

Entry Costs, Financial Frictions, and Cross-Country Differences in Income and TFP*

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August 7, 2012

Abstract

This paper develops a model to assess the quantitative effects of entry costs and financial frictions on cross-country income and total factor productivity (TFP) differences, with a primary focus on the interaction between entry costs and financial frictions. The model is calibrated to match the establishment level statistics for the U.S. economy, assuming a perfect financial market. The quantitative analysis shows that entry costs and financial frictions together can generate a factor thirty-one of the differences in income per capita and a factor seven of the differences in TFP. More than half of the differences are accounted for by the interaction between entry costs and financial frictions. The main mechanism is that financial frictions amplify the effect of the costs of entry.

Keywords: entry costs, financial frictions, GDP per capita, TFP

JEL Classification: O11, O43

*We are thankful to seminar participants in 2010 Midwest Macroeconomics Meetings, 2010 Tsinghua Macroeconomics Workshop for Young Economists, Society for Economic Dynamics Annual Meetings 2010, and Southern Economic Association Annual Meetings 2010. The views in this paper represent those of the author and are not those of either the Federal Reserve Bank of Atlanta or the Federal Reserve System.

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1 Introduction

Income per capita differs by more than a factor of thirty between rich and poor countries. Research on growth accounting finds that the majority of the differences are the result of cross-country differences in total factor productivity (TFP).¹ It is worth noting also that many poor countries have poorly developed financial markets as well as substantial costs for starting new businesses. Both of these factors have been found to be negatively correlated with income per capita across countries.² Accordingly, the goal of this paper is to quantify the importance of financial frictions and entry costs in cross-country differences with respect to income per capita and TFP.

There are a number of studies that have examined either the effect of financial frictions or the effect of entry costs on cross-country differences. This paper, however, investigates whether there is any interaction between entry costs and financial frictions and, if so, how such interaction may affect cross-country income and TFP differences. Intuitively, underdeveloped financial markets may amplify the effect of entry costs as entrepreneurs cannot borrow to overcome such costs. In contrast, a better developed financial market may have less impact on how entry costs affect output and TFP. Understanding such interactions can guide policymakers in improving overall TFP and output. For instance, if the interaction is important, simplifying the entry process and improving the financial market conditions will have a much greater impact on economic development than addressing just one of the two factors.

To explore this issue, this paper develops a model that incorporates both financial frictions and entry costs and then uses the calibrated model to explore how the effects of entry costs on

¹See, for example, Klenow and Rodriguez-Clare (1997); Prescott (1998); Hall and Jones (1999). One exception is Fan and Chan-Kang (2010).

²Djankov et al. (2002) finds a negative correlation between GDP per capita and the ratio of entry costs to GDP per capita. Nicoletti and Scarpetta (2003, 2006) find that entry costs are negatively related to TFP in OECD countries. Beck et al. (2000) established a negative relationship between financial development and economic growth.

cross-country income and TFP differences change with financial market conditions. We find that financial frictions amplify the effect of entry costs on economic development. Moreover, the interaction between financial frictions and entry costs is quantitatively important in accounting with respect to the differences for cross-country income and TFP.

The model builds on the industry model studied by Hopenhayn (1992) and Hopenhayn and Rogerson (1993). In the model, establishments have different levels of productivity that evolve over time. The technology is subject to decreasing returns to scale with fixed production costs. Although an establishment finances capital and the fixed production cost from the financial market, the financial market is imperfect, and an establishment can only borrow up to a fraction of its expected discounted life-time profits. Furthermore, existing establishments may exit if they experience low productivity. In contrast, new establishments can enter after paying an upfront entry cost that can be financed from the financial market subject to a borrowing constraint similar to the one faced by existing establishments.

The model is calibrated to match the establishment level statistics in the U.S. economy, assuming a perfect financial market for the U.S. The calibrated model is then used to analyze the cross-country differences in income per capita and TFP. To perform the analysis, we vary entry costs in the range observed in the data and vary the friction in the financial market to obtain variations in the business debt to GDP ratio, which is comparable to the data. We find that entry costs and financial frictions together can account for a factor thirty-one of the differences in income per capita and a factor seven of the differences in TFP across countries. Moreover, more than half of the explanatory power comes from the interaction between entry costs and financial frictions. This finding suggests that to fully take advantage of the reduction in entry costs, it is better to improve the conditions of entry and the financial market simultaneously.

The intuition for the results consists of three parts. First, higher entry costs lead to a lower entry rate. Fewer entries lead to less output and TFP due to decreasing returns to

scale technology. Moreover, a higher entry cost protects existing establishments. Hence, establishments with lower productivity can survive, and output and TFP decrease. Second, when there are financial frictions, existing establishments cannot borrow enough capital and must operate at a smaller scale. Third, financial frictions amplify the effect of entry costs on output and TFP. To understand this, note that when there are frictions in the financial market, some of the profitable entrants may not be able to open their businesses as they cannot finance the required upfront entry cost. This, in turn, reduces the entry rate. The effect is equivalent to an increase in the entry cost. Hence, output and TFP decline. Furthermore, as financial market conditions deteriorate, the amplification effect increases, as does the decrease in output and TFP.

This paper is connected to the literature that studies the relationship between various policies and the cross-country income and TFP differences. For instance, Parente and Prescott (1999) and Herrendorf and Teixeira (2011) examine the role of monopoly rights in blocking the use of most efficient technologies, while Lagos (2006) examines how labor market institutions affect TFP. Erosa and Cabrillana (2008) investigate the role of poor contract enforcement in explaining the use of inefficient technologies and low TFP in poor countries, and Guner et al. (2008) and Restuccia and Rogerson (2008) study the effect of size-dependent policies on macroeconomic aggregates.

This paper is also related to several other papers in the literature that emphasize the importance of entry costs and financial frictions on cross-country income and TFP differences. Researchers such as Barseghyan and DiCecio (2011) quantify the effect of entry costs on economic development, while Amaral and Quintin (2010) and Buera et al. (2011) show that financial frictions can generate sizable differences in output and TFP, and D’Erasmus and Boedo (2012) explore how the costs of informality and the financial market structure affect cross-country TFP differences. We view this paper as a complement to these works. We develop an industry model that incorporates both entry costs and financial frictions, allowing

us to investigate how the interaction between entry costs and financial frictions affects income and TFP. Moreover, the simulations based on the calibrated model show that the interaction is quantitatively important.

The rest of the paper is organized as follows. Section 2 presents the model and defines the steady state equilibrium. Section 3 describes the calibration strategy. Section 4 assesses the quantitative implication of the calibrated model and the robustness of the results. Section 5 concludes the paper.

2 The Economy

We consider a discrete-time model with heterogeneity in establishment level productivity. The model can be best described as embedding borrowing constraints into the industry model studied by Hopenhayn and Rogerson (1993). In the model economy, an establishment must finance capital and the fixed production cost ahead of production by borrowing from an imperfect financial market. More importantly, there are many potential entrants who can enter after paying a front-loaded set-up cost upon entry, and this cost must also be financed. The details follow.

2.1 Production

2.1.1 Technology

The production unit is the establishment. There is a continuum of existing establishments that differ in their productivity z . Each of these establishments hires labor, invests in capital, and produces according to the following production function:

$$y = zk^\alpha h^\gamma, \tag{2.1}$$

where the individual establishment productivity z changes over time. Specifically, z is the same as the last period value with probability λ , and evolves according to the distribution $F(z)$ with probability $1 - \lambda$. The parameter λ controls the persistence of the idiosyncratic productivity shock. The establishment's production technology is assumed to be a decreasing returns to scale, i.e., $\alpha + \gamma < 1$. To stay in operation, each establishment must pay a fixed production cost f every period, measured in the unit of output. As in Hopenhayn and Rogerson (1993), the fixed production cost generates explicit exit and prevents establishments from staying in the economy while not producing. Capital is owned by establishments. We use k_{-1} to denote the establishment's capital holdings during the last period and k to denote the optimal choice of capital in the current period. The capital good is homogenous across establishments and can be freely traded in the market. Hence, if $k > (1 - \delta)k_{-1}$, establishments expand and raise capital, and otherwise, establishments downsize and sell capital in the market.

2.1.2 Financial Market

The financial market consists of many competitive intermediaries who receive deposits and lend to establishments at a constant rate r . We assume that borrowing and lending are within the same period and that establishments cannot default on the debt. Thus, the zero-profit condition for the intermediaries implies that the interest rate paid on the deposit is also r .

An establishment's ability to borrow is limited by its prospect and current capital holdings. For simplicity, we assume that an establishment can borrow up to a fraction η of its discounted life-time profits. Each establishment finances capital and fixed production cost, and the borrowing constraint is described as follows:

$$k - (1 - \delta)k_{-1} + f \leq \eta v(z, k_{-1}), \quad (2.2)$$

where $v(z, k_{-1})$ represents the value of an establishment, and the establishment's state at the beginning of a period is summarized by (z, k_{-1}) . The credit constraint imposes an upper bound on the current period capital usage. As demonstrated later in this section, $v(z, k_{-1})$ is increasing in both z and k_{-1} . Hence, the credit constraint captures the idea that establishments with more collateral and better productivity can borrow more from the financial market. The development of financial markets differs across countries due to differences in contract enforcement. For simplicity, we use η to capture the degree of financial development in different countries with the interpretation that a larger η represents a better financial market.

We implicitly exclude the possibility that establishments use retained earnings to finance production. As there is no difference in the deposit and lending rates, whether to allow establishments to use retained earnings to finance production is not important. For more discussion on retained earnings, please see the discussion in section 4.

The timing of decisions within a period is as follows. At the beginning of a period, the productivity z realizes. After seeing the new productivity, an establishment with capital holding k_{-1} can choose to stay in operation if the continuation value is larger than the value of its non-depreciated capital, or exit otherwise. If the establishment decides to stay, it chooses how much labor to hire, how much capital to use, and therefore, how much money to borrow from the financial market, taking into account the borrowing constraints. At the end of the period, production takes place, and the establishment repays the debt. If the establishment decides to exit, it sells its capital and exits the market.

Subject to the borrowing constraint (2.2) and the non-negativity constraint on capital, an establishment's value $v(z, k_{-1})$ measured immediately after the realization of productivity

is given by:

$$\begin{aligned}
v(z, k_{-1}) = & \max_{k, h} zk^\alpha h^\gamma - wh - (1+r)(k - (1-\delta)k_{-1} + f) + \beta\lambda \max[v(z, k), (1+r)(1-\delta)k] \\
& + \beta(1-\lambda) \int \max[v(z', k), (1+r)(1-\delta)k] dF(z')
\end{aligned} \tag{2.3}$$

An establishment's value consists of its current period profit and the next period's value, which reflects the evolution of productivity and the establishment's staying or exiting decision as indicated by the maximization operator nested on the right-hand side. When exiting, an establishment can sell its non-depreciated capital $(1-\delta)k$ and earn interest on the proceeds, as described by the second term inside the maximization operator. As there is no distortion in the labor market, the first order condition implies $h = (\frac{zk^\alpha \gamma}{w})^{\frac{1}{1-\gamma}}$.

The value function (2.3) implicitly defines three types of establishments: expanding, downsizing, and exiting establishments. The expanding establishments raise capital and the fixed production cost through borrowing from the financial market. The downsizing establishments sell the extra capital and deposit the proceeds and also borrow from the financial market to pay for the fixed production cost.³ The exiting establishments sell their capital and earn interest.

If the financial market is perfect, equation (2.2) will not bind. In this case, regardless of their capital holdings, establishments can always borrow the optimal amount of capital as determined only by the productivity. Hence, all the decision rules, including usage of capital and labor and the stay/exit decision, only depend on productivity. However, if the financial market is imperfect, the decision rules will depend on both z and k_{-1} . In particular, the capital usage could be either less or greater than the level in the perfect financial market for an establishment with the same state (z, k_{-1}) . On the one hand, equation (2.2) sets an

³As the borrowing and lending rates are the same, this is equivalent to the following: the downsizing establishment sells the extra capital and uses the proceeds to pay for the fixed production cost. If the fixed production cost is large, the establishment finances the difference, and if the proceed is large, the establishment deposits the extra proceed.

upper bound for k and may force some establishments to operate on a smaller scale; on the other hand, establishments with larger k_{-1} and smaller z have some probability of drawing a better productivity in the future and optimally choosing to hold more capital.

When the financial market is perfect, the stay/exit decision does not depend on capital holdings, as it is characterized by a cutoff rule for z . In contrast, when the financial market is imperfect, an establishment with more capital holdings can borrow more and operate on a larger scale, as more capital holdings imply not only that the establishment has more capital to begin with but also that the establishment can borrow more from the financial market because v is an increasing function of k_{-1} , as established in the following lemma.

Lemma 1 (i) $v(z, k_{-1})$ is strictly increasing in z and k_{-1} ;
(ii) $v(z, k_{-1}) - (1 + r)(1 - \delta)k_{-1}$ is increasing in k_{-1} .

Proof: See appendix.

As v is increasing in z , the decision to stay or exit is characterized by a cutoff rule for z at a given value of k_{-1} . In particular, the rule is to exit if z is below the cutoff value and to stay otherwise. Lemma 1 (ii) proves that an increase in k_{-1} leads to a greater increase in v . It follows that the decision to stay or exit is also characterized by a cutoff rule for k_{-1} at a given value of z . Moreover, the monotonicity proven in lemma 1 also implies the monotonicity of the cutoff values. Specifically, the cutoff value of k_{-1} becomes smaller as z increases and the cutoff value of z becomes smaller as k_{-1} increases.

2.1.3 Entry

There is a continuum of an infinite amount of ex ante identical establishments that can enter each period after paying the entry cost f_e , measured in the unit of output. To pay the entry cost, the entrant can borrow from the financial market at the rate r up to the fraction η of its value of entry. The debt is, again, within the period and must be repaid at the end

of the period. Once the entry cost is paid, each establishment receives a productivity draw z from the same distribution as the existing establishments $F(z)$. The productivity draws are i.i.d across entering establishments. After the productivity draw is realized, the entering establishment decides to stay or exit. If the establishment chooses to stay, it then decides how much to borrow and how much to produce. The borrowing constraint for entrants is as follows:

$$k + f + f_e \leq \eta v(z, 0). \quad (2.4)$$

Perfect Financial Market

As in Hopenhayn and Rogerson (1993), as there is an infinite amount of potential entrants in each period, the value of entry for an entering establishment should not exceed the entry cost in the equilibrium when the financial market is perfect. In this economy, the entrant, after paying the entry cost, is in the same position as the existing establishment with the same productivity and zero capital. Hence, when making the stay/exit decision, the entrant will compare the value of staying $v(z, 0)$ with the value of exiting 0. Thus, the free entry condition can be described as follows:

$$\int \max(v(z, 0), 0) dF(z) - r f_e \leq f_e \quad (2.5)$$

where f_e on the right-hand side denotes the entry cost and $r f_e$ on the left-hand side is the interest payment on the entry cost. The integral is taken over all the possible productivity draws. For future reference, note that the left-hand side of (2.5) denotes the value of entry for a new establishment.

If there is no financial friction, the free-entry condition (2.5) must hold in the steady state equilibrium. In this paper, we will focus on the steady state equilibrium with entry and exit.⁴ As proven in Hopenhayn (1992), if a steady state equilibrium with entry and

⁴This equilibrium exists for all the simulations in section 5.

exit exists, it is a unique equilibrium and (2.5) will hold with equality. Otherwise, more establishments will enter and produce, which drives down the value of entry until it is no longer profitable for more establishments to enter.

Imperfect Financial Market

When there are financial frictions, the free-entry condition may not hold in the steady state equilibrium. To see this, note that as for an existing establishment, a new establishment can only borrow up to η fraction of its value of entry. Hence, if f_e is less than the borrowing limit for a potential entrant, no establishment can pay the up-front cost to enter. In such cases, a steady state equilibrium with entry and exit cannot exist even when the free-entry condition holds. This implies that f_e must be less than or equal to the borrowing limit for a new establishment in the steady state equilibrium. As the left-hand side of equation (2.5) is the value of entry for a new establishment, the borrowing constraint is as follows:

$$\eta \left\{ \int \max(v(z, 0), 0) dF(z) - f_e r \right\} \geq f_e \tag{2.6}$$

Simple manipulation gives

$$\int \max(v(z, 0), 0) dF(z) - f_e r \geq \frac{f_e}{\eta} \tag{2.7}$$

If $\eta \geq 1$, there is no contradiction between equations(2.5) and (2.7), and therefore, the free-entry condition will hold with equality in the equilibrium. This implies that if the friction in the financial market is moderate, all the profitable new establishments can borrow f_e , and the entry decision is not distorted. However, if $\eta < 1$, the entry decision is distorted, and the free-entry condition cannot hold in equilibrium. In such cases, the entrant's borrowing constraint (2.7) binds. Otherwise, more establishments can acquire the up-front cost f_e from the financial market, and it is also profitable for these establishments to enter because the value of entry is greater than the entry cost. This drives up the labor demand and wage

rate, therefore driving down the value of entry until equation (2.7) holds with equality.

For future reference, note that from equations (2.5) and (2.7), it is evident that when $\eta \geq 1$, the value of entry equals the entry cost f_e , but when $\eta < 1$, the value of entry equals to $\frac{f_e}{\eta}$. Thus, when $\eta < 1$, $\frac{f_e}{\eta}$ can be viewed as the effective entry cost, as the entrants make entry decisions according to $\frac{f_e}{\eta}$ instead of f_e , and therefore output and TFP also adjust according to the effective entry cost. Hence, as long as η is small, even if the entry cost is not substantial, the effective entry cost could still be significantly large. This implies that financial frictions interact with entry costs and amplify the effects of entry costs on cross-country incomes and TFP differences by boosting the effective entry cost. Moreover, the magnitude of the amplification effect depends on the severity of the friction.

2.2 Household

There is an infinitely lived representative household who inelastically supplies one unit of labor each period and values a single consumption good c according to the utility function:

$$\sum_{t=0}^{\infty} \beta^t \log(c_t),$$

where $0 < \beta < 1$ is the discount factor. The household can deposit its savings a and earn interest at rate r from the financial intermediaries. The household also owns all the establishments in the economy. Let $W(a)$ denote the value function of the household. The problem of the representative household is given by:

$$\begin{aligned} W(a) &= \max_{c, a'} \log(c) + \beta W(a') \\ \text{s.t.} \quad &c + a' = w + a(1 + r) + \Pi, \end{aligned} \tag{2.8}$$

where w is the wage rate and Π is the total profits generated by the production sector.

A simple manipulation of the first order condition implies that if a stationary equilibrium exists, $r = \frac{1}{\beta}$.

2.3 Definition of the Steady State Equilibrium

A steady state competitive equilibrium is composed of: prices w and r , value functions $W(a)$ and $v(z, k_{-1})$, a measure of productive establishments $\mu(z, k_{-1})$, total profit Π , a mass of entry M , policy functions $c(a)$, $a'(a)$, $h(z, k_{-1})$, $k(z, k_{-1})$, and the stay/exit decision $x(z, k_{-1})$ with the convention that $x(z, k_{-1}) = 1$ corresponds to stay and $x(z, k_{-1}) = 0$ corresponds to exit, such that:

(i) Given prices, all agents solve their maximization problems.

(ii) $r = 1/\beta$.

(iii) If $\eta \geq 1$, (2.5) holds with equality and if $\eta < 1$, (2.7) holds with equality.

(iv) μ is time-invariant.

(v) Labor, good, and credit market clear:

$$1 = \int h(z, k_{-1}) d\mu(z, k_{-1}), \quad (2.9)$$

$$c(a) + \delta K = Y - \int f d\mu(z, k_{-1}) - M f_e, \quad (2.10)$$

$$a = \delta K + \int f d\mu(z, k_{-1}) + M f_e, \quad (2.11)$$

where K and Y are defined as $K = \int k(z, k_{-1}) d\mu(z, k_{-1})$ and $Y = \int z k(z, k_{-1})^\alpha h(z, k_{-1})^\gamma d\mu(z, k_{-1})$.

(vi) Profit Π is as follows:

$$\Pi = Y - w - \delta K(1 + r) - (1 + r) \int f d\mu(z, k_{-1}) - M f_e(1 + r). \quad (2.12)$$

The labor market and good market clearing conditions (2.9) and (2.10) are standard. To understand the credit market clearing condition (2.11), note that the deposits received by the financial intermediary come from three sources: household savings, capital sold by downsizing and exiting establishments. The lending by the financial intermediary is applied to three sources: capital raised by expanding establishments, fixed production costs and entry costs. In the steady state equilibrium, the economy-wide capital holdings equalize across periods, and new capital must be raised only to replace the depreciated capital. Hence, the credit market clearing can be described as in equation (2.11). The total profit received by the household is the aggregation of current period profits from the net of the entry costs of three types of establishments. Equation (2.12) can then be derived using the labor market and the credit market clearing conditions.

3 Calibration

This section calibrates the parameters to match observations in the steady state to data in the U.S. economy. For this purpose, the U.S. economy is treated as an economy without distortion in the financial market.⁵ We assume that one period in the model corresponds to one year in the data, and therefore, we target the steady state interest rate r to be 4% per year. This implies that $\beta = 0.96$. We follow the literature and set the returns to scale in the establishment level to be 0.8, and we set the capital share to be one-third of the returns to scale and the labor share to be two-thirds of the returns to scale.⁶ This indicates that $\alpha = 0.27$ and $\gamma = 0.53$. To calibrate the depreciation rate, we follow Guner et al. (2008) and target the capital to output ratio in the U.S. business sector to be 2.3 and the implied δ to

⁵The financial market in the U.S. is certainly not perfect. Hence, the quantitative results in section 4 should be interpreted as the effects of financial frictions on income and TFP relative to the U.S.

⁶The return to scale parameter is found to be between 0.8 and 0.9. See, for example, Basu (1996), Veracierto (2001), Chang (2000) and Guner et al. (2008). Section 4.3 discusses the results for the return to scale of 0.9.

be 0.08.

The U.S Census Business Dynamics Statistics (BDS) reports data for the entry/exit rates of U.S. establishments. To calibrate the persistence of the productivity process λ , we target the average exit rate from 2000 to 2010, which is approximately 10%.⁷ We assume a lognormal distribution $F(z)$ with support $[0, z_{max}]$ for the productivity process. In an economy without financial frictions, all establishments operate at their optimal scale and the establishment employment level is uniquely determined by z for any given prices. Hence z_{max} can be inferred from the maximum employment level of establishments in the steady state equilibrium, which we assume to be 10,000.

The parameters that remain to be assigned are the entry cost f_e , the fixed production cost f , the mean ϕ and the variance σ of the distribution F . We calibrate these four parameters jointly to match the ratio of entry cost to the GDP per capita, the average establishment size, and the share of the total number of establishments at different sizes in the U.S. economy. The doing business data set of the World Bank provides entry costs in terms of the GDP per capita for 184 countries since 2004. The average value for the U.S. from 2004 to 2010 is 0.73%. This number is used to calibrate the entry cost f_e . The establishment level statistics are borrowed from the 2007 U.S. Economic Census, which summarizes the establishment level distributional statistics by size.⁸ Specifically, the targets include 10 moments: the average establishment size and nine statistics related to the distribution of the share of establishments by size.

The calibrated parameters are reported in table 1, while table 2 lists the targets and the corresponding statistics generated by the model.⁹ Overall, the calibrated model matches the

⁷The data can be found in the table “Economy Wide” at the following webpage: http://www.census.gov/ces/dataproducts/bds/data_estab.html.

⁸The establishment statistics can be found in the table “U.S. & States, Totals” at the following webpage: <http://www.census.gov/econ/susb/data/susb2007.html>.

⁹Note that the fixed production cost is 54 times that of the entry cost, thus, implies that f is 39% of per capita GDP in the U.S. and is a small fraction of the total GDP.

data well.

4 Quantitative Analysis

This section uses the calibrated model to assess the effects of entry costs, financial frictions, and the interaction between these two on the cross-country income and TFP differences. The strategy is to compare the steady state equilibrium in economies that differ in the entry cost and the ability to acquire external finance. According to the data from the World Bank, entry costs vary from 0.73% of the GDP per capita in the U.S. to more than 4 times the GDP per capita in countries such as the Congo and Angola, and for most of the countries, this value is between the U.S. level and 2. Hence, for the comparison exercises, we increase the entry cost from the benchmark value to two times that of the GDP per capita.

Measuring the degree of financial frictions across countries is a complicated task. In our setting, the financial market condition determines the level of establishment borrowing and output and hence the aggregate debt to GDP ratio. Correspondingly, we measure the business sector debt to the GDP ratio from available data to provide information for pinning down η . The business debt to the GDP ratio is constructed as the sum of private credit to the GDP ratio and bond market capitalization as a share of the GDP subtracting the share of the debt contracted by the household sector. The first two variables come from the latest update of Beck et al. (2000) and the last variable comes from the International Monetary Fund financial access survey (FAS).¹⁰

When assessing the effects of the financial friction, we vary η to obtain a range of business finance to GDP ratios relative to the U.S., as in the constructed data. For the analysis, we examine three different levels of business debt to GDP ratios. The three levels correspond to the average debt to GDP ratio in high income countries, upper middle income countries, and

¹⁰The data for business sector borrowing are available upon request.

the average of lower middle income countries and low income countries, where the definitions of the groups follow the Atlas method from the World Bank. We group the lower middle income countries and the low income countries together because we only have a few low income countries in the constructed data due to the availability of household debt.

Following the standard development accounting exercise, TFP in this section is measured as follows:

$$TFP = \frac{Y}{K^\alpha H^{(1-\alpha)}},$$

where H is one, as the labor supply is inelastic.

4.1 No Distortion on Business Entry

To isolate the effects of the interaction between entry costs and financial frictions, we first discuss the effects of entry costs and financial frictions on TFP and output in the economy without distortion on business entry. In this economy, borrowing constraints are only imposed on the financing of capital and the fixed production cost and not on the financing of entry costs. This implies that the free-entry condition (2.5) holds with equality regardless of the value for η . Figure 1 plots the aggregate variables in the steady state against the entry cost to GDP ratio for different values of η , where η is chosen to be the same for every group of countries, as in the economy with distortion on business entry. Each curve shows that aggregate variables vary across countries with different levels of entry costs, but with similar levels of financial frictions.¹¹ For comparison purposes, we normalize the U.S. values to be one, except for the entry rate.

Figure 1 shows that both output and TFP decrease with the entry costs at all levels of the financial friction. The intuition goes back to Hopenhayn (1992) and Hopenhayn and Rogerson (1993). When there is no distortion on business entry, the free-entry condition

¹¹The debt to GDP ratio changes little with entry cost.

must always be satisfied in the steady state equilibrium. Thus, a higher entry cost necessarily leads to a higher expected value of entry through a lower wage rate. This implies a larger v for any pair of (z, k_{-1}) , and therefore, establishments with a smaller productivity can survive, and the cutoff value for z decreases for any level of capital holdings. Moreover, as shown in the lower left panel of figure 1, a larger entry cost reduces the entry rate of new establishments. Less productive establishments reduce the aggregate productivity, as establishments face decreasing returns to scale. Both of these channels (less entry and survival of low productivity establishment) lead to lower output.

As figure 1 indicates, varying entry costs from the U.S. level to two times that of the GDP per capita can generate approximately four times the difference in output and approximately three times the difference in TFP, while the quantitative effects are similar at different levels of financial development. The quantitative difference in output and TFP generated by entry costs is similar to that found in Barseghyan and DiCecio (2011). In addition, the curves for output and TFP become flatter when the entry costs increase. In fact, the model generates a log-linear relationship between output and TFP with entry costs. As entry costs do not affect capital accumulation, when we move along each curve, the capital output ratio remains constant, as shown in the lower right panel of figure 1. Hence, the reduction in output with entry costs is due to the reduction in TFP.

Figure 1 also presents the effects of financial frictions on economic development at given levels of the entry cost. The vertical axis represents the case of holding the entry costs to the GDP ratio at the U.S. value. As expected, tighter borrowing constraints decrease output and TFP. When moving from the perfect financial market to the worst financial market, output decreases roughly by a factor of 2.4 at every level of entry cost.

Tighter borrowing constraints reduce the establishment's production scale and distort the allocation of capital and labor. Specifically, as some of the productive establishments may not raise enough capital, they must operate on a smaller scale. As a result, the economy-wide

capital output ratio is smaller in economies with poorer financial market development. In particular, the capital output ratio in low income countries is 12% that of the U.S. value. Hall and Jones (1999) show that there is considerable variation in the capital output ratio. For low and lower middle income countries in our data, the ratio varies from a low of 14.7% of the U.S. value for Bangladesh to 87% of the U.S. value for Peru. The capital output ratio generated by our model is at the low end of the data. It is also worth noting that the capital share and labor share do not change with financial development despite the sharp decrease in capital to output ratio. This is because the capital and labor markets are both competitive.

In addition, Lemma 1 proves that an establishment's value increases as capital holdings increase. This implies that establishments with more capital holdings can raise more capital and produce on a larger scale even if their productivity is not high. In particular, establishments with greater capital holdings and less productivity may survive, and establishments with smaller capital holdings and greater productivity may not survive. This misallocation drives down TFP and hence output. However, such an effect only accounts for a small portion of the decline in output, as the change in TFP is not significant, as shown in figure 1.

This differs from the findings of Amaral and Quintin (2010) and Buera et al. (2011). To understand the difference, note that Amaral and Quintin (2010) have a three-period overlapping generations model in which the entrepreneurs can only save for one period and cannot overcome borrowing constraints through self-financing over time. As a result, the quantitative effect of financial frictions is large. Buera et al. (2011), however, generate a greater effect through an industry model with risk-averse entrepreneurs and the misallocation of capital and talent. In contrast, we did not model the misallocation of talent and show that the misallocation of capital and labor with risk neutral establishments cannot generate a large quantitative effect of financial frictions on output and TFP. This abstraction simplifies the analysis and does not undermine our results, as our main focus is on how the interaction

between entry costs and financial market frictions affects the cross-country income and TFP differences.

4.2 With Distortion on Business Entry

In figure 2, we focus on the interaction between entry costs and financial frictions. As the borrowing constraint is imposed on business entry or not is irrelevant for an economy without financial frictions, the top curves in both figures 1 and 2 are identical.¹² As shown in figure 2, when we consider the effect of the borrowing constraint on business entry, the financial friction decreases output and TFP significantly more at all levels of entry cost. To understand this, note that η is less than one in all three groups of countries with financial frictions. Hence, the free-entry condition (2.5) cannot be satisfied in these economies; thus (2.7) holds with equality. In such cases, the equilibrium wage rate adjusts according to the effective entry cost $\frac{f_e}{\eta}$, so do the output and TFP. Because $\frac{f_e}{\eta} > f_e$, the reduction in output and TFP will be greater when compared to an economy with the same entry cost and financial market development but without borrowing constraint on business entry. This implies that financial frictions interact with entry costs and amplify the effects of entry costs on output and TFP. Furthermore, as the financial market conditions deteriorate, such amplification effects increase, as a smaller η leads to greater effective entry costs.

When moving from the perfect financial market to the worst financial market, TFP decreases substantially in the case with interaction in contrast to the minimal decline in the case without interaction. Because the interaction only raises the effective entry cost and has no impact on capital accumulation, the capital output ratio is the same as it is in the case without interaction. Hence, the decline in output from figure 1 to figure 2 are completely driven by the decline in TFP.

¹²The top curves in the two figures are not completely identical because establishments must pay interest on entry cost in figure 2. However, the difference is negligible.

In the context of this model, the interaction between entry costs and financial frictions is generated by the borrowing constraints on business entry, which largely exists in reality. When business entry is explicitly modeled, such constraints imply that some of the profitable entrants may not be able to borrow the required up-front entry cost to open their businesses. Hence, financial frictions affect output and TFP not only by reducing the existing establishment's production scale and misallocation of resources but also by directly reducing the entry rate, as shown in the lower left panel of figure 2. These channels all lead to lower output and TFP. As the financial market condition deteriorates, it becomes even more difficult for new businesses to open, and therefore, the distortion increases, and output and TFP decrease.

We now turn to the quantitative magnitude of the effects. Based on figure 2, the maximum difference between output and TFP that the model can generate is a factor of thirty-one and a factor of seven, respectively. As in the data, the differences in TFP account for a substantial portion of the differences in output. The quantitative differences in output and TFP are similar to the differences between the U.S. and poor African countries found by Hall and Jones (1999). Once we eliminate the interaction between the entry cost and the financial friction, the maximum difference the model can generate is a factor of ten for output and a factor of three for TFP, as shown in figure 1. This analysis implies that the interaction between entry costs and financial frictions accounts for a significant portion of the quantitative effects, and the size of such quantitative effects is comparable to the size of the quantitative effects generated in the case without interaction. Hence, when analyzing the effects of financial frictions and entry costs on output and TFP, it is important to explicitly model business entry and to explore the interaction between financial frictions and entry costs. This also suggests that policymakers should remove barriers to entry and mitigate financial frictions to achieve the greatest improvement in economic development.

Data on business entry and exit rates across a large number of countries are scarce

(see Tybout (2000)). Djankov et al. (2010) provide business entry rates for more than 50 countries and find a negative correlation between entry rate and income per capita. This is consistent with the predicted entry rate from our simulations. Moreover, the average entry rate generated for each group of countries is close to the average as found in the data. The average entry rate for low and lower middle income countries is 7% according to the data, while the corresponding rate from our model is 7.7% for an average entry cost per capita of 71% in this group of countries.¹³ The average entry rates in the data for upper middle and high income countries are 8.6% and 8.8%, respectively, while the prediction from the model is 9.5% for upper middle income countries with an average entry cost of 20% and 9.9% for high income countries with an average entry cost of 6%. However, entry rates in the data vary considerably among the various income groups. We do not attempt to generate this dispersion as we did not model other frictions that may also contribute to the entry rate.

In summary, while the entry cost and the financial friction in the model generate large cross-country income and TFP differences, a substantial portion of the differences are accounted for by the interaction between the two. Hence, such interaction cannot be ignored when analyzing the cross-country income and TFP differences.

4.3 Discussion

4.3.1 Technology Parameters

We set the returns to scale parameter to be 0.8 in the benchmark calibration. Research in the literature normally indicates a value between 0.8 and 0.9. Recalibrating the model with the returns to scale at 0.9 generates smaller effects on TFP and output. In particular, the maximum differences for output and TFP are eleven times and three times, respectively, in the model without distortion on entry and five and one and a half times, respectively, in the

¹³The data for entry costs by country come from the Doing Business Database published by the World Bank. We use the average between 2000 and 2010 as the entry cost for each country.

model with distortion on entry. Although the maximum difference the model can generate is smaller, the quantitative effects are still sizeable. More importantly, a substantial portion of the effects is, again, derived from the interaction between the entry cost and the financial friction.

4.3.2 Entrepreneurial Sector

As we did not model the entrepreneurial sector, we assume that establishments have zero wealth before entry and must finance the entire entry cost. If allowing part of the entry cost to be paid through entrepreneurs' savings, the quantitative effects will be less than those shown in figure 2 and larger than those shown in figure 1. Furthermore, the size of the effect depends on the level of the financial friction and the wealth of the entrepreneur.

4.3.3 Retained Earnings

In this paper, as we only considered external financing, we did not allow establishments to finance capital using retained earnings. According to the theory by Miller and Modigliani (1958, 1961) the return and cost of investment should be the same regardless of the financing source. However, the empirical literature does not find evidence to support this theory. Instead, the empirical literature finds that it is less costly to use internal funds (Hubbard, 1998) and notes a positive correlation between internal funds and investment, i.e., investment is sensitive to cash flow. Two sources of frictions, asymmetric information and managerial discretion, are proposed as the cause. Specifically, when the market is unable to evaluate the investment opportunities of firms, the cost of external financing increases and firms rely on their cash flow. In contrast, agency problems may lead some managers to use their retained earnings to overinvest, even in the presence of poor opportunities.

Beginning with Fazzari et al. (1988), a substantial number of studies show that investment is more sensitive to cash flow for more financially constrained firms. However, this

finding is disputed by Kaplan and Zingales (1997, 2000) as they find that investment-cash flow sensitivity is independent of financial constraints and argue that the classification of firms in previous papers is inappropriate because the results are driven by a small number of outliers.¹⁴ Because of serious hurdles in the empirical literature, the literature review by Hubbard (1998) concludes that there is no consensus on the effect of financial friction on the sensitivity of investment to cash flow.

In this paper, tighter financial constraint leads to reduced investments, as there is no possibility of using retained earnings. If the view by Kaplan and Zingales (1997, 2000) holds, our results are not significantly affected when allowing the possibility to use retained earnings. However, if the view by Fazzari et al. (1988) holds, the income and TFP differences generated by our model will be less when allowing the possibility to use retained earnings. This does not affect, however, the mechanism that generates interaction between financial friction and entry costs in the model. As the literature provides no clear answer on this issue, we consider that our results provide a benchmark estimate on the effect of the interaction on income and TFP differences.

5 Conclusion

This paper has analyzed how the interaction between entry costs and financial frictions affect cross-country income and TFP differences. To perform such an analysis, we developed a model that incorporates both entry costs and financial frictions. In the model, entry, production, and exit decisions are all endogenous. To raise capital, establishments can borrow from the financial market. To enter the market, new establishments must pay an upfront entry cost that can be borrowed from the financial market. Because the financial market is imperfect, each establishment can only borrow up to a fraction of its expected

¹⁴Also, Gilchrist and Himmelberg (1995), Erickson and Whited (2000) and Alti (2003) argue that there exist serious measurement errors of q that affect previous results.

discounted lifetime profits.

The model is calibrated to match the establishment level statistics in the U.S. economy, assuming a perfect financial market for the U.S. The simulations show that the model can generate a factor thirty-one of the difference in income per capita and a factor seven of the difference in TFP across countries, and more than half of the differences are accounted for by the interaction between entry costs and financial frictions. The main mechanism is that financial frictions amplify the effect of entry cost by boosting the effective entry cost. This finding implies that financing constraints for start-ups and business entry costs must be addressed together to improve overall productivity.

We assume that all new establishments pay the same entry cost, which might not be true in reality. As Buera et al. (2011) has shown, allowing entry costs to vary across sectors can generate significant quantitative effects on income and TFP. Similarly, the interaction between financial frictions and sectoral or industrial entry costs may be worth studying. We leave this for future research.

References

- Alti, A., April 2003. How sensitive is investment to cash flow when financing is frictionless? *Journal of Finance* 58 (2), 707–722.
- Amaral, P., Quintin, E., August 2010. Limited enforcement, financial intermediation and economic development: A quantitative assessment. *International Economic Review* 51 (3).
- Barseghyan, L., DiCecio, R., September 2011. Entry costs, industry structure, and cross-country income and tfp differences. *Journal of Economic Theory* 146 (5), 1828–1851.
- Basu, S., August 1996. Procyclical productivity: Increasing returns or cyclical utilization? *The Quarterly Journal of Economics* 111 (3), 719–51.
- Beck, T., Levine, R., Loayza, N., 2000. Finance and the sources of growth. *Journal of Financial Economics* 58, 261–300.
- Buera, F. J., Kaboski, J. P., Shin, Y., August 2011. Finance and development: A tale of two sectors. *American Economic Review* 101 (5), 1964–2002.
- Chang, Y., August 2000. Wages, business cycles, and comparative advantage. *Journal of Monetary Economics* 46 (1), 143–171.
- D’Erasmus, P. N., Boedo, H. J. M., 2012. Financial structure, informality and development. *Journal of Monetary Economics* 59 (3), 286 – 302.
- Djankov, S., Ganser, T., McLiesh, C., Ramalho, R., Shleifer, A., July 2010. The effect of corporate taxes on investment and entrepreneurship. *American Economic Journal: Macroeconomics* 2 (3), 31–64.
- Djankov, S., Porta, R. L., de Silanes, F. L., Shleifer, A., February 2002. The regulation of entry. *Quarterly Journal of Economics* 117 (1), 1–37.
- Erickson, T., Whited, T. M., October 2000. Measurement error and the relationship between investment and q. *Journal of Political Economy* 108 (5), 1027–1057.
- Erosa, A., Cabrillana, A. H., 05 2008. On finance as a theory of tfp, cross-industry productivity differences, and economic rents. *International Economic Review* 49 (2), 437–473.
- Fan, S., Chan-Kang, C., December 2010. Human capital and the wealth of nations, university of Wisconsin-Madison Working Paper.

- Fazzari, S. M., Hubbard, R. G., Petersen, B. C., Blinder, A. S., Poterba, J. M., 1988. Financing constraints and corporate investment. *Brookings Papers on Economic Activity* 1988 (1), 141–206.
- Gilchrist, S., Himmelberg, C. P., December 1995. Evidence on the role of cash flow for investment. *Journal of Monetary Economics* 36 (3), 541–572.
- Guner, N., Ventura, G., Xu, Y., October 2008. Macroeconomic implications of size dependent policies. *Review of Economic Dynamics* 11 (4), 721–744.
- Hall, R. E., Jones, C. I., February 1999. Why do some countries produce so much more output per worker than others. *The Quarterly Journal of Economics* 114 (1), 83–116.
- Herrendorf, B., Teixeira, A., May 2011. Barriers to entry and development. *International Economic Review* 52.
- Hopenhayn, H. A., September 1992. Entry, exit, and firm dynamics in long run equilibrium. *Econometrica* 60 (5), 1127–1150.
- Hopenhayn, H. A., Rogerson, R., October 1993. Job turnover and policy evaluation: A general equilibrium analysis. *Journal of Political Economy* 101 (5), 1127–1150.
- Hubbard, R. G., March 1998. Capital-market imperfections and investment. *Journal of Economic Literature* 36 (1), 193–225.
- Kaplan, S. N., Zingales, L., 1997. Do investment-cash flow sensitivities provide useful measures of financing constraints? *The Quarterly Journal of Economics* 112 (1), 169–215.
- Kaplan, S. N., Zingales, L., 2000. Investment-cash flow sensitivities are not valid measures of financing constraints. *The Quarterly Journal of Economics* 115 (2), 707–712.
- Klenow, P. J., Rodriguez-Clare, A., 1997. The neoclassical revival in growth economics: Has it gone too far? In: Bernanke, B., Rotemberg, J. J. (Eds.), *NBER Macroeconomics Annual*. MIT Press, pp. 73–103.
- Lagos, R., October 2006. A model of tfp. *Review of Economic Studies* 73 (4), 983–1007.
- Miller, M. H., Modigliani, F., 1958. The cost of capital, corporation finance and the theory of investment. *The American Economic Review* 48 (3), 261–297.

- Miller, M. H., Modigliani, F., 1961. Dividend policy, growth, and the valuation of shares. *The Journal of Business* 34 (4), 411–433.
- Nicoletti, G., Scarpetta, S., 2003. Regulation, productivity and growth: OECD evidence. *Economic Policy* 18 (36), 9–72.
- Nicoletti, G., Scarpetta, S., 2006. Regulation and economic performance: product market reforms and productivity in the oecd. In: Eicher, T., Garca-Pealosa, C. (Eds.), *Institutions, Development and Growth*. MIT Press.
- Parente, S. L., Prescott, E. C., December 1999. Monopoly rights: A barrier to riches. *American Economic Review* 89 (5), 1216–1233.
- Prescott, E. C., August 1998. Needed: A theory of total factor productivity. *International Economic Review* 39 (3), 525–551.
- Restuccia, D., Rogerson, R., October 2008. Policy distortions and aggregate productivity with heterogenous establishments. *Review of Economic Dynamics* 11, 707–720.
- Tybout, J. R., March 2000. Manufacturing firms in developing countries: How well do they do and why? *Journal of Economic Literature* 38, 11–44.
- Veracierto, M., August 2001. Employment flows, capital mobility, and policy analysis. *International Economic Review* 42 (3), 571–95.

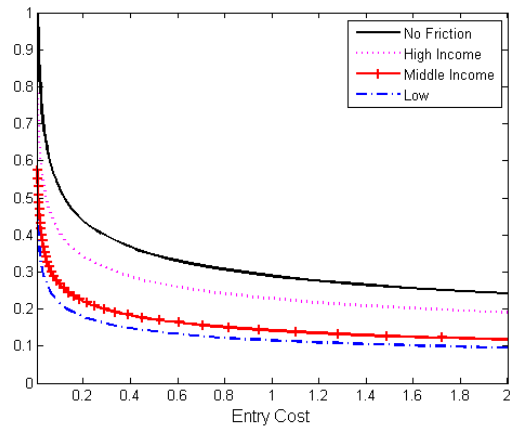
Table 1: Parameter Values

Parameter	r	β	α	γ	δ	λ	z_{max}	f_e	f	ϕ	σ
Value	4%	0.96	0.27	0.53	0.08	0.9	85.56	0.35	18.6	0.03	0.8

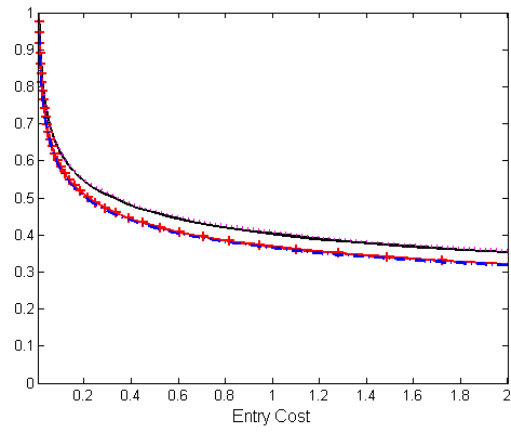
Table 2: Targets

Statistics	Data	Model
Entry cost (% of GDP)	0.73%	0.73%
Average establishment Size	15.65	15.79
% of establishments with		
1-4 employees	54.45%	58.40%
5-9 employees	18.92%	21.70%
10-19 employees	12.72%	10.42%
20-49 employees	8.63%	6.02%
50-99 employees	2.94%	1.89%
100-249 employees	1.67%	1.04%
250-499 employees	0.42%	0.31%
500-999 employees	0.16%	0.13%
1000+ employees	0.09%	0.09%

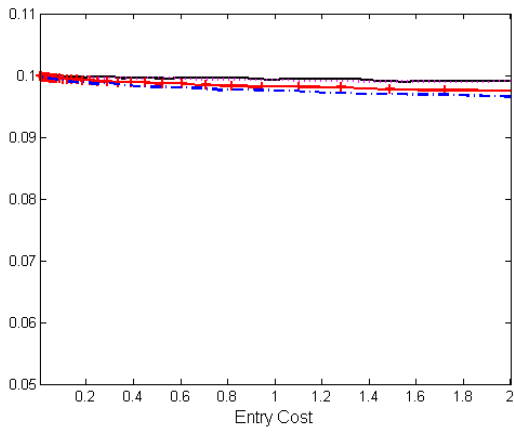
Figure 1: Without Interaction



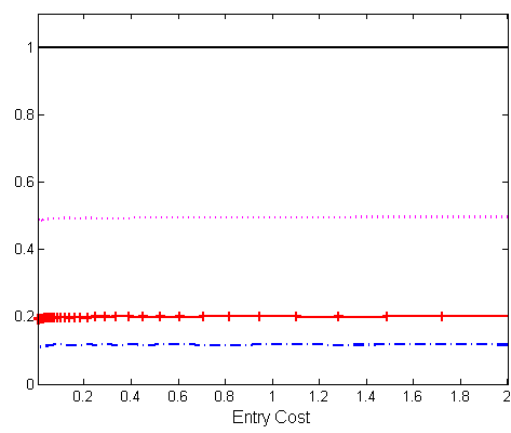
Output



TFP

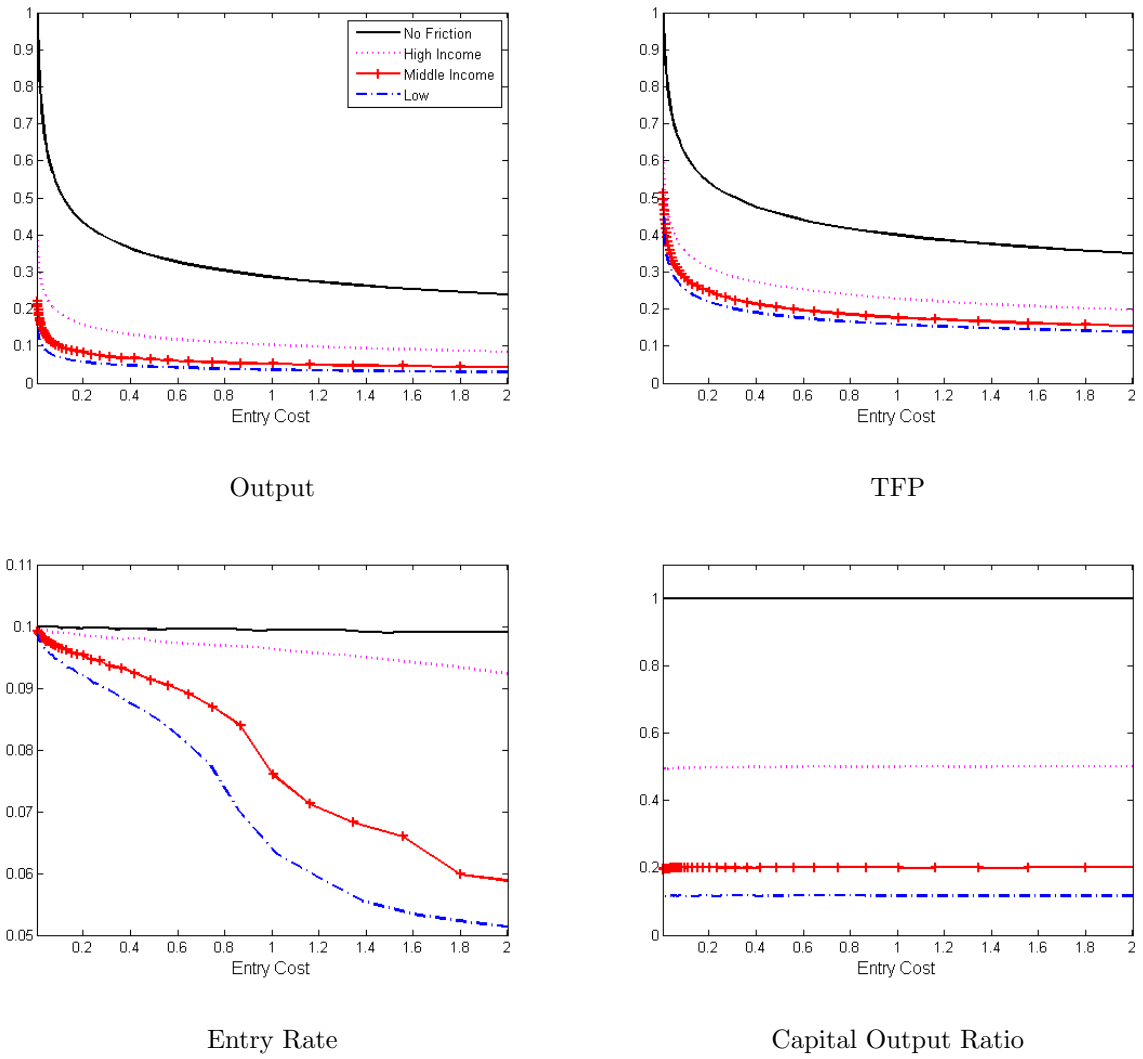


Entry Rate



Capital Output Ratio

Figure 2: With Interaction



6 Appendix

Proof of Lemma 1.

(i): Since the per period profits and the choice set for k are both increasing in z and k_{-1} , standard dynamic programming argument can easily show that $v(z, k_{-1})$ is increasing in z and k_{-1} .

(ii) Let $g(z, k_{-1}) = v(z, k_{-1}) - (1 + r)(1 - \delta)k_{-1}$. $g(z, k_{-1})$ is then defined by:

$$\begin{aligned}
 g(z, k_{-1}) &= \max_{k, h} zk^\alpha h^\gamma - wh - (1 + r)(k + f) \\
 &\quad + \beta(1 - \lambda) \int \max[g(z', k), 0] dF(z) + \beta\lambda \max[g(z, k), 0] \\
 \text{s.t.} \quad &k + f \leq \eta g(z, k_{-1}) + (\eta(1 + r) + 1)(1 - \delta)k_{-1}
 \end{aligned} \tag{6.1}$$

Since the per period payoff and the choice set for k are increasing in k_{-1} , it is easy to show that $g(z, s)$ is increasing in k_{-1} by applying the standard dynamic programming analysis to the above problem.