LABOR AND FINANCIAL MARKET FRICTIONS IN DEVELOPING ECONOMIES

by

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DISSERTATION ABSTRACT

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This dissertation investigates the implications of frictions in labor and financial markets, with a focus on developing economies. Through theoretical and empirical analyses, I first analyze the effects of a large informal labor sector on labor policies and outcomes. I then provide evidence on the effects of access to credit on export performance measured along the extensive and intensive margins of trade. Lastly, I study the implications of various finance measures at the country level on export quality upgrading. The results highlight the importance of policies that promote financial soundness at the macroeconomic level.

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To *you*

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CHAPTER I

INTRODUCTION

This dissertation examines the implications of labor and financial frictions in developing countries. Financial markets in developing countries are characterized by a lack of credit provision and distorted credit allocation. Meanwhile, inefficient labor regulations give rise to a typically large informal labor sector. Competition from the informal sector and access to finance are among the top three challenges faced by small and medium-sized firms in developing countries. According to the World Bank's 2018 Enterprises Survey (WBES), 15% of the enterprises consider access to finance the biggest obstacle to their business, and 12% find practices from informal firms their biggest threat. A better understanding of these two types of frictions will help policymakers design the appropriate policies to promote growth in developing countries.

The informal labor market refers to the labor market that may be legal but not subject to government control. Because of its nature, there are not much direct data on informal labor. However, we know that the informal labor market is large and relevant based on firm and household surveys. In the WBES 2018, nearly 88% of establishments started unregistered, and up to 50% acknowledge competition from informal firms. In Latin American countries where the informal sectors are unusually large, household surveys suggest that workers deliberately switch from

formal employment to informal employment if they want to become business owners to avoid tax payments (Maloney, 2004). Based on these observations, I set up an equilibrium search model with both sectors co-existing in Chapter II. The model allows high-skilled workers from the formal labor sector transit to the informal labor sector and become entrepreneurs. It predicts that activities in the informal labor sector could create misleading signals about the efficiency of the formal labor sector. While the government can use policies to reduce informal employment, such policies have critical drawbacks that outweigh their benefits. Instead, the government should work towards improving labor skills as a long term strategy to diminish the informal sector.

Chapters III and IV study the importance of finance for exporting firms. Compared to domestic firms, exporting firms are often larger and more productive, but also have greater financial needs to accommodate extra costs and uncertainties associated with global transactions. Even for multinational firms which tend to be less resource constrained, financing in the domestic markets is among the top ten factors affecting their investment decisions, according to the 2018 Global Investment Competitiveness Report of the World Bank. The main financial measure employed in these two chapters is private credit to GDP ratio, a commonly used indicator in the literature on finance and economic development. A larger ratio implies a less frictional - or more developed credit market. As bank

loans are the major source of external funding to firms, especially in developing countries, this indicator is relevant to the dissertation theme.

Chapter III quantifies the impact of financial development along two margins of exports: the extensive margin (measured by firm counts) and the intensive margin (measured by average sales per firm). Using a detailed industry-level dataset from the World Bank, the chapter shows that financial development has differential effects on export performance, after taking into account heterogeneity across countries, industries, and firm types. Overall, financial development has a statistically and economically significant impact: for example, a one standard deviation increase in financial development in Cambodia is associated with an increase in total exports by all firms of 58.4%. Almost half of this increase comes from the rise in the number of exporting firms. Financial development has a more substantial effect on exports of the lowest income country group, and exports of certain industries such as Pharmaceuticals and Medical appliances. Continuing exporting firms stand out from the entrant as their exports react more strongly to finance development in both margins. For any firm types, the extensive margin is more sensitive to financial development, implying fixed cost financing is more financially challenging to exporting firms. Fixed cost financing is more important to first-time exporters, as opposed to continuing exporters who may have more internal liquidity. These results are robust to the control for state-

owned enterprises, of which presence can bias downward the effect of financial development on exports.

In Chapter IV, I analyze the effect of finance on export quality upgrading, using a dataset from the International Monetary Fund. Export quality upgrading measures how fast the quality of a product from a given country moves towards the world frontier. Finance has been credited in the literature on economic convergence as an engine for innovation-led growth. Its role as a source of comparative advantage has also been studied extensively in the international trade literature. Guided by these findings, I examine whether finance influences export quality upgrading as it does economic growth and export margins. I use three country-level finance indicators: private credit to GDP ratio, FDI net inflows to GDP, and an index of financial reform. I find that finance does promote quality upgrading, and more strongly for products with low level of quality. The effects vary by country groups: financial reform can explain more of quality upgrading in the highest and lowest income country groups compared to the middle income group. FDI, in contrast, seems more important to middle income countries than the groups at extreme. Further analysis indicates that private credit promotes quality upgrading more strongly in sectors that require relatively more external finance or have relatively little tangible assets. More research is needed to isolate the effects of country-level heterogeneity (e.g., human capital, institutional quality) and product-level heterogeneity(e.g., product differentiation).

CHAPTER II

VOLUNTARY INFORMALITY IN AN EQUILIBRIUM SEARCH MODEL WITH HETEROGENEOUS LABOR

Introduction

The term "informal sector" refers to economic activities that are not reported to governments. In the developing world, the informal sector can be as large as the formal sector. Between 2010 and 2014, the proportion of informal employment as a percent of non-agricultural employment was 49% in Northern Africa, 74% in Sub-Saharan Africa, 57% in Latin America, and 57% in South Asia (Charmes, 2016). According to the International Labour Organization, the informal sector is not directly influenced by governmental policies, and is often seen as a hindrance to economic development. Informal employment is quick and easy, yet it offers low and unstable income, besides limited accessibility to social security and professional training.

Many schools of thought have emerged to explain the existence of the informal sector. The "dualist school" views the informal sector as an inferior market segment with no direct links to the formal sector and expects the informal sector to diminish with economic growth (Harris and Todaro, 1970). The "structuralists" suggest that the informal sector consists of micro-firms and workers that supply cheap inputs to larger capitalist firms. Since the two sectors

are tied in a production chain, the informal sector is unlikely to be eliminated by growth (Castells and Portes, 1989). Another major school of thought, the "legalists", defines the informal sector as a collection of micro-entrepreneurs who choose to operate informally to avoid registration cost and tax obligations (de Soto, 1989).

Empirical evidence shows that each theory can explain some but not all features of the informal sector. The multi-segmented theory thus arises as a combination of the three theories above (Chen, 2006; Fields, 2005). It stipulates that the informal sector is formed of sub-segments, among which the more advanced tier associates with more structured and capital-intensive production types. The lower-tier segment is home to subsistence activities, as suggested by the dualists. The upper-tier segment contains micro-entrepreneurs that either collaborate or compete with formal firms, as suggested by the legalists and structuralists. Workers of various productivity levels commingle and follow different channels to circulate across segments and sectors.

This research, in a similar vein, aims to capture the diverse nature of the informal sector by letting this sector employ both low-skilled and high-skilled workers. What makes this research stand out from previous studies is the specific way in which high-skilled workers enter informal employment and the relationship between the two types of workers. High-skilled workers are the only type to be employed in the formal sector. They can choose to leave formal jobs to become

entrepreneurs and hire low-skilled workers in the informal sector. The informal sector is therefore indispensable in this economy: it accommodates part of the labor force that cannot find jobs in the formal sector but also competes with the formal sector for high-quality labor. To the best of my knowledge, this research is the first to model such an informality structure.

The stance that this research takes on informality is a blend of the theories discussed previously. The theoretical part in this research speaks to a body of research that builds upon the equilibrium search framework of Diamond (1982), Mortensen and Pissarides (1994). In the second half of the chapter, a calibration analysis is conducted to match the theoretical model with informality facts in developing countries that are taken from Fields (1990) and Maloney (2004). In the calibrated economy, 7% of the high-skilled are unemployed, 36% working informally, and 57% working formally. Comparative analysis suggests that higher worker productivity can reduce informal employment while more generous unemployment benefit can encourage informality.

Using the equilibrium search model to address informality is not novel, two examples being Zenou (2008) and Ulyssea (2010). The former takes the dualists' view: workers who are neither formally hired nor unemployed are assumed to be working informally. The informal sector pays competitive wage, and is not frictional. Such feature marks the difference between two papers: Ulyssea (2010) models an informal sector almost identical to the formal one. Both sectors are

frictional and produce intermediate goods that become inputs for a common final good. Ulyssea (2010) illustrates the legalists' idea: firms operate in the informal sector to avoid regulation costs.

This research also leans on the strand of literature where equilibrium search models combine with heterogeneity and on-the-job search. Albrecht, Navarro, and Vroman (2009) extends Zenou (2008) by introducing ex-ante worker heterogeneity, and explicit labor transitions between unemployment and the informal sector. Gautier (2002) models both worker heterogeneity and job heterogeneity, though not addressing informality per se. In Gautier (2002), firms can open either simple jobs that accept both worker types or complex jobs that only accept high-skilled workers. A high-skilled individual can search for a complex job while undertaking a simple occupation.

Voluntary informality under the form of entrepreneurship has been observed in developing countries. A survey by Fields (1990) notes that many people in Malaysia and Costa Rica left the formal sector to work in the informal sector by choice. Exploiting the detailed database on worker transitions in Argentina, Brazil, and Mexico, Maloney (2004) suggests that the informal sector in these countries should be seen as an unregulated micro-entrepreneurial sector. Approximately 35% of informal self-employed workers in Mexico leaving their previous jobs for the reason of "being independent". Such findings challenge the more traditional view

that the informal sector is where high-skilled individuals work temporarily before being able to get a formal job.

In this research, high-skilled workers revolve from unemployment to formal employment, then to informal employment. Such moves are not unrealistic. Maloney (2004) reports that 75% of the unemployed in Mexico and 64% in Argentina were informal workers previously. Fields (1990) argues that the formal sector provides opportunities for workers to accumulate savings to start up their own business, and the formal sector may prefer to employ workers who have training in the informal sector. This tends to be true for better-educated workers, for example, managers of appliance stores who previously worked in small family businesses. The flow of high-skilled workers across employment states is restricted to be one-way for simplification.

Putting the low-skilled workers in a symbiotic relationship with the high-skilled opens up new questions on the implications of worker heterogeneity. A heterogeneous informal sector reflects the "internal dualism" notion of Fields (1990). Compared with other studies (such as Albretch et al., 2009) where cross-matching of skill and job types are allowed, workers of different productivity levels are rivals as they compete for the same job type. Such studies examine worker heterogeneity as an input for firms' decision on which types of jobs to open. This research, on the other hand, will explore the influence of worker heterogeneity on formal and informal market outcomes.

The chapter finalizes with an analysis of policies toward informality. Governments, for practical reasons, might want to exercise stronger regulatory control toward the informal sector. Informal activities and illegal activities sometimes conflate, and informal workers generally lack benefits and protections (Chen, 2012). Given the specific roles of the informal sector in this model, I will formulate a policy and test the effectiveness of a tax hike. Throughout the analysis, the size of the informal sector will be evaluated by both employment and income.

The remainder of this chapter is structured as follows: Section 2 provides the basic structure of the model, the definition of a steady state equilibrium and condition for uniqueness. Section 3 discusses the details of a calibration exercise. Section 5 presents results from a comparative statics analysis, including an effect of a budget neutral policy. Section 4 concludes.

The Model

Agents

The economy is populated by a continuum of infinitely lived workers of mass $L = 1$ and a continuum of firms of undetermined mass. Workers and firms are subjected to a common exogenous real interest rate r. Use L_H and L_L to indicate the number of high-skilled and low-skilled labor force, so $L = L_H + L_I$. The exogenous ratio of high-skilled workers in the labor force is ϕ, then $L_H = \phi L$ and

$L_L = (1-\phi)L$. Let $L_H = E_H + I_H + U_H$ where E_H, I_H, and U_H correspond to the number of high-skilled workers who are employed in the formal sector, employed in the informal sector, and unemployed. I use lower case characters to denote labor ratios with respect to L_H: $e_h + i_h + u_h = 1$. The productivity of each worker type is a constant, denoting y for high-skilled type and z for low-skilled type ($0 \ll z \ll y$).

Matching function

The frictional nature of the formal labor market is embodied in the matching function $M(U_H, V)$. This function returns the number of matches M per unit of time from two inputs: the number of vacancies opened by firms in the formal sector V and the number of unemployed high-skilled workers U_H. The matching function is increasing in both arguments ($M_{U_H} > 0, M_V > 0$), concave, and constant return to scale. Given the last property, the matching function can transform into functions of a single input as follows

$$q(\theta) \equiv \frac{M(V, U_H)}{V} = M\left(1, \frac{U_H}{V}\right) = M\left(1, \frac{1}{\theta}\right) \tag{2.1}$$

$$p(\theta) \equiv \frac{M(V, U_H)}{U_H} = \frac{M(V, U_H)/V}{U_H/V} = \theta q(\theta) \tag{2.2}$$

where $\theta \equiv V/U_H$ is the indicator of "market tightness" from firms' viewpoint. $q(\theta)$ is the vacancy filling rate and $p(\theta)$ is the job finding rate ($q'(\theta) < 0$, $p'(\theta) > 0$). These functions satisfy Inada conditions: $\lim_{\theta\to\infty} q(\theta) = 0, \lim_{\theta\to 0} q(\theta) =$

$\infty, \lim_{\theta\to\infty} p(\theta) = 0, \lim_{\theta\to 0} p(\theta) = \infty$. The elasticity of $q(\theta)$ is a number between -1 and 0. Its absolute value is denoted $\eta(\theta)$. The elasticity of $p(\theta)$ is then $1 - \eta(\theta) \geq 0$.

Here $q(\theta)$ and $p(\theta)$ are Poisson intensities or Poisson rates that indicate the average number of matches arriving to a firm and to a worker per unit time, respectively. Particularly, in a period of Δt the average number of matches realized is $q(\theta)\Delta t$ to firms and $p(\theta)\Delta t$ to workers. Put differently, for firms, the flow of matches is described by a Poisson process with parameter $\lambda = q(\theta)\Delta t$. For workers the process is Poisson $\lambda = p(\theta)\Delta t$. Such difference highlights the frictional characteristic of the formal labor market.

The flow of matches can be described by a Poisson process because matches, or job/worker pairs, are counted in whole numbers. Assuming a Poisson process implies these conditions hold true: i. each match occurs independently from each other, ii. the time interval can be divided into non-overlap small enough sub-intervals, where the chance that a match is formed in each sub-interval is constant and proportional to the sub-interval's length, and iii. two matches cannot form at the same instant.

By definition of Poisson rates and Poisson parameters, the mean duration of a vacant job is $1/q(\theta)$, and the mean duration of being unemployed is $1/p(\theta)$, measured as a fraction of the time interval Δt. When there are more vacancies relative to unemployed workers firms find workers more slowly while workers get

hired more quickly. The opposite happens when there are more unemployed labor relative to vacancies.

Another result stemming from the constant return to scale property of the matching function is $min\{U_H, V\} \leq M(U_H, V) \leq max\{U_H, V\}$. This result implies that the labor market will never move "too fast" or "too slow" to both parties. When $U_H < M(U_H, V) < V$, the unemployed are better off as a whole since there is at least one worker who receives more than one job offer. When $V < M(U_H, V) < U_H$, firms can easily choose one unemployed worker to fill vacancies and exit, while workers have to compete for getting matched.

Parameters

In the formal sector, a firm must pay a sunk cost $\kappa \geq 0$ to enter the market. The firm opens a vacant job and wait until it is filled. A filled job or a match will generate gross output y, which is also the productivity of high-skilled individuals.

An ongoing match can be destroyed if it is hit by an adverse productivity shock. The shock arrives at rate $\delta_F > 0$, and is severe enough to make the match no longer profitable to firms. After the match is dissolved, firms will either withdraw from the market or re-enter the market with a vacancy. When the match is destroyed by a negative productivity shock, the worker becomes unemployed.

A current match will also dissolve if the employee by choice breaks the contract to join the informal sector. The informal sector is not frictional like the formal sector; therefore, the workers need not spend time and effort on finding a

business opportunity. The average number of high-skilled workers starting informal ventures is $\alpha > 0$ per unit time. The mechanism of informal job arrival is left undiscussed here. However, it can be justified by the "very reduced form", "no micro foundation" spirit of the equilibrium search framework.

High-skilled workers in the formal sector receive w_{HF} if employed and b if unemployed. Formal wage w_{HF} is determined endogenously by a Nash bargaining scheme. The equilibrium wage depends on the bargaining power of workers, denoted $\beta \in [0, 1)$. Unemployment income b is a fixed parameter. I assume high-skilled workers earn more from working in any sector than from being unemployed $b < min\{w_{HF}, w_{HI}\}$.

In the informal sector, high-skilled individuals earn w_{HI} and pay low-skilled workers w_l. Both values are endogenous. Wage w_{HI} is defined as the maximum profit attained by the informal micro-enterprises. Wage w_l is the marginal product of low-skilled labor. The informal labor market is perfectly competitive, and given that the supply of low-skilled workers is perfectly inelastic, there is no unemployment among low-skilled labor.

The informal enterprises close at rate δ_I - a Poisson intensity measured at the same temporal unit with α and δ_F. Unlike α and δ_F, δ_I is not a constant. The destruction rate of informal business is rather a decreasing function of w_{HI} (see Calibration section). Intuitively, the informal owner is more likely to quit and

return to unemployment when business profits decline. Lastly, I assume that the processes of job destruction and job arrival in two sectors are independent.

Transition across states

Following Albrecht et al. (2002) and Gautier (2002): in steady state, for each worker type, the inflows and outflows of each employment state must balance. In other words, we are looking at the long-run equilibrium where the allocation of high-skilled workers into formal employment, informal employment, and unemployment is constant.

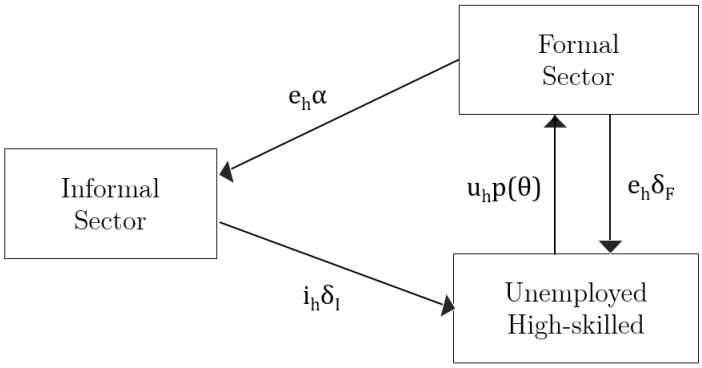

FIGURE 1. Flows of High-skilled Workers

i. High-skilled workers and formal employment

The outflow from this pool includes high-skilled individuals who either lose formal jobs due to adverse shocks or leave for the informal sector by choice $E_H\delta_F + E_H\alpha$. The inflow is made of unemployed high-skilled individuals who find jobs in the formal sector $U_H p(\theta)$. The change in the pool of employed high-skilled worker

per unit time, written in labor ratios, is $\dot{e_h} = e_h\delta_F + e_h\alpha - u_h p(\theta)$. In steady state $\dot{e_h} = 0$ or

$$e_h\delta_F + e_h\alpha = u_h p(\theta) \tag{2.3}$$

ii. High-skilled workers and informal employment

The pool of informal high-skill workers expands by $E_H\alpha$ and reduces by $I_H\delta_I$ per unit time. The net flow is $\dot{e_h} = e_h\alpha - i_h\delta_I$. In steady state $\dot{e_h} = 0$ or

$$e_h\alpha = i_h\delta_I \tag{2.4}$$

iii. High-skilled workers and unemployment

The inflow to this pool consists of high-skilled workers who get displaced from informal and formal occupations $E_H\delta_F + I_H\delta_I$. The outflow contains high-skilled workers who find formal jobs $U_H p(\theta)$. In steady state, $\dot{u_h} = 0$ or

$$e_h\delta_F + i_h\delta_I = u_h p(\theta) \tag{2.5}$$

Value Functions of Formal Firms and High-skilled Labor

Value functions are the present-discounted values of income or profit accumulated by agents during the infinite horizon. Agents are assumed to hold an asset of which value varies by the state of agents in the labor market. For the

following equations, the left-hand side can be interpreted as the flow of capital cost and the right-hand side as the return of capital. The two flows equate each other since we assume a perfect capital market.

i. Formal firms: Value of a matched job V_J for a firm is the sum of the net output produced by the match and the potential loss if the match dissolves. Since adverse productivity shock and informal job formation are two independent Poisson process, their rates can be combined (term $\delta_F + \alpha$) to indicate the number of job-worker pairs separated per unit time. This setup implies that the informal sector competes against the formal sector for high-quality labor

$$rV_J = y - w_{HF} - (\delta_F + \alpha)(V_J - V_V) \tag{2.6}$$

Value of a vacant job V_V to a firm is merely the expected capital gain when the vacancy is filled. The firm does not pay a cost to maintain the vacancy per unit time, so the value of a vacancy is only the product of a filled job's premium and the mean arrival rate of a match per unit time

$$rV_V = q(\theta)(V_J - V_V) \tag{2.7}$$

ii. High-skilled worker: The employment status of a high-skilled worker is comparable to an asset with three states. An asset in the formal employment state can switch to two other states: informal employment and unemployment. Hence,

the return on working formally V_E has three components: wage w_{HF}, the expected capital loss from being unemployed, and the expected value change if the worker moves to the informal sector. This setup of V_E (and V_J) is based on studies with on-the-job search modeling (e.g., Gautier, 2002).

An asset in the informal employment or unemployment state can switch to only one other state. The return on an informal job V_I is the sum of the current yield w_{HI} and the expected capital loss from being unemployed. Value of an asset in the unemployment state V_I is the unemployment income b plus with the expected capital gain if the worker finds a formal job.

$$rV_E = w_{HF} - \delta_F(V_E - V_U) + \alpha(V_I - V_E) \tag{2.8}$$

$$rV_I = w_{HI} - \delta_I(V_I - V_U) \tag{2.9}$$

$$rV_U = b + p(\theta)(V_E - V_U) \tag{2.10}$$

The term w_{HI} refers to the salary that high-skilled workers earn from entrepreneurship in the informal sector.

Job creation relation

A firm must pay a sunk cost (or creation cost) κ to enter the market and open a vacancy. We can think of this sunk cost as firms buying machinery and equipment before hiring labor (Acemoglu, 2001). A vacancy remains open until the firm finds a suitable worker and turns the vacancy into a filled job, which is

more profitable for the firm. The vacancy has a non-negative value as described in Equation 2.7.

Profit maximization dictates that firms would continue to post vacancies until the value of vacancies is driven down to the value of the sunk cost: $V_V = \kappa$. At that time, the firm can no longer extract rent from the vacancy. Substitute this value of V_V into the value functions of a filled and a vacant job for a formal firm (Equation 2.6 and Equation 2.7) and rearrange, then the value of a filled job can be expressed in two ways:

$$V_J = \frac{y - w_{HF} + \kappa(\delta_F + \alpha)}{r + \delta_F + \alpha} \tag{2.11}$$

$$V_J = \kappa\left(1 + \frac{r}{q(\theta)}\right) \tag{2.12}$$

In Equation 2.11, the denominator is the effective discount rate of a filled job, which is the sum of the real interest rate and the risks of match destruction. The term $\kappa(\delta_F + \alpha)$ is the amount "saved" by firms when a match remains intact. In Equation 2.12, the value of a filled job balances with the paid upfront cost κ and the expense incurred during the life of the vacancy $1/q(\theta)$.

As it happens, the sunk cost is not indeed a one-time cost. After entering the market, firms continue to pay a fraction of the sunk cost (term κr) to maintain vacancies. The presence of a sunk cost not only creates an extra "flow cost" but also opens up an additional channel via which the real interest rate can affect

a match's value. In the baseline model where sunk cost is absent (so $V_V = 0$) and vacancies are maintained by a fixed cost (similar to the "flow cost", so in equilibrium $V_J = V_V \neq 0$), this channel is turned off.

In equilibrium, V_J is constant. Hence, two expressions of V_J must equal. Combine them we have the zero-profit or job-creation condition

$$y - w_{HF} - \kappa r\left(1 + \frac{r + \delta_F + \alpha}{q(\theta)}\right) = 0 \tag{2.13}$$

The job-creation condition illustrates a negative relationship between formal wage and market tightness. A higher market tightness extends the duration of the vacancy, increasing hiring cost. Firms must offer a lower wage to retain profits. The job-creation condition is comparable to the labor demand function in Walrasian economics (Pissarides, 2000).

The term α represents the influence of the informal sector. This term, along with the arrival rate of adverse shock δ_F and real interest rate r, determines the slope of the job-creation curve. An increase in this term can make firms' willingness to create jobs become more sensitive to changes in market tightness.

Wage setting relation

A formed match benefits both workers and firms. The total surplus of a match is given by $S = (V_E - V_U) + (V_J - V_V)$. This expression already accounts for the value of an informal job to workers (i.e., we need V_I to derive $V_E - V_U$). Nash

bargaining sets a wage rule that splits S linearly between the firm and the worker. The share of each party depends on the worker's bargaining power β. Here β is non-negative and strictly less than one otherwise firms have no incentive to open vacancies.

Wage in the formal sector solves

$$w_{HF} = \arg\max_{w_{HF}} (V_E - V_U)^{\beta} (V_J - V_V)^{1-\beta}$$

which can be simplified into

$$(1-\beta)(V_E - V_U) = \beta(V_J - V_V).$$

The right-hand side term represents the share of the firm in the total match surplus S. This term is derived by subtracting the value function of a vacant job (Equation 2.7) from the value function of a filled job (Equation 2.6) and rearrange

$$V_J - V_V = \frac{y - w_{HF}}{r + \alpha + \delta_F + q(\theta)} \tag{2.14}$$

The left-hand side term is the share of the worker in the total surplus S. This term is derived by combining three steady state values of the worker: being employed V_E (Equation 2.8), unemployed V_U (Equation 2.10), and informally

employed V_I (Equation 2.9)

$$V_E - V_U = \frac{(r+\delta_I)(w_{HF}-b)+\alpha(w_{HI}-b)}{(r+\delta_I)(r+\alpha+p(\theta)+\delta_F)+\alpha p(\theta)} \tag{2.15}$$

Nash Bargaining implies a wage rule

$$(1-\beta)\frac{(r+\delta_I)(w_{HF}-b)+\alpha(w_{HI}-b)}{(r+\delta_I)(r+\alpha+p(\theta)+\delta_F)+\alpha p(\theta)} = \beta\left(\frac{y-w_{HF}}{r+\alpha+\delta_F+q(\theta)}\right)$$

The job-creation condition (Equation 2.13) gives

$$q(\theta) = \frac{\kappa r(r+\delta_F+\alpha)}{y-w_{HF}-\kappa r}$$

Use this expression to substitute $q(\theta)$ and $p(\theta)$ out of the wage rule and rearrange to get

$$w_{HF} = \beta\left[(y-\kappa r)+\theta\kappa r\left(\frac{\alpha}{r+\delta_I}+1\right)\right]+(1-\beta)\left[b-\frac{\alpha}{r+\delta_I}(w_{HI}-b)\right] \tag{2.16}$$

This is the wage-setting curve, an equivalence of the labor supply curve in the Walrasian market. The wage-setting curve portrays a positive relationship between formal wage and market tightness, conditional on some parameter restrictions. Consistent with the baseline model, formal wage increases proportionally with workers' productivity and unemployment benefit.

Workers can claim a better wage at a higher market tightness essentially because of the term $\theta\kappa r$. This term is the average flow cost per unemployed worker $\theta\kappa r = v\kappa r/u$ (Pissarides, 2000). As pointed out in the previous section, this is the expense firms pay to maintain an unfilled job. Once the job is filled, the expense stops incurring, and firms reward workers for saving firms such expense.

Being formally employed also gives the worker access to the informal sector. The worker might break the contract at some point, and firms respond to that risk by taking away part of the worker's compensation as a penalty. The amount deducted from the compensation is proportional to the worker's informal income, i.e. term $(1-\beta)w_{HI}$. All else being equal, a higher bargaining power raises the reward portion while reduces the penalty portion.

The wage-setting condition (Equation 2.16) can be rewritten as

$$w_{HF} = \beta(y - \kappa r) + \beta\theta\kappa r + (1-\beta)b + \frac{\alpha}{r+\delta_I}\Big(\beta\theta\kappa r + (1-\beta)b - (1-\beta)w_{HI}\Big)$$

Without the presence of the informal sector, the term $\alpha/(r+\delta_I)$ would not exist. This term accentuates the difference between formal benefits (rewards and unemployment insurance) and informal income. The first three terms are standard for a single sector model.

Informal sector

In the informal sector, high-skilled workers are voluntary participants. They can choose to leave the formal sector to become informal business owners. Low-skilled workers are not as much privileged. They have no other choice than working for the high-skilled owners.

All informal enterprises adopt an identical technology that combines the productivity of the high-skilled owner and the collective productivity of low-skilled labor. Each enterprise hires l_i number of low-skilled workers, each of whom has productivity of z. The owner's productivity y can be interpreted as entrepreneurial skill in the technology $f(l_i) = Ay(zl_i)^{\rho}$. The technology exhibits diminishing returns in low-skilled workers' productivity z, i.e. the marginal product with respect to low-skilled labor $\rho \in (0, 1)$. The good produced by these micro-enterprises is sold on competitive markets with price normalized to one.

In the informal sector, the entrepreneur i maximizes

$$\pi_i = f(l_i) - w_l l_i$$

where A is the scale parameter. In the calibration exercise, A is constrained to keep $f(l_i)$ always smaller than y. A high-skilled individual working for a formal firm is always more productive than herself as an entrepreneur. Empirical evidence suggests that the formal sector uses more capital-intensive technology (Zenou

2008). This feature is reflected in this model where informal firms do not pay for capital (i.e., sunk cost).

The income of the high-skilled owner is the highest profit of her business: $w^*_{HI} = \max \pi_i$. Let w_l be the wage received by every low-skilled worker. The first order condition of this profit maximization problem gives $l_i = \left(\frac{w_l}{\rho A y z^\rho}\right)^{\frac{1}{\rho-1}}$.

Denote N the number of micro-enterprises or number of high-skilled workers operating in the informal sector. To pin down w_l, I equate labor demand to labor supply

$$\sum_i l_i = N l_i = \sum_i \left(\frac{w_l}{\rho A y z^\rho}\right)^{\frac{1}{\rho-1}} = L_L$$

where $N = i_h L_H = i_h \phi L$. Rearrange the term to yield the solution for w^*_l and l^*_i

$$w^*_l = \rho A z^\rho \left(\frac{1-\phi}{\phi i^*_h}\right)^{\rho-1} \tag{2.17}$$

$$l^*_i = \frac{1-\phi}{\phi i^*_h} \tag{2.18}$$

Term l^*_i is the optimal size of informal firms. Since $l^*_i = L_I/I_H$, this term should be best interpreted as the optimal amount of low-skilled workers hired by each high-skilled worker. It follows that a high-skilled worker earns in the informal sector

$$w^*_{HI} = \pi^* = A(1-\rho) y \left(\frac{z(1-\phi)}{\phi i^*_h}\right)^\rho \tag{2.19}$$

It is clear that the low-skilled workers gain when there are relatively more high-skilled workers in the economy (higher ϕ) or more high-skilled workers participate in the informal sector (greater i_h). Either change leads to a larger $I_H = N$, shifting the demand curve for low-skilled workers outward. Each entrepreneur will hire fewer workers and pay them better.

Steady state equilibrium

The steady state equilibrium is a 9-tuple $(\theta^*, w^*_{HF}, w^*_{HI}, w^*_l, v^*, e^*_h, i^*_h, u^*_h, l^*_i)$ satisfying the following conditions

i. Equilibrium worker flows

$$u_h p(\theta) = e_h \delta_F + e_h \alpha \tag{2.3}$$

$$e_h \alpha = i_h \delta_I \tag{2.4}$$

$$u_h p(\theta) = e_h \delta_F + i_h \delta_I \tag{2.5}$$

ii. Job-creation or zero-profit

$$w_{HF} = y - \kappa r \left(1 + \frac{r + \delta_F + \alpha}{q(\theta)}\right) \tag{2.13}$$

iii. Wage setting

$$w_{HF} = \beta \left[(y - \kappa r) + \theta \kappa r \left(\frac{\alpha}{r + \delta_I} + 1\right)\right] + (1 - \beta)\left[b - \frac{\alpha}{r + \delta_I}(w_{HI} - b)\right] \tag{2.16}$$

iv. Informal labor market clearing

$$w_l = \rho A z^{\rho} \left(\frac{1-\phi}{\phi i_h} \right)^{\rho-1} \tag{2.17}$$

$$l_i = \frac{1-\phi}{\phi i_h} \tag{2.18}$$

$$w_{HI} = A(1-\rho) y \left(\frac{z(1-\phi)}{\phi i_h} \right)^{\rho} \tag{2.19}$$

Solving for equilibrium

i. Solving for θ^*, w^*_{HF}, and w^*_{HI}

Three unknowns, equilibrium market tightness θ^*, earnings of high-skilled workers in the formal sectorw^*_{HF} and in the informal sector w^*_{HI}, can be solved from a nonlinear system consisting of Eqs.(13), (16), and (19). They are the job-creation condition (formal labor market demand), wage-setting condition (formal labor market supply), and informal labor market clearing condition. The detailed methodology is described in Section 3.

ii. Solving for e^*_h, i^*_h, and u^*_h

The analytical solution for the composition of the high-skilled labor force can be derived from Eqs.(3),(4) and (5). These equations are linear combinations, so only two of them are needed to yield the following expressions:

$$e_h = \frac{p(\theta)\delta_I}{p(\theta)(\alpha+\delta_I)+\delta_I(\alpha+\delta_F)} \tag{2.20}$$

$$u_h = \frac{\delta_I(\alpha+\delta_F)}{p(\theta)(\alpha+\delta_I)+\delta_I(\alpha+\delta_F)} \tag{2.21}$$

$$i_h = \frac{p(\theta)\alpha}{p(\theta)(\alpha+\delta_I)+\delta_I(\alpha+\delta_F)} \tag{2.22}$$

These labor ratios are true for all values of θ. It is easily seen that $u_h = e_h(\alpha+\delta_F)/p(\theta)$ and $i_h = e_h\alpha/\delta_I(w_{HI})$ (recall that δ_I depends on w_{HI}). The relationships among e_h, u_h, and i_h are nonlinear. The equilibrium values of the worker ratios e_h^*, i_h^*, and u_h^* are pinned down at the equilibrium value of market tightness θ^*.

Substituting i_h out of Equation 2.19 to have w_{HI} expressed in terms of θ and parameters:

$$w_{HI} = A(1-\rho)yz^\rho\left(\frac{1-\phi}{\phi}\right)^\rho\left(1+\frac{\delta_I(w_{HI})}{\alpha}+\frac{\delta_I(w_{HI})(\alpha+\delta_F)}{p(\theta)\alpha}\right)^\rho \tag{2.23}$$

Since $p(\theta)$ increases in θ, and δ_I decreases in w_{HI}, by implicit function theorem it is established that w_{HI} decreases in θ. Intuitively, a more inefficient formal market (more unemployment at the same level of unfilled jobs) makes the option of joining the informal sector more attractive. Equation 2.23 will be included in the system of three unknowns (θ, w_{HF}, w_{HI}), replacing Equation 2.19.

iii. Solving for v^*, w_l^*, and l_i^*

By definition of θ, we have $v^* = \frac{V}{L_H} = \frac{\theta^* U_H}{L_H} = \theta^* u_h$. The equilibrium values of low-skilled workers' earning w_l^*, and optimal informal firm size l_i^* are pinned down with i_h^*.

Uniqueness of equilibrium

Equate the job-creation condition (Equation 2.13) and wage-setting condition (Equation 2.16) and rearrange to yield an equilibrium condition for θ:

$$\kappa r\left(\frac{r+\delta_F+\alpha}{q(\theta)}\right) = (1-\beta)\left(y-b+\frac{\alpha(w_{HI}-b)}{r+\delta_I}-\kappa r\right) - \kappa r\beta\theta\left(\frac{\alpha}{r+\delta_I}+1\right)$$

where $w_{HI} = w_{HI}(\theta)$ and $\delta_I = \delta_I(w_{HI})$. It is not possible to derive a closed-form solution for θ^*; however, we know a unique θ^* exists if two sides of this equation move in opposite direction when θ changes monotonically. Since $q'(\theta) < 0$, the left hand side strictly increases in θ. To establish that the right-hand side strictly decreases in θ, I impose

$$(1-\beta)(w_{HI}-b) > \beta\kappa\theta r \tag{2.24}$$

The imposition of this condition also ensures the wage-setting curve slopes upward in the (θ, w_{HF}) plane (see Figure 2). Recalled that wage bargaining implies both gain and loss from a match will be distributed to the worker and the firm. The wage paid to the worker accounts for reward and punishment made

by the firm. The worker is rewarded for saving firms vacancy maintenance fee but penalized for potential voluntary leave. The penalty is proportional to the difference in income between informal employment and unemployment. This condition implies that at a greater market tightness, workers can claim a higher wage only if they accept to be penalized more than rewarded.

This condition is required because the exit rate of informal firms δ_I is set to be decreasing in informal income. Simply put, a higher θ makes the option of moving to the informal sector less attractive because profit is lower and business failure is more likely. A smaller informal profit has a leverage effect on formal wage, but the effect of a higher failure rate on formal wage is undetermined. This effect is positive only if the cost savings portion is smaller than the penalty portion, which is precisely Equation 2.24. On the contrary, this model has a single unique equilibrium unconditionally when δ_I is independent of w_{HI}.

Unique values of θ^* and w^*_{HF} pin down a unique w_{HI}. Other endogenous variables are monotone functions of θ^*, so their equilibrium values are unique too. Overall, this model conditionally has a single, unique equilibrium.

Informal sector and Beveridge curve

Figure 2 depicts how formal sector outcomes (θ^*, w^*_{HF}, v^*, u^*_h) are determined. The left panel plots the wage-setting and job-creation curves in the (θ, w_{HF}) plane. The right panel plots the Beveridge curve (also called the UV-curve) in the (u_h, v) plane.

The formula for the Beveridge curve is derived from the unemployment equation (Equation 2.21)

$$v = \left[\left(\frac{\delta_I(\alpha + \delta_F)}{\alpha + \delta_I} \right) \frac{(1 - u_h)}{u_h^{\eta}} \right]^{\frac{1}{1-\eta}}$$

where $\delta_I = \delta_I(w_{HI}(\theta))$. When the elasticity of matching rate is $\eta = 0.5$, the Beveridge curve is given by:

$$v = \left(\frac{\delta_I(\alpha + \delta_F)}{\alpha + \delta_I} \right)^2 \frac{(1 - u_h)^2}{u_h}$$

How do informal sector and sunk cost change these curves? In a baseline model without the informal sector and sunk cost (as in Pissarides, 2000), the formulae for the job-creation condition, wage-setting condition, and Beveridge curves are

$$w = (1 - \beta)b + \beta y(1 + \gamma\theta)$$

$$w = y - (r + \delta)y\gamma/q(\theta)$$

$$u = \frac{\delta}{\delta + p(\theta)}$$

where δ is the exogenous job destruction rate, and γ is the fixed cost to maintain vacancy per unit time. When the matching elasticity is 0.5, the formula of

Beveridge curve is

$$v = \delta^2 \frac{(1-u)^2}{u}$$

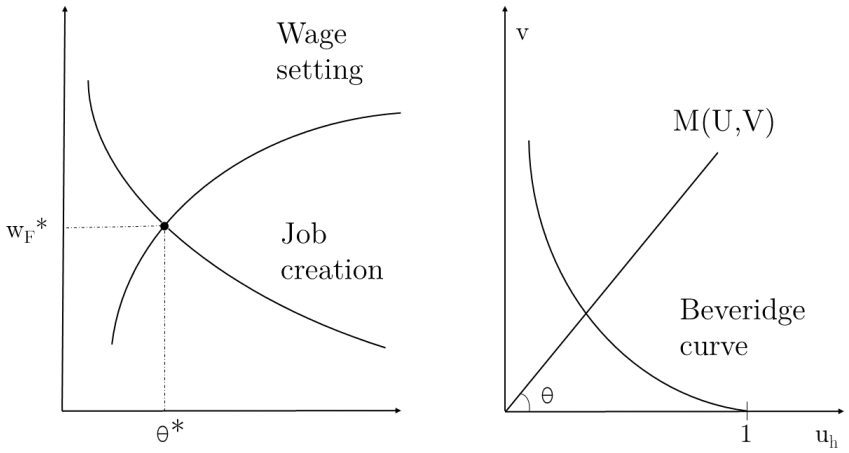

FIGURE 2. Determination of θ^*, w^*_{HF}, and u^*_h

Given the presence of a sunk cost, the intercept of the job-creation curve lowers from y to $y-\kappa r$. The upper bound for wages is not y anymore: a permanent portion of a match's productivity is spent on vacancy maintenance. The wage-setting curve used to have an intercept $b + \beta(y - b)$ in the baseline setting. With the presence of the informal sector, it does not have an intercept. It grows tangent to the y-axis (w_{HF} axis) as θ approaches zero. Its shape becomes nonlinear since w_{HI} is nonlinear and decreasing in θ.

The Beveridge curve, an indicator of labor market efficiency, retains its shape and x-axis intercept despite the existence of a sunk cost and the informal sector. Its slope, meanwhile, takes into account flow dynamics in the informal sector.

Determinants of the slope include the formation and destruction rate of informal firms α and δ_I, in addition to the arrival rate of adverse productivity shock δ_F.

Flow dynamics in the informal sector can make the formal labor market appear more or less efficient. When informal firms exit more frequently (higher δ_I), the Beveridge curve steepens or shifts rightwards. Such movement indicates a more inefficient labor market since there is more unemployment associated with the same level of vacancies. The same result establishes if adverse shock arrives more quickly.

When high-skilled workers move into the informal sector at a greater rate (higher α), a similar "inefficiency" effect appears only if informal jobs dissolve faster than formal ones do ($\delta_I > \delta_F$). When $\delta_I < \delta_F$, a higher α shifts the Beveridge curve leftwards. In words, a growing informal sector where informal businesses survive better than formal firms will make the formal labor market appear more efficient.

Some texts (such as Pissarides 2000) do not discuss the intercepts of the job-creation curve and the Beveridge curve. Realistically it is never the case that no vacancies are created, or there is no employment.

Calibrating Model Parameters

In the first part of this section, I describe a numerical method to solve the theoretical model. The results are calibrated to match several empirical facts on the informal sector in Latin American nations, taken from Maloney (2004).

In the second part, I analyze the sensitivity of equilibrium outcomes to changes in the model's parameters. Lastly, I discuss the effectiveness of a budget neutral policy where firms with filled jobs are taxed to subsidize firms with vacancies and unemployed workers. Quantitative and graphical results are presented at the end of this section.

Methodology

The first step in solving for the model's equilibrium is to compute $(\theta^*, w^*_{HF}, w^*_{HI})$. The system of these three unknowns are nonlinear; therefore, it must be solved with the numerical method. The methodology involves defining functional forms, choosing model parameters, and setting up constraints for the system.

i. Functional forms and parameter values

The functions of market tightness are $q(\theta) = K\theta^{-\eta}$ and $p(\theta) = K\theta^{1-\eta}$. By common practice I set $\eta = \beta = 0.5$. With $\beta = 0.5$, we have a symmetric situation where the match surplus is divided equally between workers and firms. These two parameter are held fixed throughout the analysis, and so comparative statics regarding β and η will not be discussed.

Other parameters are either borrowed from existing studies or picked subjectively. The productivity of high-skilled workers, real interest rate, unemployment benefit, scale parameter of the matching function, and the arrival rate of adverse shock are based on Zenou (2008). The productivity of low-skilled

workers, the sunk cost for formal firms, the marginal product of low-skilled labor, and the formation rate of informal firms are selected subjectively.

The Hosios condition $\eta = \beta$ ensures the decentralized search equilibrium is efficient, i.e. the two externalities of matching process cancel out each other (Hosios, 1990). As mentioned in Section 2.1.2, when θ increases workers find jobs more easily while firms find workers more slowly. The former effect is called 'thick-market externality', and the latter 'congestion externality'. Under the Hosios condition, a social planner facing the search frictions will maximize the utilitarian welfare with θ and v chosen at their decentralized equilibrium values, given that she knows the income of all agents and the exact composition of the labor force. It is a general result that when $\eta \neq \beta$ one externality will dominate the other.

Previously I assume δ_I is a decreasing function of w_{HI}. Let $\delta_I = d(w_{HI})^{-0.5}$, where $d \gg 0$. Prespecifying all other parameters, I then pick the smallest values of the scale parameter of δ_I and the scale parameter of the informal production technology (A, d) such that there exists an unique $(\theta^*, w^*_{HF}, w^*_{HI})$ satisfy job-creation condition (Equation 2.13), wage-setting condition (Equation 2.16), and informal sector market clearing (Equation 2.19).

The setup of parameters gives a hypothetical economy with an equal number of high-skilled and low-skilled workers. The elasticity of the matching rate is 0.5, implying that when market tightness θ doubles, the job finding rate increases by 50% while the vacancy filling rate decreases by 50%. Firms pay a sunk cost of

4 to be able to hire workers, each of whom can produce 10. At every instant, 0.2 high-skilled worker is fired because of an adverse shock while 0.8 worker purposely breaks the contract to move to the informal sector. To firms, that makes a total of one job match destruction per unit time. A low-skilled worker exerts a productivity of 2 and never earns more than an unemployed high-skilled who receives a benefit of 3.

ii. Constraints of the nonlinear system

I add four constraints to the system of $(\theta^*, w^*_{HF}, w^*_{HI})$: The high-skilled workers strictly prefer i. working informally for the lifetime to being unemployed: $V_I > V_U$; and ii. working formally to being entrepreneur: $V_E > V_I$; iii. The system has a unique solution (Equation 2.24); and iv. High-skilled entrepreneurs would never pay low-skilled workers more than their unemployment benefit: $w^*_l \leq b$. These conditions correspond to four inequalities

$$\begin{aligned} K\theta^{1-\eta}(w_{HF} - w_{HI}) - (r + \delta_F + \alpha)(w_{HI} - b) &< 0 \\ (r + \delta_F + K\theta^{1-\eta})(w_{HI} - w_{HF}) - (\delta_I - \delta_F)(w_{HF} - b) &< 0 \\ b + \theta\kappa r - w_{HI} &< 0 \\ w_{HI} i_h \rho\phi - b(1-\rho)(1-\phi) &< 0. \end{aligned}$$

The first two constraints, along with tailoring parameters (A, d, ρ), are sufficient to maintain informal wage below formal wage. A pecuniary gap does not imply workers are worse off in the informal sector. Working in the informal

sector gives the workers unquantifiable utility such as the sense of being one's own boss or reputation of being business owners (Maloney 2004, Fields 2004).

The wage of low-skilled workers is set below unemployment benefit for a technical purpose; however, the constraint also accords with empirical facts. Technically, without this constraint, the informal sector will eventually 'explode', i.e., the whole high-skilled labor force will move into it. Empirically, Maloney (2004) has noticed a suppressing wage of low-skilled workers in Latin American countries. The author observes that informal family businesses usually provide their low-skilled employees with lodging and food. The wage of the workers is artificially low because it does not account for these implicit benefits.

iii. Results and interpretation

Numerical simulation gives the equilibrium composition of the high-skilled labor force: 57% working in the formal sector, 36% working in the informal sector, and 7% unemployed. According to Maloney (2004), the informal self-employment in Latin America is generally the largest source of employment among men after formal salaried employment, in some cases exceeding 40% of the labor force.

The equilibrium market tightness is approximately 27, meaning the number of vacancies is 27 times greater than the unemployment pool and more than triple the high-skilled labor force. This situation is favorable for the workers: per unit time firms can find only $q = 0.29$ worker for each vacancy, while each unemployed worker can match with $p = 7.8$ firms. A representation firm with vacancy needs to

pay 5.4 for vacancy maintenance. The "flow cost" charged to firms per unit time is even higher than the sunk cost, highlighting the adverse influence of a high market tightness value to firms.

TABLE 1. Parameter Values

Parameters	*Definition*	*Values*
η	Elasticity of the matching rate	0.5
β	Bargaining power of high-skilled workers	0.5
ϕ	Ratio of high-skilled workers in the population	0.5
ρ	Marginal product w.r.t labor in informal sector	0.50
δ_F	Arrival rate of adverse productivity shock	0.20
α	Formation rate of informal micro-enterprises	0.80
κ	Sunk cost for formal jobs	4
r	Real interest rate	0.05
y	Productivity of high-skilled workers	10
z	Productivity of low-skilled workers	2
b	Unemployment benefit of high-skilled workers	3.0
K	Scale parameter of matching function	1.5

Once employed, high-skilled workers are paid 9.1 by formal firms. By choosing to switch to the informal sector, the high-skilled worker accepts an income loss of 8.5%. He can earn 8.4 as an informal entrepreneur, yielding an income premium of 5.4 over unemployment. The ratio of formal to informal wage is close to the case of Mexico and Colombia in late 1999 (Maloney 2004). In Colombia, relative formal to informal wage was 1.2 in 1999 : $Q3$. In the same period, the formal wage was twice as high as the informal wage in Mexico.

Calculated from the equilibrium informal wage of the high-skilled, the equilibrium exit rate of informal firms is 1.28, higher than the effective destruction

rate of formal firms. Each informal enterprise recruits 2.8 low-skilled labor in equilibrium. This ratio is slightly higher than in Maloney (2004) who observes that 80% of micro-firms in Mexico have only one or two employees.

TABLE 2. Steady State Equilibrium

Variables	*Definition*	*Values*
θ^*	Market tightness or v^*/u_h^*	26.78
v^*	Vacancies to high-skilled labor force ratio	1.96
w_{HF}^*	Formal wage of high-skilled workers	9.08
w_{HI}^*	Informal wage of high-skilled workers	8.37
w_l^*	Wage of low-skilled workers	2.99
e_h^*	Proportion of formally employed high-skilled workers	0.57
i_h^*	Proportion of informally employed high-skilled workers	0.36
u_h^*	Proportion of unemployed high-skilled workers	0.07
l_i^*	Optimal firm size in informal sector	2.80
V_E	Lifetime value of being formally employed	167.83
V_I	Lifetime value of being informally employed	167.15
V_U	Lifetime value of being unemployed	167.14
GNI_F	GNI of formal sector	2.70
GNI_I	GNI of informal sector	2.99
A	Scale parameter of informal production function	0.71
d	Scale parameter of informal production function	3.69

Over the infinite horizon, the representative high-skilled worker is not much worse-off being unemployed. The difference between the lifetime values of being informally employed (V_I) or being unemployed (V_U) and being formally employed (V_E) is less than 1%. Also, the gap in the income of a low-skilled worker and an unemployed high-skilled worker is also less than 1%. These are results from the subjective restrictions I imposed when solving the system.

Equilibrium Analysis: Comparative Statics

This section discusses how equilibrium values react when I vary each of the following parameters: y, b, K, δ_F, α, κ, r, ϕ, and z. I record the change in equilibrium values of endogenous variables: market tightness, vacancy ratio, wages, high-skilled work force composition, and measures of Gross National Income (GNI).

I construct three measures: GNI in the formal sector (denoted GNI_F), GNI in the informal sector (GNI_I), and total GNI (GNI_T).

$$GNI_F = \phi\big(e_h^*(y - \kappa r - w_{HF}^*) - u_h^*\theta\kappa r + e_h^* w_{HF}^* + u_h^* b\big) \tag{2.25}$$

$$GNI_I = \phi i_h^* w_{HI}^* + (1-\phi) w_l^* \tag{2.26}$$

$$GNI_T = GNI_F + GNI_I \tag{2.27}$$

GNI in the formal sector is the sum of the income earned by the formal firms, formal workers and the unemployed in equilibrium. GNI in the informal sector is the sum of the income generated by owners of informal enterprises and their low-skilled employees in equilibrium. Total GNI is the sum of both sectors' income. It is also GNI per capita since the population is normalized to one.

Regarding GNI_F, the term $(y - \kappa r - w_{HF}^*)$ is the profit from a match in each period. Term $\theta\kappa r u_h^*$ is the flow cost firms pay for a vacant job, or vacancy maintenance fee. The number of firms existing with a filled job is e_h^*, and the

number with a vacant job is $v* = \theta u_h^*$. Combine and rearrange the term, we have GNI_F simply be the total surplus of matching plus the income of unemployed workers. The term w_{HF} drops out of the expression, a natural consequence of surplus linear splitting.

$$GNI_F = \phi\big(e_h^*(y - \kappa r) + u_h^*(b - \theta\kappa r)\big) \tag{2.28}$$

Productivity of high-skilled workers

A boost in the productivity level from 8 to 12 (Appendix A, Figure 13) almost triples θ^* and v^*, while wages and employment in both sectors double. The effect of higher productivity can be shown graphically with Figure 2. An increase in y shifts the job-creation curve upward by y and the wage-setting curve upward by βy. With β strictly smaller than one, rising productivity always raises w_{HF}^* and θ^*. At a higher productivity, the profit from a filled job increases, leading to more job creation v^*. Workers stay unemployed for a shorter period and can claim a better wage. These findings are consistent with the baseline model.

In contrast to the baseline model where unemployment is predicted to decline monotonically, here, unemployment initially surges then declines after $y = 8.5$. The plots of trajectory show that at low levels of productivity, the informal sector is the major source of employment. It also dominates the inflow to unemployment in this economy. As productivity rises, the informal sector loses its significance

to the formal sector. There is a sharp increase in formal employment and a sharp decrease in informal employment.

This result suggests that the informal sector can shrink with development. However, in this model, the informal sector would never be eliminated because low-skilled workers are the inherent part of the sector. Hence, the evolution of the informal sector, as implied by this result, is aligned with the dualists. The final status of the informal sector, on the other hand, is leaning toward the structuralists.

Wage gap as a portion of formal wage narrows down slightly, implying the formal employees suffer a smaller income loss from their occupational switch. When high-skilled workers are significantly more productive, they choose to stay in the formal sector although they can earn equally well in the informal sector. This notion can be related to the known fact that less developed countries have lower productivity and more pronounced informal sector than developed ones.

Unemployment benefit

As benefit level b rises from 2 to 5 (Appendix A, Figure 14), market tightness reduces by 40% while formal salary is 2% higher. Similar to the case above, we can illustrate the influence of unemployment benefit on market outcomes with Appendix A, Figure 2. A higher b leaves the job-creation curve unaffected while shifts up the wage-setting curve shifts, leading to a smaller θ^* and a larger w^*_{HF}.

With a higher benefit, unemployed workers are better off. Hence, they are willing to wait longer for a match. At a lower cost of unemployment, workers can claim a higher wage, causing firms less willing to create vacancies (60% fewer). High-skilled workers in the informal sector also get a salary rise (30%), which significantly minimizes the formal-informal wage gap. The informal sector outgrows the formal sector by both employment and income.

This result suggests that generous benefit in the formal sector can promote informality. This mechanism can be related to informal experience in Latin American countries. Maloney (2004) observes that in many families some members participate in the formal sector while others work informally. Formal worker-members receive benefits which are also enjoyed by informal worker-members. Unambiguously, the formal benefit is a more stable alternative of income; hence, a more generous benefit can encourage further informality.

The behavior of market tightness, formal wages, and formal employment are standard. The difference, again, is in the reaction of unemployment. Unemployment decreases by 30% instead of increasing as in the baseline model. Low-skilled workers benefit directly from this change: their salary w_l increases as much as unemployment benefit. The sharp rise in informal GNI surmounts the decline in formal GNI, helping the economy achieve a higher aggregated GNI.

Matching efficiency

A triple in K from 1 to 3 (Appendix A, Figure 15) gives the best outcomes to all parties. As the matching process becomes more efficient, firms can create fewer vacancies (54% fewer) and save on hiring cost. Salaries in both sectors rise, and the wage gap narrows down by seven percentage points. The formal sector grows by both income and employment. The informal sector loses its workforce by 14%, but its income does not change. As a result, total GNI rises by 11%.

Destruction of formal job matches

Two independent factors can destroy a formal job match: an adverse productivity shock arriving at rate δ_F or the worker voluntary opting out at rate α. Analytically, these factors affect supply and demand on formal labor market differently. A change in δ_F does not move the wage-setting curve, but a change in α makes this curve rotated in an uncertain direction. A faster rate of any factor steepens or tilts downward the job-creation curve. Firms consider both factors detrimental: the factors shorten the life of a match, making firms more reluctant to open new vacancies. At a higher δ_F, market outcomes are clear: w^*_{HF} and θ^* become smaller. Market outcomes are undetermined when α changes.

The reaction of all endogenous variables to the two factors are similar in both direction and magnitude (Appendix A, Figure 16 and Appendix A, Figure 17). When informal micro-enterprises form at a faster rate, equilibrium formal

wage and market tightness contract. This result is identical to the case of rising δ_F. In the baseline model, the behavior of vacancy ratio is uncertain. Here, in both cases, the vacancy ratio increases, possibly because unemployment increases faster than market tightness declines. While the formal sector remains the main source for employment, its income drops dramatically. Unemployment and informal employment expand. Informal entrepreneurs are not better off as their salary lowers and drops further below formal salary.

Sunk cost and real interest rate

Market outcomes react similarly to an increase in either parameter (Appendix A, Figure 18 and Figure 19). Vacancy ratio and market tightness have identical trajectories across both cases. Consistent with standard results, unemployment rate rises when jobs become more costly for firms to afford. Wages in both sectors and formal employment reduce while the informal sector and wage gap expand. By income, the formal sector and the economy perform poorly as a whole.

A higher sunk cost raises not only the entry barrier for firms with unfilled jobs but also the flow cost incurring after the vacancy is filled. An increase in sunk cost κ shifts the job-creation curve downward by κ and rotates it clockwise. Firms' demand for labor weakens and match surplus becomes more limited. The wage-setting curve also shifts down, but by a smaller extent ($\beta\kappa r$) than the job-creation curve does. The wage-setting curve also becomes steeper i.e. tilted

counterclockwise. It can be shown analytically that the effect of rising sunk cost is adverse for θ^* but ambiguous for w^*_{HF}. A higher interest rate affects the job-creation curve similarly, but its influence on the wage-setting curve is also undetermined. Real interest rate varies in a very narrow range, yet its effect is still significant, as the effect is magnified with κ.

Other parameters

It can be shown analytically that when the exit rate of informal enterprises δ_I is non-increasing in profits $\pi = w_{HI}$, an increase in low-skilled workers' productivity z raises informal firms' profits, while an increase in the relative size of high-skilled labor force ϕ has an opposite effect. We can conclude that both types of workers in the informal sector benefit from a productivity boost to either type. The informal sector becomes more attractive to high-skilled workers in that case, but not so when the high-skilled are relatively more abundant than the low-skilled.

Plots of market outcomes for the latter situation are presented in Appendix A, Figure 20. A doubling ϕ from 0.3 to 0.6, in fact, has a negligible effect on formal and informal salaries. We can witness major changes happening to vacancy ratio and formal labor (employed and unemployed), each of which almost quadruples. Informal employment also shrinks by more than 70%. Despite such significant changes, market tightness only increases by 0.4%. This result happens due to the constant return to scale property of the matching function.

Put differently, the change in labor skill composition does not affect matching outcomes in the formal sector. The rise in unemployment can be explained by a higher exit rate of informal businesses, despite minimal change in w^*_{HI}. We can explain that entrants to the informal sector are fewer, but it is not sensible since we have more individuals working for formal firms. By income, the formal sector expands and surpasses the informal sector.

The endogenous variables do not react when I vary the low-skilled workers' productivity, even at the 10^{-5} level. Also, we can noticed that in all comparative analysis cases, w^*_l does not change except when I vary the unemployment benefit. This "unresponsiveness" should be seen as a technical issue rather than a modeling issue. Possibly too many constraints are imposed to the problem. Alternatively, the constraints are not set up strategically to allow for sufficient variation of the endogenous variables. This issue is a shortcoming of my paper.

Budget neutral policy

In this model, the informal sector has two contrasting roles. First, it competes against the formal sector for high-skilled labor. Second, it provides employment to low-skilled labor. Put differently, the informal sector is a threat to the formal sector but is beneficial to the low-skilled who are not directly reached by the government. The government might want to balance the two roles by reducing informal employment among the high-skilled and improving the income

of the low-skilled. This section analyzes the efficiency of a budget neutral policy towards these two goals.

The budget neutral policy will be structured as follows: A tax will be imposed on firms with filled jobs to finance firms with vacancies and unemployed workers. As suggested by comparative analysis results, a reduction in sunk cost increases formal employment and decreases both informal employment and unemployment. Besides, raising unemployment benefit lowers unemployment and boosts the informal sector's income.

I denote t as the dollar tax amount imposed on the profits of the formal firms with filled jobs, and σ as the ad valorem subsidy on firms' vacancy maintenance fee. This setup follows Zenou (2008) where a similar tax is used to subsidize vacancy maintenance fee and unemployment benefit. After testing for different specifications, I find that the policy should subsidize the flow cost κr instead of the sunk cost κ. Financing sunk cost, in fact, hurts formal employment. Sunk cost determines flow cost, and sunk cost subsidy also includes flow cost subsidy. A greater subsidy requires to be financed by a more onerous tax which discourages formal firms from job creation.

The experimenting also shows that the policy has a stronger effect overall when setting unemployment benefit proportional to the formal wage, instead of holding it fixed. Recall that in this model, the high-skilled entrepreneurs are not willing to pay the low-skilled employees more than their unemployment benefit.

Therefore, giving a greater allowance to the high-skilled might be the right way to improve the low-skilled's income. How unemployment benefit is modeled in the budget equation differs my methodology from Zenou (2008).

The government collect tax revenue from e_h^* firms that are operating with filled jobs. The total flow cost for all firms with vacancies is $u_h\theta\kappa r$. With an ad valorem subsidy $\sigma \in (0,1)$, these firms only need to pay $(1-\sigma)u_h\theta\kappa r$ for vacancy maintenance. The balanced budget of the government is

$$tE_H = bU_H + \sigma\kappa\theta r U_H$$

From Equation 2.20 and Equation 2.21, $E_H/U_H = e_h/u_h = p(\theta)/(\alpha+\delta_F)$, I rearrange the above condition as

$$tp(\theta)/(\alpha+\delta_F) - \sigma\kappa\theta r = 0 \tag{2.29}$$

where $b = rr * w_{HF}$ and rr is the replacement rate.

The nonlinear system needs to undergo some modifications before solving numerically. First, I add the budget equation to the list of equality constraints. Second, for all constraints, I change every incidence of κr to $(1-\sigma)\kappa r$, and replace y with $(y-t)$. Wage-setting, job-creation, and requirement for uniqueness equilibrium are three constraints to be modified. In the calibration exercise, I set the dollar tax amount $t = 0.5$ and a replacement rate $rr = 0.2$. I include ad

valorem subsidy σ among the endogenous variables of the system. This means σ is solved along with (A, d) and (θ, w_{HF}, w_{HI}). The solution for σ is 0.33, implying that the government pays roughly one third of the vacancy maintenance fee.

Raising the tax level has a strong positive effect on labor composition and a weak negative effect on incomes. Figure 3 plots the trajectories of market outcomes following a tax raise from 0.4 to 0.7. Unemployment drops significantly by 21%. Formal employment increases by 3.5% while informal employment decreases by 1.8%. The salary of informal high-skilled workers improves slightly by 1%, and the wage gap between two sectors is narrowed down by 1.7%. Meanwhile, salaries of formal workers and low-skilled workers, informal GNI, and total GNI all shrink, though by less than 1%. Reconstructing unemployment benefit to be proportional with formal wage produces an interesting side effect. Equilibrium salary of the low-skilled no longer hits its boundary (which I set to be unemployment benefit less 0.01), unlike in the initial setting where the benefit is considered a parameter.[1]

Based on the calibration results, the budget balance policy is effective in reducing unemployment and informal employment, while increasing efficiency in the formal labor sector. However, the policy has unwanted consequences: formal high-skilled workers and informal low-skilled workers earn lower wages, and gross income in either labor sector decreases. Further examination shows that tax

[1]Pegging unemployment benefit to wage helps the model attain a desirable property, that is to have an unemployment rate constant and independent of workers' productivity in the long-run equilibrium (Pissarides, 2000).

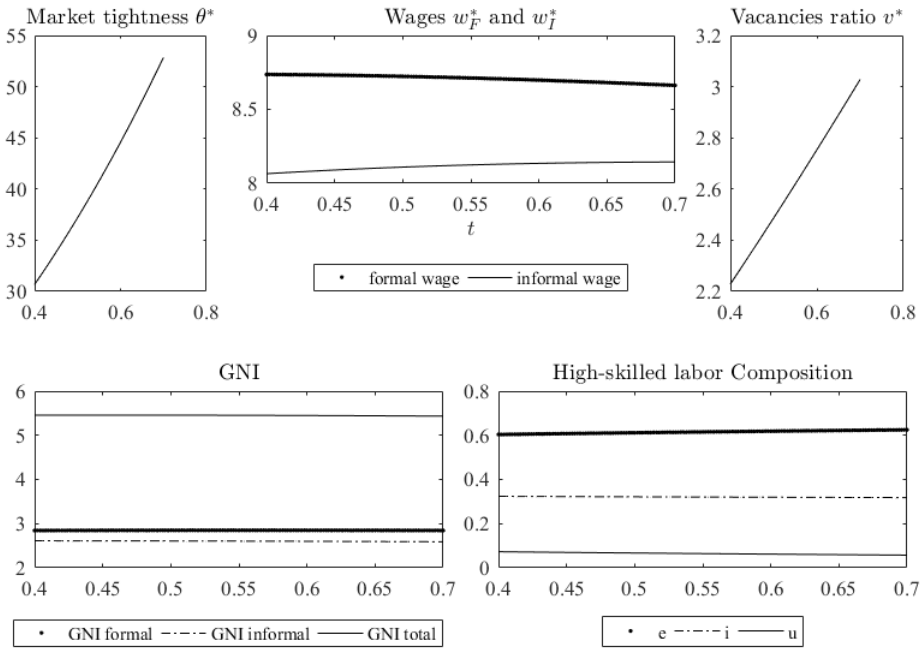

FIGURE 3. General Equilibrium Effects of a Budget Neutral Policy

revenue and subsidy for vacancy maintenance increase with the tax raise, but unemployment benefit decreases. The tax hike damages firms' profits which leads to a smaller wage paid to the high-skilled employees. Low-skilled workers also earn less since their compensation is capped by the high-skilled's unemployment benefit. A tax hike in this context helps the government achieve its goal of retaining high-skilled workers in the formal sector. However, the policy hurts both types of working labor in terms of income, and consequently, worsens aggregate national income. This policy hence is not suitable to treat informality.

Conclusion

This chapter contributes to the related literature on informality with a fresh view inspired by observations on Latin American countries. Previous studies often treat the informal sector as an "absorbent" state, and few attempt to account for its diverse nature. I fill this gap by (i) including in the model an occupational switch as formal sector workers become informal sector employers, and (ii) modeling the informal sector as an arena for micro-entrepreneurial firms that hire low-skilled workers. Using an equilibrium search framework, I investigate the interaction between two labor sectors and potential outcomes of policies towards informality. The study yields several theoretical results, some of which are substantiated with empirical evidence from Latin American countries.

This model assumes a perfectly competitive informal sector coexists with a frictional formal sector. Both types of workers participate in the informal sector. Working informally is mandatory for the low-skilled, as their productivity is too low to be qualified for formal employment. On the other hand, taking informal job is optional to the high-skilled. In every period, a fraction of the formally employed high-skilled choose to switch to the informal sector. Given that it competes directly with the formal sector for high-skilled labor, the informal sector is able to influence formal market conditions. The Beveridge curve, an indicator of efficiency in the formal labor sector, can shift due to changes in profits, formation, and failure rates of informal firms. Specifically, I find that a growing informal sector

where informal businesses survive better than formal firms will make the formal sector appear more efficient, as signaled by the Beveridge curve shifting inward.

The model yields a unique equilibrium under two key assumptions. First, the survival rate of informal firms is assumed to increase with their profits. Second, the wage paid to a worker by a formal firm should account for the possibility of worker departure to the informal sector in a certain way. Formal salary depends on the productivity of the match, plus two components with different purposes. The formal firm rewards the newly hired workers for saving its vacancy maintenance fee but also penalizes them for potential quitting in the future. The sizes of these components depend on the bargaining power of the workers and the income premium of informal employment over unemployment. Uniqueness is established when the penalty component is greater than the reward component.

The model is calibrated to match empirical observations on informality in Latin American countries. In the calibrated economy, 7% of the high-skilled workers are unemployed, 36% work informally, and 57% work formally. Comprehensive comparative analysis shows that informal employment among high-skilled workers can decrease with the productivity of the high-skilled, more efficient job matching process, lower levels of unemployment benefit, and sunk cost of formal jobs. This finding aligns with the fact that developing countries generally have lower labor productivity and more pronounced informal sectors than developed countries. The result suggests that developing countries should

improve labor productivity through education and training programs. This can be an effective strategy to reduce informality in the long run.

The informal sector in this model has two contrasting roles: (i) providing income to the low-skilled workers who otherwise cannot work formally, and (ii) taking high-skilled labor away from the formal sector which the government can regulate. Given this informality structure, the government would want to balance these roles with a policy that allows it to keep more high-skilled labor stay in formal employment while improving the income of the low-skilled. In the last comparative analysis exercise, I test whether this goal can be achieved with a budget neutral policy. This policy has a tax on profits of firms with filled jobs, and tax revenues are spent on unemployment benefits and subsidy to hiring fees of formal firms with vacancies. Fixing the levels of subsidy, I show that a tax hike in this policy package is effective in reducing unemployment and informal employment among high-skilled workers. However, other equilibrium outcomes are not desirable. The policy worsens labor and aggregate national income, hurting both types of workers. Thus, I conclude, it is ineffective to tackle informality with active government intervention in the form of labor policies.

In this chapter, the dynamics of informal labor sector and its ties with the formal sector are modeled based on a non-standard but empirically sound view. The research presented has certain limitations. First, occupational choice is set up passively: a formal sector worker does not choose to become informal entrepreneur,

they simply become one. Second, the model is quite rigid with many constraints imposed in the numerical algorithm. While these constraints are necessary to yield an equilibrium, they inhibit further interesting analyses. For example, I can show analytically that both worker types earn more when the low-skilled are more productive. This result, because of restrictions imposed, cannot be obtained numerically.

The analysis can be extended to include financial markets. This paper indeed has a result in favor of financial development: the informal sector shrinks when the output of the formal match increases, which could be due to workers becoming more productive or formal firms having better access to finance. It will be interesting to evaluate the contrasting roles of financial development: more productive matches retain more high-skilled labor in the formal sector, but also allow high-skilled workers to save up effectively to invest in their future informal business. The calibration exercises may be enhanced too by taking into account the distribution of worker skills, proxied by educational levels, and observations on labor flows across employment states.

CHAPTER III

FINANCIAL DEVELOPMENT, EXPORT PERFORMANCE, AND FIRM PRODUCTIVITY: EVIDENCE FROM CROSS-COUNTRY DATA

Introduction

Access to finance is a major challenge for the operation of firms of all kinds. According to the World Bank Enterprises Survey 2018, the majority of firms consider it to be their most significant obstacle, irrespective of their sizes. Ability to acquire capital cheaply and quickly is particularly critical for exporting firms. For these firms, extra expenses arise from activities such as exploring foreign markets, setting up business relations, and paying for international transport fees. The firms also need liquidity to prepare for adverse events such as trading partners failing to make payment or shipment lost during transit (Foley and Manova, 2015). The mechanisms whereby a well-functioning financial market promotes exporting activities, however, remain inconclusive.

Financial development increases export by either allowing more firms to export (extensive margin) or raising the level of export sales per exporting firm (intensive margin), or both. Whether the influence of financial development occurs along both margins of trade and if so, which margin is dominant has important implications. The extensive margin depends on the fixed trade cost firms have to pay upfront when enter the global market, while the intensive margin

is determined by the variable trade cost firms face once they begin exporting. The reaction of the margins to financial frictions help us understand better the financing pattern of exporting firms. Related literature agrees that financial development affects the extensive margin yet provides mixed results regarding the intensive margin. Studies that use country- or industry-level data mostly find a positive effect of financial development on the intensive margin (Beck, 2002, 2003; Besedes et al., 2011; Manova, 2003, 2013). Studies that use firm-level data find such effect to be either positive (Muul, 2008; Bricongne et al., 2012) or statistically insignificant (Bellone et al., 2010; Berman and Hericourt, 2010). While the inconsistency of evidence results from differences in data used by the studies, it suggests that the impact of financial frictions on export relies on the interplay of country, sector, and firm characteristics.

In this paper, I empirically explore the relationship between domestic financial development and export performance, accounting for factors at the country, sector, and firm levels. I use a detailed dataset from the World Bank, the Exporter Dynamics Database (EDD). Domestic financial development, measured by the private credit to GDP ratio, has a significant effect on export activities of manufacturing industries. This effect is more pronounced in industries that require more external finance or have less collateralizable assets. Export sales by industry increase mainly through the extensive margin, i.e., more firms are selected into

exporting. Financial development does expand the intensive margin, i.e., export sales per firm, but only for firms with higher productivity.

A comprehensive sensitivity analysis reveals that improving domestic financial markets has statistically and economically significant benefits to exports. For example, Cambodia, the country at the 25^{th} percentile of the distribution of financial development, would be able to raise the export revenue in its average industry by 70% from a one standard deviation increase in private credit. Some sectors benefit more from financial development, such as Pharmaceuticals, Computing machinery, Television transmitters, and Medical appliances. The rise in export sales by these sectors that results from a one standard deviation improvement in private credit is almost 80 percentage points higher than the increase in export sales by Basic ferrous metal, Fertilizers, and Starch products.

Given the richness of EDD, I verify that the effect of financial development on export varies by firm productivity. The EDD reports measures of export performance and export dynamics at firm-level for four firm types: entrants, surviving entrants, incumbents, and exiters. Though EDD does not provide further details to estimate the productivity of these firms, I can infer that incumbents and surviving entrants are the most productive types based on their continued survival and large sizes. Firm size can proxy for firm productivity, as established in the seminal work of Melitz (2003).

My empirical analysis shows that more productive firms benefit more from a deeper financial market. Total export sales of incumbents and surviving entrants rise by 170% and 58%, respectively, given a one standard deviation increase in private credit. Financial development affects export predominantly through the extensive margin. However, the relative importance of the extensive margin differs between incumbents and surviving entrants: Extensive margin explains roughly 56% the increase in total export sales of incumbents, as opposed to 72% for surviving entrants. This result implies that in terms of fixed cost financing, financial development has a more influential role over first-time exporters. Fixed trade costs are not limited to the entry cost borne by domestic firms to become exporters. Existing exporters also need to pay for activities such as exploring new destinations or developing new products. The ability to cover these costs is vital to their survival, as indicated by a significant marginal effect on their extensive margin. However, since existing firms tend to be mature firms, they are more likely to meet these costs with internal liquidity.

This paper extends the literature that studies the role of finance on export performance. Studies using country-level data measure the margins of trade at the product-variety or sectoral level. Using the number of varieties as proxy for the number of firms is an acceptable practice, as the canonical trade model (Melitz, 2003) assumes each firm produces one variety. However, this method can lead to misleading estimation of the actual extensive margin. Overestimation

occurs when one firm produces more than one variety, underestimation when the variety classification is too coarse to differentiate between two distinct products provided by two separate firms. Besides, if a firm begins exporting with the same variety it offers for the domestic market -a stylized fact in international trade- then no change in extensive margin is recorded. By using detailed sector-level data, I can give a more rigorous test on the theory put forth by Manova (2013). Manova (2013) extends the heterogeneous firm framework by Melitz (2003) into a multiple-sector, multiple-country setting. However, using data at the sectoral level (COMTRADE) prevents her from thoroughly testing her hypotheses. Besides being more theoretically well-suited, my results are comparable to Manova (2013) and other cross-country studies: the total export sales by industry in this paper are similar to the measure of intensive margin at the industry level. This paper also contributes to the rather small body of evidence on developing countries: notable works include Feenstra et al. (2011) on China, Kapoor et al. (2012) on India, and Aghion et al. (2007), Berman and Héricourt (2010), Wang (2011) on a subset of less developed countries. My sample covers 52 countries, among which 41 are lower-middle or low income.

This research also speaks to the broader literature on finance and economic growth (see Levine, 2005, for example). The empirical strategy in this paper follows the pioneering work of Rajan and Zingales (1998), who use U.S. data to explain industrial growth in non-U.S. countries. Under this method, U.S. industry-

level features interact with non-U.S. country-specific characteristics to form a combined explanatory factor. While resting on strong assumptions, this method has the advantage of exploiting industry-level variation and avoiding potential endogeneity. The later part of this paper adopts a specification that models heterogeneity across countries explicitly. This setting is guided by discussions on empirical growth methodologies (Durlauf et al., 2005) and the role of institutional quality in financial markets (La Porta et al. (1998), for example).

The remaining of this paper proceeds as follows: The next section summarizes related work, Section 3 outlines the theoretical framework and methodology, Section 4 presents data sources and description, Section 5 discusses empirical results and Section 6 concludes.

Literature Review

Prominent work at the country aggregate level includes Beck (2002), Manova (2008), Besedes et al. (2011), and Manova (2013). Beck (2002), using a 30-year panel of manufacturing exports from 65 countries, proves that more financially developed countries have a comparative advantage in manufacturing goods whose production requires more external capital. Besedes et al. (2011) yield a similar conclusion with product-level data on exports to the United States and some European countries between 1989 and 2008. Manova (2013) confirms that more financially advanced countries export relatively more in terms of product counts and quantity traded. These papers all use the ratio of private credit to GDP as a

measure of a country's financial development. Manova (2008), using data for 91 countries and the 1980-1997 period, finds that opening equity markets to foreign capital increases exports, especially in sectors with higher external financing needs.

Several papers with country-level approach exploit the event of the Financial Crisis from 2008-09. Among them are Chor and Manova (2012), Kiendrebeogo (2013) and Iacovone and Zavacka (2009). Chor and Manova (2012) observe a surge in interbank rates across many developed and some developing countries during the Financial Crisis, indicating worsening financial conditions in those countries. Examining data on 3-digit NAICS monthly imports to the United States between November 2006 and October 2009, Chor and Manova (2012) find that countries with higher interbank rates exported less to the United States, especially in more financially vulnerable sectors. Kiendrebeogo (2013), analyzing crises in both origin and destination countries, remarks that the negative effect of crises is stronger in manufacturing industries relying more on external finance. Iacovone and Zavacka (2009) study manufacturing export growth of 21 countries during 23 crises between 1980 and 2006, and conclude that sectors more dependent on external banking finance grow significantly less than other sectors. The banking finance channel is highlighted here as opposed to the inter-firm financing channel. The latter is called trade credit in accounting term. Ronci (2004) and Berman and Martin (2012) both use the amount of outstanding short-term credit in USD to proxy for trade credit at the country-level. Ronci (2004) studies crises in 10 developing and emerging

market economies and concludes that a fall in trade financing in connection with domestic banking crisis can lead to substantial loss of trade. Berman and Martin (2012) focus on how exports by African countries are affected by banking crises occurring to their trading partners.

Most evidence at the firm-level is from developed countries where firm-level data are of good quality. Amiti and Weinstein (2011) construct a unique dataset where Japanese manufacturing firms are matched with the banks providing trade finance to them. Using the market-to-book value of banks as an indicator of banks' health, Amiti and Weinstein (2011) are able to establish direct causal relationship between bank health and exports. Their most important finding is that exports are more susceptible to financial shocks than domestic sales. Similar evidence comes from Paravisini et al. (2011) that also utilizes matching firms and banks data in Peru. Additional evidence is found by Muul (2008) and Behrens, Corcos, and Mion (2011) for Belgian manufacturers, and by Eck, Engermann and Schnitzer (2012) for German firms, for British manufacturing firms by Greenaway, Guariglia, and Kneller (2007), and Chilean firms by Alvarez and Lopez (2012). Minetti and Zhu (2011) use data on Italian firms and find that credit rationing affects both the extensive and the intensive margins of exporting. Firm-level evidence from developing countries are Feenstra et al.(2011) on China and Kappoor et al. (2012) on India. Berman and Héricourt (2010) provides evidence from nine emerging economies. With access to firm-level data, these authors can compute actual need

of external capital and other measures of firms' financial health such as liquidity ratio, leverage ratio, or credit scores.

Another closely related literature investigates the role of financial development for industrial growth. Seminal papers include Rajan and Zingales (1998), Fisman and Love (2003), and Braun (2003). These papers are in agreement that sectors intensive in external finance and sectors with fewer collateralizable assets grow faster in financially developed countries. Aghion, Fally and Scarpetta (2007) examines the effect of financial constraints on firm dynamics using data from 16 industrialized and emerging economies. Their results show that financial development matters most for the entry of new firms and post-entry growth in sectors that are more dependent on external financing. In terms of methodology, Rajan and Zingales' interacting variable method has been used extensively by many papers, including those cited above such as Fisman and Love (2003), Braun (2003), Beck (2002), Berman and Héricourt (2009), Alvarez and Lopez (2012), Manova (2013). A more extensive survey of the literature in trade and finance can be found at Contessi and Nicola (2013) and Foley and Manova (2015).

All the literatures discussed so far confirm the importance of access to finance and financial health in explaining the extensive margin of international trade, consistent with the role of fixed costs defined in trade theory. The role of finance on the intensive margin is somewhat mixed. The implication of firm productivity on the intensive margin when firms face financial frictions have

been theoretically delineated in an untested hypothesis by Manova (2013), and empirically in Berman and Hericourt (2010). This paper, therefore, attempts to shed more light on this matter. Particularly, I examine whether productivity correlates with the sensitivity to financial development of exporting firms.

Methodology

Theoretical framework

I use the formal framework by Manova (2013) to examine the channels of financial development on export performance at the industry level. Manova (2013) sets up a partial equilibrium model with multiple sectors, multiple countries, and firms heterogeneous in productivity. Her model is a variation of the influential work by Melitz (2003). In her model, exporting firms must borrow in a competitive market to finance the fixed and variable trade costs, and pledge collateral to secure their loans. The model generates several testable hypotheses, two of which will be tested empirically with finer data in this paper.[1] A more detailed version of this model is presented in Appendix B.

Assume that countries differ by the degree of contractual enforcement λ_i. Higher values of λ_i imply investors are more likely to receive repayment from the firms. Sectors differ by the degree of financial vulnerability: A sector is more financially vulnerable if it requires to cover a greater portion of trade costs with

[1]Proposition 1 and Proposition 5 in Manova (2013)

external finance (higher d_s) or it relatively lacks of tangible assets that can be used as collateral (lower t_s). The sectoral difference in d_s and t_s assume to be driven by differences in production technology across sectors. Firms consider λ_i, d_s, and t_s exogenous.

The first testable hypothesis relates the extensive margin of trade with financial development and sectoral financial vulnerability. Financial development lowers the productivity cut-off a_{is} relatively more in financially more vulnerable sectors. This means more firms can enter the export market.

$$\frac{\partial^2(a_{is})}{\partial\lambda_i\partial d_s} < 0, \frac{\partial^2(a_{ijs})}{\partial\lambda_i\partial t_s} > 0$$

The second testable hypothesis relates the intensive margin of trade with financial development and sectoral financial vulnerability. Financial development (weakly) increases the level of firms' exports (revenue r_{is}) from relatively more in financially more vulnerable sectors. The term "weakly" is involved because financial development only increases the export level of firms that have a productivity between a_{is}^L and a_{is}^H. The liquidity constraint is binding for firms with productivity lower than a_{is}^L and not binding for firms with productivity at least a_{is}^H.

$$\frac{\partial^2 r_{is}}{\partial\lambda_i\partial d_s} > 0, \frac{\partial^2 r_{is}}{\partial\lambda_i\partial t_s} < 0$$

To check these propositions with the new data, I set up a regression equation where the dependent variable is either firm counts (for the first proposition) or average export sales per firm (for the second proposition). The set of independent variables is the same across regressions. This set includes the level of financial development (λ_i) and two interaction terms between financial development with each financial vulnerability measure ($\lambda_i \# d_s$ and $\lambda_i \# t_s$). According to the first proposition, we should expect the coefficients of the first and second interaction terms to be positive and negative, respectively. However, based on the second proposition, these signs would only hold for the intensive margin of firms with intermediate level of productivity, i.e., non-surviving entrants in EDD. This means the signs may not hold in regressions on average export sales of incumbents and surviving entrants.

Industry-level financial measures

The financial vulnerability of each industry is assessed by two criteria: the need for external finance and the ability to borrow. The former is captured by the portion of capital expenditure (CAPEX) that is financed by external funds. CAPEX is the amount spent on tangible assets that will be used for more than one fiscal year. Thus, CAPEX is important to the long-run viability of the business. The main source of internal fund that firms use to finance CAPEX is the net amount of cash flow generated from its operations (CFOP). A large, positive external financial dependence implies that the industry does not generate enough

liquidity internally relative to its fixed capital investment. The former is reflected in asset tangibility (TANG) which is the ratio of hard assets (i.e. net property, plant and equipment) to total assets. An industry with a greater amount of tangible assets relative to total asset has better potential to borrow, as it can secure its debt with more collateral. The variable external financial dependence is defined as in Rajan and Zingales (1998) and asset tangibility is defined as in Claessens and Laeven (2003).

$$EXTFIN_k = \frac{\text{CAPEX - CFOP}}{\text{CAPEX}}$$

$$TANG_k = \frac{\text{Tangible Assets}}{\text{Total Assets}}$$

In the literature of corporate finance, firms have two sources of funds to finance CAPEX. Firms can fund CAPEX internally from cash flow from operations (CFOP) or from the sale of long-term assets (cash inflow from investing activities). Firms can also fund CAPEX externally by borrowing or issuing capital stocks (cash inflow from financing activities). Among three types of cash flows, CFOP is the most important for financial analyst to determine the efficiency of the business. CFOP is calculated as the sum of funds from operations plus changes in working capital.[2]

[2]Funds from operations are, at the simplest, net income plus depreciation and amortization and deferred taxes. Working capital is current assets less current liabilities, and the term "current" implies "less than one fiscal year". Changes in working capital that raise CFOP include

asset tangibility strictly lies between zero and one, since tangible assets is a component of total assets and never receives negative values. Meanwhile external financial dependence can be either positive or negative. When both CAPEX and CFOP are positive, if the firms have more capital expenditures than its own liquidity and have to seek external funds, then external financial dependence will be positive. A negative external financial dependence implies that firms are able to generate more than sufficient cash to fund CAPEX. A more negative external financial dependence (or highly positive CFOP) indicates a healthier business as it shows this business has substantial liquidity of its own to survive and less dependence on external finance. The firm can use free cash flow to develop new products, make acquisitions, pay dividends and reduce debt. CAPEX is always positive but CFOP can be negative. Some industries typically have negative CFOP such as Pharmaceuticals, Oil and gas, Biotechnology, Drug manufactures and Medical instruments. Firms in these industries often make large investments which promises pay-offs only in the long term.

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increase in account payables, decrease in account receivables, and decrease in inventory. Increase in account payables (a current liabilities item) is the payment amount the business can defer to make to its customers. Account receivables (or trade receivables, or trade credit, a current asset item) arises from selling merchandise or providing services to customers on credit. A decrease in account receivables means customers have made payment on their unpaid bills. Finally, a decrease in inventory (a current assets item) implies that the firm has more sale, thus receiving more cash.

Interaction variable method

Exporting firms perform worse when facing financial imperfections because they could not raise as much financial capital as needed. Data on external financial usage and borrowing, if available, reflect the equilibrium values in a frictional market. Using such data and measure of financial frictions in the same equation to explain export performance could lead to severe endogeneity bias. Besides, such data are usually not available for a large number of countries and industries.

To isolate the effect of financial frictions across countries while still exploiting the variations in financial need across industries, Rajan and Zingales (1998) developed a technique known as "interaction variable method". According to this method, researchers can use financial characteristics of public firms in the U.S. instead. Because the U.S. arguably has the least frictional financial market in the world, the equilibrium values observed in U.S. firms are likely their true demanded value of financial capital. Put differently, as financial markets in less developed countries become less frictional, the level of financial capital attainment of firms in such countries will approach that of U.S. firms. As a result, the capital structure (the mix of debt and equity) and asset structure (the mix of tangible and intangible asset) of non-U.S. firms will eventually resemble those of U.S. ones.

Why U.S. sectoral data can be applied on similar sectors of non-U.S. countries also rests on assumption of consistent technological difference. Rajan and Zingales (1998) argue that the difference in industry-level financial structures

is driven by the technological difference among industries. Such difference is preserved across time and across countries. For example, a typical firm in Chemical products industry in the U.S. may demand relatively more external finance than a typical firm of the same industry in Mexico. However, in either country, the demand for external finance of firms in Chemical products is greater than that of any other industries. This method thus provides a rank of sectoral financial vulnerability rather than the actual demand of industries globally.

This method requires the industry-level financial measures to be computed from a 10-year period preceding the sampling period of the research and the U.S. to be excluded from the sample. Doing so helps prevent potential channels of endogeneity: there might be omitted factors that influence both financial characteristics of firms in the U.S. and export performance. The 10-year time span helps smooth out any noises during the business cycle and credit cycle. This interaction variable approach, nonetheless, is not perfect. The industry measures come from large public firms which are less liquidity constrained than small firms.

Baseline specification

Export performance is modeled using a standard gravity setting (Anderson and van Wincoop, 2003) that allows for variation at the level of country by industry by firm type. I employ the interaction variable method by Rajan and Zingales (1998), in which the country-level measure of financial development, private credit, is interacted with two industry-level measures of financial

characteristics, external financial dependence and TANG. I also include the GDP of the exporting country and a set of fixed effects to control for any omitted variables. The basic regression equation takes the form:

$$\begin{aligned} LogY_{ikt} &= \beta_0 + \beta_1 LGDP_{it} + \beta_2 PRIVCRED_{it} \\ &+ \beta_3 PRIVCRED_{it} \times TANG_k + \beta_4 PRIVCRED_{it} \times EXTFIN_k \\ &+ \alpha_i + \alpha_k + \alpha_t + \epsilon_{ikt} \end{aligned} \tag{3.1}$$

where $LogY_{ikt}$ takes on different measures of export performance for industry k in country i, in year t. Y will be total export flow, number of exporting firms, and average export level of firms. External financial dependence and asset tangibility in industry k are denoted EXTFIN and TANG, respectively.

This equation will be used to explain total export flow, extensive margins and intensive margins. Export flow (total export sales) can be decomposed into extensive margin, i.e., the increase in number of firms entering international trade, and intensive margin, i.e., the average export sales of exporting firms. The measure of extensive margin is the number of exporting firms by ISIC Rev 3 industry, and the intensive margin is measured by the average export sales of exporting firms. EDD does not provide the level of export volume, therefore for each industry, I multiply the number of exporters with average exporter size to get total export volume.

EDD reports extensive and intensive margins by different firm types: exporters, entrants, incumbents, survivors, and exiters. Exporters at time t ($Exporter_t$) refers to all firms that export in year t. Among these firms, the ones that did not export last year are called entrants ($Entrants_t$), the ones that exported last year are incumbent ($Incumbents_t$). Exporters in year t is the sum of the entrants and incumbents of the same year, minus those that exported last year but cannot continue this year ($Exiter_t$). Among the entrants, a surviving entrant ($Survivor_t$) is the one that will continue to export in the following year ($t + 1$). $Survivor_t$ thus becomes a subset of $Incumbent_{t+1}$.

The coefficients of interest are β_2, β_3 and β_4. The sign of private credit (β_2) is expected to be positive. In financially more developed countries where firms can easily secure a loan, the productivity cut-off for exporting is likely lower. The coefficient of the interaction term between private credit and asset tangibility (β_3) is expected to be negative. Industries with relatively more tangible asset can borrow more, since loans are pledged with firms' tangible assets. Being able to borrow more implies that industries are less dependent on the financial development of the country. The coefficient of the interaction term between private credit and external financial dependence (β_4) is expected to be positive. Greater needs on external finance suggests that firms in those industries should rely more on the country's financial system to obtain more liquidity.

Sensitivity to financial development

Differentiating both sides of Equation 3.1 with respect to private credit yields the marginal effect of exports to private credit:

$$\frac{\partial LogY_{ikt}}{\partial PRIVCRED_{it}} = \beta_2 + \beta_3 * TANG_k + \beta_4 * EXTFIN_k \tag{3.2}$$

This step is necessary since we want to account for both measures of sectoral financial vulnerability. As presented later in the Data section, there is no correlation between these measures. A sector can have a large ratio of asset tangibility, while requiring external finance for its capital expenditure, and vice versa. The calculation of marginal effect is also helpful, as we can identify the heterogeneity in the sensitivity to financial development. In particular, we can evaluate which trade margin is the primary channel through which financial development affects exports, whether different firm types display unequal sensitivity to financial development, or which sectors can benefit more from financial improvement. Lastly, given the same degree of financial improvement, we can assess whether exports from countries of different financial conditions will experience the same benefit.

Modified specification I

The baseline model (Equation 3.1) has a full set of fixed effects to control for factors that are invariant for a country, for an industry or for a particular

year. The time fixed effect accounts for factors that apply to all countries and industries such as a global business cycle, the industry fixed effect accounts for time-invariant difference in industrial technology, and the country fixed effect for time-invariant country-specific underlying conditions. Such factors are numerous and sometimes not measurable, and failing to account for them can lead to biased estimates. Having fixed effects thus is necessary.

One problem with using fixed effects is that the fixed effects can absorb too much variation from the data, leading to imprecise estimates. In this exercise, I remove the country fixed effects, allowing private credit display a stronger effect. private credit may not have substantial time-series variation, since the sample is fairly short by temporal dimension. Indeed, relaxing the gravity equation by omitting country fixed effects is not uncommon in the literature.[3]

That fixed effects identification strategy should be approached with care has been discussed in empirical growth literature. Most studies in this literature employ panel data analysis where income growth is regressed on various country factors, including financial development. Including country fixed effects removes between-country variation of the regressors, thus identification of the slope parameters only rely on within-country variation. If the regressors are highly persistent over time, which is not rare for a handful of country factors, the within-

[3]For example, the first paper that employs EDD (Fernandes et al. 2015) does not use country fixed effects either in their gravity equation estimations. Choi and Lugovskyy (2019), in a study that examines the effect of private credit on export quality of U.S. Imports, also follow this practice. They argue that having country fixed effects would remove meaningful cross-country differences that they are interested in.

country variation would be too meager to yield significant estimation. Having country fixed effects in such cases could lead to a misleading conclusion that a given country factor "does not matter" while it should better say that the effect cannot be identified from the data at hand (Durlauf et al., 2005).

To balance the trade-off between the benefit of bias reduction and the cost of variation reduction in using country fixed effects, some studies offer an alternative: that is to proxy for omitted variables (Temple 1999, Griliches and Mairesse 1995). Controlling for observed sources of cross-country heterogeneity leaves more identifying variation in the regressors of interest and is informative itself. Furthermore, having country fixed effects makes inference based on large changes of the regressors (for example, "one standard deviation increase in private credit") implausible, since such large changes are unlikely to occur within-country (Mummolo and Peterson, 2018).

Based on the above discussion, I replace country fixed effects in the baseline equation with country factors that are known to influence financial development and likely export performance. I use GDP per capita (in log) to isolate the effect of overall economic development, and legal rights index, rule of law index and former legal origin to proxy for institutional quality. Legal rights index measures the stringency of legal protection towards the rights of borrowers and lenders, while rule of law index reflects the quality of contractual enforcement, property rights and crime likelihood. Legal origin refers to the historical legal origin of the

country, which can be British, Scandinavian, German, French or Socialist. The role of these factors on shaping financial development has been confirmed in La Porta et al. (1998), Acemoglu et al. (2001), Beck et al. (2003), and Do and Levchenko (2007). The updated regression equation is as follows:

$$\begin{aligned} LogY_{ikt} = {} & \beta_0 + \beta_1 LGDP_{it} + \beta_2 PRIVCRED_{it} \\ & + \beta_3 PRIVCRED_{it} \times TANG_k + \beta_4 PRIVCRED_{it} \times EXTFIN_k \\ & + LEGAL_{it} + LGDPPC_{it} + RULELAW_{it} \\ & + SC\_OR_i + FR\_OR_i + SC\_OR_i + UK\_OR_i \\ & + \alpha_k + \alpha_t + \epsilon_{ikt} \end{aligned} \tag{3.3}$$

where $LGDPPC$ denotes log of GDP per capita, $RULELAW$ rule of law, $LEGAL$ legal right index, SO_OR Socialist origin, FR_OR French origin, SC_OR Scandinavian origin, and UK_OR British origin. The coefficients of interest β_3 and β_4 are identified using variation in financial vulnerability across industries and variation in financial development between countries, controlling for aggregated time trends.

Modified specification II

To allow for statistical comparison of marginal effects across firm types, I modify Equation 3.3 into two versions as follows

$$
\begin{aligned}
LogY_{ikt} &= \beta_0 + \beta_1 LGDP_{it} + \beta_2 PRIVCRED_{it} \\
&+ \beta_3 PRIVCRED_{it} \times TANG_k + \beta_4 PRIVCRED_{it} \times EXTFIN_k \\
&+ \beta_5 I_{Entrant} + \beta_6 PRIVCRED_{it} \times I_{Entrant} \\
&+ \beta_7 I_{Entrant} \times PRIVCRED_{it} \times TANG_k \\
&+ \beta_8 I_{Entrant} \times PRIVCRED_{it} \times EXTFIN_k \\
&+ \alpha_k + \alpha_t + \epsilon_{ikt}
\end{aligned} \tag{3.4}
$$

and

$$
\begin{aligned}
LogY_{ikt} &= \beta_0 + \beta_1 LGDP_{it} + \beta_2 PRIVCRED_{it} \\
&+ \beta_3 PRIVCRED_{it} \times TANG_k + \beta_4 PRIVCRED_{it} \times EXTFIN_k \\
&+ \beta_{51} I_{Survivor} + \beta_{61} PRIVCRED_{it} \times I_{Survivor} \\
&+ \beta_{61} I_{Survivor} \times PRIVCRED_{it} \times TANG_k \\
&+ \beta_{71} I_{Survivor} \times PRIVCRED_{it} \times EXTFIN_k \\
&+ \beta_{52} I_{Non-survivor} + \beta_{53} PRIVCRED_{it} \times I_{Non-survivor} \\
&+ \beta_{61} I_{Non-survivor} \times PRIVCRED_{it} \times TANG_k \\
&+ \beta_{62} I_{Non-survivor} \times PRIVCRED_{it} \times EXTFIN_k \\
&+ \alpha_k + \alpha_t + \epsilon_{ikt}
\end{aligned} \tag{3.5}
$$

I add to Equation 3.3 dummies of firm types: entrants, surviving entrants (or survivor), and non-surviving entrants (or non-survivor). I also include the interaction of those dummies with the main regressors. Incumbent is the reference group in both versions. These equations will be estimated with a transformed dataset where observations of different firm types are stacked on each other.

I will apply OLS method to estimate four equations: Equations 3.1, 3.3, 3.4, and 3.5. All GDP and trade variables are in log level. The standard errors are clustered at country level.

Data

Export performance data

Export performance at the firm level is obtained from the World Bank Exporters Dynamic Database (EDD). The EDD reports exporter statistics based on customs data collected from more than 50 countries. This dataset allows me to exploit different measures of extensive and intensive margins for different exporter types in various manufacturing industries (except oil and gas). The EDD is available at different disaggregation levels; however, as this research focuses on the characteristics of exporting countries, I choose the version at the country-year-industry level. Export values are measured in US Dollars (USD). I also limit the sample to manufacturing exporters who export at least 1000 USD a year. The EDD has a fairly short time-series (1997-2014) and strongly unbalanced

cross-sectional coverage; thus I choose the nine-year period 2004-2012 when most countries are represented. The final sample includes a total of 54 countries and 55 three-digit ISIC Revision 3 manufacturing industries.

Country-level measures

Among these 52 countries, 5 are high-income, 8 are upper-middle income, 18 are lower-middle income and 21 are low-income. This classification is based on GNI per capita in 2003. Country size is measured by GDP in PPP (constant 2011 international dollar). The smallest countries by GDP in the sample are Rwanda in 2004 and 2005, and Timor Leste in 2006. The largest is Mexico for the year 2008, 2011 and 2012. The largest country is almost 180 times larger than the smallest country in terms of GDP.

Financial development is measured by the financial resources issued to the private sector by deposit money banks as a share of GDP, or private credit to GDP ratio (in short, private credit). Domestic money banks are defined as commercial banks and other financial institutions that accept transferable deposits, such as demand deposits. Private credit excludes credit extended by central bank and other financial institutions such as insurance firms. It also excludes credit offered to state enterprises.

private credit is a widely used measure of financial development. The difference in the components of banks' balance sheet across countries of different income levels has been noted in Langfield and Pagano (2015), and Demirguc-

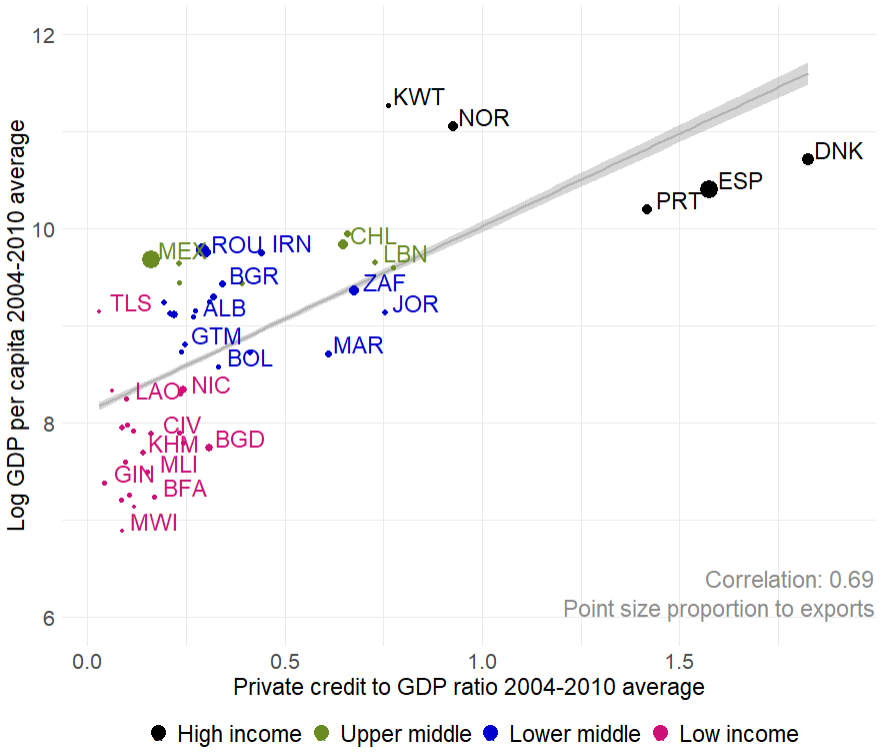

FIGURE 4. Private Credit and Income Per Capita

Kunt and Huizinga (2010). Banks in high-income countries offer more long-term loans to households and small and medium-sized enterprises. Banks in low and middle income countries focus more on government bond holdings and corporate lending, often short-term. However, private credit to GDP is a crude measure at best. It only indicates the quantity, not the quality of the financial system or the ease to access credit of consumers and firms. Its major advantage over other financial measures is availability for many developing countries. private credit is also highly correlated with other indicators of financial system efficiency, if data

on such indicators are available (Beck, 2015).[4] private credit is obtained from the Global Financial Development database from the World Bank.

There is a wide variation in the ratio of private credit to GDP in our sample. The average value of private credit is 36.9%. Timor Leste has the smallest value of private credit at only 2.96%, while Denmark has the highest private credit of 182.6%. Other countries with very low value of private credit are Guinea (4.13%), Yemen (6.3 %), Zambia and Uganda (8.7%). All are small low-income countries. Unsurprisingly, the top countries with highest private credit are large high-income countries: Spain (157%), Portugal (141.8%), and Norway (92.6%). However, the fifth position belongs to Mauritius (77.5%), a small upper-middle income country. private credit has a fairly strong correlation with GDP per capita (almost 0.7) but weak correlation with GDP (0.3).

Data on institutional quality are publicly available. Rule of law, an index from -2.5 to 2.5, is taken from Worldwide Governance Indicators (Kaufman et al. 2010). Legal rights, an index ranging from 0 to 10, is from Getting credit module, Doing Business database, the World Bank. Historical legal origin is from CEPII. These data are not available for all countries and all years in the sample. Our sample does not contain any country of former German origin.

[4]For example, bank net interest margin and lending deposit spread.

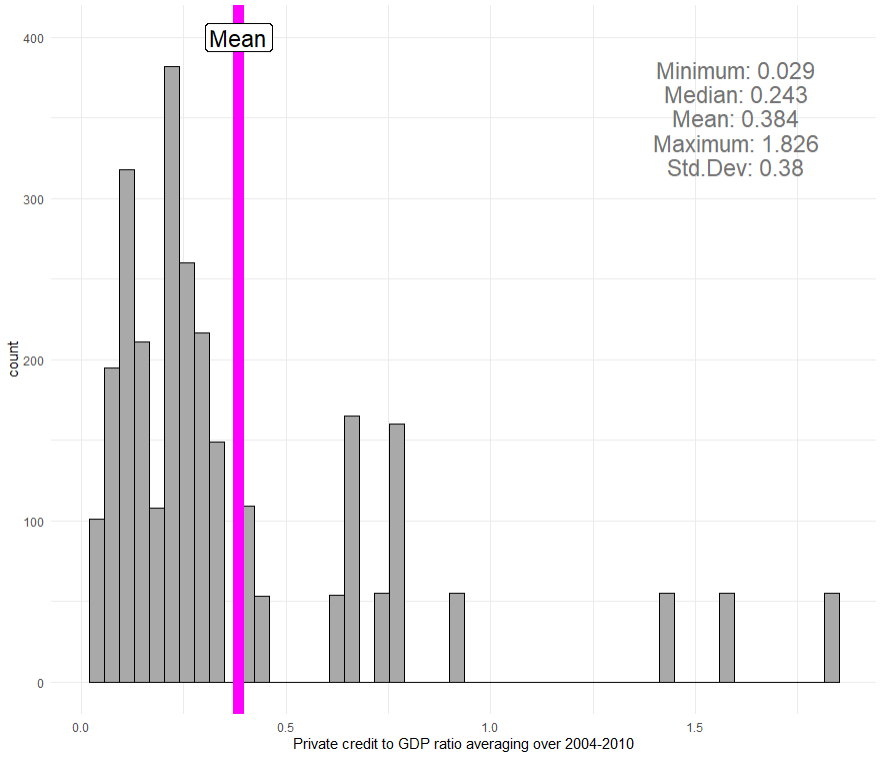

FIGURE 5. Cross-sectional Distribution of Private Credit

Industry-level measures

External financial dependence (EXTFIN) and asset tangibility (TANG) are constructed from Compustat, a database of balance sheets data of public firms in the United States. The measures are averaged for each firm between 1993 and 2003, then the median value is chosen for each industry. The standard practice popularized by Rajan and Zingales (1998) is to calculate these measures for a 10-year period before the starting point of the sampling period. Averaging over ten years will cancel out the temporal noises in the data, which may be results of business cycles and financial cycles. I then use Haveman's concordance table to convert Compustat data, which comes in 3-digit and 4-digit 1987 U.S. SIC code, to

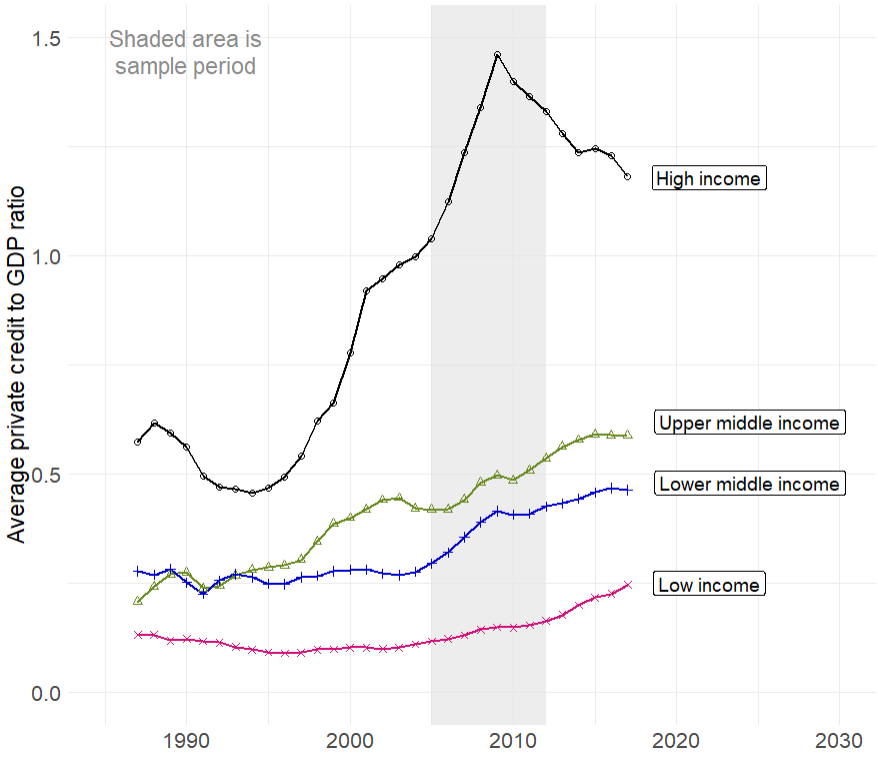

FIGURE 6. Temporal Changes in Private Credit across Income Groups

3-digit and 4-digit ISIC Rev.3. After matching, I reduce any 4-digit ISIC code into 3-digit to ensure compatibility with EDD data.

On average, 30% of an industry's capital expenditure needs to be covered by external finance, while tangible assets constitute 26% of the industry's total assets. The sector that requires the most external finance is ISIC 242, "Other chemical products". The capital expenditure in this sector is three times larger than the internal cash flow (294%). Examples for products in this sector are pesticides, pharmaceuticals, soap and detergents. ISIC code 242 belong to the same Division 24 with ISIC 241 "Basic chemicals" (e.g. fertilizers) and ISIC 243 "Man-made fibers" (e.g. nylon). On the other end of the spectrum, ISIC 160 Tobacco products

can generate the internal liquidity four times more than its capital expenditure. ISIC 160 Tobacco is a atypical industry because it is considered most vulnerable by one measure (TANG) but least vunerable by the other measure (EXTFIN).

Television and radio receiver (ISIC 323) is considered more financially vunerable by both measures. This sector has less than 10% of total asset in tangible form, while the need for external finance is 1.5 times greater than its capital expenditure. The sector with the highest asset tangibility is ISIC 201 "Saw milling and planing of wood". Based on the top five and bottom five industries measured by asset tangibility (Table A9 in Appendix B), we can tell that the industries with low asset tangibility are those having more intangible assets e.g. intellectual property. The pattern for external financial dependence (Table A8 in Appendix B) is not as clear. For example, three industries ISIC 359, 353 and 352 are from the same Division 35 Manufacture of other transport equipment. Yet ISIC 352 Railway and ISIC 353 Aircraft do not require external finance, while ISIC 359 Transport equipment not elsewhere classified does.

Export pattern

Table A2 in Appendix B summarizes the descriptive statistics of the main variables. On average, half of the exporters in a year are entrants, half are incumbents, and half of the exporters would exit the market in the following year. Among the entrants, less than half can survive until the next year. The average survival rate of entrants after the first year is 28%. In terms of firm size,

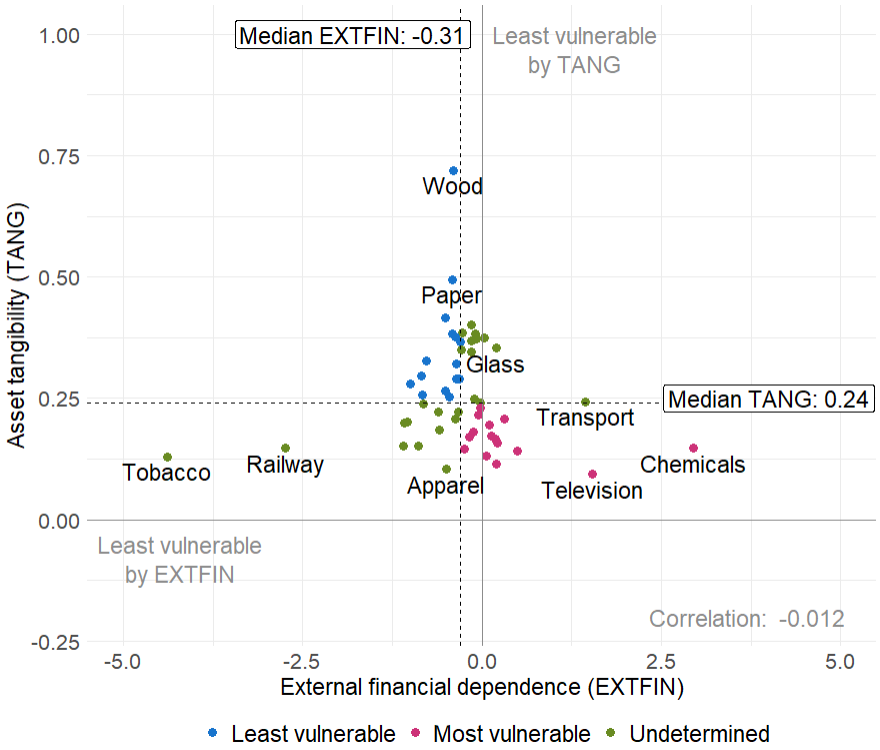

FIGURE 7. Two Measures of Financial Vulnerability

the average exporter exports 0.9 million USD, nine times larger than an average entrant, but lower than the average size of an average incumbent that exports over 1.8 million USD. Surviving entrants, on average, are twice the size of entrants. Not surprisingly, exiters have the smallest average size at only 0.08 million USD.

Despite being outnumbered by low and lower-middle income countries, high and upper-middle income countries export more in all ISIC Rev. 3 divisions (see Table 3). The top income countries export the most in Division 27, 30 and 34, and the least in Division 16, 22 and 23. The low and lower-middle income countries export the most in Divisions 17 and 18, both of which are related to textiles. The

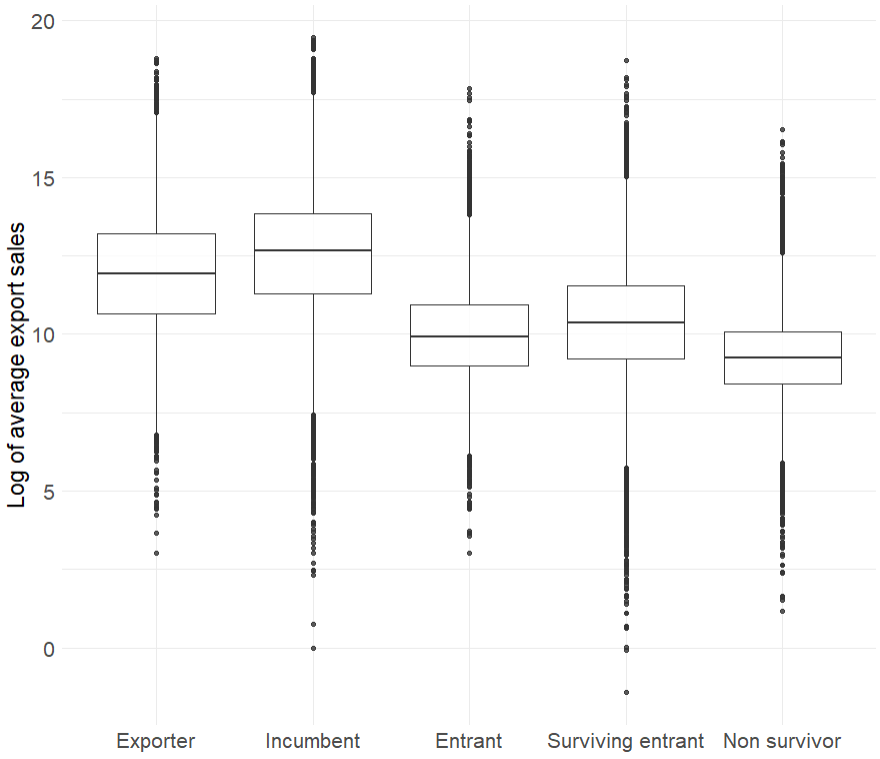

FIGURE 8. Firm Size by Export Value

low-income countries export the least in Division 30, 31, 32. The following table reports exports value averaging across all countries by ISIC division

Empirical Results

In this section, I will discuss the OLS estimation results from four specifications described in Methodology section. Each specification is regressed on three measures of export performance: total export flows, intensive margin, extensive margin. Each specification is repeated for four firm types: exporting firms, entrants, incumbents, and surviving entrants. Table 4 to 6 report the results from a basic gravity equation with a full set of fixed effects (Equation 3.1) and

TABLE 3. ISIC Revision 3 2-digit divisions

Average Exports Value (million USD)	
15 - Food products and beverages	437
16 - Tobacco products	64.4
17 - Textiles	376
18 - Wearing apparel; dressing and dyeing of fur	649
19 - Tanning and dressing of leather	144
20 - Wood and of products of wood and cork	125
21 - Paper and paper products	397
22 - Publishing, printing and reproduction of recorded media	45.7
23 - Coke, refined petroleum products and nuclear fuel	29.5
24 - Chemical products	706
25 - Rubber and plastics products	318
26 - Other non-metallic mineral products	227
27 - Basic metals	1480
28 - Fabricated metal products, except machinery and equipment	315
29 - Machinery and equipment n.e.c.	600
30 - Office, accounting and computing machinery	550
31 - Electrical machinery and apparatus n.e.c.	234
32 - Radio, television and communication equipment and apparatus	427
33 - Medical, precision and optical instruments, watches and clocks	188
34 - Motor vehicles, trailers and semi-trailers	1080
35 - Other transport equipment	146
36 - Furniture and manufacturing n.e.c.	295

a modified version of Equation 3.1 where origin country fixed effects have been replaced with additional country-level controls (Equation 3.3).Tables 7 to 9 present the marginal effects of private credit.

Regression results

In Tables 4 to 6, LGDP and private credit have positive coefficients, indicating that larger countries with more developed financial system have more and larger exporting firms of all types. Because the measure of total export flows is the product of the number of exporting firms and the average firm size and these measures are log transformed in the regression, it is true for every explanatory

variable that its coefficient from regressing on total export flows is the sum of its coefficients from regressing on firm counts and regressing on firm sizes. The relative magnitudes of the coefficients from regressions with firm counts and firm sizes reveal which margin of trade account for more of the variation in total trade flows. Given the regression results, whether extensive margin or intensive margin plays the dominant role depends on the specifications. The regression specifications with origin country fixed effects (Column 1 to 4) predict that larger countries can export more mainly because they have larger firms. Intensive margin thus explains more than 60% of the variation in total export flow in this case. Replacing origin country fixed effects with additional country controls (Column 5 to 8) balances out the roles of the two margins of trade. Extensive margin explains slightly more than 50% of the variation in total export flows across countries of different sizes.

Decomposing the overall effect of financial development by extensive and intensive margin is not straightforward as in the case of LGDP since private credit also enters the regression in interactive form. Isolating the effect of private credit needs sensitivity analysis, of which results are discussed in the next subsection. Nevertheless, comparing results from the first and last four columns in Table 4 to 6 reveals that the inclusion of origin country fixed effects substantially influences the estimated coefficient of the stand-alone private credit. While the coefficient of private credit appears large, positive and statistically significant

across all regressions without country fixed effects (Column 5 to 8), this is not the case when country fixed effects are added (Column 1 to 4). In these more stringent specifications, private credit only displays the expected positive sign and a considerable magnitude when it explains the export flows of entrants and survivors, the number of survivors, and the average size of entrants. In other cases, the coefficients of private credit are small and insignificant. The change in estimated coefficients can be explained as a result of data characteristics. The ratio of private credit to GDP is fairly stable for each country, which means it does not have much time-variation.[5] Including the origin country fixed effects in the regression, meanwhile, demeans the data. This makes private credit, due to its little temporal variation, seem to not have any effect over export data. The adequately large effect of private credit in regressions with certain export measures, such as the number of surviving entrants, may occur due to the relatively small time-variations of these export measures. Low variations in dependent variables, in contrast, magnify the impact of the explanatory variables.[6] This explanation is confirmed by the fact that the coefficients of LGDP are also larger in regressions where private credit has statistically significant effect. Such explanation is not sufficient, since LGDP does not lack time-variation yet the relative role of the margins of trade still varies with different regression

[5]For each country, I calculated the standard deviation of private credit and LGDP over time. A paired t-test shows that the mean standard deviation of private credit is significantly smaller than that of LGDP at the 1% level.

[6]Overall standard deviation of the average firm size is largest for incumbents, followed by survivors and then entrants.

specifications. The country fixed effects not only take away the mean of data but also absorb time-invariant country-specific unobservable factors. These factors capture the inherent difference among nations that influences the development of the financial system, and subsequently, exporting pattern.

Across all specifications, the coefficients of the double interaction terms between private credit and measures of sectoral financial conditions are consistent and display expected signs. The magnitudes of these coefficients are somewhat smaller in the absence of origin country fixed effects, yet their signs and significance levels are unaffected. The coefficients of the interaction term between private credit and asset tangibility are negative and highly significant, confirming that domestic firms in sectors with relatively less tangible asset find it easier to export and increase export volume when their origin country are more financially developed. This interaction term is not statistically significant when explaining the intensive margin of exporting firms (Table 6, Columns 1 and 4).

The dependent variable here is the average size of all firms that export in a certain year without regard to their status in the year before or after. This result suggests that the heterogeneity among exporting firms is not negligible and if we regard all exporting firms to be the same, we would not see the combined effect of financial development and asset tangibility on firm-level export volume. The coefficients of the interaction term between private credit and external financial dependence are positive and also highly significant in regressions with total export

flows and extensive margins (Table 4 and 5) but not with intensive margins (Table 6). This confirms a lower threshold of selection into exporting for firms in more financially dependent sectors in more financially advanced economies, yet whether such firms are able to export more is statistically uncertain. Comparing by absolute value, the coefficients of private credit and external financial dependence interaction term tend to be smaller than those of private credit and asset tangibility interaction term. Possibly this occurs due to external financial dependence being more disperse, as opposed to asset tangibility which is limited between zero and one.

Sensitivity to financial development by industry and country

Because private credit enters the regression in three terms: a stand-alone level and interacting with two measures of sectoral financial conditions, a sensitivity analysis is necessary to isolate the effect of private credit on export performance across sectors, countries and exporting firm types. Particularly, I will estimate the growth of total exports flows, number of exporting firms, and average exporting firm size given a certain increase in private credit. To enable comparability, I calculate the marginal effect when separately varying the degree of asset tangibility TANG, external financial dependence EXTFIN, and financial development private credit, while keep other variables at their means. The

sensitivity analysis is a post-estimation procedure, and I will conduct sensitivity analysis for the regression without origin country fixed effects (Equation 3.3).[7]

Table 7 reports the marginal effects of private credit calculated from the regression on total export flow for each industry. The industries that benefit the most from an improvement in the country's financial development are Other chemical products, Television and radio receivers, Office, accounting and computing machinery, Television and radio transmitters, and Medical appliances. These industries are predicted to raise their export volume by 2.5% up to 3%, and increase the mass of exporting firms by 1.4% up to 2.2%, given a one percentage point increase in private credit. These industries are either the most intensive in external finance or the least intensive in asset tangibility.

The country that benefits the most from improvement in exports by these five sectors is Costa Rica where the five sectors make up 32% of its exports. It is followed by Mexico (27% exports) and Denmark and Dominican Republic (19% and 18%). The industries that least benefit from financial improvement include "Grain mill and starch products", "Printing", "Man-made fibres", "Basic chemicals", and "Basic iron and steel". These industries are predicted to raise their export volume and number of exporting firms by 1%, given a one percentage point increase in private credit. Basic chemicals contribute to one-third of Iran's exports while Basic iron makes up one half of Macedonia's exports. Total export

[7]The marginal effects of private credit calculated from the regression with country fixed effects (Equation 1) are mixed, since the origin country fixed effects absorb too much variations in the data, as discussed before.

share of the five industries is the largest for Macedonia (47%), Iran (40%), Georgia (32%) and Senegal (32%). A low sensitivity means little gain from financial improvement, but it also means if there is a disruption in the domestic financial system, the exports of such countries may not be hampered as much.

In the distribution by external financial dependence, the sector at the 25^{th} percentile is "Domestic appliances", at the 75^{th} percentile is "Optical instruments and photographic equipment". A one standard deviation increase in private credit ratio would raise total exports in these two sectors by 53.3% and by 60.5%, and increase the number of exporting firms by 35.1% and 40%, respectively. In the distribution by asset tangibility, the sector at the 25^{th} percentile is "Other textiles", at the 75^{th} percentile is "Basic non-ferrous metal". A one standard deviation increase in private credit ratio would raise exports in these two sectors by 74.7% and by 43.2%, and expand the mass of exporting firms by 43.7% and 32.6%, respectively. This means the sector at the 75^{th} percentile in the distribution of external financial dependence can raise their exporting volume by 7 percentage point higher than the sector at the 25^{th} percentile. Similarly, the difference in how many more exporting firms can stay exporting is 5 percentage point between two sectors. The sector at the 25^{th} percentile in the distribution of asset tangibility can raise their exports by 31.5 percentage point more than the sector at the 75^{th} percentile. The difference is 11 percentage point for the number of exporting firms. These differences are statistically significance at the 5% level at the least.

Table 8 reports the sensitivity to financial development of exports in an average sector (one with the values of external financial dependence and asset tangibility at the means of the data). I calculate the marginal effects for countries at different percentile of private credit. It is clear that improvements in financial development improve trade in all countries. Further tests show that the effect on total export volume and extensive margins is significantly different for two countries at the bottom of the distribution (Timor Leste and Guinea) compared to the top country on the list (Denmark).

A one standard deviation improvement in financial development will bring Cambodia, the country at the 25^{th} percentile of the distribution by private credit ratio, to the position of El Salvador. The impact on Cambodian exports is statistically and economically significant: its total exports would grow by 58.4% and the number of exporting firms would grow by 26.7%. Cambodian exports is dominated by two sectors: Knitted and crocheted fabrics and articles (29% country total exports) and Wearing apparel (63% total exports). A one standard deviation increase in private credit ratio would raise exports sales in the first sector by 53% and in the second sector by 86%. More than one half of the increase comes from a higher number of exporting firms.[8]

[8]I further estimate the marginal effects of private credit on export performance between two country groups: "Low Income" and the rest. The marginal effects are not statistically different between two groups (for more details see the last 3 tables at the end of the text).

Sensitivity to financial development by firm types

Table 9 reports marginal effects of private credit on different firm types that are calculated from estimation results of Equations 3.4 and 3.5. Results from the first section of this table shows that the effect of financial development mostly occur along the extensive margin. A one standard deviation increase in private credit associates with an increase in total industry sales of 70%. Over 65% of this effect comes from a greater number of firms becoming or surviving in the export market. Not considering firm productivity, we can conclude that financial development has a small and insignificant effect on the intensive margin, i.e., average export sales per firms. However, when we decompose the pool of exporting firms into incumbents and entrants, a new pattern emerges. Financial development helps incumbents and surviving entrants expand their export sales. Both margins of trade measured in these two firm types react positively to financial development, with a stronger degree for incumbents. The effect of financial development on non-surviving entrants is small and not significant. Interestingly, if we treat all entrants the same, we may incorrectly conclude that financial development only benefits incumbents.

The relative importance of extensive margin also differ between incumbent and surviving entrants. Extensive margin explains roughly 56% the increase in total export sales of incumbents, as opposed to 72% the increase in total export sales of surviving entrants. Incumbents, even after breaking into the global market,

still incur some fixed cost from exporting in new destinations or introducing new products. These costs, however, may not be as vital as the cost incurred by first-time exporter. Also, if incumbents are mostly mature firms, then the results suggest that exporting firms may have different financing pattern among stages of development. Younger exporting firms may rely more on outside capital while older firms are able to cover these costs with internal liquidity. Rajan and Zingales (1998) points out a common wisdom in corporate finance that firms are more dependent on external financing early in their life than later. Using data from Compustat, the authors show that external financial usage and investment on fixed capital are the highest in the first four years of corporate life, then converge rapidly to zero after passing year 10^{th}.

Empirical evidence on the intensive margin diverges from the predictions of Manova (2013). The theory predicts that only firms of intermediate productivity can grow under the influence of financial development. The signs of the second derivatives, i.e., the interaction terms between private credit and each sectoral financial measures, are predicted to hold for firms of intermediate level only. These are not true for my results. The signs do not hold for intensive margin of average exporting firm, yet appear mixed for specific firm types (Table 6). Financial development has positive impact on average export sales of specific firm types

through the asset tangibility channel. Results on marginal effect show that even most productive firms can still benefit from financial development.[9]

Robustness Check

In this section, I conduct three exercises, using the regression specification with country controls. In the first exercise, I replace private credit ratio with its initial level (measured at the beginning of the sample period) to control for potential reverse causality. In the second exercise, I control for potential presence of state-owned enterprises which would undermine causal inference. In any exercise, the results remain robust. I conclude this section with a detailed discussion on other threats to the identification strategy. As most of the threats cannot be addressed with the data at hands, the results in this chapter should be best interpreted as strong associations.

Potential reverse causality

As private credit and export performance are measured over the same time period, a valid concern arise that private credit rises due to more intense export activities from sectors that require more credit. I dismiss this concern

[9]The effect of financial development on trade, according to my analysis, mainly operates through the extensive margin. This is different from Manova (2013) as she finds one-third of the effect of credit constraints on trade coming from limited firm entry into exporting (extensive margin), and two-thirds coming from contractions in exporters' sales (intensive margin). However, our results are not quite comparable, because (i) she measures extensive margin by the number of product variety, (ii) she controls for the effect of credit constraint on selection into domestic market and (iii) she uses a different method to separate the effect between two margins of trade. She was not able to test the second hypothesis, while I did.

by re-estimating Equation 3.3 with the initial value of private credit, i.e., $PRIVCRED_{i,2003}$. Fixing private credit at its initial value does not affect regression results (see Tables A14 to A17 in Appendix B).

Controlling for bias from state-owned enterprises

A major threat to the identification strategy here is the presence of state-owned enterprises (SOEs). Enterprises are defined as SOEs if the state owns, directly or indirectly, more than 50% of shares at the national or sub-national level. SOEs are able to receive government financial support, which makes their credit constraints very different from private firms. SOEs' access to credit is not captured by our measure of financial development - private credit to GDP, while the contribution of SOEs in our export data could be substantial. Failing to account for the presence of SOEs, therefore, would bias downward the effect of private credit on export performance.

I will address this source of bias by identifying industries that typically have large SOE presence and countries with large SOE presence, based on the findings of Kowalski et al. (2013).[10] Kowalski et al. (2013) identify economic sectors and countries where SOEs are most prevalent, using financial information from the world's largest 2000 public companies from Forbes Global 2000 list. The

[10]Data on SOEs' shares by country and by sector is not available for the majority of my sample. The most detailed dataset is provided by the OECD, which reports the size of national SOE sectors in 2012, with a breakdown by broad sector and corporate form. Only seven out of 34 countries appear in EDD: Colombia, Spain, Mexico, Norway, Chile, Portugal, and Denmark. The last three do not have data on SOEs in the manufacturing sector.

analysis also includes more than 330,000 domestic and foreign subsidiaries of these companies, which span across 37 countries. The authors use data on shares of sales, assets, and market values of each country's top ten companies to construct two indicators: country SOE shares (CSS) and sectoral SOE shares (SSS). CSS evaluates the importance of the state in the country's main international business players, rather than in the country's overall economic activities.

According to Kowalski et al. (2013), ten countries with highest CSS are China, the United Arab Emirates, Russia, Indonesia, Malaysia, Saudi Arabia, India, Brazil, Norway, and Thailand. Norway is the only country among these to be in my sample. In terms of SSS, some manufacturing sectors with moderate SSS are manufacture of fabricated metals, tobacco, basic metals, electrical equipment, machinery, and transport equipment. These sectors make notable contribution in the world merchandise trade. Their SSS are around 7-10%. Some services sectors (telecommunications, banking, and engineering) have similar SSS values. All of them seem less significant when compared to the energy and heavy industries where SSS can reach up to 40%.

As a robustness exercise, I will drop the country and industries with high presence of SOEs from the sample and re-estimate the main equation. The Norwegian share of observations in my sample is around 2.5%. The manufacturing sectors identified above correspond to Division 16, 27, 28, 29, 31, 34, and 35 in Table 3. These sectors contribute to 40% the sample observations. Table A18

reports the regression results from the original and new samples. Results from the new sample are weaker: estimates have smaller magnitudes and lower levels of significance. However, we can still conclude that private credit directly and indirectly benefits export performance, measured by total export sales and number of firms.

Policy discussion

This research may be useful for designing policies as it provides a guideline based on which policy makers can select the right industry and firms that optimize the outcomes of financial support program. Policymakers can choose large, continuing exporters, and subsidize their fixed trade costs. This would be a robust policy recommendation if the causality from finance to export can be established more carefully.

Several mechanisms undermine that causal relationship and have been documented by firm-level research as follows.

The effects of financial development on exports could be biased downward if the exporting firms do not rely much on borrowings in the private markets. This description is true for two firm types: SOEs and foreign owned firms. We have controlled for the former case but not the latter. Foreign owned firms are less dependent on private credit due to intra-group lending mechanisms from their affiliates. Manova et al. (2009) use Chinese firm-level data, and Alvarez and

Lopez (2012) use Chilean plant level to show that multinational affiliates and joint ventures had better export performance than private domestic firms.

Another potential source of downward bias is some type of "learning from exporting". Incumbents can diversify financial resources and risks, as extended overseas operations help them establish more ties with the local institutions. They thus become less dependent on the domestic financial market. This view is supported by Greenaway et al. (2007) who analyze data on British manufacturing firms. This view is not shared by several other studies. Bellone et al. (2010), using data from French manufacturing firms, argue that better financial health is not an outcome of exports. Indeed, firms committing more to international trade appear to be financially more constrained. Feenstra et al. (2009) also provide evidence that Chinese manufacturing firms experience a tighter credit constraint as their export share grows. Shipment time takes longer with more exports, increasing firms' financial need.

The effects of financial development could also be potentially biased upward. Incumbents could have better access to finance, as they tend to be larger and banks prefer larger firms. Due to information asymmetry, banks cannot observe firms' productivity. Banks opt to lend out more to large firms as they believe these firms are more credit trustworthy. Banks could also prioritize public firms for the same reason. In a study of a subsidized credit program in Pakistan, Zia (2008) finds that even though the program created incentives for banks to lend to

smaller private firms, banks are still reluctant to do so. Banks end up providing more loans to big firms than small ones, despite equal productivity.

The results in this chapter may best be interpreted as providing a strong association rather than causality. It is important to include firm ownership and firm productivity data that I do not have in future works on export and finance.

Conclusion

In this chapter, I show that financial development, measured by private credit to GDP ratio, has differential effects on export performance. The effects are stronger for the lowest income country group, for industries that require more outside capital or have relatively less collateralizable assets, and for continuing exporting firms. Among exporting firms, continuing exporters and first-time exporters are the most productive types if using sales as a proxy for firm productivity. First-time exporters rely relatively more on financial markets to finance fixed trade costs compared to continuing exporters. This result implies that the fixed cost firms pay to enter the export market for the first time is the most challenging to finance, compared to other fixed costs incurred once they survive in the market. This result highlights the importance of considering firm productivity in answering which margin of trade is more sensitive to financial development. This question is important to policy design: as the extensive margin is associated with fixed trade cost and the intensive margin with variable trade

cost, a detailed understanding of how each margin reacts to finance would help policymakers provide proper financial support to firms.

TABLE 4. Effects of Private Credit on Total Export Sales

	Specification 1: With Country FE				Specification 2: With Country controls			
VARIABLES	(1) Exporter	(2) Entrant	(3) Incumbent	(4) Survivor	(5) Exporter	(6) Entrant	(7) Incumbent	(8) Survivor
Log GDP	1.747***	1.996***	1.828***	1.902***	1.108***	1.033***	1.119***	1.106***
	(0.277)	(0.358)	(0.396)	(0.453)	(0.109)	(0.093)	(0.109)	(0.110)
Private credit	0.295	0.780**	0.448	1.255***	1.445***	1.243***	1.762***	1.810***
	(0.337)	(0.368)	(0.431)	(0.429)	(0.436)	(0.335)	(0.441)	(0.416)
Private credit × Asset tangibility	-2.026**	-1.701***	-2.881***	-2.655***	-1.868**	-1.572***	-2.669***	-2.571***
	(0.833)	(0.452)	(0.873)	(0.584)	(0.817)	(0.415)	(0.848)	(0.526)
Private credit × External finance	0.125**	0.051	0.176**	0.137**	0.135**	0.046	0.186***	0.125**
	(0.055)	(0.047)	(0.067)	(0.068)	(0.056)	(0.044)	(0.068)	(0.054)
Legal rights					0.171***	0.118***	0.181***	0.103***
					(0.046)	(0.030)	(0.052)	(0.035)
Log GDP per capita					0.600***	0.194	0.791***	0.347**
					(0.168)	(0.132)	(0.192)	(0.145)
Rule of law					0.267	0.223	0.229	0.099
					(0.244)	(0.206)	(0.277)	(0.234)
Constant	-27.819***	-36.771***	-30.028***	-35.310***	-20.131***	-16.656***	-22.641***	-20.156***
	(7.058)	(9.088)	(10.116)	(11.564)	(2.381)	(1.543)	(2.570)	(2.128)
Observations	19,447	17,546	17,080	13,940	17,885	16,044	15,626	12,590
R-squared	0.727	0.673	0.686	0.617	0.684	0.640	0.642	0.587
Country FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Results on dummies of legal origin (Socialist, French, British, Scandinavian are suppressed
Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

TABLE 5. Effects of Private Credit on Extensive Margin or Firm Counts

	Specification 1: With Country FE				Specification 2: With Country controls			
VARIABLES	(1) Exporter	(2) Entrant	(3) Incumbent	(4) Survivor	(5) Exporter	(6) Entrant	(7) Incumbent	(8) Survivor
Log GDP	0.698***	0.659**	0.686**	0.385	0.599***	0.574***	0.620***	0.575***
	(0.238)	(0.308)	(0.269)	(0.267)	(0.103)	(0.105)	(0.104)	(0.115)
Private credit	0.309	0.329	0.328	0.611**	0.942**	0.853**	1.158***	1.085***
	(0.243)	(0.331)	(0.234)	(0.261)	(0.353)	(0.373)	(0.354)	(0.394)
Private credit × Asset tangibility	-0.923***	-0.865***	-1.231***	-1.323***	-0.834***	-0.783***	-1.140***	-1.205***
	(0.279)	(0.245)	(0.339)	(0.307)	(0.262)	(0.228)	(0.325)	(0.286)
Private credit × External finance	0.126***	0.107**	0.152***	0.132**	0.120***	0.094**	0.150***	0.123**
	(0.037)	(0.041)	(0.040)	(0.051)	(0.037)	(0.040)	(0.040)	(0.047)
Legal rights					0.154***	0.136***	0.155***	0.108***
					(0.038)	(0.037)	(0.040)	(0.034)
LGDP per capita					0.462***	0.445***	0.582***	0.521***
					(0.166)	(0.165)	(0.174)	(0.161)
Rule of law					0.098	0.081	0.048	0.008
					(0.221)	(0.227)	(0.227)	(0.228)
Constant	-13.213**	-12.774	-13.651*	-6.978	-17.212***	-17.099***	-19.399***	-18.154***
	(6.000)	(7.773)	(6.832)	(6.786)	(1.740)	(1.749)	(2.088)	(2.226)
Observations	19,447	17,546	17,080	13,940	17,885	16,044	15,626	12,590
R-squared	0.868	0.864	0.847	0.831	0.770	0.755	0.752	0.734
Country FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Results on dummies of legal origin (Socialist, French, British, Scandinavian are suppressed
Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

TABLE 6. Effects of Private Credit on Intensive Margin
or Average Sales per Firm

	Specification 1: With Country FE				Specification 2: With Country controls			
VARIABLES	(1) Exporter	(2) Entrant	(3) Incumbent	(4) Survivor	(5) Exporter	(6) Entrant	(7) Incumbent	(8) Survivor
Log GDP	1.049***	1.337***	1.142***	1.517***	0.510***	0.459***	0.500***	0.531***
	(0.231)	(0.226)	(0.327)	(0.341)	(0.078)	(0.044)	(0.077)	(0.048)
Private credit	-0.015	0.451*	0.119	0.644**	0.503	0.390**	0.604*	0.724***
	(0.335)	(0.226)	(0.393)	(0.314)	(0.336)	(0.172)	(0.312)	(0.195)
Private credit × Asset tangibility	-1.103	-0.836**	-1.650**	-1.333***	-1.033	-0.789**	-1.529**	-1.366***
	(0.720)	(0.331)	(0.705)	(0.403)	(0.702)	(0.318)	(0.681)	(0.373)
Private credit × External finance	-0.001	-0.056	0.024	0.005	0.015	-0.048	0.036	0.003
	(0.047)	(0.037)	(0.051)	(0.038)	(0.048)	(0.042)	(0.053)	(0.036)
Legal rights					0.017	-0.018	0.026	-0.006
					(0.030)	(0.029)	(0.032)	(0.028)
LGDP per capita					0.138	-0.251***	0.209	-0.174*
					(0.123)	(0.087)	(0.129)	(0.096)
Rule of law					0.168	0.142	0.181	0.090
					(0.148)	(0.096)	(0.148)	(0.089)
Constant	-14.606**	-23.997***	-16.377*	-28.332***	-2.920*	0.443	-3.242**	-2.002*
	(5.883)	(5.734)	(8.374)	(8.710)	(1.614)	(0.902)	(1.589)	(1.087)
Observations	19,447	17,546	17,080	13,940	17,885	16,044	15,626	12,590
R-squared	0.502	0.393	0.443	0.348	0.450	0.348	0.393	0.316
Country FE	Yes	Yes	Yes	Yes	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Results on dummies of legal origin (Socialist, French, British, Scandinavian are suppressed
Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

TABLE 7. Industries Most and Least Benefiting from Financial Development

Total export flow			Extensive margins			Intensive margins		
ISIC	Marginal effect	Growth (%)	ISIC	Marginal effect	Growth (%)	ISIC	Marginal effect	Growth (%)
Most benefiting industries								
242	1.567***	3.79	242	1.172***	2.23	323	0.429	0.54
	(0.428)			(0.417)			(0.314)	
323	1.478***	3.38	323	1.049***	1.85	242	0.395	0.48
	(0.413)			(0.384)			(0.327)	
300	1.259***	2.52	359	0.912**	1.49	300	0.388	0.47
	(0.394)			(0.385)			(0.295)	
322	1.247***	2.48	322	0.883**	1.42	181	0.388	0.47
	(0.388)			(0.363)			(0.297)	
331	1.208***	2.35	300	0.871**	1.39	331	0.368	0.44
	(0.388)			(0.357)			(0.289)	
Least benefiting industries								
153	0.728**	1.07	315	0.684	0.98	201	-0.247	-0.22
	(0.362)			(0.347)			(0.401)	
222	0.73**	1.08	221	0.684	0.98	210	-0.015	-0.01
	(0.362)			(0.337)			(0.302)	
243	0.735**	1.09	333	0.71	1.03	251	0.066	0.07
	(0.369)			(0.34)			(0.279)	
241	0.738**	1.09	191	0.717	1.05	171	0.085	0.09
	(0.37)			(0.351)			(0.278)	
271	0.752**	1.12	293	0.718	1.05	269	0.101	0.11
	(0.372)			(0.346)			(0.274)	

Note: Table generated from the three OLS regressions without origin country fixed effects. The dependent variables in the three regressions are total export volume by exporters, extensive margins of exporter, and intensive margins of exporters. The marginal effects are calculated at means (MEM). Since the dependent variables are logged level, marginal effects are transformed into growth rate (%) according to exp(MEM)-1. The growth values are interpreted as the extent to which the dependent variable changes given a one percentage point (0.01) change in private credit.

TABLE 8. Marginal Effects of Private Credit by Country

Private credit			*Marginal effects*			*Growth rate (%)*		
Percentile	Value (%)	Countries	Total Export	Extensive Margins	Intensive Margins	Total export	Extensive Margins	Intensive Margins
1%	2.96	Timor Leste (TLS)	0.964***	0.715**	0.249	1.623	1.045	0.282
			(0.366)	(0.354)	(0.268)			
5%	6.31	Guinea (GIN)	0.931**	0.702*	0.229	1.538	1.018	0.258
			(0.365)	(0.355)	(0.267)			
25%	14.78	Cambodia (KHM)	0.917**	0.691*	0.226	1.502	0.996	0.253
			(0.364)	(0.354)	(0.267)			
50%	23.85	Pakistan (PAK)	0.918**	0.688*	0.23	1.505	0.991	0.258
			(0.364)	(0.353)	(0.267)			
75%	41.26	El Salvador (SLV)	0.919**	0.689*	0.229	1.506	0.992	0.258
			(0.364)	(0.353)	(0.267)			
95%	141.78	Portugal (PRT)	0.918**	0.689*	0.23	1.505	0.991	0.258
			(0.364)	(0.353)	(0.267)			
99%	182.58	Denmark (DNK)	0.918**	0.69*	0.228	1.504	0.993	0.257
			(0.364)	(0.353)	(0.267)			

Note: Table generated from the three OLS regressions where country fixed effects are replaced with country controls and the dependent variables are measured for generic exporters. The marginal effects are marginal effects at means (MEM). Since the dependent variables are logged level, marginal effects are transformed into growth rate (%) according to (exp(MEM)-1). The growth values are interpreted as the extent to which the dependent variable changes given a one percentage point (0.01) change in private credit. Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

TABLE 9. Nested Regression: Marginal Effects of Private Credit

VARIABLES	(1) Total export sales	(2) Extensive margin	(3) Intensive margin
	Regression with Exporters (all types)		
All firm types	1.039***	0.693*	0.346
	(0.320)	(0.355)	(0.246)
Observations	12,375	12,375	12,375
	Regression with two firm types		
Incumbents	1.613***	0.933***	0.680***
	(0.338)	(0.362)	(0.202)
Entrants	0.329	0.480	-0.152
	(0.310)	(0.366)	(0.190)
Observations	24,750	24,750	24,750
	Regression with three firm types		
Incumbent	1.730***	0.974***	0.755***
	(0.349)	(0.369)	(0.178)
Surviving entrant	0.926***	0.670*	0.257*
	(0.341)	(0.377)	(0.153)
Non surviving entrant	0.277	0.474	-0.197
	(0.312)	(0.372)	(0.178)
Observations	37,027	37,027	37,027

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: These results are generated from a transformed version of the dataset where different firm types (exporters, incumbents, entrants, non-surviving entrants) are stacked on top of each other (the original data set was transformed from wide to long form). The regression equation has country controls in place of country fixed effects. Each section of this table reports results from a separate regression. In the first section, regression is only conducted on Exporter type, i.e., any firms exporting in period t. In the next two sections, the regression has Incumbents as the reference group. The marginal effects among the firm types (row) but within the same regression (column) are statistically different. Regression results are reported in Tables A11, A12, and A13 in Appendix B.

CHAPTER IV

FINANCE AND EXPORT QUALITY UPGRADING

Introduction

Established work in international trade typically emphasizes export performance along two margins: the extensive margin (number of exporting firms) and the intensive margin (exporting size per firm). However, a country can possibly achieve greater export sales by exporting higher quality products that garner higher prices, without raising the number of exporting firms or exporting quantities per firm. Export quality is a margin of trade yet to receive adequate attention in the literature. Three questions arise regarding how to measure export quality, what the determinants of export quality are, and what drives export quality upgrading. This chapter will focus on the last question.

It is known from the literature on economic development that quality upgrading accompanies economic growth. Over time, less developed countries export products with better quality, and export more in industries that used to be produced predominantly by developed countries (Hausmann et al., 2007, Sutton and Trefler, 2011, IMF 2014). Some view the ability of a country to produce better quality goods as necessary to export success and economic growth (Grossman and Helpman, 1991). However, as quality upgrading requires better technology and inputs (Kremer, 1993), it is a challenge for poor countries to accumulate

physical and human capital stock (Hausmann and Rodrik, 2003). In researching the mechanisms of quality upgrading, this chapter can help us understand the design of growth-promoting policies in developing countries.

It is worth bearing in mind that export quality and export quality upgrading are not the same: the former refers to the level of export quality in absolute terms and the latter to the improvement in quality ranking relative to a certain threshold. Put differently, studying the determinants of export quality helps us characterize the country or industry profiles that associate with better quality exporting goods. Identifying the determinants of export quality upgrading tells us the conditions under which a certain country or industry can reach the highest level of export quality at a faster rate. So far, it is unclear whether export quality and export quality upgrading are driven by similar mechanisms. For example, while high-income countries export better products, the rate of quality upgrading is less pronounced for them compared to less developed countries (International Monetary Fund report, 2013).

In this chapter, I will explore how finance drives export quality upgrading using the Export Diversification and Quality Database provided by the IMF. This database is the most comprehensive to date, as it covers over 170 countries, 50 years, and six hundred product categories at its most disaggregated level. It is especially suitable to study export quality upgrading across countries and over time. In this database, annual export quality is calculated for each country-

product following Hallak (2006). Countries are then ranked by their export quality for each product-year. The rank of a country is the ratio of its export quality to the best export quality - which is taken as "the world frontier". The growth in the rank of a certain country-product measures its export quality upgrading. The Database itself is a notable contribution since the main challenge to studying export quality is a measurement of quality that is accurate and comparable across countries and over time.

The connection between finance and export quality upgrading has not been documented in depth, either theoretically or empirically. Based on existing literature, we could propose a simple connection: export quality upgrading results from innovation in production technology, and finance is conducive to innovation. The international trade literature provides different explanations for why firms innovate and upgrade product quality. Firms produce better products as they face stronger market competition (Amiti and Khandelwal, 2013), or take advantage of knowledge spillovers (Harding and Javorcik, 2011), or simply choose better inputs (Verhoogen, 2008). While studies on export quality upgrading are scant, the literature on how finance facilitates technological innovation is vast. Financial systems can stimulate innovation-led growth through various mechanisms, as noted in Beck and Levine (2005). In essence, a well-functioning financial system helps ease the financial constraints that restrict entrepreneurs from fully engaging in the

process of innovation. Considering these two literature together, we might expect a positive overall influence of financial development on export quality upgrading.

A closer examination of the existing literature suggests that the effect of finance may be more complicated. As export quality upgrading can be a direct outcome of technological innovation, similar to productivity growth, we can follow the Schumpetarian view. According to the Schumpetarian growth paradigm with financial constraint (Aghion, Howitt, and Mayer-Foulkes, 2005, Beck and Levine 2005), how fast a country (or a sector) catches up with the global technology frontier depends on its distance to the frontier and financial conditions in the country. The country could enjoy an "advantage of backwardness": which means the further it is away from the frontier, the more easily it progresses technologically by adopting new technologies from countries that are close to the frontier. However, there is also empirical evidence on "disadvantage of backwardness": to catch up with the world frontier, firms in "backward" countries need to pay an R&D cost, which is harder to finance under a weak financial system and low labor productivity. These two conditions are prevalent in "backward" countries. Beck and Levine (2005) conclude that rapid advancement for backward countries occurs only when the country reaches a certain level of institutional quality. A less developed financial system, therefore, can act as a source of divergence. The same reasoning can hold true here, meaning that the effect of finance on export quality upgrading is ambiguous.

We may also argue that finance is beneficial to export quality upgrading as to export performance. Improvement in financial conditions has a direct effect on exports: firms expand exporting activities because it is cheaper and easier to finance these activities with outside capital. There is also an indirect and asymmetric effects: export performance intensifies more markedly for industries that are more dependent on outside capital. These industries experience an increase in the number of exported products and the exported volume per product (Manova, 2013), the number of exporting firms and export sales per firm (Duong, 2020), and average product quality (Crino and Ogliari, 2017). We can anticipate that if certain conditions allow firms to export higher-quality goods, then these conditions may also help the products of these firms advance faster towards the world frontier.

To sum up, I explore the role of finance on export quality upgrading based on established knowledge from two strands of literature - comparative advantage and economic convergence. I will investigate the direct and indirect effect of country-level financial conditions, measured by private credit to GDP ratio, FDI net inflows to GDP ratio, and an index of domestic financial reform. Among the three indicators, private credit to GDP ratio has been widely used in related literature to proxy for domestic financial development. It reflects the ease with which the private sector of an economy borrows from depository institutions. Private credit does not account for any funding resources other than bank loans;

therefore, I include two other finance measures to address this shortcoming. FDI not only brings in foreign capital, it may also bring foreign technologies that associate with more sophisticated or higher quality products. Quality upgrading in the host countries is made possible by two channels: (i) local firms learn about new technologies from multinationals, and (ii) local firms in the supplying sector have to innovate themselves to meet higher product standards from multinationals (Harding and Javorcik, 2011). The last finance measure - financial reform index - captures advancement of governance in various financial markets, including domestic finance, banking, securities, and capital account. In my analysis, the three indicators will be included in the specification as independent terms and as interaction terms with initial export quality, and product characteristics (external financial dependence and asset tangibility). The former way of interaction would be inspired by research on economic convergence, and the latter way by studies in comparative advantage.

I find that all three indicators of finance have nonlinear effects on quality upgrading. The rate at which the quality of certain product catches up with the world frontier depends negatively on the initial gap between the product and the leading quality level. This rate will increase if the product is exported by a country with better initial financial conditions. The role of finance is not the same across country groups. FDI inflows have a stronger impact on quality upgrading of upper-middle income countries, while financial reform can explain more of quality

upgrading in the highest and lowest income groups. The direct performance of private credit is not precise when considered individually. Once controlling for indirect channels, the estimates of private credit and its interaction terms are significant with signs as expected. Both hypotheses mentioned above can be confirmed for private credit. Only the first hypothesis can be confirmed for FDI and reform index.

This chapter proceeds as follows: Section 2 discusses related literature. Section 3 describes the data and methodology. Section 4 presents empirical results. Section 5 concludes.

Related Literature

Some studies have shown the positive effect of FDI inflows on quality upgrading (Henn et al., 2017, Harding and Javorcik, 2011), and one explanation for such effect is the spillover of innovations from multinationals. Amiti and Khandelwal (2013) study the evolution of export quality under domestic competition - proxied by import tariffs. They build a theoretical model based on the distance-to-the-frontier framework by Aghion et al. (2005, 2009). The theoretical hypotheses are tested on U.S. import data. They find that countries with poorer export quality have a slower upgrading rate as competition dampens their incentives to innovate. While the authors do not directly mention financial development, they find that the nonmonotonic relationship between import tariffs and export quality upgrading only holds for countries that reach a certain level of

institutional quality, as measured by the "good business climate" indicator from Doing Business Survey Database.

A model is "Schumpeterian" when it has profit-maximizing and product obsolescence in innovation. The innovation, if successful, will give the entrepreneur a monopoly on an improved production technology. Successful innovations make existing technologies obsolete, and drive economic growth. Schumpeterian growth models have been constructed for multi-country or firm-level frameworks. For the version set in the latter context, innovations come from both entrants and incumbents. Credit constraints can either increase innovation by eliminating less efficient incumbents, or decrease innovation by preventing potentially good innovators from entering the market.

There are different versions of Schumpetarian models, starting from Aghion and Howitt (1998). A version of their model with credit constraint is discussed in Beck and Levine (2005) while a newer version with market competition is adapted in Amiti and Khandelwal (2013). Aghion, Howitt, Mayer-Foulkes (2005) present a model of cross-country convergence with financial constraints with several theoretical implications. First, financial development has a positive direct effect on the economic convergence rate. Second, such an effect vanishes once the country reaches a certain level of GDP per capita. In the empirical analysis the authors use the distance in the growth rate of GDP per capita from the U.S.'s as the dependent variable. The most important explanatory variable is the interaction

term between initial relative GDP per capita and private credit. Empirical results show an insignificant point estimate of private credit, and a negative coefficient for the interaction term. This implies that given the same income level, a more developed financial system is associated with a slower speed of convergence. The authors calculate the cutoff or critical level of GDP per capita above which the role of private credit starts to diminish. They rule out other explanations for economic divergence.

Data

Export Quality Database

Product quality itself is unobservable. Unit prices or unit values are conventionally used as a proxy for product quality due to data availability and ease of construction. However, unit prices are not an accurate measure of product quality for several reasons. They may be influenced by factors unrelated to product quality such as production costs, transportation costs, or consumer preferences. Many authors, for example Khandelwal (2010), Hallak and Schott (2011) and Feenstra and Romalis (2014), have proposed various methods to construct a more accurate measure of export quality. These methods, while arguably sophisticated, are inapplicable to most developing countries due to lack of data. Henn et al. (2017) sidestep this limitation by building upon an earlier method developed by Hallak (2006) to construct the IMF's Export Quality

Database - the most extensive dataset of export quality in terms of countries, sectors, and time periods. Its wide coverage allows for more in-depth analysis on export quality of developing countries, and further facilitates the formation of growth-promoting policies.

The methodology of Henn et al. (2017) requires three steps: estimation, aggregation, and normalization. In the estimation step, the authors applied a two-stage least squares (developed by Hallak, 2006) to UN-NBER trade data. The estimation equations can be simplified as follows

$$p_{mxt} = f^1\big(\theta_{mxt}, y_{xt}, d_{mx}\big)$$

$$Imports_{mxt} = f^2\big(\delta\theta_{mx}, K_{mxt}, d_{mx}, \alpha\big)$$

where m, x, t denote, respectively, importing country, exporting country, and year. The first equation assumes unit price (p) depends on three factors: the unobserved product quality (θ), exporter income per capita (y_{xt}), and distance between the trading partners (d_{mx}). The second estimation stage involves a quality-augmented gravity equation. It contains the set of standard "gravity" factors and an interaction term of exporter-specific quality θ_{mxt} with the importer's income per capita. Parameter α denotes importer and exporter fixed effects. Parameter δ reflects the importers' taste for quality. Combining these two equations yields a

raw estimate of export quality

$$Quality_{mxt} = \delta ln\theta_{mxt} = f^3(p_{mxt}, y_{xt}, d_{mx})$$

In this estimate, product quality and importers' taste for quality are non-separable. The functional form of the quality estimate indicates that quality still depends on unit prices, but not on production costs (proxied by y_{xt}) and selection bias (proxied by d_{mx}). Selection bias happens when exporters choose to ship products with higher quality to further destinations.[1]

After the estimation step, the authors normalize the quality indices by the 90^{th} percentile of the cross country distribution in the relevant product-year. The quality estimates are aggregated using current trade values as weights, first consolidated across importers to obtain aggregated measures at the SITC 4-digit exporting country-year level, then further aggregations provide estimates at 3-, 2- or 1-digit, respectively, and at the country level.[2] Normalization is repeated for each aggregation step. The quality index of a product category in a country thus depends on the distribution of export quality values of all other countries for that category. It is impossible for users to derive the quality value of a product category using quality values of its subcategories.

[1]Henn et al. (2017) make a detailed comparison between this quality estimate and unit prices.

[2]Table A20 in Appendix C shows an example of the SITC classification.

Due to normalization, the resultant quality indices do not reflect the absolute quality level of an exporting category in a given year. Instead, it should be best translated as the inverse of the distance of a country to the world frontier (the 90^{th} percentile) regarding a given exporting good. The quality indices are comparable across countries within a year, and across years for one specific country. A higher quality index implies a quality closer to the best quality available. The dependent variable in this chapter is the growth rate of the quality indices calculated for a specific country-product pair. It is the rate at which the quality of this country's product catches up with that of the world's best product.

This quality database, despite its wide coverage, is not convenient to analyze in conjunction with other types of data. The main limitation is that the database follows SITC Rev. 1, an outdated and more generic product classification system that has very little concordance with recent systems. Conversion among the systems is still possible, yet involving multiple steps that result in greater matching error and information loss. This is an issued directly faced by the analysis in this chapter. In particular, several SITC-2 product categories (correspondingly, around 30 SITC-4 categories) are matched to the same ISIC Rev.2 2-digit category for data on financial characteristics (i.e., external finance dependence and asset tangibility). The cross-product variation in financial features is effectively reduced, which lessens the explanatory power of these product-level financial features.

After combining with data on explanatory variables, the final sample has product quality estimates for 87 countries, 520 four-digit SITC product categories, 43 two-digit SITC categories, and 36 years (1976-2010). Half of the countries are in the middle income group, and one-third are high-income. There are seven five-year non-overlapping periods: 1976-1980, 1981-1985, 1986-1990, 1991-1995, 1996-2000, 2001-2005, and 2006-2010. Summary statistics of export quality upgrading are reported in Table A19 for the whole sample, and in Table A21 for the subsamples divided by the country groups.

Figures 9 and 10 do not show any clear pattern in the relationship between the growth of export quality and private credit. Figure 11 display a clear negative relationship between initial export quality and quality growth. The slopes of the fitting lines are different among country groups, with the steepest slope observed for the high-income group.

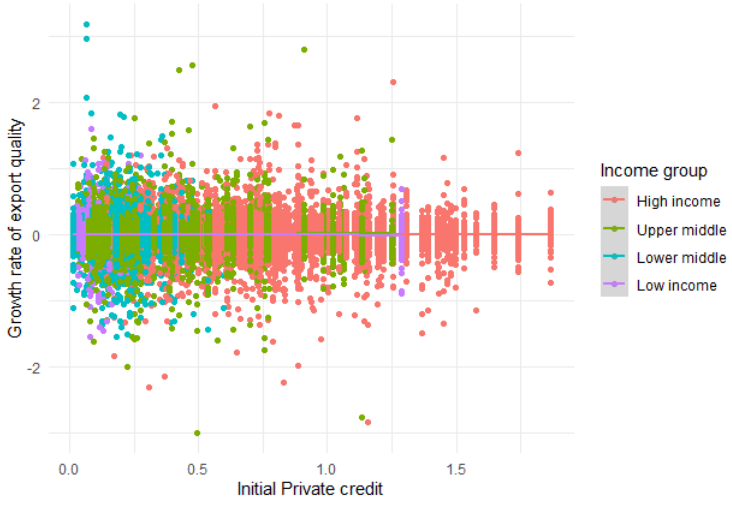

FIGURE 9. Private Credit and Quality Growth

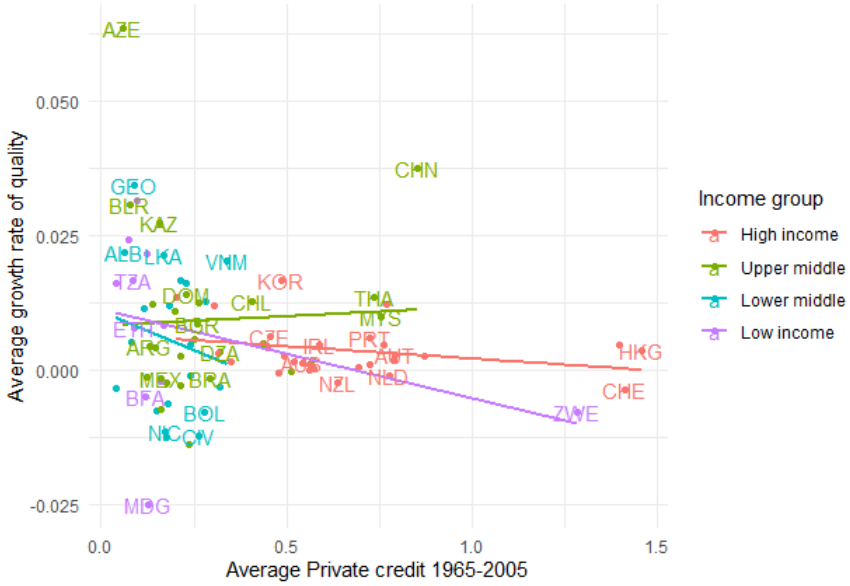

FIGURE 10. Cross-sectional Private Credit and Quality Growth

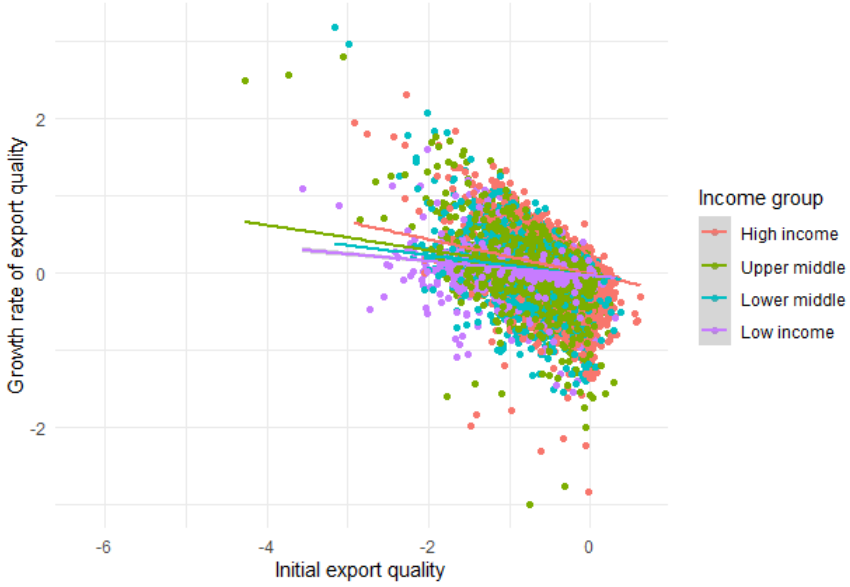

FIGURE 11. Initial Quality and Quality Growth

Quality data is widely disperse as seen in 9. For later analysis, I remove outliers from the original dataset by truncating the top and bottom 1%. Only quality estimates between -0.316 and 0.321 are kept.

Country-level measures

The country-level controls I use in my study are GDP per capita, private credit to GDP ratio, FDI net inflows as a ratio of GDP, and an index of financial reform. The last three are different indicators of financial conditions. Private credit is the variable of interest here. It has been used extensively in related research. A higher value of private credit indicates more credit issued by depository institutions to the private sector relative to GDP. Private credit signals the capability of the domestic financial market in channeling capital to firms through financial institutions. Among other funding channels of firms, FDI inflows pertain more to this analysis. Along with private credit and GDP per capita, FDI inflows data are obtained from the World Development Indicator database by the World Bank. The final financial indicator is an index of domestic financial reform. This is a normalized index taken from the Database of Financial Reforms (developed by Abiad et al. (2010) and maintained by the IMF). The index of financial reform accounts for advancement in various aspects of the domestic financial markets: controls of interest rate, reserve requirement, entry barriers, state ownership in the banking sector, capital account restrictions, supervision of the banking sector and securities market. It is expected to be more comprehensive

than private credit and FDI inflows. Table A22 shows the correlation matrix of these country-level factors. Overall, the correlation among all factors are moderately to weakly positive.

Figure 12 plots initial conditions of private credit and export quality, both averaging over the sample period. Country groups noticeably distinguish by the degree of export quality. While the fitting line has low standard errors for the high-income group, more noises and outliers are observed for other income groups, especially for the low-income.

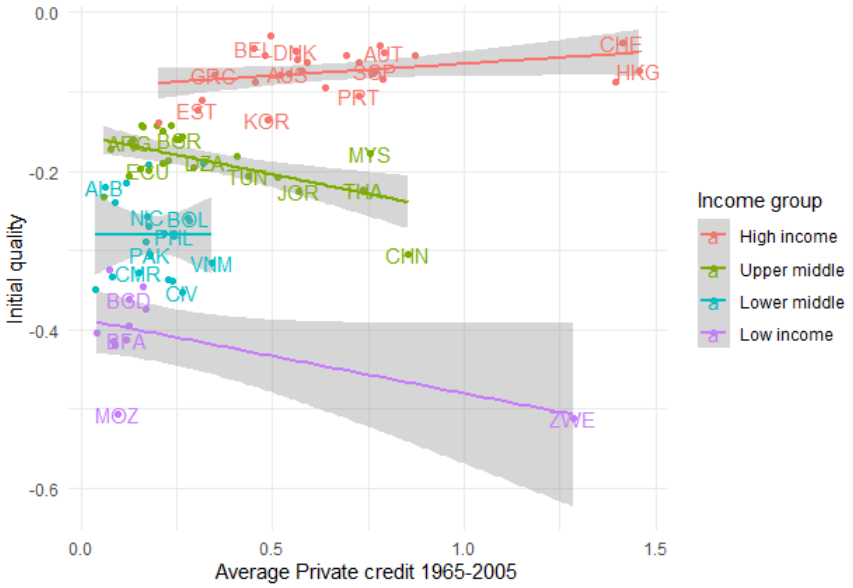

FIGURE 12. Cross-section of Initial Private Credit and Initial Quality

Product-level measures

Without particular measures for product characteristics, I use measures of production technology by sectors instead. The sectoral measures (external

financial dependence and asset tangibility) are taken from Braun (2003) and are available at ISIC Revision 2. They are calculated from COMPUSTAT, a database of accounting information of public firms in the United States. Each measure is an average for all countries in a 10-year period from 1980 to 1989, and the sectoral value is the median of these average values. The calculation is based on the seminal work by Rajan and Zingales (1998). I combine concordance tables from Haveman and UNSTAT to match the ISIC industry data with SITC export data. External financial dependence and asset tangibility are barely correlated (the correlation coefficient is -0.12).

Including these variables in the analysis requires several assumptions to be met (Rajan and Zingales, 1998): the financial structures of public firms in the U.S. represent the optimal structure for firms globally, and the rank of financial need of industries is assumed to preserve across country and time. Implementation of this method requires excluding the U.S. from the dataset, and the sampling period should be later than the period from which these financial need measures are calculated. In particular, if external financial dependence and asset tangibility are calculated from 1980-1989 data, then the sampling period should start from 1990 at the soonest. Following this practice means truncating 20 years of the quality dataset. Doing so weakens the power of the estimation methods, even when I try to compensate for the loss of observations by reducing the interval length from five to three or two years. By favoring to retain the whole quality data set, I make a

stronger assumption than Rajan and Zingales (1998): I assume that these financial measures are the optimal of worldwide production technology, and their rank stays fixed for the whole length of the sampling period (35 years). Making a stronger assumption potentially weakens the preciseness of the empirical results.

Methodology

The main specification is

$$\begin{aligned} Y_{ikt} =& \beta_1 Initial\_Quality_{ik,t-4} + \beta_2 X_{i,t-4} + \\ & \beta_3 Initial\_Quality_{ik,t-4} \times X_{i,t-4} + \beta_4 X_{i,t-4} * Z_k + \\ & \alpha_{ik} + \alpha_{kt} + \epsilon_{ikt} \end{aligned} \tag{4.1}$$

where i, k, t represent exporting country, export product category, and year, respectively. The dependent variable, Y_{ikt}, is the log growth rate of export quality of product k from country i between year t and $t-4$

$$Y_{ikt} = ln\left(\frac{Quality_{ik,t}}{Quality_{ik,t-4}}\right)$$

Among the main regressors, $X_{i,t-4}$ are the initial values of the country-level factors: log GDP per capita, private credit to GDP ratio, domestic financial reform index, FDI net inflows to GDP ratio. These regressors are measured in the initial year of the five-year non-overlapping interval (year $t-4$). Z_k are product or

industry-level factors: asset tangibility and external financial dependence. Fixed effects are denoted by α.[3]

The basics of my estimation follow the setup of Henn et al. (2017) and Can and Gorgoz (2018), the only two papers that have explored this dataset so far.[4] The dependent variable is log growth rate of product quality which is measured over a non-overlapping period of a certain length (10 years in Henn et al., 2017; and five years in Can and Gorgoz, 2018). The basic explanatory variables are initial product quality and log GDP per capita, all measured at the first year of each non-overlapping period. Both mentioned studies show that initial proximity to the world quality frontier is the most important determinant of quality upgrading. Specifically, products near the bottom of the quality ladder (defined as the difference between the highest and lowest quality, Grossman and Helpman, 1991) will move faster towards the world frontier. GDP per capita is the second most important driver of export quality upgrading.

The length of the non-overlapping period is fixed at five years. It should not be shorter due to a potential increase in measurement error bias (Henn et al., 2017). Macroeconomic data are often measured with error, due to limited data

[3]In an additional exercise, I explore the role of the initial level of export quality of two-digit SITC categories. Preliminary analysis yield a positive and significant estimate for SITC-2 initial export quality, suggesting that quality upgrading is faster for a SITC-4 product when it belongs to a high-quality SITC category.

[4]Henn et al. (2017) are the authors of the EDD. Their paper discusses different attributes of the EDD, and presents a simple panel analysis where export quality upgrading depends on initial quality and various country-level measures such as GDP per capita, institutional quality, reform indices, etc. They use quality data reported in 3-digit Broad Economic Categories classification. Can and Gorgoz (2018) examine the relationship between product diversification (which is also an attribute of EDD) and overall export quality upgrading.

sources (Chang and Li, 2018). The problems of measurement error worsens with taking first differences, as doing so reduces the meaningful signal and increases the unwanted noise. Widening the differencing intervals (from five or 10 to 20 years) may alleviate this problem (Krueger and Mikael, 2001). In this chapter, measurement error will not be a serious issue because we only take differences of the dependent variable. While measurement error in the dependent variable does not bias the coefficients, it can make them less precise. Setting the interval at five years ensures sufficient treatment towards measurement error without risking too many observations.

The coefficients of interest here are β_2, β_3 and β_4. Consistent with previous research, we expect β_2 to be positive, as GDP per capita and financial conditions should promote export quality upgrading. Should the effects of the country-level conditions be nonmonotonic, that will show in β_3. A negative β_3 implies that more private credit helps low-quality products upgrade disproportionately faster. Lastly, β_4 is expected to be positive for the interaction term of country-level financial measures with external financial dependence and negative for the interaction term with asset tangibility.

The set of fixed effects I employ will follow Can and Gorgoz (2018) and Henn et al. (2017). Both studies control for unobservable heterogeneity along the country-product and product-year dimensions. Henn et al. (2017) especially emphasize the importance of the product-year heterogeneity. Therefore, while I

try estimating the equation with different sets of fixed effects (individual country and product fixed effects or interacting the two), I keep year-product fixed effects in all regressions.[5] This type of fixed effects is crucial because: (i) quality values are estimated separately for each product category, so quality values are only comparable within category, and (ii) there are unobservable shocks or changes in production technology that affects all categories worldwide (Henn et al., 2017; Amiti and Khandelwal, 2013). All regressions are estimated with OLS and standard errors are clustered at the country level.

Empirical Results

This section presents empirical results from seven tables. In Table 10, I compare the first-order effects of the three finance measures. I also evaluate their performance when different combinations of them are included in one regression. I construct Tables 11 to 13 to examine whether the effect of each individual finance measure differ by country groups. I repeat this exercise for the full specification as in Equation 4.1, and report the results in Tables 14, 15 and 16.

All regressions include the initial level of export quality and GDP per capita. Initial level of export quality is the most important determinant of export quality upgrading. The estimates of this factor are negative and their magnitudes are the highest among all regressors. This result is consistent with Henn et al. (2017),

[5]The results are indeed much weaker when I estimate the specification where the country-product fixed effect are separated into a country fixed effect and a product fixed effect.

Amiti and Khandelwal (2013), and Can and Gozgor (2018) despite different export quality measures.[6] Another result that is consistent with these previous studies is the estimates of GDP per capita, which are always positive and significant. We can conclude that export quality upgrading is faster for products with lower initial levels of export quality, and for products exported by a country with better economic development

In the baseline estimation using the whole sample (Table 10), the estimates of private credit are negative and highly significant. Estimates of FDI net inflows are also negative with varying degree of significance. FDI net inflows indicator is significant when being estimated alone, or in conjunction with private credit. It loses significance when the index of domestic financial reform is introduced into the regression. This result suggests a potential multicollinearity between two indicators. The estimates of financial reform index, on the contrary, is positive and highly significant across all regressions. As these results are somewhat counter-intuitive for private credit and FDI inflows, I separate the sample into four country groups. I start from the simplest form of specification that has only initial quality, GDP per capita, and one financial indicator. I gradually add the interaction terms of the financial indicator with product characteristics.

[6]Henn et al. (2017) and Can and Gozgor (2018) employ the same IMF database, but different indicators and frequency. Henn et al. (2017) analyze data on 3-digit Broad Economic Category products and calculate export quality growth over 10-year non-overlapping periods. Can and Gozgor (2018) use the 1-digit SITC product classification and five-year non-overlapping intervals. Amiti and Khandelwal (2013) use 10-digit HS varieties and five-year intervals.

Effects of Private credit

The estimates of private credit do not change their negative sign when I regress by country groups (Table 11). They only become insignificant with a much smaller magnitude. There are two possible explanations of these results: either private credit has little variation within each country group and/or there are other channels through which private credit impacts quality upgrading that I have not accounted for. Results in Table 14 support both explanations. Private credit becomes positive and significant when all of the necessary interaction terms are included. The interaction term between private credit and initial quality is negative, suggesting that private credit is more important for sectors with initially low quality. The interaction term between private credit and sectoral financial conditions bear expected signs. Export quality upgrading is therefore faster in more financially vulnerable sectors.

Some interesting patterns appear when estimation results are compared across country groups. The direct effects and indirect effects through initial quality are stronger for lower income countries, especially the low and lower-middle income groups. The interaction term with external finance is technically zero for all four sub-samples. The interaction term with asset tangibility is also zero for the high income group, but statistically significant for other groups. Such differences require a closer examination on the exporting pattern of the country groups. It is possible

that there is little variation in the degree of tangible assets implied in the products of the high income.

Effects of FDI

The overall effect of FDI on quality upgrading is negative and significant, which is mostly driven by the high income countries (Table 12). The estimate of FDI is zero for the high income group, but positive for the others. Its magnitude is especially large for the upper-middle group, and fairly large for the low and lower-middle group (approximately the same magnitude with GDP per capita). For both the highest and lowest income groups, FDI is not significant. It is possible that FDI is not truly meaningful for the high income - they have the ability to innovate on their own, without relying on new technologies introduced by FDI. They may not find it necessary to adopt new technologies from FDI since their technologies are already the most advanced. For the lowest income group, the imprecise estimate of FDI suggests that some but not all of them benefit from FDI. The difference between the lowest income and the upper-middle income could be explained by other underlying factors that are known to influence the rate of economic convergence such as institutional quality and human capital.

Similar to private credit, FDI has a stronger effect for sectors with initially low quality (Table 15). The indirect effect through the initial quality channel is also stronger for the upper-middle income group. The indirect effects through sectoral financial characteristics display somewhat random pattern. These

interaction terms are probably misspecified: FDI and private credit are completely different funding resources. Firms choose to apply for credit from financial institutions depending on their need for external finance and their endowment of tangible asset. Meanwhile, FDI is initiated by the parent company without regards to the financial characteristics of the subsidiary firms.

Effects of Financial reform

Domestic financial reform is meaningful to export quality upgrading on average (Table 13). Its effects are not monotonic with income level: stronger and significant effects are observed in the highest and lowest income group. The effect is basically zero for the upper-middle income group. Interpreting these results require a closer look at the trend of financial reform in each country group. Financial reform is conducive to quality upgrading, and especially more for lower quality products (Table 16). It is unclear whether the effects of financial reform is stronger in financially vulnerable sectors.

Conclusion

Recent research in international trade has shifted focus to export quality, another margin of trade besides the traditional extensive and intensive margins. The growth in export quality, or export quality upgrading, has important implications for economic development, however, not much research attempt has been done on this subject. In this chapter, I aim to fill this research gap by

analyzing the role of domestic financial conditions on export quality upgrading. I use three financial indicators: private credit to GDP ratio, FDI net inflows to GDP ratio, and a domestic financial reform index. Since there is a lack of research on the topic, my approach is guided by established understanding of how finance influences economic convergence and comparative advantage. In particular, I investigate whether finance has a nonlinear effect on export quality upgrading, and whether finance affects export quality upgrading in a similar fashion as it does export volume.

I conduct an empirical analysis using data on export quality of SITC 4-digit products from the IMF. I estimate a specification where export quality upgrading is explained by initial values of export quality, GDP per capita, one indicator of country-level finance, and three terms where the financial measure interacts with initial quality, external financial dependence, and asset tangibility. In the estimation, I control for heterogeneity along country-product and product-time dimensions. Results from the full specification suggest that all three country-wide measures of finance positively impact quality upgrading. Their effects are disproportionately stronger for products with lower values of initial quality. Better financial conditions at the macroeconomic level allows firms to invest more in the costly process of innovation, or to be able to approach and adopt more advanced technologies. I find that, for the case of private credit, quality upgrading also occurs more rapidly in sectors that require more external finance or have little

tangible assets. Both hypotheses are hence confirmed for this indicator, while only the first hypothesis is confirmed for FDI inflows and financial reform.

I further examine whether the effects of finance are similar for countries of different income levels. It is possible that firms finance their innovative process differently depending on the development stage of their home country. Estimation results on the first-order effects show a clear pattern of differences across country groups for FDI inflows and financial reform. FDI inflows appear to be more important to the upgrading process for upper-middle income countries, while financial reform is more important for the highest and lowest income groups. The patterns become less clear when I consider the indirect effects of these indicators, through the channels of initial quality and financial characteristics of the products. A concrete explanation for such results would require a comprehensive analysis using these indicators, exporting pattern by country groups, and other structural factors. This is the main limitation of the analysis in this chapter: it needs a stronger argument, either theoretically or empirically, as to why these channels, especially the financial characteristics, are relevant to FDI and financial reform. There might be other aspects of the production technologies, such as R&D intensity, that better correspond to FDI inflows indicator.

The scope for future work is wide. One reason why the lowest income country group does not benefit from FDI as much is their low level of human capital. The role of human capital in helping countries catch up with the world

frontier has been discussed in Benhabib and Spiegel (2005). Less developed countries are introduced to advanced technologies through FDI. However, these countries would not be able to catch up with developed nations if they lack sufficient human capital to retain and incorporate new technologies into their production. By adapting this idea to the research at hand, it will be interesting to calculate the critical level of human capital above which quality upgrading of a nation can converge to the world frontier. Another avenue to extend this analysis is product differentiation. The effects of finance could be stronger for differentiated products, where firms have more scope to adjust quality (Crino and Ogliari, 2017). There are three methods to define product differentiation: quality dispersion (Fan et al., 2015), quality ladder (Khandelwal, 2010), differentiation index (Rauch, 1999). These methods can be easily applied to the research in this chapter: the first method uses the standard deviation in quality, the second is the gap between the maximum and minimum quality, and the last is a index available in SITC Revision 2 - the classification system closest to SITC Revision 1 as of my knowledge.

TABLE 10. Finance Measures and Quality Upgrading

	Dependent variable:						
	Quality Growth at SITC 4-digit						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Initial Quality	−0.577***	−0.577***	−0.577***	−0.577***	−0.577***	−0.577***	−0.577***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Initial (log) GDP per capita	0.032***	0.032***	0.032***	0.029***	0.028***	0.029***	0.032***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Initial Private credit	−0.011***	−0.011***	−0.011***				−0.011***
	(0.003)	(0.003)	(0.003)				(0.003)
Initial FDI net inflows		−0.015*		−0.018*		−0.015	−0.012
		(0.008)		(0.010)		(0.009)	(0.008)
Initial Domestic financial reform			0.013***		0.014***	0.013***	0.013***
			(0.004)		(0.004)	(0.004)	(0.004)
Observations	132,481	132,481	132,481	132,481	132,481	132,481	132,481
R^2	0.517	0.517	0.517	0.516	0.517	0.517	0.517
Adjusted R^2	0.361	0.362	0.362	0.361	0.361	0.361	0.362
Country-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

TABLE 11. Private Credit and Quality Upgrading by Income Group: Baseline

	Dependent variable:				
	Quality Growth at SITC 4-digit				
	All	H	(UM+LM+L)	UM	(LM+L)
Initial Quality	-0.577^{***}	-0.639^{***}	-0.560^{***}	-0.610^{***}	-0.526^{***}
	(0.015)	(0.023)	(0.019)	(0.027)	(0.032)
Initial (log) GDP per capita	0.032^{***}	0.030^{***}	0.038^{***}	0.037^{***}	0.044^{***}
	(0.005)	(0.005)	(0.007)	(0.011)	(0.010)
Initial Private credit	-0.011^{***}	-0.005	-0.010	-0.008	-0.006
	(0.003)	(0.003)	(0.011)	(0.013)	(0.010)
Observations	132,481	68,764	63,717	38,895	24,822
R^2	0.517	0.530	0.568	0.600	0.634
Adjusted R^2	0.361	0.390	0.380	0.419	0.398
Country-Product FE	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

Notes: Tables 11 to 13 report results from estimation on sub-samples of country groups. Bases on country classification of the World bank in 2011, the sample is first divided into two groups: High-income countries (denoted H) and other (UM+LM+L). The latter is further divided into the Upper-middle group (UM) and a group summing up Lower-middle and Low income (LM+L). Low and lower-middle income countries are not separated, due to the small share in observations of the low income group. In the sample, high-income countries occupy almost half of the observations, while the share of upper-middle countries is about one-fourth. Diving the sample in two steps as described enable more precise cross-group comparison.

TABLE 12. FDI and Quality Upgrading by Income Group: Baseline

	Dependent variable:				
	Quality Growth at SITC 4-digit				
	All	H	(UM+LM+L)	UM	(LM+L)
Initial Quality	−0.577***	−0.639***	−0.561***	−0.610***	−0.526***
	(0.015)	(0.023)	(0.019)	(0.026)	(0.032)
Initial (log) GDP per capita	0.029***	0.030***	0.033***	0.033***	0.042***
	(0.005)	(0.005)	(0.007)	(0.010)	(0.009)
Initial FDI inflows to GDP	−0.018*	−0.008	0.063**	0.080**	0.044
	(0.010)	(0.007)	(0.029)	(0.035)	(0.032)
Observations	132,481	68,764	63,717	38,895	24,822
R^2	0.516	0.530	0.568	0.600	0.634
Adjusted R^2	0.361	0.390	0.381	0.419	0.398
Country-Product FE	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

TABLE 13. Financial Reform and Quality Upgrading by Income Group: Baseline

	Dependent variable:				
	Quality Growth at SITC 4-digit				
	All	H	(UM+LM+L)	UM	(LM+L)
Initial Quality	−0.577***	−0.640***	−0.560***	−0.610***	−0.526***
	(0.015)	(0.023)	(0.019)	(0.027)	(0.032)
Initial (log) GDP per capita	0.028***	0.031***	0.034***	0.034***	0.040***
	(0.004)	(0.005)	(0.007)	(0.010)	(0.009)
Financial reform index	0.014***	0.010***	0.013	0.001	0.031***
	(0.004)	(0.004)	(0.009)	(0.011)	(0.010)
Observations	132,481	68,764	63,717	38,895	24,822
R^2	0.517	0.530	0.568	0.600	0.635
Adjusted R^2	0.361	0.390	0.381	0.419	0.399
Country-Product FE	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

TABLE 14. Private Credit and Quality Upgrading by Income Group

	Dependent variable:							
	Quality Growth at SITC 4-digit							
	All	All	All	All	H	(UM+LM+L)	UM	(LM+L)
Init. Quality	−0.577***	−0.516***	−0.577***	−0.515***	−0.562***	−0.519***	−0.571***	−0.481***
	(0.015)	(0.020)	(0.015)	(0.020)	(0.030)	(0.023)	(0.034)	(0.037)
Init. LGDP per capita	0.032***	0.028***	0.031***	0.028***	0.028***	0.039***	0.039***	0.044***
	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)	(0.007)	(0.011)	(0.010)
Init. Private credit to GDP	−0.011***	0.169***	−0.009*	0.177***	0.135***	0.212***	0.139**	0.420***
	(0.003)	(0.029)	(0.005)	(0.029)	(0.027)	(0.058)	(0.055)	(0.130)
Init. Priv. cred. × Init. Quality		−0.193***		−0.195***	−0.147***	−0.240***	−0.161***	−0.481***
		(0.032)		(0.031)	(0.029)	(0.064)	(0.056)	(0.158)
Init. Priv. cred. × External finance			0.005	0.007**	0.005	0.003	0.006	−0.003
			(0.003)	(0.003)	(0.003)	(0.008)	(0.010)	(0.014)
Init. Priv. cred. × Asset tangibility			−0.014	−0.028**	−0.004	−0.073***	−0.042*	−0.199***
			(0.009)	(0.011)	(0.011)	(0.019)	(0.021)	(0.046)
Observations	132,481	132,481	132,481	132,481	68,764	63,717	38,895	24,822
R^2	0.517	0.523	0.517	0.523	0.533	0.572	0.602	0.639
Adjusted R^2	0.361	0.369	0.361	0.369	0.395	0.385	0.421	0.405
Country-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

TABLE 15. FDI Net Inflows and Quality Upgrading by Income Group

	Dependent variable:							
	Quality Growth at SITC 4-digit							
	All	All	All	All	H	(UM+LM+L)	UM	(LM+L)
Init. Quality	−0.577***	−0.565***	−0.577***	−0.565***	−0.631***	−0.545***	−0.584***	−0.522***
	(0.015)	(0.016)	(0.015)	(0.016)	(0.024)	(0.020)	(0.029)	(0.032)
Init. LGDP per capita	0.029***	0.029***	0.029***	0.029***	0.030***	0.034***	0.033***	0.043***
	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.007)	(0.010)	(0.009)
Init. FDI inflows to GDP	−0.018*	0.644***	−0.018	0.644***	0.247**	1.429***	1.792***	0.796
	(0.010)	(0.169)	(0.013)	(0.168)	(0.118)	(0.370)	(0.441)	(0.540)
Init. FDI × Init. Quality		−0.699***		−0.699***	−0.264**	−1.677***	−2.099***	−0.969
		(0.183)		(0.182)	(0.127)	(0.436)	(0.513)	(0.640)
Init. FDI × External finance			0.018	0.018	0.010	0.044	0.018	0.141**
			(0.013)	(0.018)	(0.017)	(0.041)	(0.055)	(0.059)
Init. FDI × Asset tangibility			−0.019	−0.017	−0.012	−0.032	0.063	−0.122
			(0.024)	(0.035)	(0.026)	(0.089)	(0.086)	(0.235)
Observations	132,481	132,481	132,481	132,481	68,764	63,717	38,895	24,822
R^2	0.516	0.519	0.516	0.519	0.530	0.571	0.604	0.635
Adjusted R^2	0.361	0.364	0.361	0.364	0.391	0.384	0.424	0.398
Country-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

TABLE 16. Financial Reform and Quality Upgrading by Income Group

	Dependent variable:							
	Quality Growth at SITC 4-digit							
	All	All	All	All	H	(UM+LM+L)	UM	(LM+L)
Init. Quality	−0.577***	−0.488***	−0.577***	−0.488***	−0.501***	−0.466***	−0.472***	−0.436***
	(0.015)	(0.018)	(0.015)	(0.018)	(0.036)	(0.022)	(0.033)	(0.032)
Init. LGDP per capita	0.028***	0.032***	0.028***	0.032***	0.025***	0.034***	0.032***	0.040***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.008)	(0.008)
Init. Reform index	0.014***	0.238***	0.007	0.234***	0.241***	0.331***	0.406***	0.399***
	(0.004)	(0.023)	(0.006)	(0.023)	(0.040)	(0.033)	(0.050)	(0.052)
Init. Reform × Init. Quality		−0.260***		−0.260***	−0.267***	−0.392***	−0.474***	−0.456***
		(0.027)		(0.026)	(0.045)	(0.038)	(0.056)	(0.060)
Init. Reform × External finance			0.004	0.012**	0.020*	0.012	0.004	0.025*
			(0.006)	(0.006)	(0.011)	(0.008)	(0.009)	(0.015)
Init. Reform × Asset Tangibility			0.019	0.001	0.024*	−0.004	−0.010	−0.058
			(0.014)	(0.012)	(0.013)	(0.021)	(0.024)	(0.037)
Observations	132,481	132,481	132,481	132,481	68,764	63,717	38,895	24,822
R^2	0.517	0.530	0.517	0.530	0.538	0.583	0.615	0.648
Adjusted R^2	0.361	0.379	0.361	0.379	0.401	0.401	0.440	0.420
Country-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors clustered at the country level
*p<0.1; **p<0.05; ***p<0.01

CHAPTER V

CONCLUSION

This dissertation employs a variety of modeling techniques and databases to shed more light on the role of financial and labor frictions on macroeconomic outcomes. In Chapter II, the outcomes are employment status and labor income. In Chapters III and IV, the outcomes are three margins of exports: firm counts (extensive margin), firm size (intensive margin), and product quality.

Chapter II takes a unique view to exploring informality in the labor market, using an equilibrium search model with heterogeneous labor productivity. In the model, high-skilled employers can voluntarily leave formal firms to become entrepreneurs in the informal sector. Working for high-skilled entrepreneurs is the only occupational choice of low-skilled labor. Given this setting, dynamics in the informal labor sector can distort the formal sector's signal of efficiency, which is reflected in the Beveridge curve. The model is solved numerically and calibrated to Latin American countries. It has a single, unique equilibrium if formal firms react more strongly to future loss from a job match rather than future gain. The government can reduce informal employment with a budget neutral policy where it taxes firms' profits to subsidize unemployment benefits and a vacancy maintenance fee. The policy comes at the cost of worsening labor and national income. Labor informality will eventually shrink if labor skills improve. Therefore,

the government should focus on education and training programs rather than intervening in the formal sector with policies.

Chapter III investigates the differential effect of financial development on export performance empirically. The analysis uses a detailed data set from the World Bank, the Exporter Dynamics Database. Financial development is measured by the amount of credit that depository institutions provide to the private sector as a proportion of GDP. I find that 67% of the positive impact of financial development on exports comes from more firms able to survive or start exporting. This result supports a popular view set by the heterogeneous firm trade theory that the main channel through which finance influences exports is the extensive margin. I do not find evidence regarding the role of financial development on the intensive margin measured by average sales per firm. However, when I separate the exporting firms by status, I find that the intensive margin of the more productive groups (incumbents and surviving entrants) reacts positively to improvements in credit markets. While the extensive margin remains the more important channel, its relative role to the intensive margin is not the same between incumbents and surviving entrants. The contribution of extensive margin to the total effect of financial development is roughly 56% for incumbents, and 72% for surviving entrants. This result highlights the challenge from fixed cost financing to first-time exporters. Continuing exporters still incur fixed costs, e.g., from exploring new destinations or exporting new products. However, these fixed costs are less of

a financial obstacle to continuing exporters. The results in this chapter should be taken as strong associations instead of causation. There are several threats to the causal inference, which can only control with more detailed data.

Chapter IV explores the roles of finance as drivers of export quality upgrading, i.e., the speed at which export quality of a product in a specific country approaches the world frontier. I propose that finance has a positive direct effect: it speeds up quality upgrading through promoting innovative technologies. Finance is more influential for products with specific characteristics: (i) further away from the world frontier of quality, or (ii) requiring more external finance to produce. These hypotheses are based on an established understanding of financial development as a source of comparative advantage and an engine of economic convergence. Finance as the main explanatory variable is measured in three ways: private credit to GDP ratio, FDI net inflows to GDP ratio, and a financial reform index. I use quality data from the IMF at the most disaggregated level (SITC 4-digit). I confirm that all measures positively affects quality upgrading and disproportionately more for products with initially low quality. Products of more financially vulnerable sectors would upgrade their quality faster as a result of improvements in private credit. A simple exercise shows that the importance of three financial measures varies across countries of different income levels. Similar exercises that explore the heterogeneity across countries and product characteristics are necessary to enrich the analysis in this chapter.

APPENDIX A

COMPARATIVE STATICS GRAPHS FOR CHAPTER II

FIGURE 13. Comparative Statics: Productivity of high-skilled workers

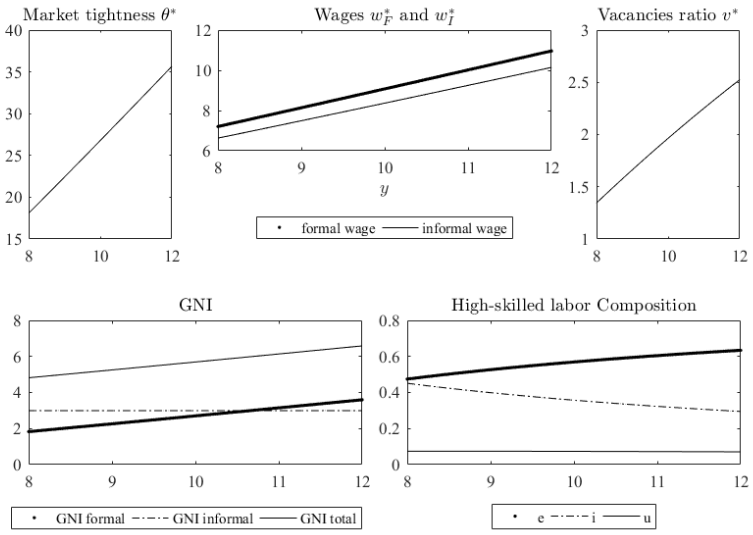

FIGURE 14. Comparative Statics: Unemployment benefit

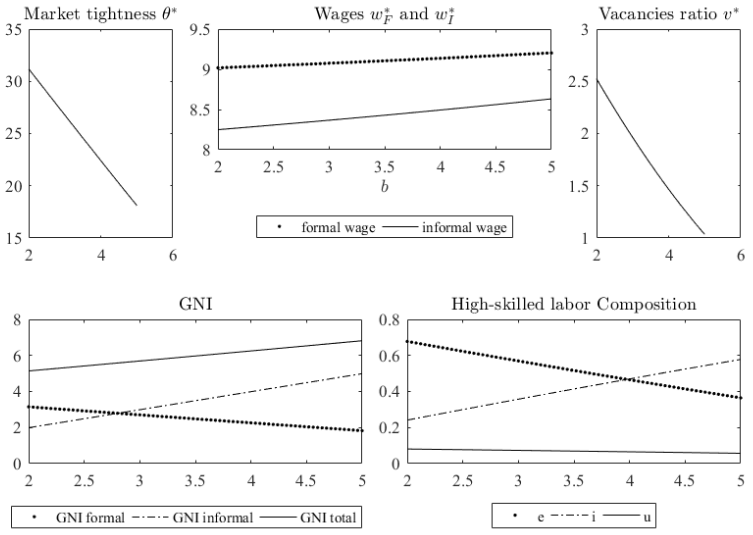

FIGURE 15. Comparative Statics: Efficiency of matching function

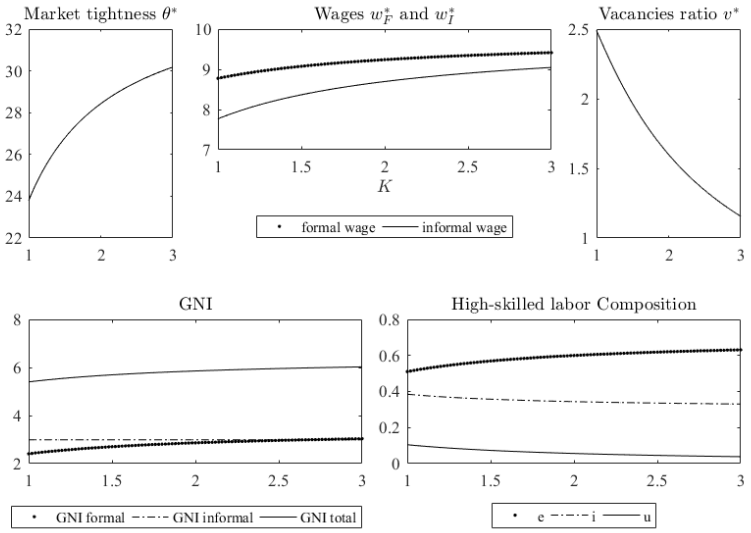

FIGURE 16. Comparative Statics: Adverse shock arrival rate

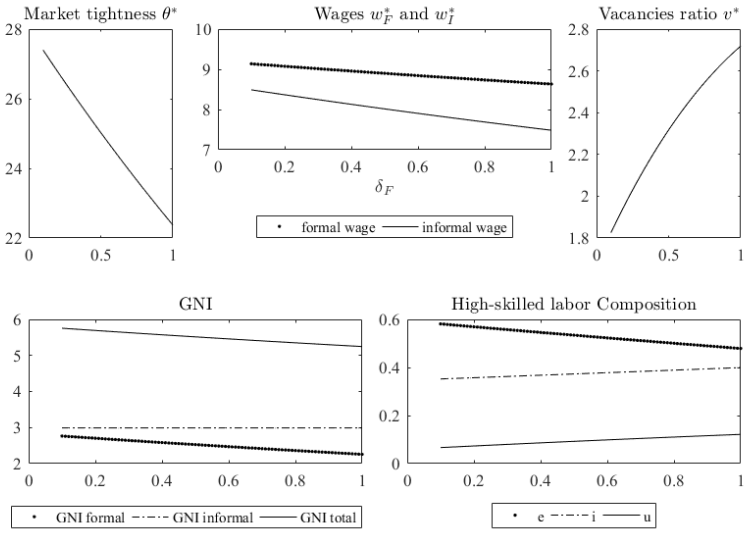

FIGURE 17. Comparative Statics: Formation rate of informal entrepreneurs

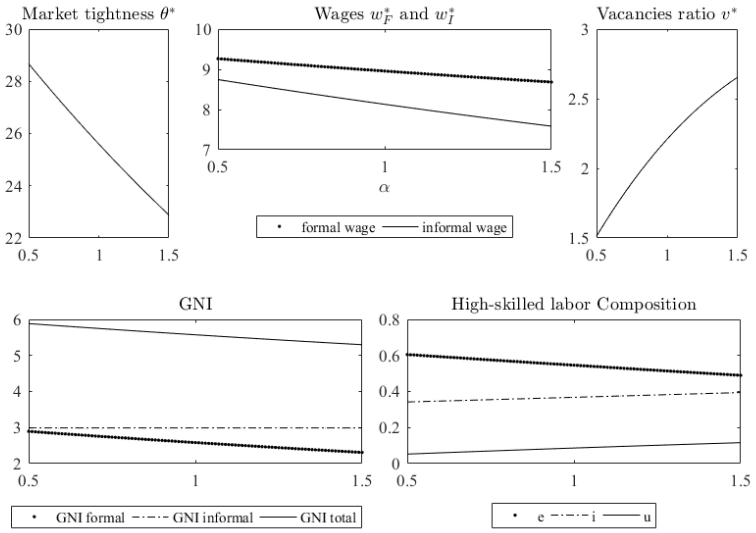

FIGURE 18. Comparative Statics: Sunk cost of formal firms

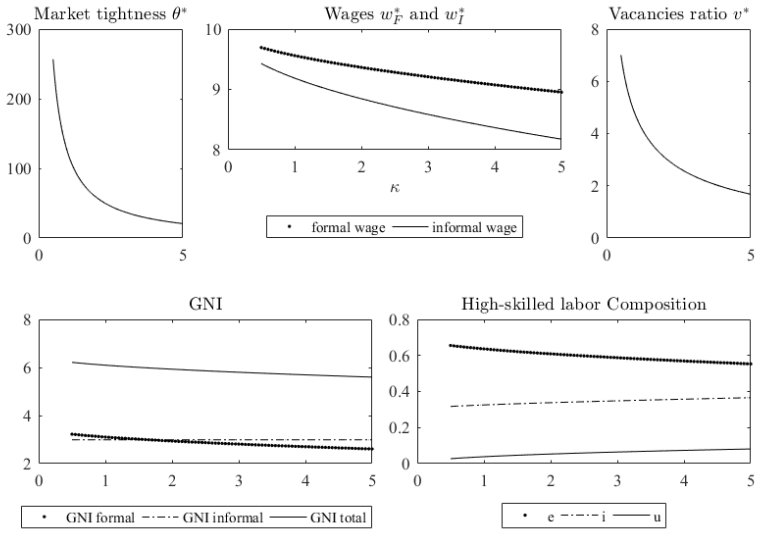

FIGURE 19. Comparative Statics: Real interest rate

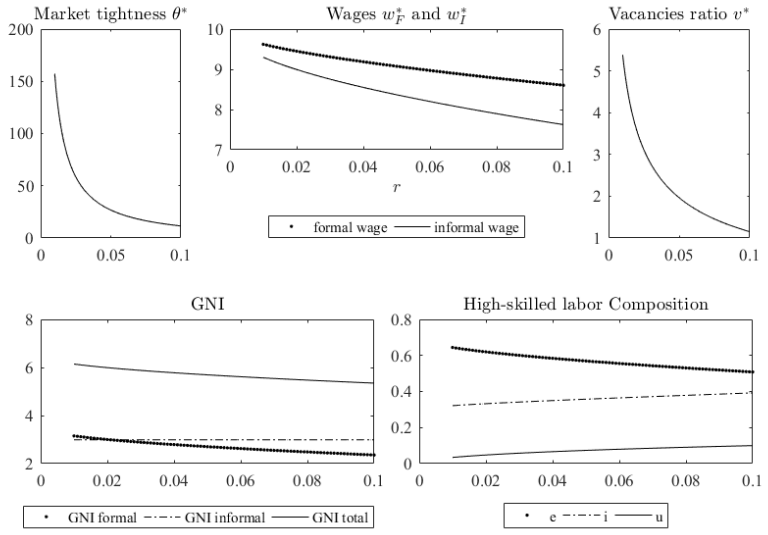

FIGURE 20. Comparative Statics: Proportion of high-skilled worker in the population

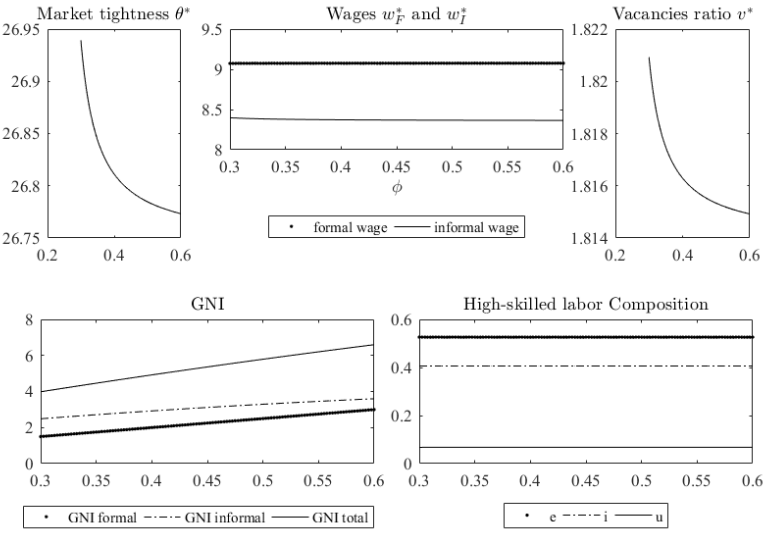

TABLE A1. Comparative Statics: Percentage changes of equilibrium values

Parameters	Range	Change (%)	θ^*	w^*_{HF}	w^*_{HI}	e^*_h	i^*_h	u^*_h
y	8.00:12.00	50	97.1	52.2	53.0	33.7	-34.7	-4.8
b	2.00:5.00	150	-41.9	2.1	4.6	-46.2	139.6	-29.4
K	1.00:3.00	200	26.8	7.3	16.4	23.6	-14.1	-63.4
δ_F	0.10:1.00	900	-18.3	-5.5	-11.8	-17.6	13.4	82.4
α	0.490:1.50	200	-20.2	-6.3	-13.3	-19.1	15.3	120.0
κ	0.490:5.00	900	-92.0	-7.6	-13.3	-15.6	15.3	197.4
r	0.01:0.10	900	-92.7	-10.49	-18.0	-21.1	22.0	191.2
ϕ	0.30:0.490	100	-0.49	0.0	-0.4	-0.0	-0.0	0.3
z	3.00:5.00	66.7	0.0	-0.0	0.0	-0.0	0.0	-0.0
t	0.40:0.70	75	72.3	-0.8	1.0	3.5	-1.8	-21.1
Parameters	Range	Change (%)	w_{gap}	v^*	GNI^*_F	GNI^*_I	GNI^*_T	w^*_l
y	8.00:12.00	50	-0.49	87.7	96.8	0.0	36.7	0.00
b	2.00:5.00	150	-2.3	-59.0	-42.0	150.8	32.6	150.8
K	1.00:3.00	200	-7.6	-53.6	26.0	0.0	11.6	0.00
δ_F	0.10:1.00	900	6.2	48.9	-18.4	0.0	-8.8	0.00
α	0.490:1.50	200	7.0	75.5	-20.2	-0.0	-9.9	-0.00
κ	0.490:5.00	900	6.0	-76.1	-19.1	0.0	-9.9	0.00
r	0.01:0.10	900	8.0	-78.6	-25.2	-0.0	-12.9	-0.00
ϕ	0.30:0.490	100	0.4	-0.3	100.0	38.9	71.2	86.7
z	3.00:5.00	66.7	-0.0	-0.0	-0.0	0.0	0.0	0.00
t	0.40:0.70	75	-1.7	35.9	0.0	-0.8	-0.4	-0.85

Unit: The range of all parameters (Column 2) are measured in level. The changes of parameters (Column 3) and, except for wage gaps, changes of endogeneous variables (Column 4 to 9) are measured in percent. The change in wage gaps is measured in percentage point, since the wage gap is the difference between formal wage and informal wage as a percentage of formal wage.
Notation: y: Productivity of high-skilled workers, b: Unemployment benefit of high-skilled workers, K: Scale parameter of matching function, δ_F: Arrival rate of adverse productivity shock to formal matches, α: Formation rate of informal firms, κ: Sunk cost for formal jobs, r: Real interest rate, ϕ: Ratio of high-skilled workers in the population, z: Productivity of low-skilled workers, t: Tax on profits of formal firms with filled jobs, Endogenous variables: θ^*: Market tightness, v^*: Vacancy ratio, w^*_{HF}: Formal wage and w^*_{HI}: Informal wage of high-skilled workers, w^*_l: Wage of low-skilled workers, e^*_h: Formal employment rate and i^*_h: Informal employment rate among high-skilled workers, u^*_h: Unemployment rate, GNI^*_F: GNI of formal sector, GNI^*_I: GNI of informal sector, GNI^*_T: total GNI.

APPENDIX B

SUPPLEMENTAL MATERIALS FOR CHAPTER III

A Model of Credit Constraints

Manova (2013) builds upon Melitz (2003) a static, partial equilibrium model with credit constraints. There is a continuum of firms producing differentiated products in J origin countries and S sectors. Destination country is denoted i. Country i has a Cobb-Douglas utility $U_i = \Pi_s C_{is}^{\theta_s}$ aggregated over sector specific CES consumption indices C_{is} where Ω_{is} is the set of available products, $\epsilon = 1/(1-\alpha) > 1$ is the elasticity of substitution, and $\theta_s \in (0,1)$ is the share of each sector in total expenditure Y_i ($\sum_s \theta_s = 1$). Country i's demand for a variety with price $p_{is}(\omega)$ is $q_{is}(\omega) = (p_{is}(\omega)^{-\epsilon} Y_i)/(P_{is}^{1-\epsilon})$ where P_{is} is the ideal price index.

Consumers in country j have CES preferences over product varieties ω. Denote $\epsilon = 1/(1-\alpha)$ as the elasticity of substitution, Y_j as total expenditure of destination country, and $\theta_s \in (0,1)$ as the share of each sector s in country j's total expenditure, and P_{js} as ideal price index. Every period, a firm with a productivity of $1/a_{ijs}$ in country i and sector s chooses its exporting level q, exporting price p, and the repayment amount F to its investors. The firm maximizes profit subject to three constraints: the demand for variety from foreign consumers, liquidity

constraint, and the promise of a non-negative return from the loan to the investors.

$$\max_{p,q,F} \pi_{ijs}(a) = p_{ijs}(a)q_{ijs}(a) - (1-d_s)q_{ijs}(a)\tau_{ij}c_{is}a - (1-d_s)c_{is}f_{ij} - \lambda_i F(a) - (1-\lambda_i)t_s c_{is} f_{ei}$$

subject to

$$\text{(i)} q_{ijs}(a) = \frac{p_{ijs}(a)^{-\epsilon}\theta_s Y_j}{P_{js}^{1-\epsilon}}$$

$$\text{(ii)} A_{ijs}(a) = p_{ijs}(a)q_{ijs}(a) - (1-d_s)q_{ijs}(a)\tau_{ij}c_{is}a - (1-d_s)c_{is}f_{ij} \geq F(a)$$

$$\text{(iii)} B_{ijs}(a) = -d_s q_{ijs}(a)\tau_{ij}c_{is}a - d_s c_{is}f_{ij} + \lambda_j F(a) + (1-\lambda_j)t_s c_{is} f_{ei} \geq 0$$

Here $A_{ijs}(a)$ denotes the revenue of the firms, which is also the highest repayment that the firm could offer to the investors. $B_{ijs}(a)$ denotes their return from lending the firms. Investors would only make loans to firms if the return from the loans $B_{ijs}(a)$ exceeds their outside option, here normalized to 0.

Solving this optimization problem yields the optimal revenue r_{ijs}. The cost for a firm to produce one unit of its variety is $c_{is}a_{ijs}$, where c_{is} is the cost of a cost-minimizing bundle of inputs specific for each country and sector. Every firm draws its productivity from a distribution G(a) after paying a fixed sunk cost of $c_{is}f_{ei}$ to enter the domestic market. An exporting firm would incur extra expense: it pays a fixed cost $c_{is}f_{ij}$ (where $f_{ij} > 0$ if $i \neq j$, $f_{ii} = 0$) and an iceberg trade cost $\tau_{ij} > 1$ each period.

Contractual enforcement is denoted $\lambda_i \in (0,1)$. This exogenous parameter reflects the probability that investors can be repaid in the case the firm defaults on its debt. Contractual enforcement is greater in countries with better institutional quality. Every period the exporting firm finances a fraction d_s of its trade costs with external funds from borrowing. The firm pledges the loan with tangible assets that comes from its sunk entry cost. How much of the sunk entry cost goes into tangible assets ($t_s \in (0,1)$), and how much of the trade costs is financed externally ($d_s \in (0,1)$) are determined by the technological difference across industries. These factors t_s and d_s, assumed to be exogenous to the firms, capture the heterogeneity in sectoral financial vulnerability. A sector is more financially vulnerable if it needs more external fund (higher d_s) or has little tangible assets (lower t_s).

The first testable hypothesis relates the extensive margin of trade with financial development and sectoral financial vulnerability. The productivity cut-off for exporting is higher in financially more vulnerable sectors and lower in financially more developed countries $\big(\frac{\partial(1/a_{ijs})}{\partial d_s} > 0, \frac{\partial(1/a_{ijs})}{\partial t_s} < 0, \frac{\partial(1/a_{ijs})}{\partial \lambda_i} < 0\big)$. Financial development lowers this cut-off relatively more in financially more vulnerable sectors $\big(\frac{\partial^2(1/a_{ijs})}{\partial \lambda_i \partial d_s} < 0, \frac{\partial(1/a_{ijs})^2}{\partial \lambda_i \partial t_s} > 0\big)$

The second testable hypothesis relates the intensive margin of trade with financial development and sectoral financial vulnerability. Financial development (weakly) increases the level of firms' exports from country i to country j relatively more in financially more vulnerable sectors $\big(\frac{\partial^2 r_{ijs}}{\partial \lambda_i \partial d_s} > 0, \frac{\partial^2 r_{ijs}}{\partial \lambda_i \partial t_s} < 0\big)$. The term

"weakly" is involved because financial development only increases the export level of firms that have a productivity between a_{ijs}^L and a_{ijs}^H. The liquidity constraint (ii) is binding for firms with productivity lower than a_{ijs}^L and not binding for firms with productivity at least a_{ijs}^H.

Data Exploration

TABLE A2. Variables description and source

Variable	Description	Source
Country-level variables		
gdp	GDP 2011 PPP constant USD	WDI
gdppc_ppp	GDP per capita, 2011 PPP constant USD	WDI
privcred	Domestic credit to private sector to GDP (percent)	WDI
legal	Legal right index	
rulelaw	Rule of Law	
so_or	Socialist origin before transition	CEPII
fr_or	French origin before transition	CEPII
uk_or	British origin before transition	CEPII
sc_or	Scandinavian origin before transition	CEPII
Industry-level variables - Author calculated		
EXTFIN	External financial dependence ratio	Compustat
TANG	Tangible assets to total assets ratio	Compustat
Export data		
A1	Number of Exporters	EDD
A2	Number of Entrants	EDD
A3	Number of Exiters	EDD
A4	Number of Surviving Entrants	EDD
A5	Number of Incumbents	EDD
A6i	Export Value per Exporter: Mean	EDD
A7i	Export Value per Entrant: Mean	EDD
A9i	Export Value per Surviving Entrant: Mean	EDD
A10i	Export Value per Incumbent: Mean	EDD

Country-level data

Pool data highest and lowest country-year instances: The smallest countries by GDP are Rwanda (2004, 2005) and Timor Leste (2006). Largest is Mexico

(2008, 2011, 2012). The one with the lowest GDP per capita is Niger (2009, 2010, 2008). Highest are Norway (2007), Kuwait (2009 and 2010). The one with the lowest private credit, Timor Leste (2008, 2011, 2012). Highest is Denmark (2008, 2009, 2010). Pearson's correlation: the pool data correlation coefficient between GDPpc and Privcred is 0.68, significant at 10%, between GDP and GDPpc or GDP and Privcred is 0.3 and significant at 10%

TABLE A3. Country level cross-section statistics

Variable	Obs	Mean	SD	Min	Max
Privcred	52	36.92	37.55	2.96	182.58
GDP	52	2.21 E11	3.87 E11	1.02 E10	1.82 E12
GDP per capita	52	11394	14631.2	803.6	78563.4

TABLE A4. Countries by income ranking 2003

Income rank	Description	Obs	Percent	Countries
High income	$GNIpc > 9,205$	2,033	9.95	5
Upper-middle	$2,976 < GNIpc < 9,205$	3,552	17.39	6
Lower-middle	$746 < GNIpc < 2,975$	7,259	35.54	18
Low income	$GNIpc < 745USD$	7,582	37.12	23
Total		20,426	100	52

TABLE A5. Country level cross-section extremes

GDP per capita		GDP		Private credit	
Top 5 countries					
Portugal	26858.2	Pakistan	6.69 E11	Mauritius	77.5
Spain	32929.2	Turkey	1.25 E12	Norway	92.6
Denmark	44751	Iran	1.25 E12	Portugal	141.8
Norway	63140.1	Spain	1.50 E12	Spain	157.6
Kuwait	78563.3	Mexico	1.82 E12	Denmark	182.6
Bottom 5 countries					
Niger	803.6	Timor-Leste	1.02 E10	Timor-Leste	2.96
Ethiopia	924.5	Rwanda	1.22 E10	Guinea	4.13
Malawi	975.8	Niger	1.27 E10	Yemen	6.31
Rwanda	1245.6	Malawi	1.44 E10	Zambia	8.71
Uganda	1370.6	Kyrgyz	1.48 E10	Uganda	8.78

Industry-level data

TABLE A6. List of 3-digit ISIC Rev. 3 industries

ISIC	Description	ISIC	Description
151	Processing meat, fish, veggie, oils	281	Structural metal
152	Dairy	289	Other fabricated metal
153	Grain mill and starch	291	General purpose machinery
154	Other food	292	Special purpose machinery
155	Beverages	293	Domestic appliances n.e.c.
160	Tobacco	300	Office machinery
171	Spinning/finishing of textiles	311	Electric motors
172	Other textiles	312	Electricity apparatus
173	Knitted and crocheted fabrics	313	Insulated wire and cable
181	Wearing apparel, except fur apparel	314	Primary batteries
182	Dressing, dyeing, articles of fur	315	Electric lighting equipment
191	Tanning and dressing leather	319	Electrical equipment n.e.c.
192	Footwear	321	Electronic valves/tubes
201	Saw milling, planing of wood	322	Television/radio transmitters
202	Wood, cork, straw	323	Television/radio receivers
210	Paper	331	medical appliances
221	Publishing	332	Optical/photographic instruments
222	Printing and service activities	333	Watches and clocks
233	Processing of nuclear fuel	341	Motor vehicles
241	Basic chemicals	342	Bodies motor vehicles/trailers
242	Other chemicals	343	Motor accessories
243	Man-made fibres	351	Building, repairing ships/boats
251	Rubber	352	Railway/tramway locomotives
252	Plastics	353	Aircraft/spacecraft
261	Glass	359	Transport equipment n.e.c.
269	Non-metallic mineral n.e.c.	361	Furniture
271	Basic iron and steel	369	Manufacturing n.e.c.
272	Basic precious/non-ferrous metals		

There are 55 manufacturing industries. Pearson's correlation coefficient from panel data between EXTFIN and TANG is -0.019, significant at 10%. Correlation from cross section (industry-wise) data is similar at -0.013 and not significant.

TABLE A7. Two measures of financial vulnerability by industry

ISIC	External finance	Asset tangibility	ISIC	External finance	Asset tangibility
151	-0.291	0.35	281	0.125	0.173
152	-0.088	0.382	289	-0.356	0.32
153	-0.779	0.328	291	-0.461	0.254
154	-0.408	0.382	292	0.188	0.166
155	-0.847	0.296	293	-0.587	0.185
160	-4.381	0.13	300	0.203	0.114
171	-0.152	0.402	311	0.215	0.159
172	-0.183	0.171	312	-1.002	0.28
173	-0.514	0.265	313	-0.1	0.248
181	-0.5	0.104	314	0.319	0.207
182	-0.044	0.216	315	-0.611	0.223
191	-0.33	0.223	319	-0.115	0.181
192	-0.364	0.208	321	0.104	0.196
201	-0.4	0.72	322	0.489	0.142
202	-0.355	0.289	323	1.544	0.094
210	-0.409	0.495	331	0.064	0.132
221	-1.099	0.152	332	-0.027	0.23
222	-0.781	0.326	333	-0.885	0.152
233	-0.375	0.376	341	-0.02	0.24
241	-0.079	0.373	342	-1.036	0.201
242	2.94	0.147	343	-0.818	0.239
243	-0.151	0.369	351	-0.315	0.291
251	-0.511	0.415	352	-2.737	0.147
252	-0.307	0.366	353	-1.083	0.2
261	0.205	0.354	359	1.441	0.243
269	-0.278	0.385	361	-0.835	0.257
271	0.037	0.374	369	-0.248	0.145
272	-0.154	0.346			

	EXTFIN	TANG		EXTFIN	TANG
Mean	-0.312	0.261	Min	-4.381	0.094
SD	0.932	0.115	Max	2.940	0.720

TABLE A8. Industries with highest and lowest external finance

ISIC	Description	EXTFIN
	Largest/most vunerable	
242	Other chemical products	2.94
323	Television and radio receivers	1.544
359	Transport equipment n.e.c.	1.441
322	Television and radio transmitters	0.489
314	Primary cells and primary batteries	0.319
	Smallest/least vunerable	
160	Tobacco products	-4.381
352	Railway and tramway locomotives	-2.737
221	Publishing	-1.099
353	Aircraft and spacecraft	-1.083
342	Bodies for motor vehicles, trailers	-1.036

TABLE A9. Top industries with highest lowest asset tangibility

ISIC	Description	TANG
	Largest/least vulnerable	
201	Saw milling and planing of wood	0.72
210	Paper	0.495
251	Rubber products	0.415
171	Spinning and finishing of textiles	0.402
269	Nonmetallic mineral products n.e.c.	0.385
	Smallest/most vulnerable	
323	Television and radio receivers	0.094
181	Wearing apparel, except fur apparel	0.104
300	Office, accounting and computing machinery	0.114
160	Tobacco products	0.13
331	Medical appliances	0.132

In the list above, Tobacco (ISIC 160) is among the industries with the least tangible assets but is least dependent on external financial dependence. Tobacco is a controversial industry because it is considered most vulnerable by one measure (TANG) but least vunerable by the other measure (EXTFIN). Television and radio receiver (ISIC 323), is considered more financially vunerable by both measures.

TABLE A10. Pearson Correlation of Export variables

Description	GDP	GDP per capita	Private credit	External finance	Asset tangibility
No. of Exporters	0.573*	0.320*	0.372*	0.069*	-0.021*
No. of Entrants	0.571*	0.318*	0.356*	0.072*	-0.030*
No. of Surviving Entrants	0.588*	0.296*	0.318*	0.067*	-0.018*
No. of Incumbents	0.553*	0.317*	0.365*	0.067*	-0.014*
Export Value per Exporter	0.010*	0.050*	0.034*	-0.057*	0.036*
Export Value per Entrant	0.028*	0.013*	0.011	-0.045*	0.006
Export Value per Surviving	0.035*	0.010	0.011	-0.053*	0.006
Export Value per Incumbent	0.096*	0.038*	0.019*	-0.036*	0.033*

TABLE A11. Nest regression with exporter firm type only

VARIABLES	(1) Total exports	(2) Extensive margin	(3) Intensive margin
Log GDP	1.030***	0.572***	0.457***
	(0.095)	(0.104)	(0.073)
Private credit	1.694***	0.972***	0.722**
	(0.380)	(0.352)	(0.291)
Private credit × Asset tangibility	-2.394***	-0.970***	-1.423**
	(0.758)	(0.272)	(0.685)
Private credit × External finance	0.103	0.094**	0.009
	(0.067)	(0.042)	(0.062)
Observations	12,375	12,375	12,375
R-squared	0.681	0.766	0.455
Country FE	No	No	No
Country controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Exporters include all three firm types: incumbents, surviving entrants and non surviving entrants. Effects on Surviving entrants are similar to the separate regression

TABLE A12. Nested regression with two firm types: Incumbents and Entrants

VARIABLES	(1) Total exports	(2) Extensive margin	(3) Intensive margin
Log GDP	1.034***	0.576***	0.458***
	(0.092)	(0.105)	(0.056)
Private credit	1.945***	1.104***	0.841***
	(0.353)	(0.352)	(0.238)
Private credit × Asset tangibility	-1.207*	-0.574*	-0.633
	(0.689)	(0.303)	(0.596)
Private credit × External finance	0.061	0.081*	-0.020
	(0.062)	(0.044)	(0.053)
$I_{Entrant}$ × Private credit	-0.626***	-0.174*	-0.452***
	(0.191)	(0.087)	(0.140)
$I_{Entrant}$ × Private credit × Asset tangibility	-2.474***	-1.029***	-1.445**
	(0.757)	(0.243)	(0.557)
$I_{Entrant}$ × Private credit × External finance	0.035	0.034**	0.001
	(0.047)	(0.016)	(0.041)
Observations	24,750	24,750	24,750
R-squared	0.671	0.742	0.568
Country FE	No	No	No
Country controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE A13. Nested regression with three types of firms

VARIABLES	(1) Total exports	(2) Extensive margin	(3) Intensive margin
Log GDP	1.034***	0.572***	0.462***
	(0.095)	(0.107)	(0.046)
Private credit	1.918***	1.130***	0.788***
	(0.344)	(0.357)	(0.218)
Private credit × Asset tangibility	-0.705	-0.511*	-0.193
	(0.680)	(0.302)	(0.588)
Private credit × External finance	0.013	0.084*	-0.071
	(0.063)	(0.045)	(0.054)
$I_{Non-survivor}$ × Private credit	-0.561**	-0.162	-0.399*
	(0.266)	(0.103)	(0.210)
$I_{Non-survivor}$ × Private credit × Asset tangibility	-3.295***	-1.237***	-2.058**
	(1.075)	(0.306)	(0.822)
$I_{Non-survivor}$ × Private credit × External finance	0.106*	0.053***	0.053
	(0.060)	(0.019)	(0.049)
$I_{Survivor}$ × Private credit	-0.327*	-0.170***	-0.157
	(0.165)	(0.056)	(0.139)
$I_{Survivor}$ × Private credit × Asset tangibility	-1.728***	-0.504***	-1.223**
	(0.559)	(0.102)	(0.490)
$I_{Survivor}$ × Private credit × External finance	0.091*	0.009	0.082*
	(0.052)	(0.008)	(0.048)
Observations	37,027	37,027	37,027
R-squared	0.681	0.747	0.561
Country FE	No	No	No
Country controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE A14. Marginal effects of Initial Private Credit

Firm types	Exporter	Entrant	Incumbent	Survivor
Total Export sales	1.095**	0.871**	1.253***	1.203**
	(0.473)	(0.421)	(0.483)	(0.527)
Extensive margin	0.710	0.614	0.895*	0.725
	(0.474)	(0.497)	(0.478)	(0.542)
Intensive margin	0.385	0.257	0.358	0.478**
	(0.327)	(0.217)	(0.318)	(0.221)

The initial level of private credit to GDP ratio is set in 2003. The values in this table are calculated from based on estimation results reported in three tables following.

TABLE A15. Regression with Initial Value of Private Credit: Total Export Sales

VARIABLES	(1) Exporter	(2) Entrant	(3) Incumbent	(4) Survivor
Log GDP	1.127***	1.054***	1.140***	1.138***
	(0.108)	(0.093)	(0.109)	(0.110)
Initial Private credit	1.637***	1.365***	2.070***	2.036***
	(0.576)	(0.438)	(0.576)	(0.550)
Init. Private credit × Asset tangibility	-1.886*	-1.843***	-2.866**	-3.037***
	(1.105)	(0.573)	(1.133)	(0.711)
Init. Private credit × External finance dep.	0.165**	0.041	0.235***	0.139**
	(0.068)	(0.062)	(0.083)	(0.069)
Observations	17,885	16,044	15,626	12,590
R-squared	0.684	0.639	0.642	0.585
Country controls	Yes	Yes	Yes	Yes
Country FE	No	No	No	No
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

TABLE A16. Regression with Initial Value of Private Credit: Extensive Margin

VARIABLES	(1) Exporter	(2) Entrant	(3) Incumbent	(4) Survivor
lgdp	0.616***	0.591***	0.640***	0.599***
	(0.103)	(0.104)	(0.105)	(0.113)
Init. Private credit	1.004**	0.900*	1.294**	1.153**
	(0.475)	(0.495)	(0.485)	(0.536)
Init. Private credit × Asset tangibility	-0.973***	-0.995***	-1.332***	-1.498***
	(0.324)	(0.294)	(0.392)	(0.361)
Init. Private credit × External finance dep.	0.137***	0.092	0.178***	0.137**
	(0.049)	(0.055)	(0.051)	(0.061)
Observations	17,885	16,044	15,626	12,590
R-squared	0.768	0.752	0.750	0.730
Country controls	Yes	Yes	Yes	Yes
Country FE	No	No	No	No
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

TABLE A17. Regression with Initial Value of Private Credit: Intensive Margin

VARIABLES	(1) Exporter	(2) Entrant	(3) Incumbent	(4) Survivor
lgdp	0.511***	0.462***	0.501***	0.539***
	(0.076)	(0.042)	(0.076)	(0.046)
Init. Private credit	0.632	0.465*	0.776*	0.882***
	(0.446)	(0.243)	(0.419)	(0.253)
Init. Private credit × Asset tangibility	-0.913	-0.848*	-1.534	-1.539***
	(0.962)	(0.450)	(0.945)	(0.511)
Init. Private credit × External finance dep.	0.028	-0.051	0.057	0.002
	(0.062)	(0.054)	(0.069)	(0.047)
Observations	17,885	16,044	15,626	12,590
R-squared	0.450	0.348	0.394	0.316
Country controls	Yes	Yes	Yes	Yes
Country FE	No	No	No	No
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

TABLE A18. Robustness check: Excluding countries and sectors with highest shares of SOEs

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample			Edited sample		
VARIABLES	Total Export sales	Firm count	Avg. sales	Total Export sales	Firm count	Avg. sales
Log GDP	1.030***	0.572***	0.457***	0.948***	0.596***	0.352***
	(0.095)	(0.104)	(0.073)	(0.085)	(0.102)	(0.087)
Private credit	1.694***	0.972***	0.722**	1.565***	1.079**	0.486
	(0.380)	(0.352)	(0.291)	(0.391)	(0.410)	(0.344)
Private credit × Asset tangibility	-2.394***	-0.970***	-1.423**	-2.016**	-1.021***	-0.995
	(0.758)	(0.272)	(0.685)	(0.871)	(0.235)	(0.759)
Private credit × External finance	0.103	0.094**	0.009	0.088	-0.017	0.105
	(0.067)	(0.042)	(0.062)	(0.076)	(0.033)	(0.066)
Constant	-17.013***	-17.058***	0.044	-16.511***	-17.719***	1.208
	(2.090)	(2.032)	(1.550)	(1.881)	(2.067)	(1.711)
Observations	12,375	12,375	12,375	7,316	7,316	7,316
R-squared	0.681	0.766	0.455	0.670	0.762	0.425
Country FE	No	No	No	No	No	No
Country controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors of regression clustered at the country level
*** p<0.01, ** p<0.05, * p<0.1

APPENDIX C

SUPPLEMENTAL MATERIALS FOR CHAPTER IV

TABLE A19. Summary statistics of main variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Log growth of export quality SITC-4	135185	0.0048	0.1078	-2.9902	3.1832
Log growth of export quality SITC-2	221035	0	0.0557	-1.7461	1.9019
Initial quality SITC-4	148177	0.8612	0.1494	0	1.8538
Initial quality SITC-2	39106	0.8676	0.1338	0.0793	1.2845
Initial log GDP per capita	231850	9.1519	1.0344	5.8914	11.3031
Initial Private credit to GDP ratio	231850	0.4179	0.3514	0.0131	1.8651
Initial Domestic financial reform index	231850	0.5367	0.2992	0	1
Initial FDI net inflows to GDP ratio	231850	0.0263	0.0484	-0.0409	0.4107
Asset Tangibility	231850	0.3103	0.1235	0.0906	0.6708
External Financial dependence	231850	0.2956	0.2411	-0.4512	1.1401

The country-level variables are 'initial' values, meaning they are measured at the starting year of the five-year non-overlapping period (seven years include 1975, 1980, 1985, 1990, 1995, 2000, and 2005). GDP per capita, Private credit to GDP ratio, and FDI net inflows to GDP ratio are from World Development Indicator database, by The World Bank. Domestic Financial reform index is from the Financial Reform Database by the IMF (Prati et al., 2013; Abiad et al., 2010). Asset tangibility and External financial dependence are from Braun (2003)

TABLE A20. Example of 4 levels of SITC Rev.1

Level	Code	Description
SITC-1 digit	1	Beverages and tobacco
SITC-2 digit	11	Beverages
SITC-3 digit	111	Non alcoholic beverages, nes.
	112	Alcoholic beverages
SITC-4 digit	1121	Wine of fresh grapes including grape must
	1122	Cider and fermented beverages, nes.
	1123	Beer including ale,stout,porter
	1124	Distilled alcoholic beverages

TABLE A21. Summary statistics by country groups

Country group	Countries no.	Growth SITC4	Growth SITC2	Initial quality SITC4	Initial quality SITC2
High income	28	0.0032	0.0003	0.931	0.9621
Upper middle	27	0.0067	0.0002	0.8304	0.852
Lower middle	21	0.0062	-0.001	0.7544	0.7789
Low income	11	0.0048	0.0012	0.6822	0.6991

Country group	Log GDP per capita	Private credit	Financial reform	FDI net inflow	Obs.
High income	10.1646	0.6785	0.7008	0.04	88947
Upper middle	9.0875	0.3249	0.4802	0.0232	71157
Lower middle	8.2199	0.2025	0.3878	0.0135	53345
Low income	7.2072	0.1427	0.3935	0.0096	18401

Classification of countries is based on the World Bank's methodology (using GNI per capita for fiscal year 2011)

TABLE A22. Correlation matrix of country-level initial conditions

	LGDP per cap.	Private credit	FDI inflows	Financial reform
LGDP per cap.	1			
Private credit	0.6074	1		
FDI inflows	0.2835	0.312	1	
Financial reform	0.5644	0.5053	0.4174	1

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