector $B$ should increase. On the other hand, the lowering borrowing limit affects the constrained entrepreneurs in sector $B$ more than those in sector $A$, and thus, the share of profits from sector $B$ should decrease. Figure 5.2 compares the share of profits from sector $B$ in Buri Ram in baseline scenario with those in the counterfactual exercises. Again, the result suggests that the effect from lowering borrowing limit dominates since the share of profits from sector B in the baseline scenario is lower than that in the “Real-only” counterfactual exercise.
The calibrated relative price in Buri Ram shows upward trend between 1999 and 2001 and shows downward trend between 2001 and 2005 (see Figure 4.6). However, the calibrated relative price never goes below the initial value in 1999. An increase in relative price would increase the profit from becoming an entrepreneur in sector \( B \) and lower the profit from becoming an entrepreneur in sector \( A \). As the marginal entrepreneurs switch from sector \( A \) to sector \( B \), the share of profit from sector B would increase. At the same time, the wage rate would decrease due to the lower demand for labor. Therefore, the wage rate in the “Financial-only” counterfactual exercise which does not include the effect from the real factor should be higher than the wage rate in the baseline scenario. At the same time, the share of profits from sector B in baseline scenario should be higher than that in the “Financial-only” counterfactual exercise. Both predictions are supported by the results in Figures 5.1 and 5.2.
5.2.2 Lop Buri

The interest rate and the borrowing limit in Lop Buri have been decreasing since 1999 (see Figures 4.10 and 4.13). As discussed in the case of Buri Ram, these changes have opposing effects on the wage rate and the share of profit from sector $B$. Figures 5.3 and 5.4 show the effects of financial factors on the wage rate and the sector-$B$ profit, respectively. The results suggest that, similar to the case of Buri Ram, the effect of the decreasing borrowing limit dominates the effect of the decreasing interest rate.

Also, in Lop Buri, the calibrated relative price from 2000 to 2005 are slightly higher than the level in 1999. As discussed in the case of Buri Ram, the higher relative price will lower wage rate and raise the share of profit from sector $B$. These conjectures are also confirmed in Figures 5.3 and 5.4.

![Figure 5.3](image-url)  
Figure 5.3 – Real wage rates in baseline scenario and counterfactual exercises in Lop Buri
5.3 Counterfactual Exercises II

In the second counterfactual exercise, we try shutting down trade, shutting down external finance, and shutting down both. When trade channel is shut down, the demand for goods must equal the supply of goods from within the village. When external finance channel is shut down, the local demand for capital must equal the local supply of capital.

5.3.1 Buri Ram

Figure 5.5 shows the value for outputs from both sectors in baseline scenario in Buri Ram. The level of output from labor-intensive sector \( A \) is higher than the level of output from capital-intensive sector \( B \) between 1999 and 2001. From 2002, however, the level of output from sector \( B \) becomes higher. Figure 5.6 shows the demand for and the supply of capital in baseline scenario in Buri Ram. The model predicted that the village has excess supply of capital in every year.
Figures 5.7, 5.8, 5.9, and 5.10 show real wage rates, real interest rates, relative price, and share of profits from manufacturing sector in baseline scenario and counterfactual exercises, respectively.
Figure 5.7 – Real wage rates in baseline scenario and counterfactual exercises in Buri Ram

Figure 5.8 – Real interest rates in baseline scenario and counterfactual exercises in Buri Ram
The effect of shutting down trade channel will depend on the relative output levels in baseline scenario. For example, if the village exports labor-intensive goods and imports capital-intensive goods, as in Buri Ram (1999-2001), shutting down trade will create an
excess supply of labor-intensive goods and excess demand for capital-intensive goods. Therefore, relative price $\frac{p_B}{p_A}$ will increase in the counterfactual exercise. Moreover, shifting village’s production toward capital-intensive goods will lower the demand for labor and, therefore, the wage rate.

The effect of shutting down external finance channel depends on the excess supply of (or the excess demand for) capital in baseline scenario. If the village has excess supply of capital, as in Buri Ram, shutting down external finance channel will lower interest rate. In the no-external-finance counterfactual exercise in year 2000, for example, there still exists excess supply of capital even though the interest rate dropped to zero due to the borrowing limit. The lower interest rate increases the demand for capital and hence the marginal product of labor and, therefore, the wage rate. Sector $B$ benefits more from the lower interest rate since it is more capital-intensive.

Lastly, the effect of shutting down both trade and external finance channels will tend to reflect the (nonlinear) combination of the effect of shutting down each channel.

5.3.2 Lop Buri

Figure 5.11 shows the value for outputs from both sectors in baseline scenario in Lop Buri. The level of output from labor-intensive sector $A$ is higher than the level of output from capital-intensive sector $B$ in every year. Figure 5.12 shows the demand for and the supply of capital in baseline scenario in Lop Buri. The model predicted that the village has excess supply of capital in every year.

Figures 5.13, 5.14, 5.15, and 5.16 show real wage rates, real interest rates, relative price, and share of profits from manufacturing sector in baseline scenario and counterfactual exercises, respectively.
As discussed above, the village’s output from sector A is higher than the village’s output from sector B in every year. If trade channel was suddenly shut down, there would be excess demand for goods B and excess supply of goods A. Therefore, the relative price of good B would increase. As a result, the village would increase the production in sector B and reduce the production in sector A. Since sector B is more capital-intensive in
relative to sector $A$, the shift in production would also lower the demand for labor and increase the demand for capital. Therefore, the wage rate in the counterfactual exercise will be lower than that in the baseline scenario. Also, the share of profits from sector $B$ will be higher than that in the baseline scenario.

In baseline scenario, the supply of capital is higher than the demand for capital in all years for the village in Lop Buri. Therefore, if external finance channel was shut down, there would be excess supply of capital and the interest rate would go down. The lower interest rate would increase the marginal product of labor, and the wage rate would go up. Finally, the capital-intensive sector $B$ would benefit more from the lower interest rate. Therefore, the share of profits from sector $B$ would go up.

Similar to the case of Buri Ram, in the autarky counterfactual exercise, the wage rate, the relative price, and the share of profit from sector $B$ tend to be the combination of the equilibrium values in no-trade counterfactual exercise and no-external-finance counterfactual exercise.
Figure 5.14 – Real interest rates in baseline scenario and counterfactual exercises in Lop Buri

Figure 5.15 – Relative prices in baseline scenario and counterfactual exercises in Lop Buri
5.3.3 Welfare Analysis

Finally, we return to our main theme and consider the effects of counterfactual exercises on the income of agents. We pick Buri Ram as a leading example, so as to not overwhelm the reader with too many scenarios and regions. Figure 5.17 shows the income difference between baseline scenario and no-trade counterfactual exercises in Buri Ram in year 1999. Figure 5.18 shows the occupational switch from baseline scenario to no-trade counterfactual exercises in Buri Ram in year 1999. The households are classified into three groups based on their ability; the average-skilled group \((z_i = 0)\), the high-skilled group \((z_i = \sigma)\), and the very-high-skilled group \((z_i = 2\sigma)\).

Shutting down trade channel lowers incomes of all average-skilled and high-skilled households in year 1999. This is because wage rate is lower when trade channel is shut down, and the average-skilled and high-skilled households are workers. At the same time, the very-high-skilled households who are entrepreneurs receive higher profits due to lower wage rate.
Figure 5.17 – Welfare gains/losses from shutting down trade channel in Buri Ram in 1999

Figure 5.18 – Occupational change from shutting down trade channel in Buri Ram in 1999
On the other hand, shutting down trade channel increases the wage rate in 2002. Therefore, incomes of those who are workers (i.e., the average-skilled households and the high-skilled households with low wealth) increase, while the profits of the very-high-skilled households and the high-skilled households with high wealth (i.e., those who are entrepreneurs) decrease. Figure 5.19 shows the income difference between baseline scenario and no-trade counterfactual exercises in Buri Ram in year 2005. Figure 5.20 shows the occupational switch from baseline scenario to no-trade counterfactual exercises in Buri Ram in year 2002.

![Figure 5.19 – Welfare gains/losses from shutting down trade channel in Buri Ram in 2002](image-url)
Figure 5.20 – Occupational change from shutting down trade channel in Buri Ram in 2002

Figure 5.21 shows the income difference between baseline scenario and no-external-finance counterfactual exercises in Buri Ram in year 1999. Figure 5.22 shows the occupational switch from baseline scenario to no-external-finance counterfactual exercises in Buri Ram in year 1999. When financial channel is shut down, wage rate increases while interest rate decreases. Therefore, the average-skilled and the high-skilled household with very low wealth have higher income. On the other hand, those with higher wealth get lower income due to lower interest. The very-high-skilled entrepreneurs benefit from the lower interest rate.
Figure 5.21 – Welfare gains/losses from shutting down external-finance channel in Buri Ram in 1999

Figure 5.22 – Occupational change from shutting down external-finance channel in Buri Ram in 1999
Figure 5.23 shows the income difference between baseline scenario and no-external-finance counterfactual exercises in Buri Ram in year 2002. Figure 5.24 shows the occupational switch from baseline scenario to no-external-finance counterfactual exercises in Buri Ram in year 2002. High-skilled households who switch from being wage workers to being entrepreneurs receive higher income. High-skilled households who are entrepreneurs in both baseline and counterfactual cases also benefit from the lower interest rate. Similarly, very-high-skilled households benefit from the lower interest rate.

Figure 5.23 – Welfare gains/losses from shutting down external-finance channel in Buri Ram in 2002
Figure 5.24 – Occupational change from shutting down external-finance channel in Buri Ram in 2002
6.1 Conclusions

In this paper, we disentangle the impacts of real and financial factors on village economies. To do so, we start by developing a two-factor two-sector trade model with occupational choices and financial frictions. Then, we calibrate our model using both the macro-level stylized facts of Thai economy and the micro-level household data. The calibrated model can perfectly match the village-level stylized facts (i.e., wage rate and the share of profits from each sector).

Then, we evaluate the calibrated model by comparing the occupational choices, income, and wealth level predicted by the model with those in the data. The model can predict the occupational choices of high-ability and low-ability particularly well. However, the model under-predicts entrepreneurs with intermediate ability. Moreover, the model can predict the average-level of household income but fails to predict the change in income due to the lack of income shocks in the model.

Lastly, we conduct two counterfactual experiments. In the first counterfactual experiment, we disentangle the impacts of real and financial factors by keeping one factor at the initial level and varying the others. In the second counterfactual experiment, we make the economies closed with respect to trade, to capital flows, or to both at the same time. The results suggest that the impact of real and financial factors can be heterogeneous and large, generating both gains and losses and non-monotone impact across wealth classes and occupations (even allowing for occupation shifts).

6.2 Discussions

Based on the results presented in this paper, several findings are worth further discussions. First, the calibrated borrowing limits in both provinces are remarkably high in 1999 before drop sharply in 2000. Noted that, at that time, Thailand just came out of the 1997–1998 Financial Crisis, and the results could simply reflect the economy going through an adjustment to the new equilibrium.
Next, Chapter 5 reports the results from the counterfactual experiments. In these counterfactual experiments, when we shut down financial channel or when we shut down both trade and financial channels, there is excess supply of capital and the equilibrium interest rate equals to zero. There are several factors that, when put together, create this result. First, the returns to scale of the estimate production functions are quite low. Therefore, the optimal business size is quite small. Second, in this model, one household can run at most one business at a time. If we allow wealthy households to run more than one business, then we could have positive equilibrium interest rates.
References


