

THREE ESSAYS ON INTERNATIONAL TRADE AND INFORMAL EMPLOYMENT

A Dissertation Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

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August 2020

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Acknowledgments

First and foremost, I would like to thank my dissertation committee. Georg Schaur, my committee chair, provided exceptional guidance, and encouraged me at every step of the dissertation writing process. I have benefited greatly from our conversations. Mohammed Mohsin, Scott Gilpatric, and Chad Autry, my committee members, have given me invaluable comments. I can say that this dissertation would not come to fruition without them. I also would like to say special thank you to Mrs. Anh Dao, Deputy Head of Financial System Division, Monetary and Financial Stability Department, State Bank of Vietnam, for her kindness to share the Vietnamese firm-level and household-level data with me. Without her permission to use the data, I would not have made headway in this dissertation.

Abstract

In this dissertation I use theory, empirics, and calibration with Vietnamese firm-level data which I obtain from the Statistics General Office of Vietnam to examine the effects of international trade and foreign direct investment on the hiring of informal employment.

In the first chapter, I study the effects of export opportunities on the share of informal employment across firms in an environment in which tariffs through demand volume and volatility can affect firms' hiring decisions. I demonstrate that the heterogeneity in productivity is a relevant factor in explaining changes in informality share. It is predicted that access to international trade reduces the incidence of informality if the effects of raising output on the demand for formal workers dominate the increased demand for informal workers due to the greater volatility. Using tariff data on the United States-Vietnam Bilateral Trade Agreement together with the Vietnam Enterprise Surveys, I find that greater export opportunities are significantly related to reductions in relative demand for informal employment, and focusing on cross section variation, more productive firms hire a lower share of informal workers. Larger firms respond less to tariff liberalization, so my findings suggest that access to international markets may be the most effective for smaller exporters to reduce informal employment.

The second chapter provides firm-level evidence of the relationship between foreign investment and informal employment. I examine the informality differentials between FDI and domestic firms and the informality spillover effect of FDI in the Vietnamese manufacturing sector. The results indicate that FDI firms not only create more jobs but

also reduce informality by creating relatively more formal jobs. Foreign multinationals offer higher wages than domestic firms even after controlling for differences in informality share. The prevalence of foreign direct investment generates a negative spillover effect in terms of informality share in domestic firms within an industry, but increases the informality level of domestic firms within a province.

In the third chapter, I analyze the effects of trade liberalization and foreign direct investment on labor informality in a dynamic general equilibrium model. I show that escalating import competition increases the size of the informal sector, inducing a reallocation of workers from the formal sector to informal firms. More specifically, the informal sector grows by 1.5% in response to a 10% drop in import tariffs. Alternatively, export opportunities diminish the level of informality, suggesting that a 10% drop in export tariffs reduces the size of the informal sector by 0.1%. Comparative advantage in wages motivates agents to reallocate labor between the two sectors. Moreover, the FDI analysis shows that a decline in the size of the formal sector is associated with increases in foreign direct investment. Quantitatively, a 10% increase in FDI reduces informal output and employment by 2%. This is because foreign firms bring intense competition that drives out both formal and informal domestic firms, creating a smaller informal labor market. The policy implication is that export and FDI liberalization should be employed to improve labor conditions by reducing the level of informality.

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Chapter 1

Exports and Informality: Firm-Level Theory and Evidence

1.1 Introduction

In Vietnam, informal employment is a major component of the labor market. Informal jobs are often associated with low job quality and bad working conditions. Countries struggling with informal employment consider trade liberalization as a potential policy to lift informal employees to formal employment and improve living standards.¹ For trade policy to deliver these benefits, firms must adjust their hiring decisions in response to trade liberalization. This paper extends the existing theory to examine firms' competing incentives to hire workers informally and to predict the potential consequences of trade liberalization. Firm-level data from Vietnam provide background information to support my modeling strategy and provide empirical evidence for my theory's predictions.

My data report the number of formal or informal workers employed by Vietnamese firms and provides three informative facts. First, firms either employ formal workers only, or they mix informal with formal workers. Rarely do firms work only with informal workers.

¹Colombia and India have similarly high levels of informal employment as found by Goldberg and Pavcnik (2003) for Columbia, by Nataraj (2011) for India, and by McCaig and Pavcnik (2015) for Vietnam.

Therefore, industry-level informal employment is determined by an extensive margin, the number of firms hiring informal workers, and an intensive margin, the number of informal workers that firms hire relative to formal workers. The second fact shows that these extensive and intensive margins vary widely to determine industries' employment of informal workers. Finally, the data provide evidence that firm heterogeneity is important to explain the share of informal workers in total employment.

My theory reconciles these facts. Saint-Paul (1997) shows that, if demand is volatile, then firms consider hiring informal workers because they are easier to fire in the case of bad demand shocks. However, firms always hire formal workers because they are more efficient. I extend this model to examine how firm heterogeneity in productivity affects firms' trade-off between hiring formal and informal workers. The theory shows that the effect of firm productivity on the intensity of informal employment depends on the monitoring costs. If monitoring costs increase in productivity, perhaps because firms get larger and employees have more opportunity to shirk, then smaller firms self-select into hiring informal workers. In that case, greater productivity predicts lower shares of informal employment. However, if more productive firms are also better at monitoring workers, then the model predicts that higher productivity is associated with greater shares of informal workers. Consequently, the relationship between firm productivity and hiring of informal workers is an empirical question.

The model also shows that export opportunities have an ambiguous effect on hiring informal workers. Conditional on firm productivity, an increase in a firm's labor force associated with increased sales reduces firms' incentive to hire informal workers. However, a potential increase in total sales volatility due to unstable export markets leads firms to shift to informal workers in order to minimize expected hiring and firing costs.

I use Vietnamese firm-level data to provide evidence that larger and more productive firms are less likely to hire informal workers and that these firms hire a lower share of informal workers. Based on my model, this is evidence that monitoring costs and productivity are

positively correlated. Next I provide evidence of how export opportunities affect firms' hiring of informal versus formal workers. I exploit the effect of tariff changes with respect to the U.S. market owing to the 2001 United States-Vietnam Bilateral Trade Agreement (BTA). I provide evidence that industries exposed to greater export opportunities reduce their relative demand for informal workers. I also show that larger firms respond less to the tariff reforms. This is consistent with the results that larger firms employ lower shares of informal employment before the trade liberalization. Combined, the empirical evidence shows that export liberalization leads smaller firms to move beyond hiring informal workers as they increase their sales, despite the potentially negative effects due to increased volatility.

Identification requires a measure of informal employment, firm productivity, and export opportunities. My data provide two measures of informal employment standard in the literature. One measure reports the number of workers without a formal contract, whereas in the other measure, informal workers are those to whom their employer does not contribute to social security. I focus on the former for my main results and examine robustness with respect to alternative definitions. I use firm size as a proxy for productivity. I employ two measures of export opportunity: the firm's export status and, following McCaig and Pavcnik (2018), export liberalization with respect to the U.S. While export status is an extensive measure, tariff liberalization provides an intensive measure, as I expect that industries with greater tariff liberalization saw a greater increase in export opportunity. Firms may engage in the informal labor market due to their location, industry, management, and ownership. Variation across firms and time allows us to mitigate potential omitted variable bias by using various sets of fixed effects. Finally, I examine the effect of clustering on standard errors for my various hypothesis tests.

Identifying the impact of changes in international trade environment on the share of informal employment is an on-going area of research. Empirical studies find industry-level evidence that trade can affect the extent of informality in developing countries. Paz (2014), who uses Brazilian data, finds that a decrease in import tariffs by Brazil's trade

partners reduces the share of informality in Brazil, but a reduction in the Brazilian import tariffs increases the share of informal labor. McCaig and Pavcnik (2018), using Vietnam household surveys, find evidence that export opportunities lead to a reallocation of workers from household businesses to the formal enterprise sector. Goldberg and Pavcnik (2003) also use St. Paul’s dual labor market model to motivate an empirical study of the effect of import tariffs on the share of informal employment in Brazil and Colombia. They find a slight increase in the informality share in response to import tariff cuts in Colombia but find no such effect in Brazil. Aleman-Castilla (2006) finds that increased access to the U.S. market decreases the informal employment in the Mexican tradable sector, whereas a reduction in Mexican import tariffs has no impact on the share of informal labor. Bosch et al. (2012) find little effect of reductions in the degree of trade protection on the changes in informality in Brazilian metropolitan labor markets. Menezes-Filho and Muendler (2011), who use Brazilian data, find no evidence that changes in import tariffs affect the probability that a worker will switch from a formal to informal job. Acosta and Montes-Rojas (2014) show that a decrease in import tariffs raises the industry-level share of informal employment for Argentinean manufacturing sectors. Fugazza and Fiess (2010), using different data sets and alternative definitions for informal labor, do not find any conclusive relationship between trade liberalization and informality share.

My paper contributes to the literature in several ways. First, I examine firm heterogeneity. My informative facts suggest that firm heterogeneity is relevant to explain the share of informal employment. This evidence complements the work of Paz (2014), who employs a heterogeneous firm model, but does not reconcile the empirical fact that most firms only use formal workers or mix formal with informal employees. Reconciling all three facts allows us to examine an alternative channel for the existence of informality because the Paz’s (2014) payroll tax compliance decisions channel is not significant in Vietnam.²

²My paper also complements the study by Ulyssea (2018), who explains the hiring of both formal and informal workers within a formal firm in Brazil, but does not examine the effect of trade on informal employment. In the theory, he supposes that firms face a “constant payroll tax on formal workers” and “an increasing and convex expected cost to hire informal workers.” This structure guarantees that firms mix

Second, I also examine sales volatility as a channel of informality. Sales volatility leads to an increase in the relative demand for the informal employment of a firm. This evidence extends the paper by Goldberg and Pavcnik (2003), who examine the relationship between trade liberalization and firm-level share of informality through the revenues channel. Third, the theoretical predictions and empirical results of the literature are mixed and far from conclusive. I provide firm-level evidence that greater export opportunities for Vietnamese firms decrease their relative informal employment. This evidence complements McCaig and Pavcnik (2018), who use a different Vietnamese dataset and find that export liberalization contributes to industry-level decreases in informality. Fourth, despite the prediction of standard trade models like Melitz (2003) that there are heterogeneous responses of firms to trade, little is known about how trade liberalization affects the hiring decisions on the informal labor of small firms differently from that of large firms. My results show that larger firms respond less to tariff liberalization, thus suggesting that smaller exporters benefit the most.

My empirics contribute to the current research that examines the relationship between volatility and trade at the micro level. For example, Čede et al. (2018) show that exporting has a positive impact on firm-level sales volatility for Estonia, Hungary, Romania, Slovakia, and Slovenia. Vannoorenberghe (2012) and Nguyen and Schaur (2010), using French and Danish data, find that higher export share is associated with higher sales volatility of the firm. In contrast, Buch et al. (2009) show that larger export share is related to a lower volatility of German firms. Kurz and Senses (2016), while examining the relationship between the volatility of employment growth and trade, find that U.S. exporters are less volatile than non-export firms. My paper focuses on the impact of exporting on the interquartile range of total output produced by Vietnamese firms. I find that export firms are more volatile than

informal and formal workers and that larger firms hire a lower share of informal workers. However, I think this channel is not suitable in the context of Vietnam due to different labor laws. In addition, the channel does not provide a good mechanism through which trade affects the hiring of informal workers.

non-exporters, raising firms' demand for informal employment. However, this positive effect is offset by the increase in size due to exporting.

My paper complements the empirical literature on the employment protection on employment dynamics. In particular, many papers examine a firm's motivation to hire temporary workers who do not have employment protection. For example, Devicienti et al. (2015), using Italian data, find firm-level evidence that unionization and demand volatility have a positive effect on the share of temporary workers. Saha et al. (2013) examine the impact of trade openness and worker bargaining power on the share of temporary workers across Indian industries. Caggese and Cuñat (2008) show that financing constraints affect firms' hiring decisions regarding temporary employment in Italy. Bosch et al. (2012) suggest that increased firing costs and unionization are associated with higher levels of informality across Brazilian industries. My paper suggests that firm-level sales volatility affects the hiring of informal workers (or temporary workers, depending on the context of the study).

The paper is organized as follows. Section 2 discusses the background and facts of labor informality in Vietnam. Section 3 presents the theoretical model and its predictions. In Section 4, I provide the empirical analysis of the relationship between export liberalization and the informality share, main results, and several robustness checks. Section 5 concludes.

1.2 Background on Informal Employment in Vietnam

My measure of informality reports the number of workers without formal employment contracts at the firm level in Vietnam. This definition of informality focuses on job quality and social protection across workers (Saavedra and Chong, 1999) and has been employed in theory and empirical work emphasizing the effect of firms' hiring decisions on informal employment (Goldberg and Pavcnik, 2003).³ I observe data from a representative survey of

³The complementary definition focuses on household businesses or self employment (McCaig and Pavcnik, 2018; Perry et al., 2007).

Table 1.1 Formal and Informal Firms 2002

Industry	Total number of firms	Share of formal firms	Share of mixed firms	Share of informal firms
Food processing	1,647	0.40	0.58	0.02
Tobacco products	21	0.48	0.52	0.00
Textiles	423	0.53	0.41	0.06
Wearing apparel, dressing and dyeing of fur	655	0.59	0.36	0.05
Leather, leather products and footwear	283	0.47	0.48	0.05
Wood and products of wood and cork	590	0.41	0.56	0.02
Paper and paper products	425	0.51	0.45	0.04
Printing and publishing	313	0.61	0.37	0.02
Coke, refined petroleum products and nuclear fuel	11	0.73	0.18	0.09
Chemicals and chemical products	426	0.64	0.34	0.02
Rubber and plastics products	549	0.57	0.38	0.06
Other non-metallic mineral products	828	0.49	0.50	0.01
Basic metals	149	0.57	0.41	0.02
Fabricated metal products	722	0.53	0.43	0.04
Machinery and equipment	278	0.54	0.42	0.03
Office, accounting and computing machinery	7	0.43	0.57	0.00
Electrical machinery and apparatus	180	0.63	0.33	0.03
Radio, television and communication equipment	87	0.72	0.24	0.03
Medical, precision and optical instruments	45	0.82	0.18	0.00
Motor vehicles, trailers and semi-trailers	173	0.49	0.48	0.03
Other transport equipment	254	0.53	0.45	0.02
Furniture manufacturing	530	0.47	0.48	0.04
Total	8,596	0.51	0.46	0.03

Notes: Formal firms are firms that use only formal workers. Mixed firms offer both formal and informal contracts. Informal firms employ only informal jobs.

Vietnamese firms with more than 10 employees covering the period 2002-2005.⁴ Firms are sorted into industries according to the Vietnam Standard Industrial Classification (VSIC) 1993. For summary statistics on the number of firms and incidence of firm-level employment, see Table 1.1. I focus on 127 distinct four-digit manufacturing industries. Data are collected by the General Statistics Office of Vietnam with the Vietnam Enterprise Surveys (VES).

A potential problem with all data reported on informal employment is that firms might misreport the number of their employees with contracts or those are contributed to social

⁴The survey responses were collected annually from 2000 to 2013, but consistent data on exports and measures of informal labor are only available from 2002-2005. In the empirical section, I will examine robustness with respect to alternative measures.

security. There are two reasons to believe this is not causing a systematic problem. First, under the Law on Statistics, all firms are legally required to comply with the survey. Second, firms have no reason to under report the number of temporary workers, because hiring temporary workers is legal in Vietnam.

For comparison with the existing literature, I decompose the change in the total number of employees without a formal labor contract from years 2002 to 2005 into within- and across-industry variation (Goldberg and Pavcnik, 2003; McCaig and Pavcnik, 2018; Paz, 2014). Let E_{jt} be industry j 's total number of workers in year t and i_{jt} be the share of informal workers in total employment. Define $E_j = 1/2(E_{j2002} + E_{j2005})$ and $i_j = 1/2(i_{j2002} + i_{j2005})$. The change in total informal employment from 2002 to 2005 is then $\Delta I = \sum_j \Delta i_{jt} E_j + \sum_j \Delta E_{jt} i_j$, where the first component measures within-industry variation and the second component measures across-industry variation. I find that informal employment decreased over this time period in Vietnam, and 88% of the decrease in informal employment is due to within-industry adjustment of informal employment. This is consistent with the findings in Paz (2014) and Goldberg and Pavcnik (2003), using different data sources and time periods. McCaig and Pavcnik (2018), using different data for Vietnam and time periods, find that the variation within and across industries is about equal, each accounting for about 50% percent.

With this industry variation in mind, I now develop three empirical facts that examine firms' role in determining informal employment.

Fact 1: Most firms use only formal employment contracts or mix formal with informal employment contracts.

Table 1.1 provides summary statistics across 2-digit industries for the year 2002.⁵ Columns (1)-(4) present the total number of firms, share of firms that only offer formal contracts, share of firms with formal and informal positions, and share of firms with only informal workers. The economy-wide share of firms that use informal labor is 49 percent, but this figure varies across industries. Most of the remaining firms hire only formal employees.

⁵Patterns are similar in other years.

This is consistent with Goldberg and Pavcnik (2003), who show that firms may maintain both types of employees to optimally respond to market volatility. This fact is inconsistent with Paz (2014), whose theory provides intuition that firms sort exclusively into formal and informal employment based on productivity. A possible reason is that my measure of informal labor is different. According to Paz’s theory and data, firms that use informal workers face the risk of getting caught and fined. In contrast, informal jobs are legal in Vietnam, and only misuse results in a monetary penalty.⁶

Goldberg and Pavcnik (2003) focus on a representative firm model and do not model a firm selection margin. Fact 1 suggests that the sorting mechanism is not quite as discrete as suggested by Paz (2014), but implies that firms sort between using only formal workers and mixing formal and informal workers. To examine this finding, let L_j^i be the number of informal employees in industry j and L_j be the total number of workers. Let N_j be the total number of firms and N_j^i be the number of firms that hire informal employees. Then, the intensity of informal workers, $\frac{L_j^i}{L_j}$, decomposes into a measure of average use of informal workers relative to the average use of formal workers, $\frac{L_j^i/N_j^i}{L_j/N_j}$, and an extensive margin measure of firms that employ informal workers, $\frac{N_j^i}{N_j}$, to obtain $\frac{L_j^i}{L_j} = \frac{L_j^i/N_j^i}{L_j/N_j} \frac{N_j^i}{N_j}$. In the extreme case of homogeneous forms or a representative firm, $\frac{L_j^i}{L_j} = \frac{L_j^i/N_j^i}{L_j/N_j}$. Therefore, all variation across industries is explained only by the intensive margin. To examine this, I regress $\ln\left(\frac{L_j^i}{L_j}\right)$ on $\ln\left(\frac{N_j^i}{N_j}\right)$ to obtain an R-squared of 28 percent.⁷

Fact 2: Across industries, both intensive and extensive variation in informal employment explain variation in average informal employment intensity.

⁶I consulted the data provider, the 1994 labor law, and, the 2002 and 2006 amended labor codes. Firms can legally have a no-contract employment relationship with a seasonal or short-term (1-3 months) worker. Hence, informal jobs in this data set do not necessarily capture the firms’ compliance with labor laws and involuntary informal labor. Weak law enforcement and workers’ lack of knowledge about their rights, however, allow for the possibility that some informal jobs do not meet basic legal requirements. A legal violation, for instance, occurs when the employer uses temporary/informal workers for long-term jobs.

⁷Note that the second component also captures covariance with the first component. If I regress on the first component, $\frac{L_j^i/N_j^i}{L_j/N_j}$, the residual variation explained by the second components is 13 percent. If I split the difference, then the second component explains about 20 percent of the variation.

If firm heterogeneity is important to explain the sorting of firms into using informal labor, then I expect that firm heterogeneity is also important to explain the intensity of informal labor used. To examine this, I first regress the firm-level shares of informal employment on an industry fixed effect and then add a firm fixed effect. The R-squared from these regressions are 0.07 and 0.38, suggesting that firm heterogeneity is important in explaining variation in the intensity of informal employment.

Table 1.2 Informality Share and Firm Heterogeneity

	(1)	(2)
Observations	45258	45258
Adjusted R-squared	0.07	0.38
Industry fixed effects	Yes	Yes
Firm fixed effects	No	Yes

Notes: The unit of observation in the pooled cross sectional data is firm. The dependent variable is the share of informal workers which equals the number of informal workers/total number of employment within a firm. The within adjusted R-squared in column 2 is estimated using the command "areg" in Stata.

Fact 3: Firm heterogeneity is a relevant factor to predict heterogeneity in the intensity of informal employment.

Existing theories don't reconcile all of my facts. Goldberg and Pavcnik (2003) provide intuition that firms may use both formal and informal workers, which is consistent with my Fact 1. Goldberg and Pavcnik (2003) do not provide intuition for Facts 2 and 3, which suggest a sorting of firms into varying intensities of informal employment. Paz (2014) provides intuition for the sorting of firms, but it is not consistent with Fact 1 that shows that firms may use both formal and informal workers. In the following section, I combine the models of Goldberg and Pavcnik (2003) and Paz (2014) to reconcile my empirical facts and provide a foundation for the empirical evidence related to the effects of trade liberalization and informal employment.

1.3 Theory

1.3.1 Production and Costs

In each period, a firm with productivity φ hires l_t units of labor to produce output q_t according to the production function $l_t = \frac{q_t}{\varphi}$. Following Goldberg and Pavcnik (2003) and Saint-Paul (1997), firms choose to either hire workers with a formal employment contract l_t^F or workers without a formal employment contract, l_t^I , such that $l_t = l_t^I + l_t^F$. For simplicity, informal workers are as productive as formal workers.

Firms monitor informal workers to observe their effort perfectly. Therefore, to hire an informal worker, the firm must pay the reservation wage $w_I = R$. Because monitoring informal workers is costly, in each period the firm also incurs the monitoring cost $m(\varphi)$ to observe an informal worker's effort. I consider two cases, constant monitoring costs and monitoring costs that are related to productivity, such that higher productivity is related to lower monitoring costs, $m'(\varphi) < 0$. In the case of informal workers, Davis and Harrigan (2011) show in theory that firms with better monitoring ability pay lower wages. For notational ease, I treat the relationship of the monitoring cost with productivity as understood. The total cost of hiring informal workers in any period is then $c(l_t^I) = (w_I + m)l_t^I$.

The firm offers efficiency wages for formal workers to prevent shirking and elicit effort. Let δ be the discount rate, x the probability of catching a shirker, and, ϕ_t the probability of firing a worker for reasons other than shirking, Saint-Paul (1997) shows that the efficiency wage in this case is

$$w_F = a + \frac{b}{1 - \phi_{t-1}} = R - \frac{1}{x} + \frac{1}{\delta x} \frac{1}{1 - \phi_{t-1}}.$$

Assuming that the the firing rule is uniform across all formal workers, $\phi_t = \max\{\frac{l_t^F - l_{t+1}^F}{l_t^F}, 0\}$, the cost of formal workers totals

$$c(l_t^F) = al_t^F + b \max(l_t^F, l_{t-1}^F).$$

The cost function has a kink. In any period, the firm must decide how many formal workers to employ, taking into account its stock of formal employees l_{t-1}^F . To increase in the pool of formal employees, the firm incurs the marginal cost $a + b$. However, to reduce the pool of formal employees, the marginal savings are only a . The intuition is straightforward. If the firm fires people, then due to the uniform firing rule, the retained employees demand a greater wage to perform. As a consequence, there is an adjustment cost. Firing people increases the cost of each retained worker.

Following Saint-Paul (1997) and Goldberg and Pavcnik (2007), I assume that $w_I + m > a + b$. Therefore, while it is possible that formal employees receive higher wages, the cost of hiring informal employees is greater due to monitoring costs.

1.3.2 Demand

The preferences of a representative consumer are given by a CES utility function with elasticity σ , where $\sigma > 1$. The demand for firm ω is:

$$q_{\omega t} = \theta_{\omega t} Q \left(\frac{p_{\omega t}}{P} \right)^{-\sigma},$$

Demand is subject to an idiosyncratic shock, θ_t . Q_t and P_t are the CES quantity and price aggregators that, in monopolistic competition, are determined endogenously. I focus on partial equilibrium and take $R_t = P_t Q_t$ as given.

1.3.3 Firm's Labor Demand

Combining demand with the production function and subtracting the cost of formal and informal workers, the value of the firm equals

$$\begin{aligned} V(l_t^F, \alpha_{t+1}) = & \max_{l_{t+1}^I, l_{t+1}^F} \alpha_{t+1} [\varphi(l_{t+1}^I + l_{t+1}^F)]^{\frac{\sigma-1}{\sigma}} - a l_{t+1}^F \\ & - b \max(l_{t+1}^F, l_t^F) - (w_I + m) l_{t+1}^I + \delta E_t V(l_{t+1}^F, \alpha_{t+2}) \end{aligned} \quad (1.1)$$

At the beginning of period $t + 1$, the firm observes the realization of the shock $\alpha_{t+1} = \theta_{t+1}^{\frac{1}{\sigma}} P_{t+1} Q_{t+1}^{\frac{1}{\sigma}}$. Based on this information and knowledge of the existing stock of formal employees l_t^F , the firm determines the optimal number of formal and informal workers to produce the optimal output to sell on the market.

In a static model, firms would exclusively hire formal workers because they are cheaper and as productive as informal workers. In this dynamic version of the efficiency wage model, firms take into account that hiring more formal workers affects future profits due to expected firing costs $\frac{\partial \delta E_t V(l_{t+1}^F, \alpha_{t+2})}{\partial l_{t+1}^F} = \delta k(l_t^F)$. Then, firms hire additional formal workers if the marginal revenue from increasing the labor force is greater than the marginal costs, including the expected marginal firing costs, and the marginal cost of hiring an informal worker exceeds the marginal cost of hiring a formal worker. On the other hand, firms hire additional informal workers if the demand shock is such that marginal revenues from increasing the labor force are greater than the marginal cost of hiring an informal worker and the marginal cost of hiring an informal worker is lower than the cost of hiring a formal worker. I formally distinguish these cases with the first-order conditions of (1.1) with respect to l_{t+1}^I and l_{t+1}^F .

Starting with the first-order condition (FOC) with respect to l_{t+1}^I I obtain:

$$\alpha_{t+1} \frac{\sigma - 1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_{t+1}^F)^{\frac{-1}{\sigma}} = w_I + m \quad \text{if} \quad \alpha_{t+1} \frac{\sigma - 1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^F)^{\frac{-1}{\sigma}} > w_I + m, \quad (1.2)$$

$$l_{t+1}^I = 0 \quad \text{if} \quad \alpha_{t+1} \frac{\sigma - 1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^F)^{\frac{-1}{\sigma}} < w_I + m \quad (1.3)$$

For a given choice of l_{t+1}^F , the firm increases its labor force with temporary workers if the marginal revenue exceeds the marginal cost. To determine the optimal choice of l_{t+1}^F and if the marginal cost of hiring temporary workers is lower, I require first-order conditions w.r.t. l_{t+1}^F . I distinguish three cases.

Case 1: Increase formal labor pool $l_{t+1}^F > l_t^F$:

$$\begin{aligned} \text{If: } & \alpha_{t+1} \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_t^F)^{\frac{-1}{\sigma}} > a + b - \delta k(l_t^F) \\ \Rightarrow & \frac{\partial V(l_t^F, \alpha_{t+1})}{\partial l_{t+1}^F} = \alpha_{t+1} \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_{t+1}^F)^{\frac{-1}{\sigma}} + \delta k(l_{t+1}^F) = a + b \end{aligned} \quad (1.4)$$

Case 2: Shrinking the formal labor pool $l_{t+1}^F < l_t^F$:

$$\begin{aligned} \text{If: } & \alpha_{t+1} \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_t^F)^{\frac{-1}{\sigma}} < a - \delta k(l_t^F) \\ \Rightarrow & \frac{\partial V(l_t^F, \alpha_{t+1})}{\partial l_{t+1}^F} = \alpha_{t+1} \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_{t+1}^F)^{\frac{-1}{\sigma}} + \delta k(l_{t+1}^F) = a \end{aligned} \quad (1.5)$$

Case 3: Maintaining the formal labor pool $l_{t+1}^F = l_t^F$:

$$\begin{aligned} \text{If: } & a \leq \alpha_{t+1} \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_t^F)^{\frac{-1}{\sigma}} + \delta k(l_t^F) \leq a + b \\ \Rightarrow & l_{t+1}^F = l_t^F \end{aligned} \quad (1.6)$$

Combined, the first-order conditions determine the relevant case and optimal l_{t+1}^I, l_{t+1}^F conditional on the demand shock α_{t+1} and stock of formal employees l_t^F at the beginning of the period. With slight modifications for my setup, Saint-Paul (1997), Appendix Chapter 4, shows that the solution exists. For a sufficiently high shock $\alpha_{t+1} > \underline{\alpha}$, the firm hires $l_{t+1}^F = \tilde{l}$ and l_{t+1}^I is determined by $\alpha_{t+1} \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} (l_{t+1}^I + l_{t+1}^F)^{\frac{-1}{\sigma}} = w_I + m$. The upper bound for formal labor, $\tilde{l}$, is determined implicitly by the relationship

$$a + b - w_I - m = -\delta \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{\frac{-1}{\sigma}} \int_{\alpha_m}^{\alpha_M} G(\alpha) d\alpha, \quad (1.7)$$

where $\alpha_m = \frac{w_I + m - b}{\frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{\frac{-1}{\sigma}}}$ and $\alpha_M = \frac{w_I + m}{\frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{\frac{-1}{\sigma}}}$. Let s_{t+1}^I be the share of informal workers a firm hires in any given period. Then, based on the first-order conditions and the solution to the optimization problem, I can show the following proposition.

Proposition 1.1. (i) If $\frac{\partial m}{\partial \varphi} = 0$, then $\frac{s_{t+1}}{\partial \varphi} = 0$ (ii) If $\frac{\partial m}{\partial \varphi} = -\Theta < 0$, then $\frac{s_{t+1}}{\partial \varphi} > 0$. (iii) If $\frac{\partial m}{\partial \varphi} = \Theta > 0$, then $\frac{s_{t+1}}{\partial \varphi} < 0$.

Proof: see Appendix [A.1](#).

The first case shows that an increase in productivity does not affect the share of informal labor if the relative cost of hiring informal and formal workers remains the same. The reason for this is that an increase in total factor productivity does not affect relative productivity. Therefore, as productivity increases, firm proportionately increases formal and informal employment. This case is consistent with Paz (2014), according to which the share of informal employment does not depend on firm productivity. The second case shows that, if the cost of hiring informal employees decreases as productivity increases, then the share of informal employees increases as a firm become more productive. In other words, if firms that are more productive are also better at monitoring workers, then the increase in total factor productivity is also associated with a decrease in the relative cost of informal workers, and firms shift into informal employment. On the other hand, if firms that are more productive incur greater monitoring costs, then more productive firms shift into formal labor. A reason for this could be that monitoring costs increase as workers have to work with newer technologies that require more supervision. An alternative explanation could be that larger firms incur greater costs of acquiring information about informal personnel.⁸

Combined, proposition 1 suggests that the relationship between productivity and the demand for informal employment is an empirical question. As standard trade models suggest that mostly high productivity firms engage in export activity (Melitz, 2003), this relationship is important in determining the effect of export opportunities on the demand for informal relative to formal employment. However, given the heterogeneity in productivity, it is not obvious which firms likely employ informal workers. I examine this with the following proposition.

⁸Many studies focus on the assumption that larger employers have more difficulty monitoring workers to explain the size-wage relationship (see Garen (1985), Barron et al. (1987), Brown and Medoff (1989), and Ferrer and Lluís (2008)).

Proposition 1.2. *(i) If $\frac{\partial m}{\partial \varphi} = 0$, then the probability of hiring informal workers does not depend on productivity. (ii) If $\frac{\partial m}{\partial \varphi} < 0$, then firms with greater productivity are more likely to hire informal workers (iii) If $\frac{\partial m}{\partial \varphi} > 0$, then firms with greater productivity are less likely to hire informal workers.*

For proof, see [A.1](#). Proposition 2 establishes which firms I expect to hire informal workers. Again, this is an empirical question. Whether firms that are highly productive and therefore likely engaged in export activity also are the firms that are likely to hire informal workers depends on whether greater productivity is also associated with lower monitoring costs.

1.3.4 Export Liberalization

How does trade liberalization affect firms according to my model? Goldberg and Pavcnik (2003) assume that the representative firm is a price taker and that prices follow a cumulative distribution function, say $F(P)$. They logically argue that import competition reduces prices on the domestic market and therefore leads to a new distribution such that $F^*(p) > F(p)$, and the expected price under liberalized trade is lower, $E_{F^*}(p) < E_F(p)$. They prove that this change in distribution reduces $\tilde{l}$, the maximum number of formal workers a firm would be willing to employ. Instead of considering price-reducing import competition, I examine demand-increasing export opportunities. As such, I assume that export liberalization leads to a new distribution of revenues shocks, $G^*(\alpha) < G(\alpha)$, and therefore increases the expected revenue shock $E_{G^*}(\alpha) > E_{G(\alpha)}$. I obtain the following proposition.

Proposition 1.3. *If trade liberalization increases revenue shocks such that $G^*(\alpha) < G(\alpha)$, then export liberalization will increase formal employment $\tilde{l}$*

Proposition 3 is the reverse to Goldberg and Pavcnik (2003). As firms realize export opportunities, increased revenues lead them to increase formal employment. On

the other hand, two mechanisms may still increase informal employment relative to formal employment. First, the new distribution realizations of the shock may be such that firms hire even more informal workers.

Second, Saint-Paul (1997) shows that, if the new distribution is more volatile compared to the distribution without export opportunities, then this may cause export activity to increase the relative demand for informal employment. Existing results show that sales volatility may indeed be associated with export activity (Vannoorenberghe, 2012; Giovanni and Levchenko, 2009; Nguyen and Schaur, 2010).

My combined results show that the effect of productivity and export activity on the relative demand for informal workers is an empirical question. In the next section, I deliver an identification strategy to inform my and other existing theories on the direction and magnitudes of these relationships.

1.4 Empirics

1.4.1 Additional Data

Trade Policy and Export Status

To estimate the relationship between trade and informal employment, I merge my data on informal employment from the background section with export activity and trade policy. Following McCaig and Pavcnik (2018) I construct industry-level trade policy measures based on the US-Vietnam Bilateral Trade Agreement which was implemented in December of 2001. The trade policy agreement immediately reduced the U.S. tariffs on Vietnamese exports from Column 2 to most-favored nation status. In my analysis, I follow McCaig (2011) to calculate the U.S. industry-level tariffs on Vietnam exports pre- and post-BTA. I use the 2001 U.S. tariffs downloaded from the U.S. International Trade Commission’s online Tariff Information Center. I then compute the ad valorem rate of any tariff lines by converting specific rates

to ad valorem equivalent rates. Next, I match these tariff lines to industries in order to construct industry-level tariffs according to 4-digit ISIC nomenclature.⁹

My identification strategy relies on 6 features of the U.S tariff reductions discussed in McCaig and Pavcnik (2018): (1) The magnitude of tariff cuts is large. (2) The tariff cuts varied across manufacturing industries. (3) The tariff declines significantly increased the volume as well as the share of Vietnamese exports to the U.S. (4) The BTA tariff reductions are not correlated with global demand shocks for Vietnamese exports. (5) The tariff declines are not correlated with pre-existing industry trends and levels. (6) The tariff cuts are exogenous. Table 6 in the appendix provides descriptive statistics for manufacturing firms in the pre-BTA, post-BTA, and 2010-2013 periods.

Firms at the beginning of the year 2002 are assigned with the pre-BTA tariffs. The BTA was implemented in December 2001. Due to the lack of data availability on informal labor in 2000 and 2001, I use the calculated share of informal workers at the beginning of the year for four years: 2002, 2003, 2004, and 2005. Firms at the beginning of the year 2003, 2004, and 2005 are assigned with the post-BTA tariffs. Thus, my results may underestimate the impact of the BTA on firms' share of informal labor.

In addition to exploiting policy changes at the industry level, I also examine the relationship between firms' export status and informal employment. I obtain the firms' export status from the Enterprise Surveys. Unfortunately, I do not observe product or destination-level export transaction. However, the theory predicts that the levels and volatility of sales due to export activity may affect the demand for informal workers. To examine if these channels explain my results, I collect data on the total production for a subset of manufacturing firms covered by the enterprise survey. I match the product data with the firm-level data. This allows us to examine if export activity in Vietnam is associated with mean shifts and changes in the volatility of production.

⁹I use the package named 'H2 to ISIC Rev 3', which is available via the World Integrated Trade Solution database. <http://wits.worldbank.org/product-concordance.html>

1.4.2 Empirical Models and Identification

I start by exploiting large heterogeneous tariff cuts by the trade agreement to investigate the relationship between trade policy and the demand for informal workers in the enterprise sector in Vietnam. I relate both the share of informal workers and an indicator for whether the firm employs any informal workers to BTA tariff across manufacturing industries:

$$Y_{jspt} = \beta_0 + \beta_1 \tau_{st} + \beta_2 labor_{jspt} + \gamma_p + \lambda_s + \theta_t + \epsilon_{jspt}, \quad (1.8)$$

The dependent variable Y_{jspt} stands for the share of informal employment computed as the number of temporary workers divided by the total work force in firm j in industry s of province p in year t . In an alternative specification, I let Y_{jspt} be an indicator that equals one if the firm hires informal workers. τ_{st} is the U.S. tariffs on Vietnamese exports across industries and time. I proxy productivity with firm size, computed as log of total employment, $labor_{jspt}$. I also examine robustness with respect to an alternative measure of productivity. To account for unobserved variables, I include province, industry, and year fixed effect, γ_p , λ_s , and θ_t , respectively. To account for firm-level unobservables, I also experiment with firm-level fixed effects to account for productivity differences.

The main parameter of interest is the coefficient on tariffs. A positive coefficient ($\beta_1 > 0$) suggests that tariff reductions are associated with a decline in the share of informal workers in a firm and a decrease in the probability of using informal workers. The coefficient on firm size captures the impact of firm heterogeneity and examines the mechanisms explained in Proposition 1.

Identification requires that changes in tariff are independent of firms' demand for informal employment. I follow the literature and take the tariff measure as exogenous. Industry and province fixed effects account for institutional differences that may be correlated with the local labor market and export activity. Sector fixed effects account for varying production technologies that may favor temporary versus permanent work. For example, if

jobs require intensive training, then this would lead firms to prefer permanent employees. If these industries also benefit the most from trade liberalization, then omitting this information might bias my estimates.

A potential threat to identification is the spurious correlation between my dependent variable, the share of informal workers, and the contemporaneous total workforce. This is less of a problem in the probability specifications, but is a concern when I examine the effect of trade policy on the share of informal workers. I address the spurious correlation issue by replacing the contemporaneous labor with either the lag of employment or labor in the year 2001. I also use lag of labor or employment in 2001 to instrument for the contemporaneous labor variable.

My theory predicts heterogeneity across firms. Highly productive firms may rely more or less on informal workers depending on their compensation. Therefore, effects of trade liberalization may vary across firms. I do not observe firm-level exports, but interacting tariff changes with my proxy for productivity allows for heterogeneous trade effects across the productivity distribution consistent with standard trade models. To examine this prediction, I add an interaction term between labor and tariffs to obtain:

$$Y_{jspt} = \beta_0 + \beta_1\tau_{st} + \beta_2labor_{jspt} + \beta_3\tau_{st} * labor_{jspt} + \gamma_p + \lambda_s + \theta_t + \epsilon_{jspt} \quad (1.9)$$

The addition of the interaction term implies that the partial effect of tariffs on the share of informal workers for an average firm is equal to $\beta_1 + \beta_3 * \bar{labor}$, where $\bar{labor}$ is the average employment of the sample.

While I do not observe firm-level trade flows, I do observe an export status indicator. I exploit this information and repeat my empirical models, including the export status indicator instead of the industry-level tariff changes. The advantage of this indicator is that it introduces firm-level variation. The disadvantage is that, for exporting firms that

Table 1.3 Effect of U.S. Tariffs on Informal Employment Share

	(1)	(2)	(3)	(4)	(5)
Tariff (τ)	0.041** (0.017)	0.17*** (0.030)	0.035* (0.018)	0.043** (0.018)	0.122*** (0.036)
$Labor_t$	-0.009*** (0.001)	-0.006*** (0.001)		0.034*** (0.004)	0.036*** (0.004)
Interaction		-0.029*** (0.006)			-0.017*** (0.006)
Industry FE	Yes	Yes	No	No	No
Province FE	Yes	Yes	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes	Yes
N	43655	43655	43655	43655	43655

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

just export volumes due to trade liberalization, this indicator does not capture that variation. The above specifications using tariff changes are better suited for that type of adjustment.

Lastly, an additional concern may arise beyond my definition of informality. In addition to my main definition of informality, the data also report employees without social security in 2010-2013. Thus, to be sure that my findings are robust to different informality definitions, I repeat my previous analysis for the latter period.

1.4.3 Main Results

Table 1.3 reports the results from my regression of the share of informal workers on U.S. import tariffs and firm size. Column (1) reports the baseline specification. The coefficient on tariffs is positive and significant. Firms in industries that experienced greater export opportunities due to U.S. tariff liberalizations reduced their relative demand for informal workers. A 1 percentage point reduction in tariffs in a given industry reduces the share of informal workers by about 0.04 percentage points.

Columns (2) augments the baseline specification with the interaction of total employment and tariffs to examine heterogeneity in the tariff effect. Larger firms respond less to

tariff liberalization. This seems counterintuitive, as I would expect from standard trade theory that especially large firms benefit from more access to international markets. On the other hand, the baseline specification shows that larger firms already employ lower shares of informal workers. Therefore, access to international markets may be most effective for smaller exporters to reduce informal employment.

Column (3) reports results when I control for productivity differences with a firm fixed effects instead of firm size. The coefficient on tariff liberalization is similar to the baseline specification. Column (4) augments this specification with total firm size. Note that, in this specification, the effect of firms size switches to a positive effect. Remember that, with firm fixed effects, this coefficient is identified from within variation. While column (1) shows that with cross section variation, larger firms hire a lower share of informal workers, focusing on within-variation firms that increase size over the sample period shift into informal workers. A plausible explanation is that firm fixed effects focus identification of short-term variation. In the short term, firms that expand do so by increasing the share of temporary workers. In column (5) I again examine heterogeneity in the effect of tariff liberalization. Firm fixed effects do not change the conclusion. Larger firms adjust informal employment shares by less in response to tariff liberalizations.

Table 1.4 reports the results from my probability model. Coefficient signs are similar as when I focus on the share of informal employment, but I lose significance. Nevertheless, when I account for heterogeneity in the effect of tariff liberalization on the probability of hiring informal workers, the results corroborate the conclusions from the estimates on employment composition. In particular, tariff liberalization reduces the probability of hiring informal workers. Focusing on cross-section variation, larger firms are less likely to hire informal workers. Conditioning on firm fixed effects shows that increases in the work force are positively associated with the probability of hiring informal workers, similar to the share regressions.

Table 1.4 Effect of U.S. Tariffs on Probability of Informal Employment

	(1)	(2)	(3)	(4)	(5)
Tariff (τ)	0.001 (0.032)	0.114* (0.058)	0.007 (0.034)	0.02 (0.034)	0.307*** (0.066)
$Labor_t$	-0.21 (0.002)	-0.018*** (0.002)		0.064*** (0.006)	0.071*** (0.007)
Interaction		-0.025** (0.011)			-0.063*** (0.012)
Industry FE	Yes	Yes	No	No	No
Province FE	Yes	Yes	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes	Yes
N	43655	43655	43655	43655	43655

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

I draw several conclusions. The results show that firm heterogeneity is important to understand the effect of trade liberalization on informal employment. I reject the base case of proposition 1 that relative costs of hiring informal workers are constant across firms. Cross-section variation traces differences in firm size due to variation in productivity. Estimates based on this source of variation therefore examine the relationship between exporting, firm size, and the workforce composition most closely related to my theory.

My results allow us to draw several conclusions with respect to my theory. According to propositions 1 and 2, firm heterogeneity is related to the informal employment composition if relative costs of informal to formal workers vary systematically with firm size. My results are consistent with the intuition that large firms have greater relative costs of hiring informal workers than small firms. As a consequence, because large firms hire a lower share of informal workers, they also respond less in terms of employment composition to changes in export opportunities.

The results also show that the benefits of export opportunities to reduce informal employment dominate the informality-increasing channel due to the greater uncertainty based on volatile export markets. This could be the case for two reasons. First, exporting raises the level of production, and this channel dominates the increase in volatility. Second,

Table 1.5 Export Status, Total Output and Volatility

	OLS		Interquartile (0.05-0.95 quantiles)	
	(1)	(2)	(3)	(4)
Export	1.126*** (0.05)	0.171*** (0.054)	0.913*** (0.104)	0.651*** (0.116)
Labor		0.588*** (0.019)		0.144*** (0.03)
Observations	57262	52636	57262	52636

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. I use data on export status when it is available in 2000-2005 period except the year 2001. The drop in observations is due to missing labor variable. In columns (3) and (4), the standard errors are bootstrapped. All regressions include 2-digit industry and year fixed effects.

the U.S. is a relatively stable export market and actually lowers firms' total sales volatility. To examine this, I estimate the effect of exporting on the mean of log-total-output produced and the 5th-95th interquartile range. Table 1.5 reports the results. Exporting firms produce more output, but also experience a greater spread around the median. When I do not control for firm size in columns (1) and (3), this could be due to the heterogeneity in productivity or heterogeneity in sales shocks. In columns (2) and (4), I control for firm size to better isolate the effect of exporting on volatility due to demand variation. Based on my theory, I conclude that the effects of raising output on the demand for formal workers dominate the increased demand for informal workers due to the greater volatility.

A natural follow up empirical question is whether sales volatility affects firms' hiring of informal employment. I follow Nguyen and Schaur (2010) to construct a measure of sales volatility based on total sales of a firm. Following Kurz and Senses (2016) for the measure of intensity, I calculate the informal employment intensity as average informal workers as a fraction of average total workers over the years. I then regress the informal labor intensity on sales volatility and industry fixed effects. The assessment for proposition 3 is displayed in Table 1.6. Firms that experience larger sales volatility increase their hiring of informal workers. This result is consistent with my prediction.

To examine the effects of export status further, in Table 1.7 I report the effects of export status and firm size on the share and probability of hiring informal workers. Without firm

Table 1.6 Effect of Sale Volatility on Informal Employment Intensity

	Share of Informal Workers		Indicator of Informal Workers	
	2002-2005 (1)	2006-2013 (2)	2002-2005 (3)	2006-2013 (4)
Sales volatility	0.021* (0.011)	0.098*** (0.013)	0.044** (0.019)	0.061*** (0.014)
Industry FE	Yes	Yes	Yes	Yes
Number of firms	4561	4963	4561	4963

Notes: Robust standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Column (2) uses an alternative measure of informal employment because the data report number of workers who do not receive social security from their employer during the period 2006-2013.

Table 1.7 Export Status and Informal Employment

	Share of Informal Workers		Indicator of Informal Workers	
	(1)	(2)	(3)	(4)
Export status	-0.013*** (0.004)	-0.005 (0.007)	-0.036*** (0.008)	-0.014 (0.012)
$Labor_t$	-0.008*** (0.001)	0.043*** (0.006)	-0.02*** (0.002)	0.079*** (0.009)
Industry FE	Yes	No	Yes	No
Province FE	Yes	No	Yes	No
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
N	30527	30527	30527	30527

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

fixed effects, the results are consistent with the industry-level tariff reductions. Exporting reduces the probability and share of informal workers. When including firm fixed effects, the results on export status are insignificant. This suggests that it is not the export extensive margin that drives changes in the share and probability of hiring informal workers. Consequently, the significant effects of tariff changes on informal employment with firm fixed effects are likely due to increases in the intensive margin. Two caveats apply. First, I do not observe the extensive margin at the destination level, and I can therefore not examine it.

Table 1.8 Effect of U.S. Tariffs on Informal Employment Share, Using Lagged Employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tariff(τ)	0.016 (0.019)	0.167*** (0.035)	0.016 (0.019)	0.181*** (0.038)	0.039* (0.02)	0.139*** (0.038)	0.036* (0.02)	0.143*** (0.04)
$Labor_t$			-0.011*** (0.001)	-0.008*** (0.002)			-0.017*** (0.002)	-0.013*** (0.002)
$Labor_{t-1}$	-0.01*** (0.001)	-0.007*** (0.001)						
$Labor_{2001}$					-0.015*** (0.002)	-0.012*** (0.002)		
Interaction		-0.032*** (0.006)		-0.034*** (0.006)		-0.021*** (0.006)		-0.02*** (0.007)
Instrument variable	No	No	$Labor_{t-1}$	$Labor_{t-1} * \tau$, $Labor_{t-1}$	No	No	$Labor_{2001}$	$Labor_{2001} * \tau$, $Labor_{2001}$
N	31067	31067	31067	31067	19340	19340	19340	19340

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. All columns include year, province, and industry fixed effects.

Second, limited reporting of export status reduces the sample compared to my estimation sample with industry-level tariff reductions.

1.4.4 Robustness Checks

I undertake several robustness checks to test the sensitivity of the results to the replacement of contemporaneous labor variable with lags of employment, an alternative measure of productivity, the inclusion of small firms (firms that have fewer than 10 workers), a different definition of informality, and more aggregated cluster-robustness. I conduct a robustness exercise in which I re-estimate the coefficients in Table 1.3 columns (1) and (2) using lagged employment and initial employment in 2001. I also use lagged labor and employment level in 2001 to instrument for the contemporaneous employment. The estimates are reported in Table 1.8, and these results are statistically significant and similar to those in Table 1.3 for U.S. import tariffs when I account for heterogeneity in the effect of tariff liberalization on the share of informal employment.

Table 1.9 Effect of U.S. Tariffs on Informal Employment Share, Using an Alternative Measure of Productivity

	(1)	(2)	(3)	(4)
Tariff(τ)	0.040** (0.019)	0.071*** (0.023)	0.035* (0.020)	0.052** (0.024)
TFP	-0.024*** (0.002)	-0.021*** (0.002)	-0.011*** (0.003)	-0.010*** (0.003)
Interaction		-0.027*** (0.010)		-0.014 (0.011)
Industry FE	Yes	Yes	No	No
Province FE	Yes	Yes	No	No
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes
N	36580	36580	36580	36580

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In the second robustness check, I adopt an alternative measure of productivity which is TFP.¹⁰ The results are shown in Table 1.9. The tariff estimated coefficients are statistically significant in all specifications.

Small firms are less likely to export and more likely to hire informal workers. The exclusion of firms with fewer than 10 workers may bias the results. Therefore, my third robustness exercise adopts the full sample which includes all registered firms. The estimates are displayed in Table 1.10, and these results are consistent with those in Table 1.3

In the next robustness check, I re-estimate specifications in Table 1.7 using the 2010-2013 sample, which considers an alternative definition of informality, in which informal workers are individuals who do not have social security. The results are displayed in Table 1.11. The estimated coefficient for export status is negative and statistically significant at the 1% level in all columns, which provides a strong robustness check to the result in Table 1.7.

Because the choice of using cluster-robustness in panel data usually affects standard errors and the significance of the estimated coefficients, I cluster SEs in the specifications from

¹⁰TFP is measured following Olley and Pakes's (1996) method.

Table 1.10 Effect of U.S. Tariffs on Informal Employment Share, Including All Firms

	(1)	(2)	(3)	(4)	(5)
Tariff	0.039** (0.015)	0.093*** (0.026)	0.048*** (0.016)	0.055*** (0.016)	0.082*** (0.031)
Labor	-0.015*** (0.001)	-0.014*** (0.001)		0.029*** (0.004)	0.029*** (0.004)
Interaction		-0.013*** (0.005)			-0.006 (0.006)
Industry FE	Yes	Yes	No	No	No
Province FE	Yes	Yes	No	No	No
Year FE	yes	yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes	Yes
N	56630	56630	56630	56630	56630

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 1.3 at industry and industry-year levels. The results are presented in Table 1.12. As I expect, cluster-robustness by industry and two-way cluster-robustness by industry and year increase SEs and turn the tariff coefficient to insignificance in some specifications. However, I can see in columns (2), (4), (5), (6), and (7) that the estimated coefficient for tariff is still statistically significant.

1.5 Conclusions

This paper sheds light on the relationship between trade policy and informal employment theoretically and empirically. My theoretical model shows two opposite channels through which trade affects firms' hiring of informal workers. First, conditional on firm productivity, an increase in a firm's labor force associated with increased export volume reduces the firm's incentive to hire informal workers. Second, a potential increase in total sales volatility due to unstable markets causes firms to shift to informal workers in order to minimize their expected hiring and firing costs. I also examine the relationship between firm productivity and the hiring of informal workers, which turns out to be an empirical question.

Table 1.11 Export Status and Informal Employment 2010-2013, Using an Alternative Definition of Informality

	Share of Informal Workers		Indicator of Informal Workers	
	(1)	(2)	(3)	(4)
Export status	-0.122*** (0.004)	-0.026*** (0.004)	-0.036*** (0.005)	-0.024*** (0.006)
$Labor_t$	-0.082*** (0.001)	0.089*** (0.004)	-0.029*** (0.002)	0.115*** (0.005)
Industry FE	Yes	No	Yes	No
Province FE	Yes	No	Yes	No
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
N	93849	93849	93849	93849

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

I assess my theories on the direction and magnitudes of these relationships using data from Vietnam Enterprise Surveys. I find that firms reduced their relative demand of informal workers in the industries with larger tariff cuts and that larger firms respond less to export liberalization. This finding and the predictions in my theories point to the conclusion that the U.S. tariff liberalization led to the dominance of effects of raising output on the demand for formal workers over the increased demand for informal workers due to the greater volatility. For my probability model, since some estimates are not statistically significant at the 10% level, they provide mild support to my previous conclusion. Another important finding is that increased intensive margins of exports are likely to be associated with reductions in probability and the share of informal workers. For the effect of productivity on informality, I find that larger firms hire a lower share of informal workers, whereas focusing on within-variation firms that expand do so by increasing the relative demand for informal workers.

It is safe to say that access to international markets may be the most effective for smaller exporters to reduce informal employment in developing countries, according to the share of informal workers employed by a firm. Given the promising result for firms in

Table 1.12 Effect of U.S. Tariffs on Informal Employment Share, with Cluster Robust at Industry-year Level

	Cluster-robust by industry					Two-way cluster-robust by industry and year				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Tariff(τ)	0.041 (0.029)	0.17*** (0.042)	0.035 (0.023)	0.043** (0.021)	0.122*** (0.035)	0.041** (0.017)	0.17*** (0.028)	0.035 (0.028)	0.043 (0.023)	0.122 (0.061)
$Labor_t$	-0.009*** (0.002)	-0.006** (0.003)		0.034*** (0.005)	0.036*** (0.006)	-0.009*** (0.002)	-0.006*** (0.002)		0.034** (0.01)	0.036** (0.01)
Interaction		-0.029*** (0.008)			-0.017** (0.007)		-0.029*** (0.005)			-0.017 (0.011)
Industry FE	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Province FE	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
N	43655	43655	43655	43655	43655	43655	43655	43655	43655	43655

Notes: Standard errors in parentheses and are clustered at firm level * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Vietnam, studying the impacts of trade reforms on informality in other developing countries remains an important topic for future research.

Chapter 2

FDI and Informality: Evidence from Vietnam

2.1 Introduction

Empirical evidence suggests that multinationals are larger, more productive, and pay higher wages than domestic firms.¹ This argument has been used to justify promotion policies to attract foreign direct investment (FDI) in many developing countries. However, while foreign multinationals may contribute to increased employment and the development of human capital in the host country, little is known about the interaction between foreign ownership and informality. In these developing countries, a substantial share of employment is in the informal sector, in which workers experience worse working conditions and fewer benefits. Thus, attracting FDI can potentially be considered to be policy importance if increased FDI boosts economic growth by drawing labor demand from the informal sector.

¹Foreign firms pay higher wages than domestic firms because they are inherently larger, more productive, and higher capital-intensive than local firms. Chen et al. (2011) argue that there are several alternative reasons that may not be observable in data. First, foreigners may have to pay higher wages than domestic firms to attract best employees. Second, foreign firms may offer higher salaries in order to lower “labor turnover and thus minimize the leakage” of their technological advantages. Third, workers prefer domestic to foreign firms because they may experience greater pressure and higher labor demand uncertainty in FDI firms than in domestic firms.

In this paper, I identify the direct and indirect effects of FDI on informal worker allocation across firms using a Vietnamese firm-level data set, from which I construct a measure of informality that reports the number of workers without social security or worker benefits at the firm-level.² This paper addresses the following questions: (1) Do FDI firms demand a lower share of informal employment? (2) Does the presence of FDI create spillover effects? There are multiple channels that result in a lower demand of informal workers. First, foreign firms may use a different technology that requires a higher share of formal workers.³ Second, due to the possession of enhanced technology, know-how, and managerial practices, such firms try to reduce worker turnover and thus minimize technology leakage by replacing temporary jobs with formal positions that afford higher job satisfaction. Third, foreign investors may face greater training and monitoring costs on informal workers, because they are not accustomed to working with them. Fourth, foreign owned firms are less volatile in production and thus minimize labor costs by hiring more formal workers.⁴ In contrast, foreigners hire relatively more informal workers if, instead of being less volatile, foreign firms' sales are more volatile.

An additional question is how the prevalence of FDI affects labor informality in the host country. Current theories present ambiguous predictions on the effects of FDI on the local economy. The two proposed channels are technology externalities and competition effects. For example, technology externalities (or agglomeration effects) diffused from foreign investment may improve the productivity of domestic firms through channels such as labor pooling, imitation, and backward and forward linkages. The competition effect of FDI is ambiguous. Hence, the spillover effect of foreign participation on the demand for informal workers is clearly an empirical question.

²The definition focuses on job quality and social protection across workers.

³Empirical studies document overwhelming evidence of a positive relationship between the prevalence of FDI and productivity across industries and firms (Javorcik, 2004; Matthias Arnold and Javorcik, 2009; Lu et al., 2017).

⁴Cao (2018) provides evidence of relationship between the volatility of firms' sales and the demand of informal workers.

My analysis, based on firm-level data from Vietnam Enterprise Surveys, covers the period from 2010-2013, showing that foreign firms hire a lower share of informal workers than domestic firms, even after including firm characteristics such as total factor productivity, export status, size, and economic zone indicator. The analysis of spillover effects suggests that foreign participation has a significant spillover effect on the level of informal employment in domestic firms. On the one hand, I find that an increase in FDI intensity in the same industry lowers the demand for informal labor in domestic firms in that industry. On the other hand, the results regarding within-province spillovers indicate that an increase in the presence of FDI in the same province raises the share of informal employment in domestic firms in that province. Collectively, these findings suggest that the estimated spillover effects are the net effect of two opposite forces proposed in the literature, namely the technology spillovers and the competition channels.

One of the contributions of the paper is that it provides an analysis of the effect of foreign direct investment on the demand of informal employment in the host country. To my knowledge, this paper is the first to study the effect of FDI on the relative demand for informal workers at the firm level.⁵ Academic research on FDI and informality is lackluster owing to the lack of available data that can provide information on firms' characteristics and their informal employment. In many countries, the fact that it is illegal for firms to use informal workers prevents researchers from collecting reliable firm-level data on informal employment. The Vietnamese data presents the advantage of providing detailed information on the number of informal workers hired by a firm, because informal jobs are legal there.

My paper is also related to the literature that emphasizes the implications for employment. Waldkirch et al. (2009), using Mexican data, find that FDI has a significantly positive effect on manufacturing employment. Karlsson et al. (2009), using Chinese manufacturing firm-level data, find that foreign firms demonstrate high growth in employment. Bandick and

⁵The only exception is the study by Dougherty and Escobar (2013) on Mexico, which finds that increases in stock of FDI are associated with lower share of informal employment, but the lack of data has limited this work to informal employment at the industry level, thereby completely ignoring firm characteristics that could impact firms' hiring decisions on informal employment.

Gorg (2010) find positive effects that FDI has on employment growth only if the acquisition is vertical in Sweden. Jude and Silaghi (2016) provide evidence of FDI leading to negative short-run effect on employment in Central and Eastern Europe ; however, the long-run effect is positive. My paper complements this literature to the extent that FDI contributes to the creation of new formal jobs and the destruction of informal jobs.

My work contributes to the literature that investigates the foreign wage premium (Lipsey and Sjöholm, 2004b; Sjöholm and Lipsey, 2006; Almeida, 2007; Girma and Gorg, 2007; Huttunen, 2007; Matthias Arnold and Javorcik, 2009; Martins, 2011; Heyman et al., 2011; Chen et al., 2011; Liu et al., 2015; Peluffo, 2015). Controlling for the differences in the share of informal workers, I find evidence of the foreign wage premium which is consistent with previous studies. Finally, the paper also contributes to the literature that examines the determinants of informality. For example, Goldberg and Pavcnik (2003) investigate the response of informal employment to trade liberalization in Colombia and Brazil. Ulyssea (2018), who uses Brazilian data, shows a negative relationship between firm size and productivity and the hiring of informal workers. My analysis shows that ownership, export, size, and productivity are key determinants of the hiring of informal workers.

This study is structured as follows. Section 2 provides some background to FDI inflows and informal employment in Vietnam. Next, I describes the data, the estimation strategy, and the results. Robustness checks are presented in Section 6. Section 7 concludes the paper.

2.2 Background of FDI and Informality Employment in Vietnam

Before 1986, Vietnam was a closed economy, and there was zero foreign direct investment in the country. However, FDI flows and stock have drastically increased since Vietnam initiated the Doi Moi policy in the late 1980s that intended to facilitate the transition from a planned economy to a market economy. The 1987 Law on Foreign

Investment encouraged FDI in Vietnam and brought a wave of foreign-investment enterprises from 1990 to 2016 (Figure 2.1). The sharp increase in FDI between 2006 and 2008 was due to Vietnam's 2007 accession to WTO.⁶ Most FDI inflows into Vietnam consisted of “greenfield” investment, while only a small portion was the result of the expansion of existing projects. With that said, many foreign investors chose Vietnam in which to open new plants, which were expected to contribute to human capital development and the provision of enhanced technologies in the local economy.

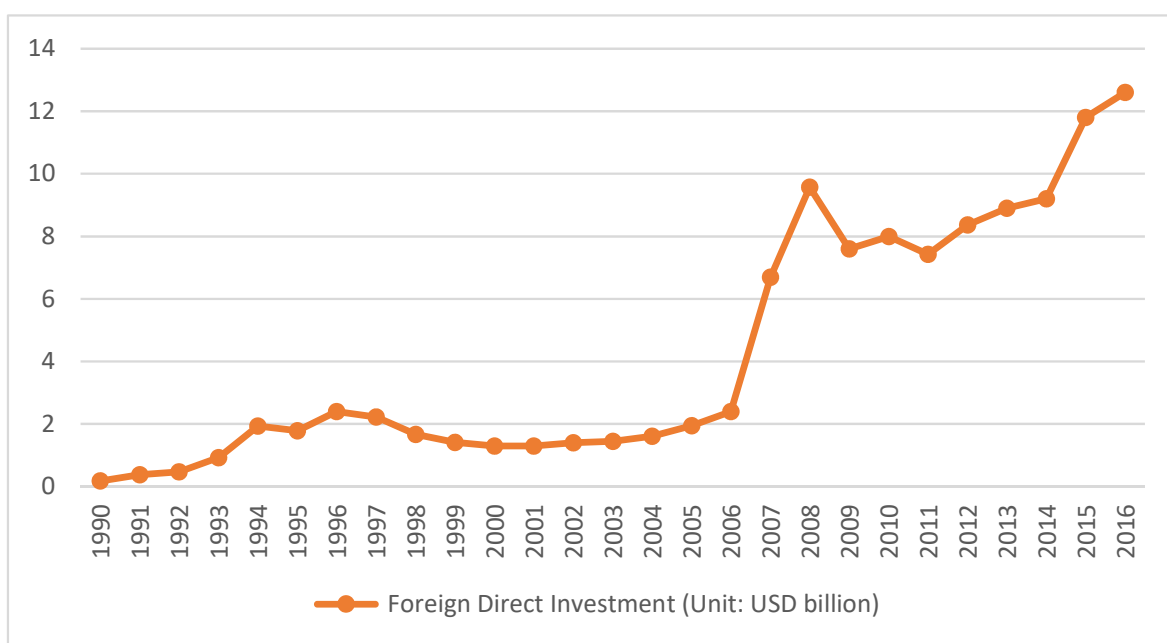


Figure 2.1 Foreign direct investment, 1990-2016 (USD billion). Source: World Bank

Foreign ownership include those enterprises with 100% foreign capital or those are joint venture between domestic and foreign firms. Nevertheless, FDI firms obey the same labor law with domestic firms. In opposite to other developing countries, hiring informal employment is lawful in Vietnam. The definition of informality ranges from workers without contract to those without social security contributed by firms. In 2010, while roughly 27%

⁶This can provide a valid identification strategy to study the effect of FDI on outcomes in Vietnam. However, I think it does not fit the structure of this paper because a large portion of the FDI increase flowed into the service sector.

of the labor force did not receive social security from all firms, that number is only 10% among FDI firms. Moreover, one would expect differences among industries and regions due to the spillover effects of FDI.

The spillover effects of FDI on informality share in domestic firms are ambiguous because the competition channels and technology externalities are more likely to move in opposite directions. The former channels refer to the competition between foreign-owned firms and local firms in both product and labor markets. One possible channel is that competition in the labor market may increase the demand for formal workers and drive up wages for formal workers, leading to the reallocation of formal workers toward foreign firms, and thus forcing local firms to increase the use of informal workers. This results in a negative wage spillover effect of FDI in domestically-owned firms.⁷ This effect seems to be substantial when considering regional spillovers of FDI in local firms. Second, competition in product markets may impact domestic firms' hiring decisions. In particular, intense competition from foreign multinationals may draw demand from local firms, which results in a fall in productivity owing to the diminishing scale economies.⁸ Domestic firms become less productive, thereby hiring more informal workers.⁹ However, the effect of competition in product markets may not be significant, because Vietnam is a small market, and Vietnam has been used as an export platform for multinationals.

Technology externalities refer to a technology spillover to domestic firms through several channels. Aitken and Harrison (1999) argue that domestic technological progress can occur via imitation of foreign multinational's knowledge. In addition, they argue that domestic firms may get access to foreign multinationals' firm-specific knowledge through

⁷There is massive empirical evidence to support the existence of the wage spillovers. Aitken et al. (1996) find wage spillovers in the United States. Bedi and Cielik (2002), using Polish data, identify evidence of wage spillover effects. Driffield and Girma (2003) find positive wage spillovers among regions. Lipsey and Sjöholm (2004a), using Indonesian manufacturing data, find positive spillover effects on wages in locally-owned plants. In the case of China, Chen et al. (2011) find a significant negative spillover in wage level.

⁸Aitken and Harrison (1999) argue that foreign firms producing for the domestic market can gain market share from local firms, causing them to lose productivity. Lu et al. (2017), using Chinese firm-level data, identify a negative spillover effect of FDI on domestic firms' productivity.

⁹Cao (2018) finds that more productive firms use a lower share of informal workers.

the recruitment of workers previously employed by foreign firms. Finally, technology spillovers are likely to take place through the relationship between domestic suppliers of intermediate goods and their foreign partners (backward linkage) or purchase of intermediate inputs produced by multinationals (forward linkage). Javorcik (2004) finds evidence of spillovers from FDI occurring through backward linkages. These technology spillovers may improve the efficiency of domestic firms and lower the share of informal employment in those domestic firms. Given the opposite spillover effects from competition channels and technology externalities, the net informality spillover effect of FDI in Vietnamese domestic firms is an empirical question. If the competition effects dominate the technology spillovers, we will find that the presence of FDI increases the share of informal employment. On the other hand, if the technology externalities offset the competition effects, FDI intensity is negatively correlated with informality share.

2.3 Data

The data used in this study are from the Vietnam Enterprise Surveys (VESs), conducted by the General Statistics Office of Vietnam for the 2010-2013 period.¹⁰ These surveys cover all of the registered enterprises with total employees over 30 and a random sample of firms with less than 30 workers. Firms are sorted into industries according to the Vietnam Standard Industrial Classification (VSIC) 2007. This paper focuses on 141 distinct four-digit manufacturing industries. The sectoral distribution of firms and the foreign equity share at the two-digit industry level in 2010 of the sample is presented in Table 2.1.

The data contain information on foreign ownership, sales, employment, total wages and compensation, export status, and location. FDI firms are defined as enterprises with 100% foreign capital or joint venture between domestic and foreign firms. Average wages are calculated by dividing total wages and compensation by the total employment. I estimate

¹⁰The survey responses were collected annually from 2000 to 2013, but consistent data on exports and measures of informal labor are only available from 2010-2013.

Table 2.1 Distribution of FDI Firms and Foreign Equity Share by Two-digit Industry in 2010

Industry	Domestic firms (1)	FDI firms (2)	All firms (3)	(2)/(3) (4)	Foreign equity share (5)
Food processing & manufacturing	4,506	319	4,825	0.066	0.294
Beverage manufacturing	1,585	38	1,623	0.023	0.310
Tobacco products	22	4	26	0.154	0.124
Textiles	1,549	278	1,827	0.152	0.551
Wearing apparel, dressing & dyeing of fur	3,162	594	3,756	0.158	0.505
Leather, leather products & footwear	820	223	1,043	0.214	0.791
Wood & products of wood & cork	3,317	105	3,422	0.031	0.150
Paper & paper products	1,515	121	1,636	0.074	0.290
Printing & publishing	3,002	64	3,066	0.021	0.097
Coke, refined petroleum products	57	4	61	0.066	0.032
Chemicals & chemical products	1,350	283	1,633	0.173	0.484
Medical & pharmaceutical products	247	35	282	0.124	0.173
Rubber and plastics products	2,319	457	2,776	0.165	0.424
Other non-metallic mineral products	2,897	138	3,035	0.045	0.227
Basic metals	741	74	815	0.091	0.240
Fabricated metal products	5,873	540	6,413	0.084	0.369
Electronic & telecommunications equipment	340	209	549	0.381	0.927
Electric equipment & machinery	645	187	832	0.225	0.572
Special purpose equipment	819	101	920	0.110	0.474
Transport equipment	178	137	315	0.435	0.617
Other transport equipment	501	130	631	0.206	0.655
Furniture manufacturing	2,401	240	2,641	0.091	0.458
Other manufacturing	773	248	1,021	0.243	0.818
Maintenance & installation of machinery	657	21	678	0.031	0.019

Notes: Output-weighted average of foreign equity share across all firm in each two-digit industry.

firm productivity measured by TFP using the method proposed by Olley and Pakes (1996). Firm size is measured by log of total revenue. Export status indicates whether the firm is exporting in the contemporary year. Lastly, the economic zone indicator equals 1 if the firm is located in an economic zone and 0 otherwise. In panel A of Table 2.2, I compare firm variables across domestic and FDI firms. In an unreported analysis (available upon request), I find significant mean differences across domestic-owned and foreign-owned firms.

The data also report the number of workers to whom their employers do not contribute social security. I divide that number by the total number of workers to obtain the share of informal workers. One concern is that my measure of informal workers and the measure

Table 2.2 Descriptive statistics and correlations for variables in 2011

Panel A: Descriptive Statistics						
	All firms		Domestic firms		FDI firms	
	Obs.	Mean	Obs.	Mean	Obs.	Mean
Informality share	31316	0.502 (0.399)	26373	0.562 (0.395)	4943	0.185 (0.238)
Log employment	52113	2.893 (1.518)	47023	2.693 (1.364)	5090	4.733 (1.632)
Log wage rate	51292	2.473 (0.781)	46222	2.412 (0.77)	5070	3.025 (0.658)
Log firm TFP	28855	1.687 (0.883)	25116	1.616 (0.84)	3739	2.162 (1.011)
Log revenue	51044	7.196 (2.45)	45995	6.912 (2.316)	5049	9.780 (2.102)
Export status	52184	0.140 (0.347)	47023	0.082 (0.274)	5161	0.672 (0.469)
Panel B: Correlations						
	Informal employment			Informality share		
Unskilled employment	0.1437					
Share of unskilled workers				-0.01		

Notes: The standard deviations are reported in parentheses. Unskilled employment is measured as the number of workers who are not trained for the profession.

of unskilled workers in previous studies may overlap.¹¹ To address this issue, I exploit the 2011 survey that reports the number of workers by qualification training. Thus, unskilled workers are measured as those who are not trained for the profession. Panel B of Table 2.2 shows the correlations between informal employment and unskilled employment and between informality share and the share of unskilled workers. There is no evidence that these measures are correlated in the data.¹²

¹¹A number of empirical papers investigate the effect of FDI on the relative demand for skilled workers (see Feenstra and Hanson (1997), Peluffo (2015), Souare and Zhou (2016), Blonigen and Slaughter (2001), and Bandick and Hansson (2009)).

¹²Using a different definition of unskilled workers (those with no more than vocational training) does not change the results.

2.4 Estimation Strategy

To investigate the relationship between a firm's labor outcomes and ownership, I adopt an approach that is widely used in the earlier literature.¹³ Several variations of the following linear equation are estimated

$$Y_{ijst} = \sigma + \delta X_{ijst} + \beta \text{ownership}_{ijst} + \lambda_j + \gamma_s + \theta_t + \epsilon_{ijst}, \quad (2.1)$$

where Y_{ijst} is the outcome of interest for firm i of industry j in province s in year t (share of informal workers in the firm, log of average wages, log of employment) ; X_{ijst} is a vector of time-varying firm characteristics (i.e. firm productivity measured by TFP, export status, firm size, and an indicator for whether the firm is located in an economic zone) used to isolate the FDI effect.¹⁴ Ownership is not the only factor that affects firms' hiring of informal workers. Firm heterogeneity and export activity are relevant factors in determining the demand for informal workers. Cao (2018) finds evidence that firm productivity and export activity are key determinants of informal employment. The economic-zone dummy sweeps out potential differences across firms that are located inside and outside of economic zones that could influence the outcomes. Oxfam (2015) reports that FDI firms and firms that trade are encouraged to establish a physical presence in the economic zones in return for more favored tax policy, better labor conditions, and ground infrastructure. The industrial zone indicator could be correlated with all other independent variables. Hence, the exclusion of it biases the estimated coefficient on ownership upward, increasing the likelihood of finding significant relationship.¹⁵

¹³The estimation strategy is close to what has been used in the literature on FDI, wages, and employment (see Lipsey and Sjöholm (2004b), Chen et al. (2011), and Karlsson et al. (2009)). For the literature on FDI and productivity, see Aitken and Harrison (1999).

¹⁴When the dependent variable in Equation 2.1 is average wages, I control for differences across firms in informality share and female share.

¹⁵From the policy point of view, it is interesting to know whether economic zones help the local government lower the level of informality.

The main independent variable, $Ownership_{ijst}$, is a dummy variable indicating 1 if the firm is 100% owned by foreign investors or a joint venture with foreign firms, and 0 otherwise; λ_j , γ_s and θ_t are industry, province, and year fixed effects, respectively; and ϵ_{ijst} is the error term. Industry and province fixed effects absorb all time-invariant characteristics affecting labor market conditions in an industry and a province, while year fixed effects capture economy-wide institutional changes over time. I address the potential serial correlation and heteroskedasticity issues by clustering the standard errors at the firm level. The main parameter of interest is the coefficient on $Ownership_{ijst}$. The coefficient β is the average difference in informal share, wages, and employment level between multinationals and domestic firms in the same industry, province, and year.

One potential issue with the identification of the FDI effect on the labor outcomes is endogeneity bias in the cases where foreigners "cherry pick" the best local firms through M&A based on firm characteristics that are unobserved by econometricians.¹⁶ As a result, the estimated cross-sectional effects of foreign ownership on the demand of informal labor are biased. To address this endogeneity problem, I first claim that foreign M&A is not a common practice in Vietnam during the period under analysis. FDI in Vietnam consists mostly of "greenfield" investment as opposed to foreign M&A. Nevertheless, I econometrically mitigate this problem by using a firm fixed effect model. Including firm fixed effects suggests that the estimated parameter β is a measure of the change in the informality share of firms that change their ownership. This specification focuses on M&A firms.

The above analysis focuses on comparing the informality share between domestic and foreign firms. It has been suggested in the literature that there exist intra-industry spillovers from FDI, implying that the entry of foreign firms has significant effects on a number of outcome variables (e.g. productivity, employment, and wages) in domestic firms. I examine informality spillovers in three different ways. First, to investigate the within-industry spillover effects of foreign investment on informality share, I follow a benchmark

¹⁶The endogeneity problem is well reported in the literature. See Almeida (2007) for evidence.

model used in the literature to investigate the spillovers of FDI (Aitken and Harrison, 1999) by including the industry-level FDI intensity in Equation 2.1:

$$Y_{ijst} = \sigma + \delta X_{ijst} + \beta \textit{ownership}_{ijst} + \alpha \textit{FDI_Sector}_{jt} + \zeta \textit{FDI_Province}_{st} \quad (2.2) \\ + \lambda_j + \gamma_s + \theta_t + \epsilon_{ijst},$$

where Y_{ijst} is the share of informal workers for firm i of industry j in province s in year t , $\textit{FDI_Sector}_{jt}$ represents within-industry FDI intensity (FDI presence in industry j at year t), $\textit{FDI_Province}_{st}$ represents within-province FDI intensity (FDI presence in province s at year t), and all other notations are as in Equation 2.1.¹⁷ The coefficients of interest, α and ζ , capture the spillover effects of foreign presence across industries and provinces, respectively. To avoid confusion, I refer to a positive informality spillover as when α or ζ is positive and vice versa. A positive spillover effect implies that the presence of FDI increases the relative demand of informal labor, suggesting that the competition effects dominate the technology spillovers. If the technology externalities are dominant, we will see a negative spillover.

One concern with these identifications of foreign spillovers is a potential endogeneity bias. Firms' demand for formal and informal workers could be a key determinant of FDI inflows and outflows among industries and regions. For example, if foreign investment is expected to flow into industries or provinces with the best infrastructure already in place and where skilled labor is most likely to be available (i.e. industry/province with highly formal intensity), then the negative effect of foreign informality spillovers will be overestimated. On the other hand, if foreign multinationals are more eager to move into a low-cost and labor-intensive industry/province (i.e. industry/province with highly informal intensity), then the positive spillover effects are more likely to be overestimated.¹⁸ The inclusion of industry and

¹⁷I assume that foreign spillovers on informal employment operate in two different ways. First, FDI participation impacts firms across regions but in the same industry. Second, foreign spillover effects operate across industries but are restricted to the same region.

¹⁸According to the Foreign Investment Agency of the Ministry of Planning and Investment, Vietnam government provides investment incentives for foreign investors. For instance, new projects in areas with difficult socio-economic conditions are granted tax reductions and exemption on land rental.

province fixed effects serves to control for unobserved industry and province characteristics that are correlated with foreign investors' investment decision. I also experiment with a firm fixed effect model to account for firm-level unobservables and the "cherry picking" problem. To investigate the spillover effects of FDI on domestic firms, I exclude all foreign firms from my regression sample.

FDI_Sector_{jt} is the regressor of interest, capturing the presence of FDI in industry j and year t . To calculate the within-industry FDI intensity, I use the standard measure in the literature, i.e.,¹⁹

$$FDI_Sector_{jt} = \frac{\sum_{i \in \Omega_{jt}} FDI_Firm_{ijt} \times Output_{ijt}}{\sum_{i \in \Omega_{jt}} Output_{ijt}},$$

where $Output_{ijt}$ measures the output of firm i of industry j in year t ; FDI_Firm_{ijt} measures the foreign equity share of firm i in industry j in year t . Similarly, the within-province FDI intensity is calculated as

$$FDI_Province_{st} = \frac{\sum_{i \in \Omega_{st}} FDI_Firm_{ist} \times Output_{ist}}{\sum_{i \in \Omega_{st}} Output_{ist}},$$

where $Output_{ist}$ measures the output of firm i of province s in year t ; FDI_Firm_{ist} measures the foreign equity share of firm i in province s in year t .

2.5 Results

The results of estimating Equation 2.1 for several outcomes are presented in Table 2.3. Columns (1) and (2) show the results of the regression of the share of informal workers on ownership and firm characteristics. The coefficient on ownership is negative and statistically significant, suggesting that foreign-owned firms hire informal workers at a rate of 15.7 percentage points lower than domestic firms. More productive firms demand

¹⁹The measure is used by many papers such as Javorcik (2004) and Lu et al. (2017).

Table 2.3 Differences between foreign-owned firms relatively to domestic firms

	Informality share		Employment		Average wage	
	(1)	(2)	(3)	(4)	(5)	(6)
FDI	-0.157*** (0.005)	-0.069** (0.027)	0.290*** (0.016)	0.209*** (0.075)	0.102*** (0.007)	-0.023 (0.053)
TFP	-0.035*** (0.001)	-0.030*** (0.002)	-0.126*** (0.004)	-0.089*** (0.003)	0.334*** (0.004)	0.315*** (0.005)
Export	-0.088*** (0.004)	-0.019*** (0.004)	0.716*** (0.012)	0.088*** (0.008)	0.021*** (0.005)	0.030*** (0.007)
Size	-0.033*** (0.001)	0.001 (0.001)	0.430*** (0.002)	0.191*** (0.003)	0.001 (0.001)	-0.012*** (0.002)
Industrial Zone	-0.097*** (0.004)		0.177*** (0.013)		0.050*** (0.006)	
Informality Share					-0.239*** (0.005)	-0.266*** (0.008)
Female Share					-0.209*** (0.010)	-0.065*** (0.014)
Industry FE	Yes	No	Yes	No	Yes	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	No	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes	No	Yes
N	128406	128406	154125	154125	128215	128215

Notes: Standard errors in parentheses are clustered at firm level $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

more formal employment. This effect holds for export activity since the share of informal employment is 8.8 percentage points lower for firms that export. The results on productivity and export status are consistent with Cao (2018)'s findings. Larger firms use a lower share of informal workers. Firms located in industrial zones also have relatively low demand for informal workers.²⁰ The estimation results of the fixed effects model are reported in column (2). The FDI coefficient is consistent with the OLS specification, is significant at the 5% level, and indicates that, by focusing within variation, firms that change ownership from domestic- to foreign-owned reduce their share of informal labor by 6.9 percentage points. The reason for the smaller magnitude could be that the within-group variation is much less

²⁰The industrial zone variable is excluded from firm fixed effect regression due to the fact that most firms do not have location changed.

than the between-group variation. The vast majority of FDI in Vietnam are greenfield investments, which means that foreign investors choose Vietnam to open their new plants or factories. The magnitude of the impact of total factor productivity and exporting is smaller, but the sign is still negative.

Columns (3) and (4) report results in which the outcome is total employment. The coefficients on ownership are positive and significant, suggesting that FDI firms are larger than domestic firms. The results of estimating Equation 2.1 for average wage are reported in columns (5) and (6). Controlling for the differences in informality and gender share, I find evidence that foreign-owned firms pay higher average wages. FDI firms pay approximately 10.2% higher average wages than domestic firms. The negative and significant coefficients of informality share confirm that formal workers earn higher average wages than informal workers.²¹

In sum, my findings show that foreign firms are different from domestic ones in terms of the share of informal workers, size, and average wages. Multinationals are not only larger, but also they use relatively more formal workers. Combined, this implies that FDI firms not only contribute to the creation of jobs but also improve social development by creating relatively more formal (better) jobs. Moreover, after controlling for the differences in informality share, the average wages are higher in FDI firms. This is in line with the finding of previous studies on foreign wage premium. In addition, there is evidence of wage premium for formal workers, suggesting that, on average, informal workers are paid less in terms of wages and benefits. Also, it is worthwhile to mention that firms in economic zone perform better in terms of size, wages, and informality share. The findings shed some light on government policies that try to eliminate informality and to increase wages. Further investigations will be needed to completely explain the underlying channels.

²¹Cao (2018) and Goldberg and Pavcnik (2003) theorize that formal wages are higher than informal wages.

Table 2.4 Differences between origins of FDI firm relatively to domestic firms

	Informality share (1)	Employment (2)	Average wage (3)
Korea	-0.172*** (0.007)	0.393*** (0.028)	0.128*** (0.010)
Japan	-0.172*** (0.007)	0.310*** (0.036)	0.118*** (0.014)
Singapore	-0.143*** (0.012)	0.164*** (0.056)	0.209*** (0.028)
Taiwan	-0.162*** (0.006)	0.278*** (0.025)	0.031*** (0.009)
Hongkong	-0.187*** (0.015)	0.665*** (0.067)	0.087*** (0.026)
Malaysia	-0.174*** (0.014)	0.212*** (0.069)	0.134*** (0.029)
U.S.A	-0.143*** (0.017)	0.171*** (0.058)	0.166*** (0.034)
China	-0.078*** (0.011)	0.245*** (0.040)	0.080*** (0.017)
Thailand	-0.158*** (0.015)	0.070 (0.083)	0.079* (0.047)
Other countries	-0.144*** (0.007)	0.198*** (0.031)	0.141*** (0.014)

Notes: Standard errors in parentheses are clustered at firm level $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The coefficients on firm characteristics are not reported. All columns include industry, province, and year fixed effects.

I further examine the extent to which the FDI effect is heterogeneous among origins of FDI.²² To investigate whether there exists some country-specific effects of FDI, I exploit the data that report the origins of FDI. Specifically, I categorize foreign investment based on the list of countries that invest the most in Vietnam. These variables enter into a regression. The estimated results for several outcomes with OLS are presented in Table 2.4. Coefficients are interpreted as the differences between foreign firms from a country relatively to domestic firms. For instance, column (1) shows that Korean-owned firms hire informal workers at a rate of 17.2 percentage points lower than domestic firms. Among foreign firms, I observe

²²Empirical studies document significant differences in firm productivity among FDI firms depending on the origin of the foreign investment (see Chen (2011) and Kamal (2015))

a similar pattern of hiring informal workers between Korean, Japanese, Taiwanese, Hong Kong, Thai, and Malaysian firms. This could be due to the fact that these nations are close in proximity. Moreover, these firms are significantly different from Chinese firms. There is only a 7.9 percentage points difference between Vietnamese domestic firms and firms that receive Chinese investment. The reason could be that Vietnam and China are border-sharing countries and have a lot of similarities in terms of labor composition, technology, and work environment. Chinese firms know how to work with informal workers in Vietnam, resulting in a lower monitoring cost on informal workers than that of firms from other countries. Furthermore, there is also evidence of differences among the origins of FDI when it comes to firm size and average wages. These findings suggest that FDI firms are subject to significant differences in labor structure, internal wage policy, and technology, depending on the origin of the parent firm.

The spillover estimation results for Equation 2.2 are reported in Table 2.5. Columns (1)-(2) show estimates of the spillover effect in all firms.²³ I find that the coefficients on FDI_Sector_{jt} are negative and statistically significant, implying a negative effect on firms' share of informal employment. Specifically, firms in industries that have higher FDI intensity tend to hire a lower share of informal workers. The coefficients on $FDI_Province_{st}$ are positive and opposite to the effect of industry intensity, implying that an increase in the presence of FDI significantly increases the relative demand for informal labor in the same province. The fixed effect specification is reported in column (2), suggesting that a 10 percentage point increase in the industry-level share of FDI lowers the informality share by about 0.5 percentage points, and that a 10 percentage point increase in the FDI share in the same province raises the informality share in all firms by 1.4 percentage points. In this analysis, the spillover effect is the net effect of technology externalities and competition channels. A negative spillover suggests that the effect through externalities may offset the

²³It is worth mentioning that adding regressors FDI_Sector_{jt} and $FDI_Province_{st}$ only makes a small changes to other coefficients. These estimates look identical to the ones in Columns (1) and (2) of Table 2.3 because of rounding.

Table 2.5 Spillover effects of FDI on informal employment

	All firms		Domestic firms	
	(1)	(2)	(3)	(4)
FDI	-0.157*** (0.005)	-0.068** (0.027)		
TFP	-0.035*** (0.001)	-0.030*** (0.002)	-0.043*** (0.002)	-0.035*** (0.002)
Export	-0.088*** (0.004)	-0.019*** (0.004)	-0.100*** (0.004)	-0.023*** (0.005)
Size	-0.033*** (0.001)	0.001 (0.001)	-0.031*** (0.001)	0.001 (0.001)
Industrial zone	-0.097*** (0.004)		-0.123*** (0.005)	
FDI_Sector	-0.065*** (0.020)	-0.049*** (0.011)	-0.071*** (0.023)	-0.052*** (0.011)
FDI_Province	0.166*** (0.028)	0.138*** (0.027)	0.208*** (0.031)	0.201*** (0.032)
Industry FE	Yes	No	Yes	No
Year FE	Yes	Yes	Yes	Yes
Province FE	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes
N	128406	128406	113178	113178

Notes: Standard errors in parentheses are clustered at firm level $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

effect through competition channels. Focusing on the within-region spillovers, I can conclude that the technology externalities are dominated by the competition effect. I interpret these findings as suggestive that domestic firms are forced to use more informal workers due to the intense competition from FDI firms in regional labor markets. Columns (3)-(4) report the results of estimating Equation 2.2 only for domestic firms. The results are significant and consistent with those for all firms.

In summary, my study suggests that foreign firms not only hire a lower share of informal workers, but also that their within-industry presence reduces the share of informal employment in domestic firms. Focusing on the within-region variation, FDI presence increases the share of informal employment in domestic firms.

2.6 Robustness Checks

This section analyzes three additional robustness checks. First, foreign spillovers may be restricted to a larger-digit industry level. To test this, I use an alternative measure of FDI presence. Columns (1) and (2) in Table 2.6 report the results when I use the FDI intensity at the five-digit industry level. The results show that spillover effects are significant and consistent and support the finding that technology spillovers outweigh competition effects at the industry level.

Table 2.6 Robustness checks

	Within five-digit industry		Firms with more than 10 workers		Klein and Vella
	(1)	(2)	(3)	(4)	(5)
FDI	-0.156*** (0.005)	-0.065** (0.027)	-0.143*** (0.005)	-0.061** (0.027)	-0.238*** (0.013)
TFP	-0.035*** (0.001)	-0.030*** (0.002)	-0.036*** (0.002)	-0.026*** (0.002)	-0.033*** (0.002)
Export	-0.089*** (0.004)	-0.018*** (0.004)	-0.058*** (0.004)	-0.016*** (0.004)	-0.067*** (0.005)
Size	-0.033*** (0.001)	0.001 (0.001)	-0.045*** (0.001)	-0.005** (0.002)	-0.032*** (0.001)
Industrial zone	-0.096*** (0.004)	-0.019*** (0.005)	-0.072*** (0.004)	-0.016*** (0.005)	-0.072*** (0.006)
FDI_Sector	-0.049*** (0.016)	-0.051*** (0.010)	-0.002 (0.023)	-0.029** (0.012)	
Industry FE	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	No	Yes	No	Yes
Firm FE	No	Yes	No	Yes	No
N	128406	128406	78094	78094	128406

Notes: Standard errors in parentheses and are clustered at firm level $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Column (5) reports the results using the estimator proposed by Klein and Vella (2009).

Second, a concern is that foreign spillover effects may be driven by small firms because such firms with fewer than 10 workers enjoy a different labor law on social security

contribution. I exclude from the sample all firms with fewer than 10 employees to examine foreign informality spillovers to domestic firms. The results are presented in columns (3) and (4). The magnitude of the coefficients on FDI are smaller but still significant, providing consistent results with those reported in columns (1) and (2). The within-industry foreign spillovers are insignificant in the OLS estimation but significant in the fixed effect specification. Thus, the technology spillovers offset the competition effects.

Finally, the best way to address the endogeneity issue of the FDI variables in Equation 2.1 is to construct appropriate firm-level instruments. Unfortunately, the data do not allow for the construction of IV. Instead, I employ a semi-parametric strategy by Klein and Vella (2009) that employs heteroscedasticity to construct instruments from the existing data. This method is more suitable in cases where the endogenous variable is binary. The idea behind this identification is that, when there is significant changes in variance, the heteroscedasticity problem helps identify the causal relationship between the informality share and the ownership. I implement the K-V estimator as follows. First, consider the equations:

$$Y_{ijst} = \sigma + \beta \text{ownership}_{ijst} + \delta' Z_{ijst} + \epsilon_{ijst} \quad (2.3)$$

$$\text{Ownership}_{ijst} = \mu + \alpha' Z_{ijst} + u_{ijst}, \quad (2.4)$$

where Y_{ijst} is the outcome of interest and ownership_{ijst} is the FDI dummy variable. Z_{ijst} includes the elements in vector X_{ijst} and the fixed effects in equation 2.1. Equations 2.3 and 2.4 do not have the exclusion restriction. However, they show that β can be consistently estimated if the residuals u_{ijst} are heteroscedastic. Hence, I estimate equation 2.4 by heteroscedastic probit regression to generate the predicted probability of foreign ownership. In the second step, I use this predicted probability as an instrument for the binary ownership to estimate the impact of being foreign owned on the hiring of informal workers. Therefore, this endogeneity corrections follows three stages: (1) the zero stage generates the instrumental variables, (2) & (3) the second and third stage then provide the

estimates using the standard 2SLS method. Column (5) present the results. The effect of FDI on the share of informal workers is significant and larger than those reported in the OLS estimations.

2.7 Conclusion

Understanding the link between FDI and informality is important to developing countries, as they have experienced a dramatic increase in FDI inflows. Using Vietnamese firm-level data, I investigate informality differentials and foreign spillover effects to domestic firms. My findings suggest that foreign multinationals differ from domestic firms in terms of the share of informal workers, size, and average wages. FDI firms have a larger workforce, create more jobs, hire relatively more formal workers, and pay higher average wages for a given workforce composition. Moreover, these firms are subject to differences in labor structure, internal wages policy, and technology, depending on the origin of the parent firm.

In the second part of the analysis, I examine the technology spillovers and competition effects. From a theoretical point of view, the FDI spillover effect on informal employment can be either negative or positive, depending on the strength of the technology externalities and the competition effects. Interestingly, I find that the presence of foreign investment has significant spillover effects on the demand for informal labor in domestic firms at the industry and province levels. My findings suggest negative within-industry spillover effects, implying that an increase in FDI intensity in the same industry reduces the share of informal workers of firms in that industry. In contrast, the presence of FDI in the same province increases the informality level in firms in that province. The reason is that, focusing on within-province spillovers, the competition effects are sufficiently strong due to the intense competition between foreign multinationals and domestic firms in the regional labor market.

I recognize that there are a number of limitations to my study. The lack of data availability does not allow me to adopt the method of instrumental variables to address the

”cherry picking” issue at the firm level and the endogeneity bias problem at the industry level. I also find it is difficult to disentangle the technology spillovers and the competition effects because such a specification would require more extensive data that are not yet available. Further research is needed to fully understand the effects of FDI on informal employment in the host country.

Chapter 3

Effects of Trade and FDI on Informal Economy

3.1 Introduction

The informal economy accounts for a large share of GDP and the workforce in most developing countries.¹ According to the World Bank, informality contributes 25% to 40% of annual output and up to four-fifths of non-agricultural employment in developing countries in Asia and Africa.² Cling et al. (2011) report that Vietnam's informal sector contributes 20% of GDP and 82% of employment.³ The country has experienced drastic tariff reductions and foreign investment policy liberalization. While trade liberalization is believed to contribute to economic growth and higher productivity, many have expressed concerns that it may lead distributional consequences between the informal sector and the formal sector in these developing countries. Existing empirical literature yielded mixed evidence regarding the

¹The term “informal sector” has been used in terms of the economic context to describe a sector with different characteristics, such as a low-level organization, a small-scale household enterprise, lack of compliance with taxation and regulation, and lack of protection or benefit for workers

²<http://web.worldbank.org/wbsite/external/topics/extsocialprotection/extlm/0>.

³McCaig and Pavcnik (2018), based on the 2002 and 2004 Vietnamese household surveys, report that 83% of workers work in a household business.

effects of import liberalization and export opportunities on informality level in the home country.

This study is motivated by two empirical facts in Vietnam. First, McCaig and Pavcnik (2018) point to the co-existence of formal firms and informal firms (household businesses), including licensed and unlicensed household businesses. The reason for not obtaining a business license is unclear.⁴ Therefore, my model focuses on household businesses with and without a license, which are called informal firms. In this model, the informal firms only hire informal workers. Second, Cao (2018) shows that formal firms hire both formal and informal labor, suggesting the co-existence of both types of worker in the formal sector. This is because hiring informal workers is legal in Vietnam. Therefore, my model allows the employment of both formal and informal workers by formal firms. I incorporate these empirical facts into a general equilibrium model to examine the aggregate outcomes.

The main contributions of this paper is the analysis of the impact of trade and foreign direct investment on the informal economy in a dynamic stochastic general equilibrium (DSGE) model that includes monopolistic competition and differentiated labor services. While most studies focus on one aspect of trade or foreign investment, this study has three exogenous disturbances: import competition, export opportunities, and FDI presence. Moreover, my model is different from those used in the trade literature, because it allows me to analyze the general equilibrium and transition dynamics of trade and FDI policy liberalization. I employ a numerical analysis for symmetric countries, with parameters selected to reflect economic characteristics in Vietnam, to derive the primary results and frame the welfare analysis.⁵

The first result is that increased import competition enlarges the informal economy. My results in this study demonstrate that a 10 percentage point reduction in import tariffs increases the size of the informal sector by 1.5%. This result is similar to the findings of

⁴World Bank (2010) reports that the great majority of households had no difficulty registering a household business. Cling et al. (2012) find no evidence of avoiding taxes by remaining unlicensed.

⁵I do not attempt to calculate optimal tariff or FDI policy. I assume that trade liberalization and FDI presence begin at factual rates.

Paz (2014) for the 1989-2001 Brazilian trade liberalization. His estimates indicate that a 10 percentage point reduction in import tariffs raises the informality share by 1.29 percentage points. Attanasio et al. (2004) suggest that a similar change in tariffs raises the probability of having an informal job by 0.87 percentage points. Acosta and Montes-Rojas (2014) identify a positive relationship between trade openness and informality in industries that experienced sudden foreign competition in Argentina. They obtain larger estimates, which implies that a reduction in average tariffs of 10 percentage points produces an incremental increase in informality rates of 5.5 percentage points. This is because their analysis captures the effects of multilateral trade liberalization, while this study analyzes the impact of a bilateral trade agreement.

The second result is that increased export opportunities are associated with a decrease in the size of the informal economy. My results are consistent with the findings of McCaig and Pavcnik (2018), who employ the United States-Vietnam Bilateral Trade Agreement. Their findings suggest that expanded export opportunities reduce the size of the informal economy in Vietnam, inducing a reallocation of workers away from informal household businesses. More specifically, they find that a reduction in U.S. tariffs on Vietnamese exports of 10 percentage points is associated with a 1.6 percentage point reduction in the probability of informal labor in manufacturing industries. Paz (2014) finds a similar change, with foreign import tariffs decreasing the informality share by 1.5 percentage points. These results are larger than the estimates produced by this study, which suggest that a 10 percentage point reduction in tariffs decreases informal employment by 0.1%. One possible explanation for the difference is that this study captures a symmetric model in which two countries have the same size and characteristics, while in fact the U.S. economy is about 100 times larger than its counterpart, Vietnam.

The third main result is that FDI policy liberalization reduces informal output, leading to a reallocation of workers from informal firms to the formal sector. I find that a 10% increase in FDI presence shrinks the informal economy by more than 2%. This is consistent with the

work of Dougherty and Escobar (2013), who find that Mexican industries with a larger FDI presence experience a lower share of informal employment. These main results provided by this paper are considerably important, because they imply that new export opportunities and increased FDI presence provide a powerful market-based solution for improving social welfare in developing countries, including Vietnam.

This paper falls into the growing body of trade literature that examines the impact of trade liberalization on labor informality. Most of the empirical quantitative studies on trade and informality are focused on India or Latin America, including Brazil, Argentina, Mexico and Columbia. This study adds conclusive results to the extant literature, which to date has yielded mixed results. Goldberg and Pavcnik (2003) find no impact from trade liberalization in Brazil and some weak evidence of minimal effects stemming from trade reform in Colombia. Bosch et al. (2012), using data from the Brazilian metropolitan labor market, do not find that trade reform has a significant effect on the rise in informality. Fugazza and Fiess (2010), using different data sets to assess the sign of the relationship, do not find any conclusive association with trade liberalization. They find that aggregate data generates results which support the view that trade liberalization will lead to a rise in informality, while micro-founded data does not. Finally, Castilla (2006) finds that reductions in Mexican import tariffs are associated with decreases in the likelihood of informality in the tradable sector. Of those tradable industries, informality's decrease is less significant in more import-oriented industries, and is greater in more export-oriented industries.

My study is also related to the literature on FDI. Although little is known about the causal relationship between FDI and informality, one strand of literature emphasizes the implications for employment. Waldkirch et al. (2009), Karlsson et al. (2009), and Bandick and Gorg (2010) find that FDI has a significantly positive impact on local employment. In contrast, Jude and Silaghi (2016) provide evidence that FDI leads to negative short-term effects on employment in Central and Eastern Europe. However, the long-term effects are

positive. My paper complements this literature to the extent that FDI contributes to the creation of new formal jobs and the destruction of informal jobs.

This study is structured as follows. Sections 2 and 3 provide the trade and FDI models, respectively. Section 4 presents the parameterization of these models. Section 5 analyzes the effects of trade liberalization and FDI. Section 6 analyzes the sensitivity of the main results to changes in key parameters. Section 7 describes the welfare analysis. Section 8 concludes this study.

3.2 Trade shocks in a two-country model

The model is structured to examine the effect of increased import competition and export opportunities on the size of the informal economy. The world economy consists of two countries: home country and foreign country. The domestic (foreign) country is populated by a continuum of households of measure m ($1 - m$). The two countries trade with each other.

3.2.1 Households

Intratemporal problem

In the home country, households consume a bundle of final goods, C_t , which is a composite index of formal and informal consumption goods, Y_m and Y_n , respectively:

$$C_t = \left[\gamma^{1/\zeta} Y_{m,t}^{\frac{\zeta-1}{\zeta}} + (1-\gamma)^{1/\zeta} Y_{n,t}^{\frac{\zeta-1}{\zeta}} \right]^{\frac{\zeta}{\zeta-1}}$$

where ζ is the elasticity of substitution between formal and informal goods, and γ represents the share of formal goods in the consumption basket. Formal goods, Y_m , is a composite of

home and foreign traded goods, C_d and C_f , respectively:

$$Y_{m,t} = \left[\eta^{1/\theta} C_{d,t}^{\frac{\theta-1}{\theta}} + (1-\eta)^{1/\theta} C_{f,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

where θ is the elasticity of substitution between home and foreign goods and η denotes the share of domestic goods in the consumption basket of formal goods. The CES specification above ensures the existence of exports and imports. The general price index for consumption is P_t , the price index for formal goods is $P_{m,t}$, the price index for informal goods is $P_{n,t}$, the price of domestic goods is $P_{d,t}$, and the price of foreign goods is $P_{f,t}$. Define $p_{m,t} = \frac{P_{m,t}}{P_t}$, $p_{n,t} = \frac{P_{n,t}}{P_t}$, $p_{d,t} = \frac{P_{d,t}}{P_t}$, and $p_{f,t} = \frac{P_{f,t}}{P_t}$ as the prices in terms of the domestic final good. So it holds:

$$Y_{m,t} = \gamma(p_{m,t})^{-\zeta} C_t \quad (3.1)$$

$$Y_{n,t} = (1-\gamma)(p_{n,t})^{-\zeta} C_t \quad (3.2)$$

$$1 = \left[\gamma p_{m,t}^{1-\zeta} + (1-\gamma) p_{n,t}^{1-\zeta} \right]^{\frac{1}{1-\zeta}} \quad (3.3)$$

$$C_{d,t} = \eta \left(\frac{p_{d,t}}{p_{m,t}} \right)^{-\theta} Y_{m,t} \quad (3.4)$$

$$C_{f,t} = (1-\eta) \left(\frac{p_{f,t}}{p_{m,t}} \right)^{-\theta} Y_{m,t} \quad (3.5)$$

$$p_{m,t} = \left[\eta p_{d,t}^{1-\theta} + (1-\eta) p_{f,t}^{1-\theta} \right]^{\frac{1}{1-\theta}} \quad (3.6)$$

In Foreign, symmetric expressions hold:

$$C_{m,t}^* = \gamma(p_{m,t}^*)^{-\zeta} C_t^* \quad (3.7)$$

$$C_{n,t}^* = (1-\gamma)(p_{n,t}^*)^{-\zeta} C_t^* \quad (3.8)$$

$$1 = \left[\gamma p_{m,t}^{*1-\zeta} + (1-\gamma) p_{n,t}^{*1-\zeta} \right]^{\frac{1}{1-\zeta}} \quad (3.9)$$

$$C_{d,t}^* = (1 - \eta) \left(\frac{p_{d,t}^*}{p_{m,t}^*} \right)^{-\theta} Y_{m,t}^* \quad (3.10)$$

$$C_{f,t}^* = \eta \left(\frac{p_{f,t}^*}{p_{m,t}^*} \right)^{-\theta} Y_{m,t}^* \quad (3.11)$$

$$p_{m,t}^* = \left[(1 - \eta) p_{d,t}^{*1-\theta} + \eta p_{f,t}^{*1-\theta} \right]^{\frac{1}{1-\theta}}, \quad (3.12)$$

where asterisks indicate variables of the foreign country.

Define the real exchange rate as follows:

$$rer_t = e_t \frac{P_t^*}{P_t}$$

where the nominal exchange rate e_t is the price of one unit of domestic currency in terms of foreign currency, and P_t^* is the foreign general price index.

Intertemporal problem

The domestic economy consists of a continuum of households indexed by i on the unit interval. Each of them provides a homogeneous labor service as an informal worker and a differentiated labor service as a formal worker. There are two types of firms: informal firms in the informal sector, and formal firms in the formal sector. Informal firms exclusively use informal workers, while formal firms use both formal and informal workers as their inputs. This modeling strategy has two implications. First, the model does not capture the decision of firms to enter formal or informal sectors. Second, it does not model the decision of formal firms to use formal and informal labor. Instead, this information is abstracted from the determinants of the hiring decision.⁶ The CES production function guarantees the co-existence of both informal and formal firms.

⁶This feature of the model is consistent with Vietnamese data. McCaig and Pavcnik (2018) show the existence of both the informal (household business) and formal (non-household business) sectors. Cao (2018), using firm-level data, shows that formal firms hire both informal and formal workers. This is also in line with the theory and empirics of Ulyssea (2018), who uses Colombian data.

Household i solves the following problem:

$$U_t(i) = E_t \sum_{t=0}^{\infty} \beta^t \left(\log C_t(i) - \frac{l_t(i)^{1+\kappa}}{1+\kappa} - \frac{h_t(i)^{1+\kappa}}{1+\kappa} - \frac{n_t(i)^{1+\kappa}}{1+\kappa} \right)$$

where l_t denotes hours worked as formal labor in the formal sector, h_t denotes hours worked as informal labor in the formal sector, and n_t denotes hours worked in the informal sector. For each hour of work, formal workers earn w_l , while informal workers in the formal sector and informal sector earn w_h and w_n respectively.⁷ κ represents the elasticity of substitution between three types of labor.

Following Mineyama (2018), I use the aggregate labor supply for formal workers as follows:

$$L_t = \left[\int_0^1 l_t(i)^{\frac{\mu-1}{\varepsilon_w}} di \right]^{\frac{\mu}{\mu-1}},$$

where μ represents the labor demand elasticity. The standard individual labor demand function is as follows:

$$l_t(i) = L_t \left(\frac{w_t(i)}{W_t} \right)^{-\mu},$$

where the aggregate wages are defined as

$$W_t = \left[\int_0^1 w_t(i)^{1-\mu} di \right]^{\frac{1}{1-\mu}}$$

Household i maximizes its utility subject to the budget constraint:

$$C_t(i) = w_{l,t}(i)l_t(i) + w_{h,t}h_t(i) + w_{n,t}n_t(i) + \Gamma_t(i),$$

where $\Gamma_t(i)$ is the share of producer's profits distributed to household i . FOCs are

$$l_t^\kappa \left(\frac{w_{l,t}(i)}{W_t} \right)^{-\mu\kappa} = \frac{w_{l,t}(i)}{C_t(i)} \left(\frac{\mu-1}{\mu} \right)$$

⁷I could model same wages for informal workers in both sectors. However, it is not possible to test this feature with the Vietnamese data. Since there is no evidence to support the equal wage, I leave this issue.

$$h_t^\kappa(i) = \frac{w_{h,t}}{C_t(i)}$$

$$n_t^\kappa(i) = \frac{w_{n,t}}{C_t(i)}$$

In the following analysis, I follow Mineyama (2018) to impose an assumption that “each household has access to a complete insurance market for consumption.” Consumption is therefore identical across households:

$$C_t(i) = C_t$$

In a symmetric equilibrium, households choose same wages, and supply the same amount of labor. Then the optimality conditions are:

$$l_t^\kappa = \frac{w_{l,t}}{C_t} \left(\frac{\mu - 1}{\mu} \right) \quad (3.13)$$

$$h_t^\kappa = \frac{w_{h,t}}{C_t} \quad (3.14)$$

$$n_t^\kappa = \frac{w_{n,t}}{C_t} \quad (3.15)$$

Equation 3.13 indicates that each household requires constant markup $\frac{\mu}{\mu-1}$ on formal labor services.

Foreign households face similar conditions:

$$l_t^{*\kappa} = \frac{w_{l,t}^*}{C_t^*} \left(\frac{\mu - 1}{\mu} \right) \quad (3.16)$$

$$h_t^{*\kappa} = \frac{w_{h,t}^*}{C_t^*} \quad (3.17)$$

$$n_t^{*\kappa} = \frac{w_{n,t}^*}{C_t^*} \quad (3.18)$$

3.2.2 Firms producing domestic goods

The representative domestic firm uses the following CES aggregator to produce domestic goods $Y_{d,t}$:

$$Y_{d,t} = \left[\int_0^1 Y_{d,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

where $Y_{d,t}(j)$ is an intermediate input produced by the intermediate firm j , whose price is $p_{d,t}$, and ε represents the elasticity of substitution between intermediate goods. The domestic goods are used domestically and internationally. The law of one price applies to this producer, indicating the following profit maximization problem:

$$\max_{Y_{d,t}, Y_{d,t}(j)} P_{d,t} Y_{d,t} - \int_0^1 P_{d,t}(j) Y_{d,t}(j)$$

$$s.t. Y_{d,t} = \left[\int_0^1 Y_{d,t}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

The demand function for the generic input j is as follows

$$Y_{d,t}(j) = Y_{d,t} \left(\frac{p_{d,t}(j)}{p_{d,t}} \right)^{-\varepsilon}$$

The profits are zero in equilibrium. The price $p_{d,t}$ can be expressed as follows:

$$p_{d,t} = \left[\int_0^1 p_{d,t}(j)^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}}$$

3.2.3 Formal sector

There is a continuum of firms indexed by j , producing a differentiated domestic input using the following technology:

$$Y_{d,t}(j) = l_t^\alpha(j) h_t^{1-\alpha}(j)$$

Firms operate in monopolistic competition, setting prices subject to the demand of the firm producing domestic goods. The profit maximization problem of generic firm j is as follows

$$\max_{Y_{d,t}(j), p_{d,t}(j), l_{d,t}(j)} p_{d,t}(j)Y_{d,t}(j) - w_{l,t}l_t(j) - w_{h,t}h_t(j)$$

The lagrangian can be written as:

$$L = p_{d,t}(j)Y_{d,t}\left(\frac{p_{d,t}(j)}{p_{d,t}}\right)^{-\varepsilon} - w_{l,t}l_t(j) - w_{h,t}h_t(j) + mc_t(j)\left[l_t^\alpha(j)h_t^\alpha(j) - Y_{d,t}\left(\frac{p_{d,t}(j)}{p_{d,t}}\right)^{-\varepsilon}\right]$$

where $mc_t(j)$ is the Lagrangian multiplier, which can be interpreted as the real marginal cost of producing an additional unit of output. The first order conditions w.r.t. labor:

$$w_{l,t}l_t(j) = mc_t(j)\alpha Y_{d,t}(j)$$

$$w_{h,t}h_t(j) = mc_t(j)(1 - \alpha)Y_{d,t}(j)$$

The FOC w.r.t. the price $p_{d,t}(j)$:

$$(1 - \varepsilon)Y_{d,t}\left(\frac{p_{d,t}(j)}{p_{d,t}}\right)^{-\varepsilon} + \varepsilon mc_t(j)Y_{d,t}\frac{p_{d,t}(j)^{-\varepsilon-1}}{p_{d,t}^{-\varepsilon}} = 0$$

In a symmetric equilibrium, firms have the same marginal cost, choose the same price, hire the same amount of labor, and produce the same amount of output. Three equations above is rearranged to obtain the pricing equation:

$$p_{d,t} = \frac{\varepsilon}{\varepsilon - 1}mc_t$$

This pricing strategy suggests that the price has a constant markup $\frac{\varepsilon}{\varepsilon-1}$ over the marginal cost. Using the production function results in the following:

$$Y_{d,t} = l_t^\alpha h_t^{1-\alpha} \tag{3.19}$$

$$w_{l,t}l_t = \alpha \frac{\varepsilon - 1}{\varepsilon} p_{d,t} Y_{d,t} \quad (3.20)$$

$$w_{h,t}h_t = (1 - \alpha) \frac{\varepsilon - 1}{\varepsilon} p_{d,t} Y_{d,t} \quad (3.21)$$

Domestic profits can be expressed as:

$$\Gamma_{d,t} = p_{d,t} Y_{d,t} - w_{l,t}l_t - w_{h,t}h_t$$

Firms that produce foreign intermediate goods face similar conditions:

$$Y_{f,t}^* = (l_t^*)^{\alpha^*} (h_t^*)^{1-\alpha^*} \quad (3.22)$$

$$w_{l,t}^* l_t^* = \alpha^* \frac{\varepsilon - 1}{\varepsilon} p_{f,t}^* Y_{f,t}^* \quad (3.23)$$

$$w_{h,t}^* h_t^* = (1 - \alpha^*) \frac{\varepsilon - 1}{\varepsilon} p_{f,t}^* Y_{f,t}^* \quad (3.24)$$

$$\Gamma_{f,t}^* = p_{f,t}^* Y_{f,t}^* - w_{l,t}^* l_t^* - w_{h,t}^* h_t^*$$

3.2.4 Informal sector

The representative informal firm produces a homogeneous informal good using the following Cobb-Douglas function:

$$Y_{n,t} = n_t \quad (3.25)$$

The firm operates in a perfect competition environment and takes the price $p_{n,t}$ as given.

The profit maximization problem provides that

$$w_{n,t} = p_{n,t}, \quad (3.26)$$

and profits are zero in equilibrium. The foreign informal firm face similar conditions:

$$Y_{n,t}^* = n_t^* \quad (3.27)$$

$$w_{n,t}^* = p_{n,t}^* \quad (3.28)$$

3.2.5 Trade costs

I assume that traded goods are subject to international iceberg trade costs, τ_t and τ_t^* . It is assumed that the trade costs evolve according to the following AR(1) process:

$$\ln\left(\frac{\tau_t}{\tau}\right) = \rho \ln\left(\frac{\tau_{t-1}}{\tau}\right) + \epsilon_t \quad (3.29)$$

$$\ln\left(\frac{\tau_t^*}{\tau^*}\right) = \rho \ln\left(\frac{\tau_{t-1}^*}{\tau^*}\right) + \epsilon_t \quad (3.30)$$

where ρ denotes the persistence of a trade shock and ϵ_t represents an unexpected change in the tariff barriers. τ and τ^* denote the steady state value of τ_t and τ_t^* , respectively. The parameter ϵ_t serves to model tariff policy shifts. It is worth noting that the parameter ρ does not appear in steady-state equilibrium conditions, but plays a role in equilibrium dynamics.

Since the law of one price holds for the producer prices:

$$p_{d,t}\tau_t^* = rer_t p_{d,t}^*$$

$$p_{f,t} = rer_t p_{f,t}^* \tau_t$$

Note that the law of one price here implies:

$$\frac{p_{d,t}\tau_t^*}{p_{f,t}} = \frac{p_{d,t}^*}{p_{f,t}^* \tau_t} \quad (3.31)$$

suggesting that the relative price of domestic (foreign) goods to foreign (domestic) goods in the home (foreign) countries are equal if $\tau = \tau^*$. In other words, the home term of trade (ToT) is the same as the foreign ToT.

3.2.6 Market clearing

Households' consolidated budget constraint can be expressed as

$$C_t = p_{d,t}Y_{d,t} + p_{n,t}Y_{n,t} \quad (3.32)$$

$$C_t^* = p_{f,t}^*Y_{f,t}^* + p_{n,t}^*Y_{n,t}^* \quad (3.33)$$

Market clearing conditions are given by

$$mY_{d,t} = mC_{d,t} + \tau_t^*(1 - m)C_{d,t}^* \quad (3.34)$$

$$(1 - m)Y_{f,t}^* = \tau_t mC_{f,t} + (1 - m)C_{f,t}^* \quad (3.35)$$

The latter two equations imply that the domestic (foreign) country must export τ^* (τ) units of the domestic (foreign) goods in order for 1 unit to arrive at the destination. According to Walras's Law, one equation is redundant.

3.2.7 The impact of trade liberalization

The model is log-linearized around a symmetric steady state. Without loss of generality, I set $\theta = 1$, indicating the Cobb Douglas aggregator for domestic and imported goods.⁸ The log-linear version of Equation 3.3 can be expressed as

$$\hat{p}_{m,t} = -\frac{(1 - \gamma)p_n^{1-\zeta}}{\gamma p_m^{1-\zeta}}\hat{p}_{n,t} = \left(1 - \frac{1}{\gamma p_m^{1-\zeta}}\right)\hat{p}_{n,t}$$

where the hat is used to denote the percentage deviation from the steady state of the variables.⁹ The positive steady state prices, p_m and p_n , ensures that $B = (1 - \frac{1}{\gamma p_m^{1-\zeta}}) < 0$, suggesting that formal and informal prices move in the opposite direction.

⁸The Cobb Douglas function for formal domestic good is $Y_{m,t} = C_{d,t}^\eta C_{f,t}^{1-\eta}$.

⁹See the Appendix for all log-linearized equations.

Households' optimality and firms' profit maximization conditions guarantee that output and labor inputs grow at the same rate, implying $\hat{y}_{n,t} = \hat{n}_t$ and $\hat{y}_{d,t} = \hat{l}_t = \hat{h}_t$. Hence, the change in labor composition is expected to come from the between-sector movement, meaning households reallocate working hours between the formal and informal sectors. To theoretically analyze how trade shocks impact domestic labor composition, the system of log-linear equations is used to derive the following comparative statics ¹⁰:

$$\begin{aligned}\frac{d\hat{y}_{d,t}}{d\hat{\tau}_t} &= \frac{B(1-\eta)(\zeta-1)}{(\zeta+1)(B-1)(\zeta-2B\zeta+1)} [B\eta(\zeta-1) + (\zeta+1)(B-1)] \\ \frac{d\hat{y}_{n,t}}{d\hat{\tau}_t} &= \frac{(1-\eta)(\zeta-1)}{(\zeta+1)(B-1)(\zeta-2B\zeta+1)} [B\eta(\zeta-1) + (\zeta+1)(B-1)]\end{aligned}$$

and,

$$\begin{aligned}\frac{d\hat{y}_{d,t}}{d\hat{\tau}_t^*} &= \frac{B^2\eta(1-\eta)(\zeta-1)^2}{(\zeta+1)(B-1)(\zeta-2B\zeta+1)} \\ \frac{d\hat{y}_{n,t}}{d\hat{\tau}_t^*} &= \frac{B\eta(1-\eta)(\zeta-1)^2}{(\zeta+1)(B-1)(\zeta-2B\zeta+1)}\end{aligned}$$

It is worth noting that these equations illustrate the transition of one equilibrium to another, showing the long-term consequences of a permanent shock. This is slightly different from my calibration practice in which I conduct stochastic shocks. Nevertheless, the use of deterministic shocks does not change the results of this study.

Proposition 3.1. *(i) Export opportunities increase (diminish) the size of the formal (informal) sector. (ii) If the elasticity of substitution between formal and informal goods, ζ , is less than one (and greater than zero), then increased import competition results in a larger informal output and a smaller formal sector.* ¹¹

¹⁰ κ is set equal 1

¹¹ In notational forms: if $0 < \zeta < 1$, then $\frac{d\hat{y}_{d,t}}{d\hat{\tau}_t} > 0$, $\frac{d\hat{y}_{n,t}}{d\hat{\tau}_t} < 0$, . For $\zeta > 1$, the inequality signs flip.

Trade liberalization can only impact the formal and informal sectors in opposite directions. Since B is negative, it is true that $\frac{d\hat{y}_{d,t}}{d\hat{\tau}_t}$ and $\frac{d\hat{y}_{n,t}}{d\hat{\tau}_t}$ have opposite signs. This is also applied to $\frac{d\hat{y}_{d,t}}{d\hat{\tau}_t^*}$ and $\frac{d\hat{y}_{n,t}}{d\hat{\tau}_t^*}$. The analysis provides conclusive results regarding how trade openness drives the two sectors: if trade liberalization hurt the informal sector, it will benefit the formal sector. Moreover, the first part of this proposition suggests that the effects of export opportunities are decisive, i.e., $\frac{d\hat{y}_{d,t}}{d\hat{\tau}_t^*} < 0$ and $\frac{d\hat{y}_{n,t}}{d\hat{\tau}_t^*} > 0$. That is, increased access to foreign markets helps the home country to reduce labor informality.

The directions of the effects of import competition, however, depend on the value of the elasticity of substitution between formal and informal goods, ζ . For the parameterization process, I treat the formal and informal sectors as tradable and non-tradable, respectively. The empirical literature shows positive estimates for cross-sector substitutability.¹² Thus, it is reasonable to assume that $0 < \zeta < 1$ in this analysis. The second part of this proposition suggests that increased import competition through a reduction in foreign trade costs expands the size of the informal sector, resulting in larger labor informality.

3.3 FDI shocks in a small closed economy model

This small closed economy model examines the effect of increased FDI presence on the size of the informal economy. To ensure the model remains tractable, I remove the trade feature from the previous model. The economy includes two sectors: formal and informal. Firms in the informal sector use informal labor to produce informal goods. Formal goods production combines the production processes of domestic and foreign firms, respectively denoted as Y_d and Y_f . Foreign and domestic goods themselves are not traded. Firms in the formal sector use both formal and informal workers for production.

¹²Stockman and Tesar (1995) estimate the elasticity of 0.44, while Mendoza (1995) produces an estimate of about 0.74.

3.3.1 Firms

Formal firms operate in a monopolistic market. The symmetric equilibrium guarantees that all domestic firms are identical. Domestic and foreign production are given by the following Cobb-Douglas functions:

$$Y_{d,t} = l_{d,t}^{\alpha_d} h_{d,t}^{1-\alpha_d} \quad (3.36)$$

$$Y_{f,t} = l_{f,t}^{\alpha_f} h_{f,t}^{1-\alpha_f} \quad (3.37)$$

where $l_{d,t}$ denotes hours worked as a formal worker in domestic firms, $h_{d,t}$ denotes hours worked as an informal worker in domestic firms, $l_{f,t}$ denotes hours worked as a formal workers in foreign firms, $h_{f,t}$ denotes hours worked as an informal worker in foreign firms. Wages equal marginal products owing to perfect competition in the labor market.

It is worth noting that any profits earned by foreign-owned firms are sent back to the foreign country. The monopolistic market results in positive profits, $\pi_f = \frac{1}{\varepsilon} p_f Y_f$. This indicates that a fraction, $v = \frac{\varepsilon-1}{\varepsilon}$, of the foreign output is used in the next domestic production process.

Informal firms are similar to the trade model. They operate in a perfect competition, producing a homogeneous informal good.

3.3.2 Households

Intratemporal problem

Final good production combines the production processes of formal and informal goods, respectively denoted as Y_m and Y_n . The aggregate production function for the final goods is similar to the trade model.

The aggregate production function for the formal good Y_m is given by

$$Y_{m,t} = \left[Y_{d,t}^{\frac{\theta-1}{\theta}} + \eta_t (vY_{f,t})^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \quad (3.38)$$

where η_t denotes the share of Y_f in the basket of the formal good. I do not model the decision of foreign firms to enter the domestic market, instead abstracting from the determinants of FDI. The CES production functions guarantee the co-existence of both domestic and foreign-owned firms. The aggregator of foreign and domestic production therefore allows me to capture the effect of an increase in FDI (through an increase in η_t) on the composition of the local labor market. In addition, this simple setup allows me to emulate different interactions between domestic and foreign-owned firms, as supplements or substitutes, for example.

Intertemporal problem

The informal sector is similar to the trade model. However, the formal sector includes two types of firms: domestic and foreign-owned firms. Formal firms' production processes require both formal and informal workers. Similar to the trade model, formal workers provide a differentiated labor service, while informal workers provide a homogeneous service. A household's utility maximization problem takes the following form (omitting the index i for now):

$$U_t = E_t \sum_{t=0}^{\infty} \beta^t \left(\log C_t - \frac{l_{d,t}^{1+\kappa}}{1+\kappa} - \frac{h_{d,t}^{1+\kappa}}{1+\kappa} - \frac{l_{f,t}^{1+\kappa}}{1+\kappa} - \frac{h_{f,t}^{1+\kappa}}{1+\kappa} - \frac{n_t^{1+\kappa}}{1+\kappa} \right), \quad (3.39)$$

subject to the following budget constraint

$$C_t = p_{d,t}Y_{d,t} + \frac{\varepsilon - 1}{\varepsilon} p_{f,t}Y_{f,t} + p_{n,t}Y_{n,t} \quad (3.40)$$

The optimality conditions are standard.¹³

¹³See the Appendix

3.3.3 FDI policy

The FDI presence follows an AR(1) process

$$\ln\left(\frac{\eta_t}{\eta}\right) = \varphi \ln\left(\frac{\eta_{t-1}}{\eta}\right) + u_t \quad (3.41)$$

where φ is the persistence of an FDI shock and the parameter u_t serves to model FDI policy shifts. The parameter φ only plays a role in the equilibrium dynamics of the model.

3.3.4 The impact of FDI policy liberalization

The log-linear version of Equation 3.38 can be written as

$$\hat{y}_{m,t} = K\hat{y}_{d,t} + (1 - K)(\hat{y}_{f,t} + \frac{\theta}{\theta - 1}\hat{\eta}_t), \quad (3.42)$$

where $K = \left(\frac{Y_d}{Y_m}\right)^{\frac{\theta-1}{\theta}} < 1$.

Optimality conditions ensure $\hat{y}_{n,t} = \hat{n}_t$, $\hat{y}_{d,t} = \hat{l}_{d,t} = \hat{h}_{d,t}$, and $\hat{y}_{f,t} = \hat{l}_{f,t} = \hat{h}_{f,t}$. To examine the effect of FDI policy liberalization on the local economy, I derive comparative statics related to a firm's output with respect to $\hat{\eta}_t$. One would expect a clear-cut result in terms of how foreign investment impacts formal domestic and foreign firms. That is, $\frac{d\hat{y}_{d,t}}{d\hat{\eta}_t} < 0$ and $\frac{d\hat{y}_{f,t}}{d\hat{\eta}_t} > 0$. In other words, increased FDI leads to an expansion of foreign firms and a contraction of domestic firms in the formal sector. However, the impact is ambiguous for the informal sector. Retaining other notations from the trade model, I obtain the comparative statics ¹⁴:

$$\frac{d\hat{y}_{n,t}}{d\hat{\eta}_t} = \frac{\theta(1 - K)(1 - \zeta)}{(\theta - 1)(1 - B)(\zeta + 1)} \quad (3.43)$$

The signs depend on the elasticity of substitution between formal and informal goods, ζ , and the elasticity of substitution between domestic and foreign goods, θ .

¹⁴This equation analyze the consequences of a permanent shock, which is not implemented in my calibrating analysis. Using a deterministic shock does not change the result of this paper

Proposition 3.2. *For cross-sector substitutability, ζ , that is between 0 and 1, (i) If the elasticity of substitution between domestic and foreign goods, also called the Armington elasticity, is less than 1, then a higher FDI presence results in a smaller informal sector, (ii) If the Armington elasticity is greater than 1, then increased FDI presence increases the size of the informal sector.*¹⁵

ζ is set between 0 and 1 to be consistent with the trade model. This proposition suggests that the effects of FDI presence on the size of the informal sector depend on the relationship between domestic and foreign goods. The first case shows that a decrease in informal output is associated with increased FDI presence if the elasticity of substitution between domestic and foreign goods is lower than 1, meaning the two goods are more complementary. In the second case, the result is flipped. When domestic and foreign goods are more like substitutes (elasticity is greater than 1), then a higher FDI presence leads to an expansion of the informal sector.

3.4 Calibration

The parameterization of the two models, summarized in Tables 3.1 and 3.2, is set to match the features of Vietnam. I assume the time unit is one year. Thus, the discount factor is set at 0.9. The Frisch elasticity of labor supply is equal to 1, implying $\kappa = 1$ based on Keane and Rogerson (2012). The elasticity of substitution between intermediate goods, ε , and labor demand elasticity, μ , is set to 6, which implies a 20% markup in the steady state.

The elasticity of substitution between formal and informal goods, ζ , is important in this model. My propositions show that the effects of policies depend on the value of ζ . Therefore, the best approach is to estimate the parameter using Vietnamese data. Due to the lack of consumption data on formal and informal goods, however, I rely on estimates of the elasticity of substitution between tradable and nontradable goods. My assumption is that

¹⁵Notational form: For $0 < \zeta < 1$: (i) If $\theta < 1$, then $\frac{d\hat{y}_{n,t}}{d\hat{\eta}_t} < 0$, (ii) If $\theta > 1$, then $\frac{d\hat{y}_{n,t}}{d\hat{\eta}_t} > 0$.

Table 3.1 Parameterization of the trade model

Parameter	Baseline value	Description
β	0.9	Discount factor
κ	1	Inverse of Frisch elasticity of labor supply
ε	6	Elasticity of substitution between intermediate goods
μ	6	Labor demand elasticity
ζ	0.5	Elasticity of substitution between formal and informal goods
m	0.5	Relative size of the domestic economy
α	0.7	Share of formal workers in formal firms
γ	0.6	Share of formal goods in the consumption basket
η	0.25	Share of domestic goods in the consumption basket of formal goods
θ	1	Elasticity of substitution between home and foreign goods
ρ	0.9	Persistence of a trade cost shock
τ (τ^*)	1.2	Initial domestic (foreign) trade costs
ϵ (ϵ^*)	-0.08	Size of a domestic (foreign) tariff shock

Table 3.2 Parameterization of the FDI model

Parameter	Baseline value	Description
β	0.9	Discount factor
κ	1	Inverse of Frisch elasticity of labor supply
ε	6	Elasticity of substitution between intermediate goods
μ	6	Labor demand elasticity
ζ	0.5	Elasticity of substitution between formal and informal goods
α_d	0.7	Share of formal workers in formal domestic firms
α_f	0.9	Share of formal workers in formal foreign firms
γ	0.55	Share of formal goods in the consumption basket
θ	0.8	Elasticity of substitution between home and foreign goods
η	0.25	Share of domestic goods in the consumption basket of formal goods (η represents the level of FDI presence)
φ	0.9	Persistence of a FDI shock
u	0.1	Size of a FDI shock

the formal and informal sectors are considered to be tradable and nontradable, respectively. My baseline choice for cross-sector substitutability is 0.5, which is in line with Mendoza (1995) and Uribe and Schmitt-Grohe (2017). I test the sensitivity of my main results as I change the cross-sector substitutability from 0.2 to 1.5.

The parameter ϵ_t is set such that the reductions in the tariff rate are always 10 percentage points. In the baseline calibration (the tariff rate is 20%, i.e. $\tau = \tau^* = 1.2$), this implies a reduction in τ and τ^* of 8%. I set m , the relative size of the home country,

to 0.5. This simplifies the model by providing a symmetric equilibrium. Using firm-level data from Vietnam, I obtain the average share of informal workers in the formal sector of about 30%. Thus, I set $\alpha = 0.7$. Based on the ILO's report, the informal sector is estimated to contribute 20% of the Vietnamese GDP. Thus, I impose the restriction $p_n Y_n / (p_n Y_n + p_d Y_d) = 0.2$. I also document that Vietnamese imports in the GDP are above 60%. Thus, I set $p_f C_f / (p_n Y_n + p_d Y_d) = 0.6$. These two restrictions imply the share of formal goods in the consumption basket, γ , to be 0.6, and the share of domestic goods in the consumption basket of formal goods, η , to be 0.25. Finally, I set $\theta = 1$, implying a Cobb Douglas production function for the aggregator of domestic and foreign goods. This completes the calibration strategy of the trade model.

The FDI model removes the trade feature but adds FDI presence to the domestic economy. The parameter u_t , used to model shifts in the FDI presence, is set so that FDI presence increases by 10%. Consistent with the calibration of the trade model, I assume that the share of formal workers in formal domestic firms, α_d , is 0.7. Using the same data set, I calculate the share of informal workers in formal foreign firms of about 10%, implying $\alpha_f = 0.9$. In line with the calibration of the trade model, I impose the restriction $p_n Y_n / (p_n Y_n + p_d Y_d) = 0.2$, which implies $\gamma = 0.55$. The elasticity of substitution between home goods and foreign goods (θ) is set at 0.8. This is consistent with the estimates of Heathcote and Perri (2002), Corsetti et al. (2008), and Blonigen and Wilson (1999). However, I employ a sensitivity analysis to investigate how the main results change in response to changes in this parameter.

The parameters (ρ and φ) governing the persistence of the changes in trade and FDI policies are set to 0.9. This implies that the changes are very persistent.¹⁶ I conduct a sensitivity analysis to assess how the equilibrium dynamics of this model change in response to changes in this parameter.

¹⁶Value one implies that the changes are permanent.

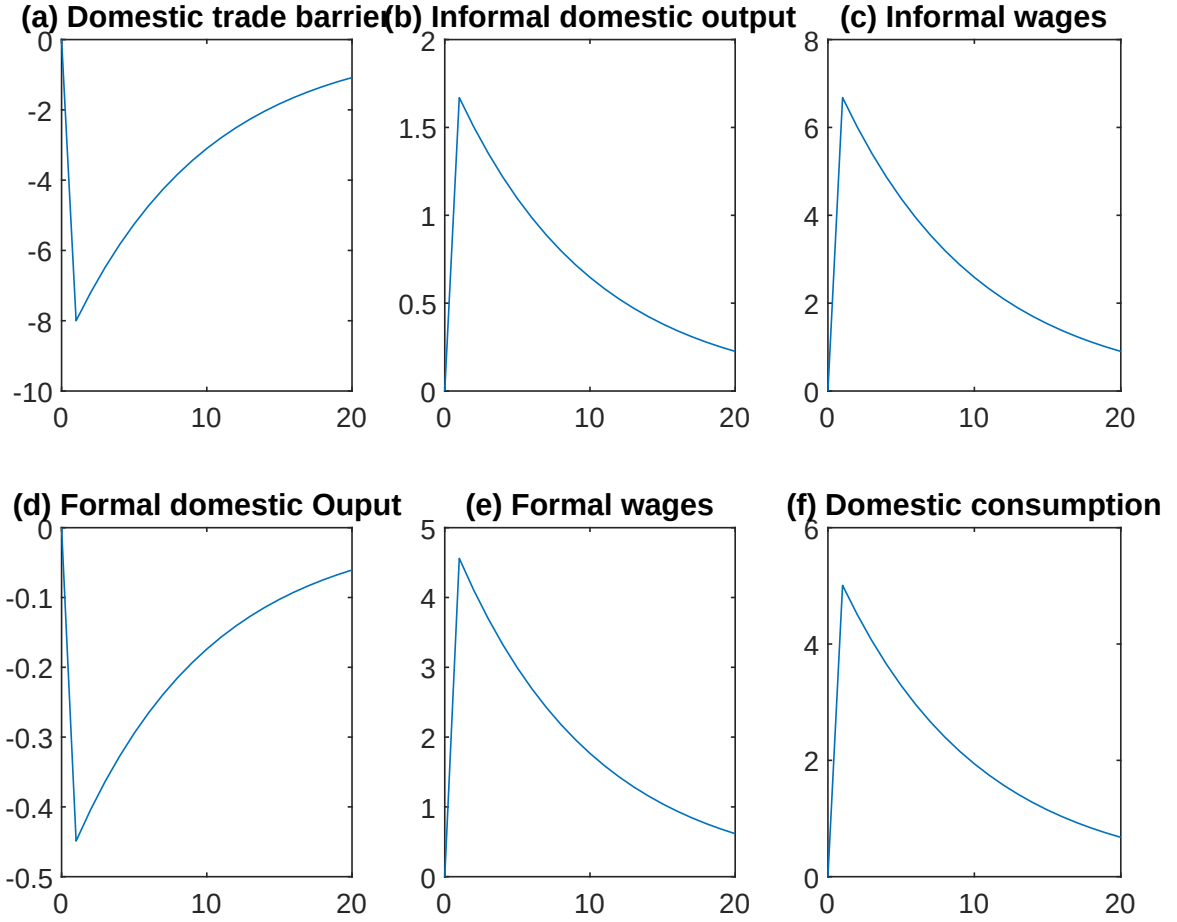


Figure 3.1: Dynamic effects of domestic trade liberalization

Notes: All variables are expressed in percent deviations from steady state.

3.5 Results

In this section, I analyze the effects of trade and FDI policy liberalization. The horizontal axes indicate time in all figures. Figures 3.1 and 3.2 show the effects of an 8% decrease in trade costs, which is equivalent to a drop of 10 percentage points.¹⁷ The vertical axes indicate the percent deviation from the initial steady state. Figure 3.1(a) shows that the domestic trade barrier is gradually reduced. Panel (b) illustrates that domestic trade liberalization gradually increases informal output, suggesting an expansion of informal employment. This is due to the decrease in trade costs, which exert an increase in import

¹⁷The initial trade barrier is 20%. After the shock, trade barrier drops to 10%.

competition in the formal sector. One year after the shock, the informal sector grew by 1.5%. This result is consistent with the existing empirical literature. Panel (d) shows that output in the formal sector declined by about 0.4% in the first year. Panels (c) and (e) illustrate that informal wages increase more than the formal wages. This explains the reallocation of workers from the formal sector to the informal sector. The net effect on consumption is presented in panel (f), showing that it increased by 5% in the short term. The increase in consumption is due to the dominant effect of the shock in the informal economy.

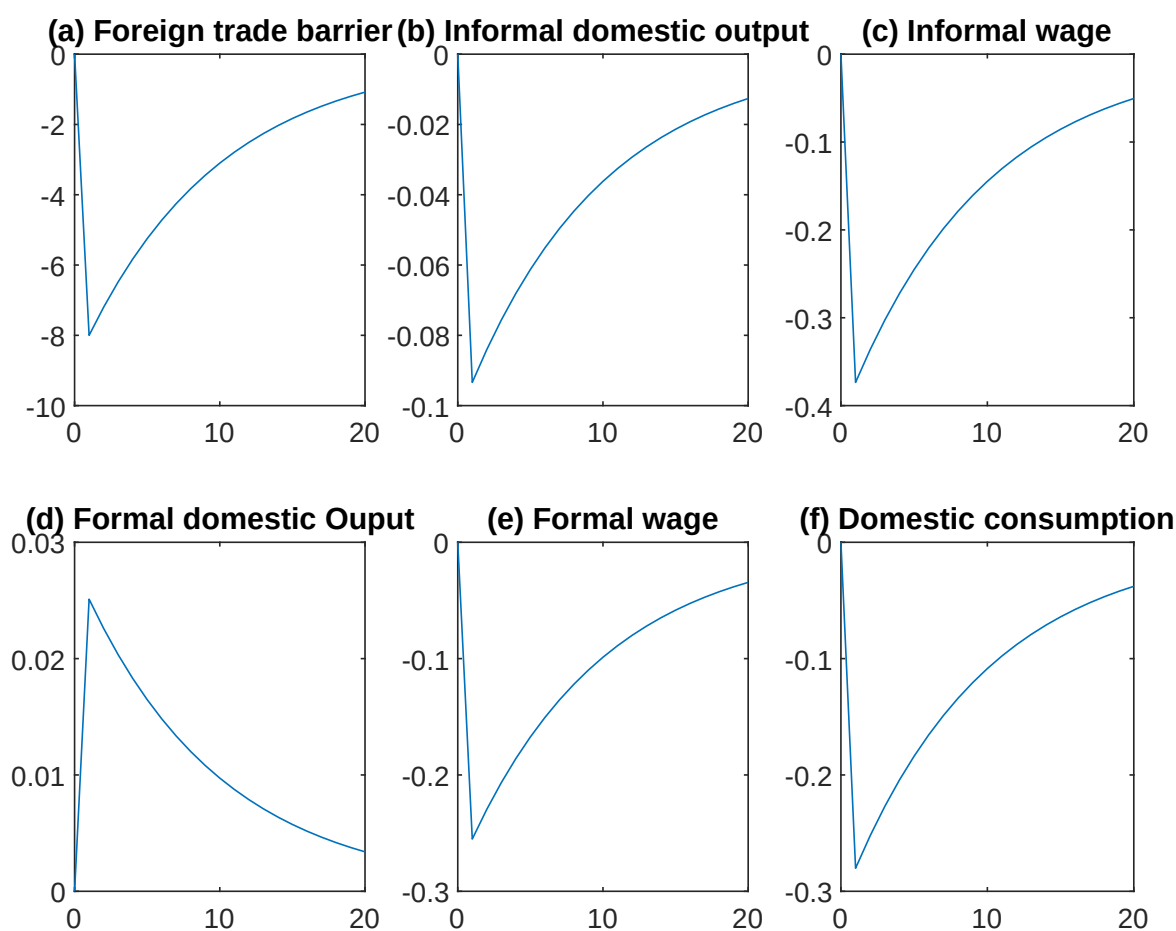


Figure 3.2: Dynamic effects of foreign trade liberalization

Notes: All variables are expressed in percent deviations from steady state.

Figure 3.2(a) shows the decrease in foreign trade barriers. Formal domestic firms expand because of better export opportunities, which leads to the contraction of the informal sector. Figures 3.2(b) and (d), therefore, show the formal sector expands by almost 0.03%, while the size of the informal sector is reduced by 0.1%. The decrease in informal output dominates the increase in formal output. Hence, panel (f) shows that consumption drops by 0.3% in the short term. Panels (c) and (e) show that the decrease in the foreign trade barrier lowers informal wages more than it does formal wages. This comparative advantage in wages allows formal firms to hire more workers.

Figure 3.3 shows the effect of higher FDI presence. The vertical axes show the percentage deviations. Figure 3.3(a) illustrates a 10% increase in η , which demonstrates an increase in FDI. As a result, formal foreign firms expand, while domestic firms contract. However, the total output of the formal sector is reduced due to greater competition from FDI firms. Because the model is calibrated with formal and informal goods as complements, decreased formal output leads to a decline in informal output. Panels (b), (d), and (f), therefore show the dynamic effects on informal, domestic, and foreign firms, respectively. Informal output and employment decline by slightly more than 2%. This is explained by the wage responses in panels (c), (e), and (g). Specifically, informal wages decline by almost 10%, which is larger than the decline found in formal domestic and foreign firms. Panel (h) illustrates that FDI policy liberalization hurts households, with consumption dropping by 7%.

3.6 Sensitivity analysis

In this section, I determine the dependence of the main results on key parameter values. I first analyze the role of cross-sector substitutability in the trade model, and I then shed light on the Armington elasticity in the FDI model. Table 3.3 demonstrates the dependence of the main outcomes on the elasticity of substitution between formal and informal goods.

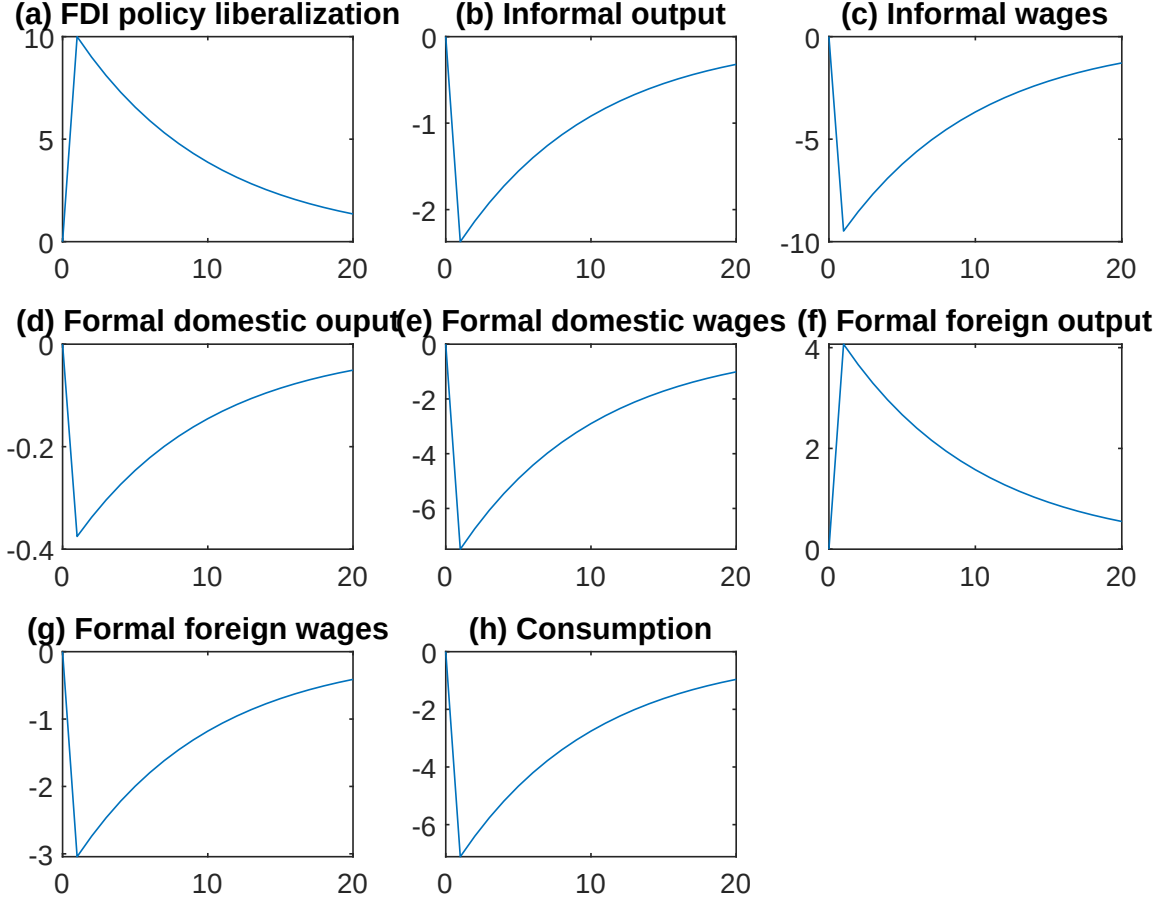


Figure 3.3: Dynamic effects of FDI policy liberalization

Notes: All variables are expressed in percent deviations from steady state.

It reveals that elasticity plays an important role in determining not only the size but also the direction of the effects of import competition. For $\zeta < 1$, import competition increases the size of the informal sector. If elasticity is at 1.5, an increase in import competition leads to a reduction in the informal sector and an expansion of the formal sector.

Table 3.4 reveals that the higher the elasticity, the smaller the effects of export opportunities on the output of both sectors. It also demonstrate that the signs of the effects are not dependent on cross-sector substitutability. Table 3.5 illustrates how responsive the main outcomes are to changes in the Armington elasticity. It shows that an increase in the Armington elasticity implies larger effects of FDI on foreign firms' output. This comes at

a cost to formal domestic firms, i.e., their output is reduced. If the Armington elasticity is at 1.5, the informal sector experiences the positive effect of increased FDI. The net effect, however, is still in favor of the formal sector.

Table 3.3 The short-term effects of import competition: Different cross-sector substitutabilities

	$\zeta = 0.2$	$\zeta = 0.5$ (benchmark)	$\zeta = 0.8$	$\zeta = 1.5$
Informal output	3.8%	1.7%	0.5%	-0.5%
Informal wages	9.5%	6.7%	4.6%	2.1%
Formal Output	-0.41%	-0.45%	-0.2%	0.6%
Formal wages	5.2%	4.5%	3.9%	3.2%
Consumption	5.7%	5%	4.1%	2.6%

Table 3.4 The short-term effects of export opportunities: Different cross-sector substitutabilities

	$\zeta = 0.2$	$\zeta = 0.5$ (benchmark)	$\zeta = 0.8$	$\zeta = 1.5$
Informal output	-0.2%	-0.09%	-0.01%	-0.04%
Informal wages	-0.5%	-0.37%	-0.13%	0.15%
Formal output	0.021%	0.025%	0.006%	0.04%
Formal wages	-0.3%	-0.25%	-0.1%	0.24%
Consumption	-0.3%	-0.28%	-0.1%	0.2%

Table 3.5 The short-term effects of FDI: The role of different Armington elasticity

	$\theta = 0.2$	$\theta = 0.5$	$\theta = 0.8$ (benchmark)	$\theta = 1.5$
Informal output	-0.21%	-0.66%	-2.3%	0.91%
Informal wages	-0.8%	-2.6%	-9.5%	3.6 %
Formal domestic output	-0.53%	-0.66%	-0.38%	-1.7%
Formal domestic wages	-1.2%	-2.6%	-7.5%	1.1%
Formal foreign output	1.1%	2.7%	4%	4.3%
Formal foreign wages	0.49%	0.68%	-3%	7.1%
Consumption	-0.65%	-2%	-7.1%	0.2%

Figures 3.4, 3.5, 3.6, 3.7, 3.8, and 3.9 show the changes in equilibrium dynamics in response to changes in the persistence values. If the value is 0.99, then the shocks are close to permanent.

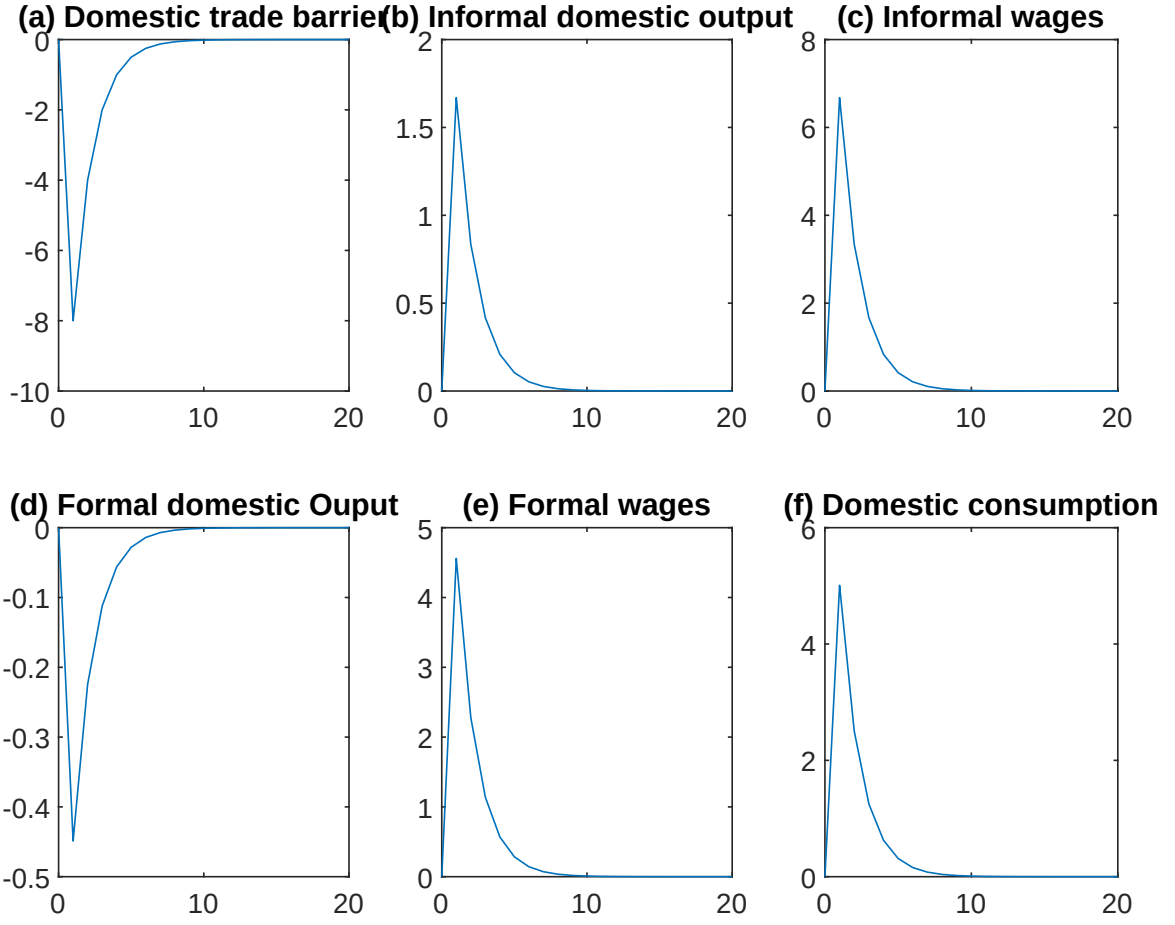


Figure 3.4: Dynamic effects of domestic trade liberalization: $\varphi = 0.5$

Notes: All variables are expressed in percent deviations from steady state.

3.7 Welfare analysis

In this section, I describe a welfare analysis of trade and FDI policy liberalization. Following Faia and Monacelli (2007), I will conditional welfare by including household utility:

$$W_{0,t} = E_0 \sum_{t=0}^{\infty} \beta^t \left(\log C_t - \frac{l_t^{1+\kappa}}{1+\kappa} - \frac{h_t^{1+\kappa}}{1+\kappa} - \frac{n_t^{1+\kappa}}{1+\kappa} \right)$$

or in recursive form:

$$W_{0,t} = \log C_t - \frac{l_t^{1+\kappa}}{1+\kappa} - \frac{h_t^{1+\kappa}}{1+\kappa} - \frac{n_t^{1+\kappa}}{1+\kappa} + \beta E_t W_{0,t+1}$$

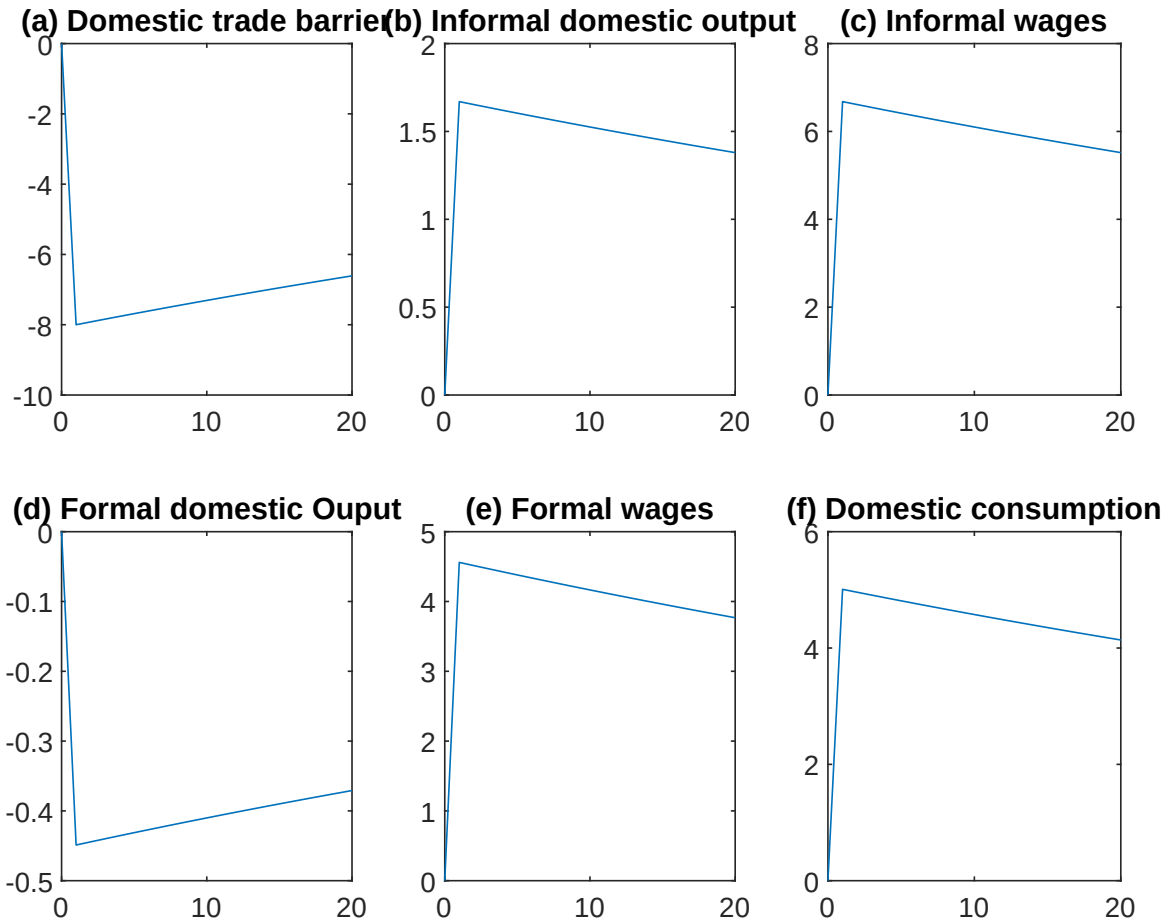


Figure 3.5: Dynamic effects of domestic trade liberalization: $\varphi = 0.99$

Notes: All variables are expressed in percent deviations from steady state.

The results are displayed in Figures 3.10 and 3.11. The vertical axes show percent deviations from the steady state. Figure 3.10(a) shows that domestic trade liberalization leads to a gain in welfare, which is primarily attributable to higher consumption. Specifically, a 10 percentage point decrease in domestic trade costs increases welfare by almost 3%. In contrast, panel (b) indicates that a decrease in foreign trade barriers results in a welfare loss for home households. The magnitude of the loss- only about 0.16%-is rather small.

In Figure 3.11, increased FDI presence decreases the home country's welfare, suggesting that a 10% increase in FDI causes a welfare loss of nearly 3.5%. This is because of the

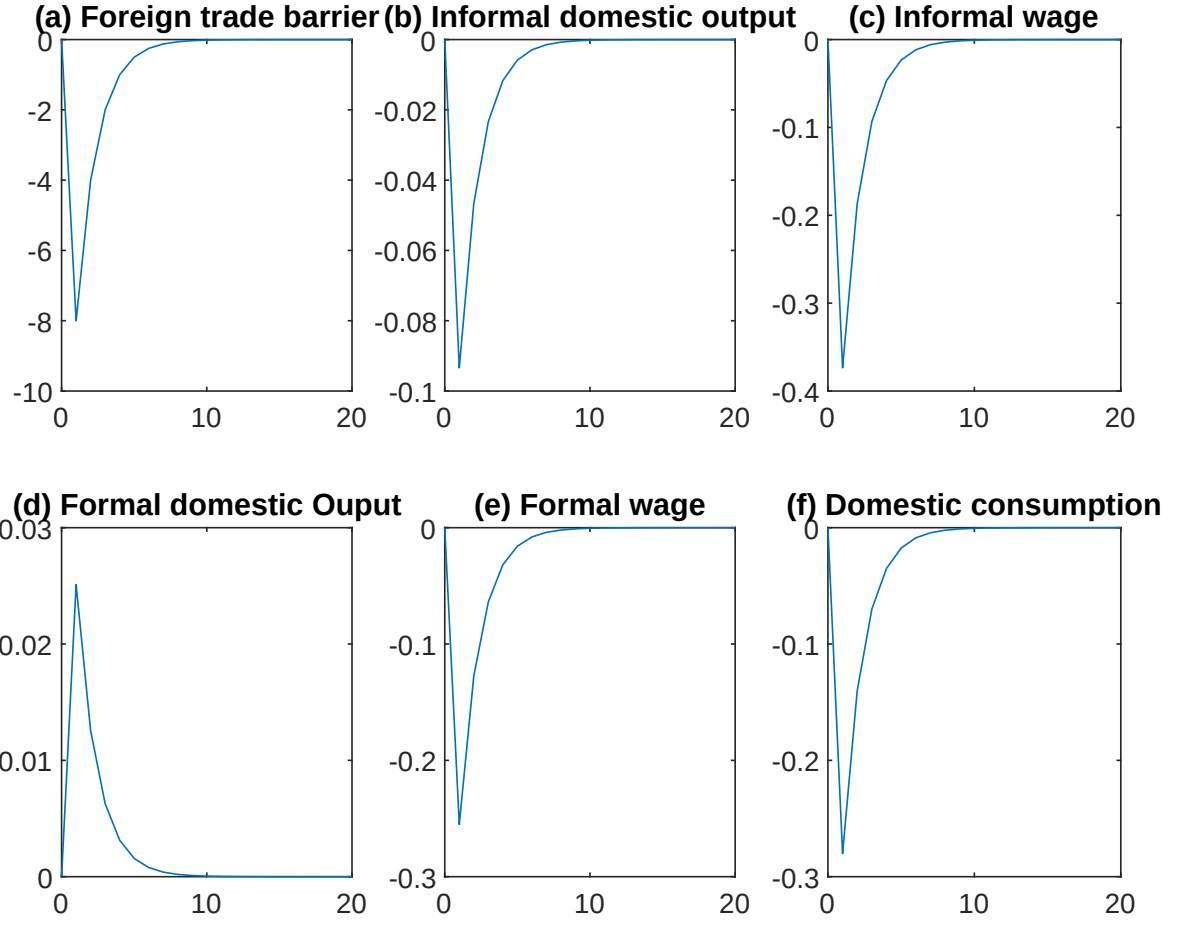


Figure 3.6: Dynamic effects of domestic trade liberalization: $\varphi = 0.5$

Notes: All variables are expressed in percent deviations from steady state.

contraction in formal and informal domestic firms. Households earn lower wages, a result which in turn forces them to consume less.

3.8 Conclusion

This paper quantifies the effects of trade and FDI liberalization in models that combine Armington and monopolistic elements. I choose the parameters of the two models to reflect existing tariff barriers and characteristics in Vietnam to derive the main results. My findings demonstrate that an increase in the size of the informal sector is associated with increases

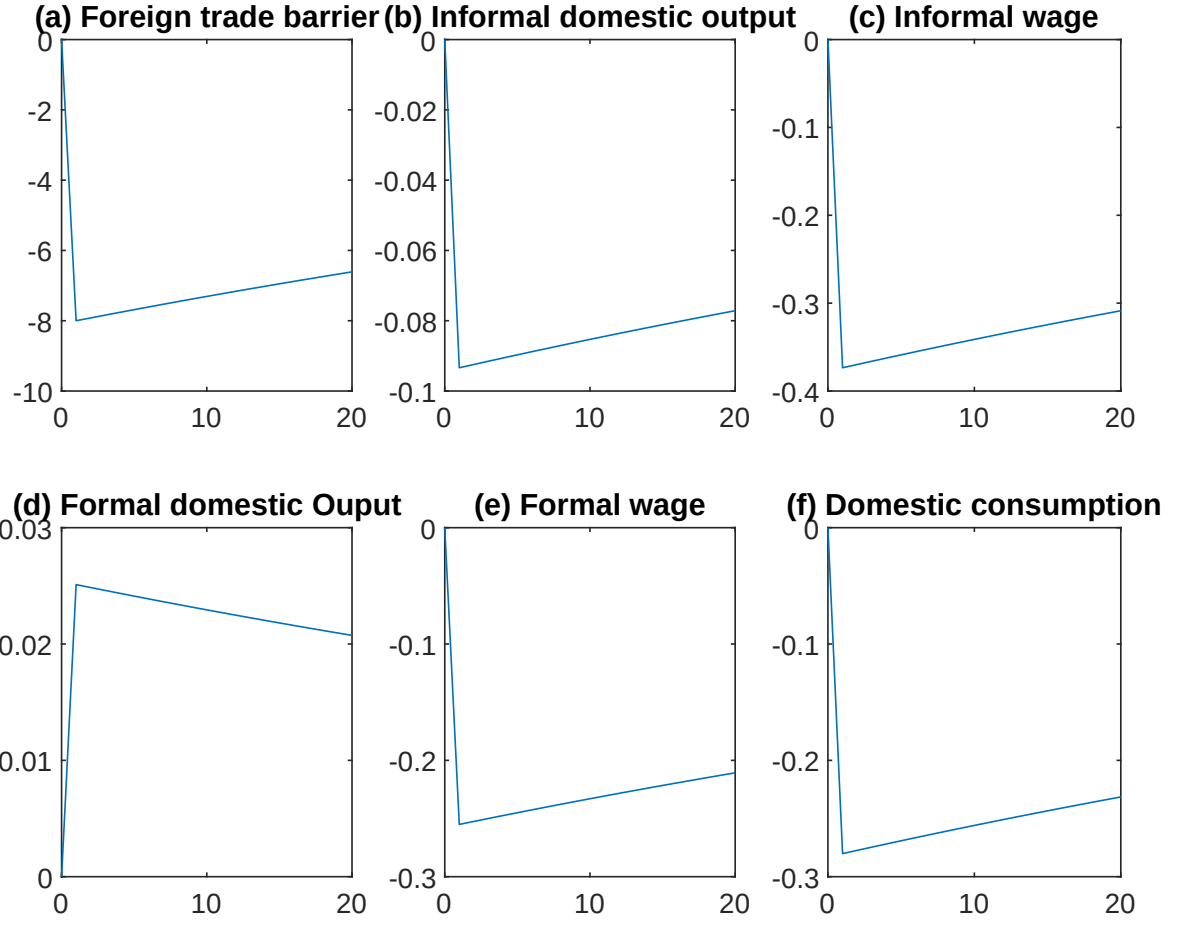


Figure 3.7: Dynamic effects of domestic trade liberalization: $\varphi = 0.99$

Notes: All variables are expressed in percent deviations from steady state.

in import competition. Alternatively, new export opportunities and larger FDI presence improve labor conditions by reducing the informality level.

I recognize there are a number of limitations of my models because they exclude several channels through which trade and FDI liberalization may affect the informal economy. First, my trade model is unable to capture the impact of trade on the hiring of informal labor within the formal sector. In particular, exporting increases sales volatility (Nguyen and Schaur, 2010; Vannoorenberghe, 2012), which in turn raises demand for informal employment in formal firms (Cao, 2018; Saint-Paul, 1997).

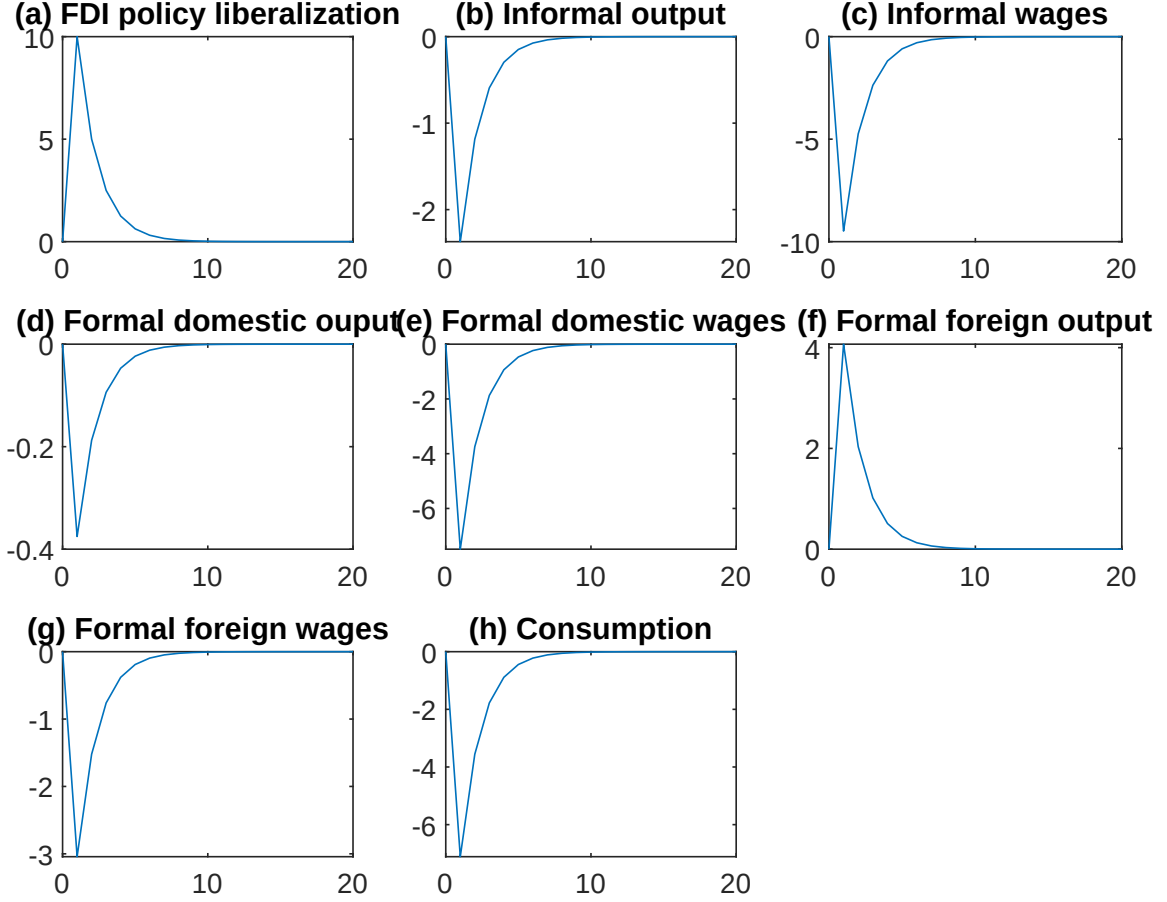


Figure 3.8: Dynamic effects of domestic trade liberalization: $\varphi = 0.5$

Notes: All variables are expressed in percent deviations from steady state.

Second, my FDI model is not able to address the reallocation of informal workers within the formal sector in response to increased FDI presence. Cao (2019), using firm-level Vietnamese data, examines the direct effects and the spillover effects of FDI on formal firms' hiring of informal workers. He finds that foreign-owned firms employ a lower share of informal labor. He also points out that industries with a higher FDI presence experience a decrease in demand for informal workers.

Third, I ignore one of the most important characteristics of FDI, which I am not able to incorporate in my model: the attractiveness of Vietnam as an export platform. The United Nations (2008) reports that "Vietnam has increasingly been establishing itself as an export

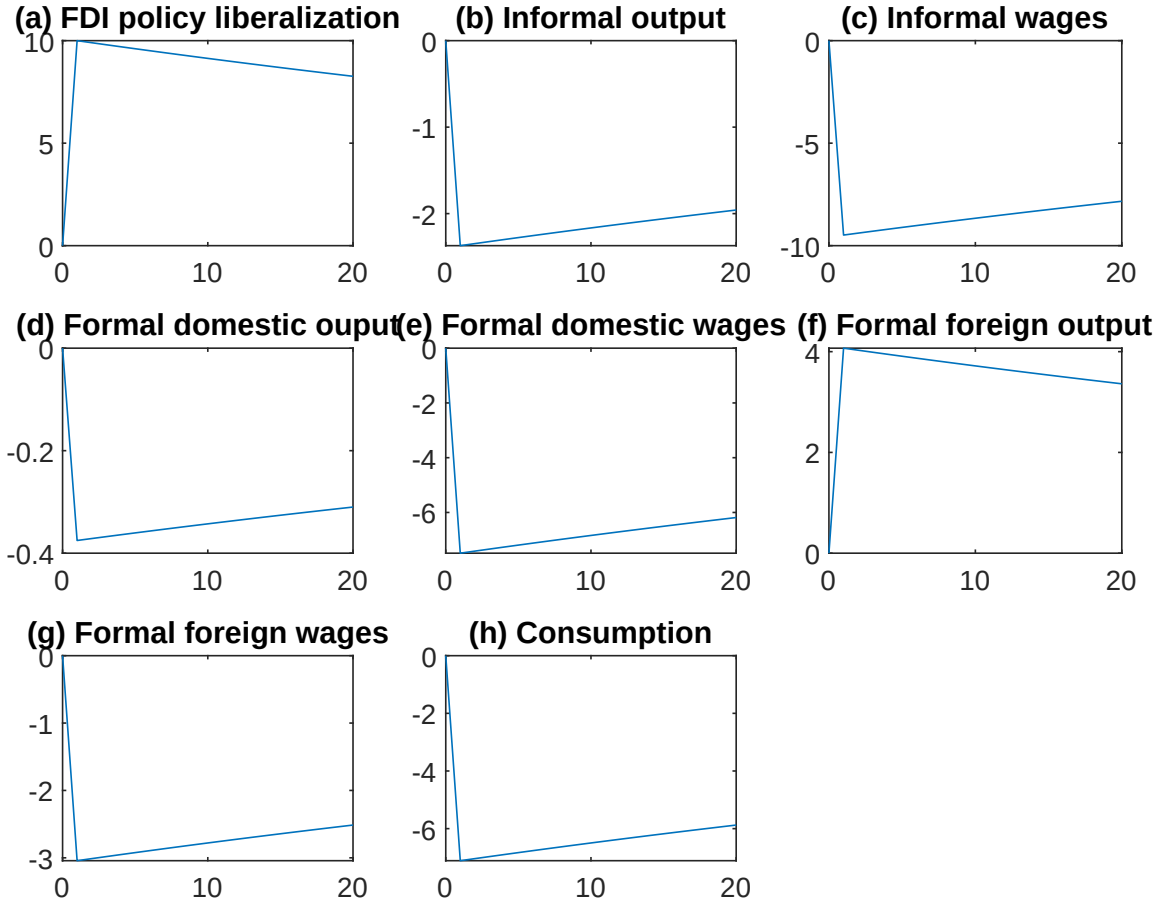


Figure 3.9: Dynamic effects of domestic trade liberalization: $\varphi = 0.99$

Notes: All variables are expressed in percent deviations from steady state.

platform for the production of manufactured goods for the global economy,” which stands in contrast to the market-seeking foreign investment employed in this study. To address this topic, I either allow a trade feature in the FDI model or combine the trade and FDI models. Therefore, further research is needed.

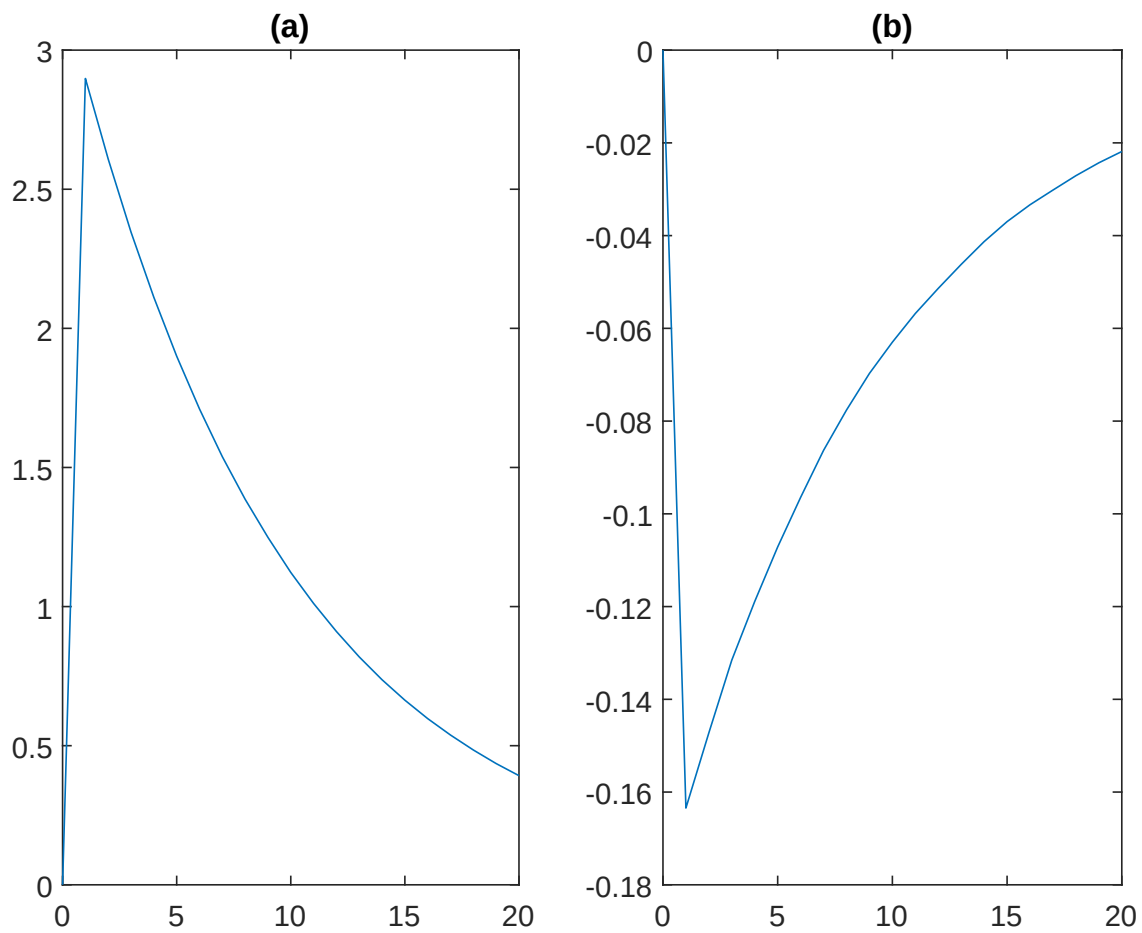


Figure 3.10: Welfare effects of trade liberalization

Notes: All variables are expressed in percent deviations from steady state. Panel (a) represents a welfare gain from domestic trade liberalization. Panel (b) shows a welfare loss in response to a decrease in foreign trade barrier.

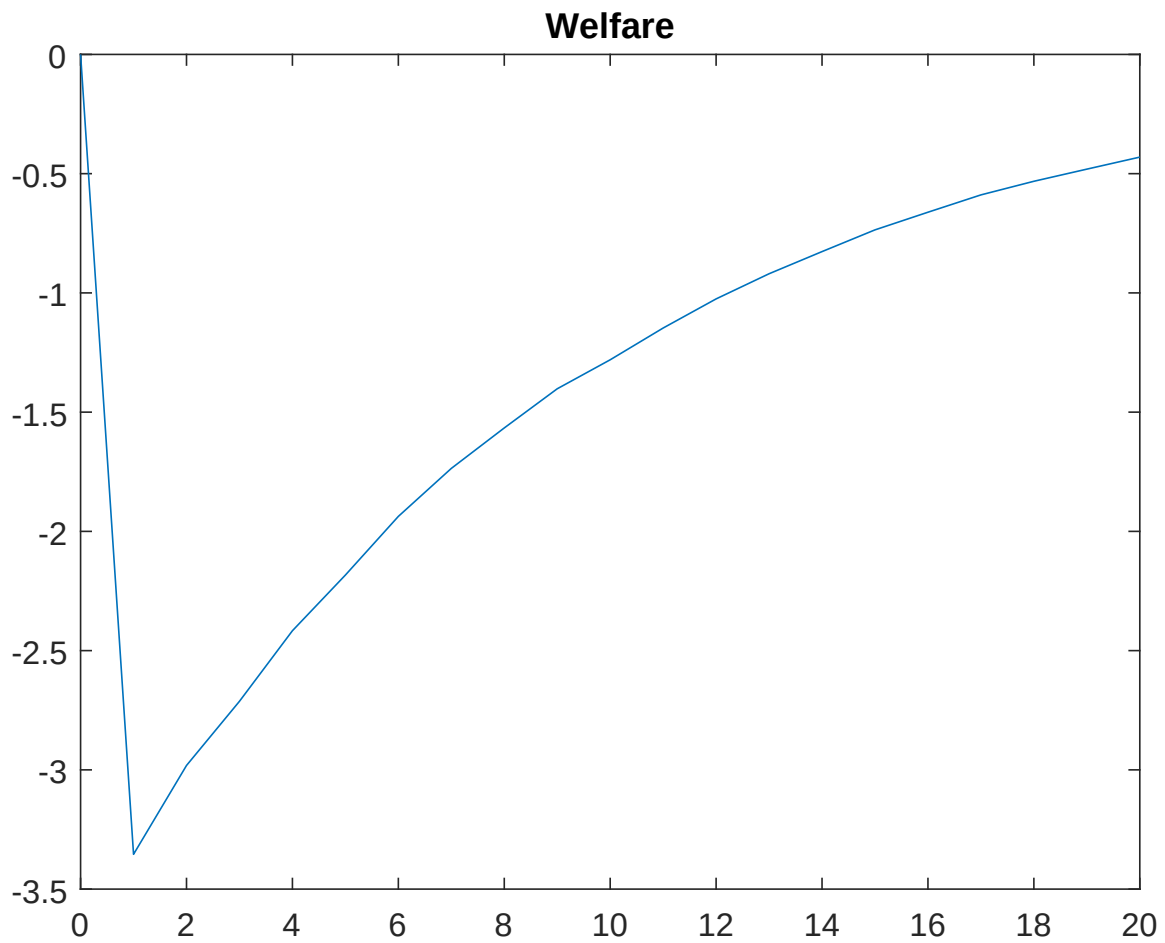


Figure 3.11: Welfare effects of FDI policy liberalization

Notes: All variables are expressed in percent deviations from steady state.

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Appendices

A Chapter 1

A.1 Proofs

Proof of Proposition 1

If firms do not hire informal workers then $s_{t+1} = 1$. If firms hire informal workers than the optimal number of workers is determined by (1.2) and $l_{t+1}^F = \tilde{l}$. Rearranging the first order condition and taking derivatives I obtain

$$\frac{\partial L}{\partial \varphi} = \frac{(\sigma - 1)L}{\varphi} - \frac{\Theta L^{\frac{\sigma+1}{\sigma}}}{\alpha_{t+1}^{\frac{\sigma-1}{\sigma^2}} \varphi^{\frac{\sigma-1}{\sigma}}} \quad (44)$$

Applying the implicit function theorem to (1.7) I obtain

$$\frac{d\tilde{l}}{d\varphi} = \frac{1}{\varphi}(\sigma - 1)\tilde{l} + \frac{\Theta \sigma \tilde{l}(1 - \delta G(\alpha_M) + \delta G(\alpha)m)}{[a + b - (w_I + m)(1 - \delta(G(\alpha_M) - G(\alpha_m))) + \delta b G(\alpha_m)]} \quad (45)$$

Note that $\frac{d}{d\varphi} \frac{\tilde{l}}{L} = 0 \iff \left(\frac{d}{d\varphi} \tilde{l}(\varphi) \right) L(\varphi) - \tilde{l}(\varphi) \left(\frac{d}{d\varphi} L(\varphi) \right) = 0$. Therefore, if $\Theta = 0$, then $\frac{d}{d\varphi} \frac{\tilde{l}}{L} = 0$.

Note that $\frac{d}{d\varphi} \frac{\tilde{l}}{L} > 0 \iff \left(\frac{d}{d\varphi} \tilde{l}(\varphi) \right) L(\varphi) - \tilde{l}(\varphi) \left(\frac{d}{d\varphi} L(\varphi) \right) > 0$. Therefore, if $\Theta = 0$, then $\frac{d}{d\varphi} \frac{\tilde{l}}{L} = 0$. Also, $\frac{\partial L}{\partial \varphi}$ decreases in Θ and $\frac{\partial \tilde{l}}{\partial \varphi}$ increases in θ . Therefore, if $\frac{d}{d\varphi} \frac{\tilde{l}}{L} = 0$ evaluated at $\Theta = 0$, it must be positive if $\Theta > 0$, and, it must be negative if $\Theta < 0$.

Proof of Proposition 2

With some minor additional notation Saint-Paul (1997) shows that $l_{t+1}^I > 0 \iff \alpha_{t+1} > \underline{\alpha} = \frac{w_I + m}{\alpha_{t+1}^{\frac{\sigma-1}{\sigma}} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{-1/\sigma}}$. Applying the implicit function theorem to (1.7) I obtain

$$\frac{d\tilde{l}}{d\varphi} = \frac{1}{\varphi}(\sigma - 1)\tilde{l} + \frac{\Theta \sigma \tilde{l}(1 - \delta G(\alpha_M) + \delta G(\alpha)m)}{[a + b - (w_I + m)(1 - \delta(G(\alpha_M) - G(\alpha_m))) + \delta b G(\alpha_m)]} \quad (46)$$

If $\frac{\partial m}{\partial \varphi} = \Theta = 0 \Rightarrow \frac{d\tilde{l}}{d\varphi} = \frac{1}{\varphi}(\sigma - 1)\tilde{l} \Rightarrow \frac{d}{d\varphi} \left(\frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{-1/\sigma} \right) = 0$. In other words, the numerator and denominator do not change if φ changes. Therefore, as productivity changes the probability of hiring informal workers remains the same.

Now consider $\frac{\partial m}{\partial \varphi} = \Theta > 0$. Note that $\frac{d\tilde{l}}{d\varphi}$ increases in Θ . Also note that the denominator in $\underline{\alpha}$ decreases in $\tilde{l}$. Then, because the denominator does not change in productivity when $\Theta = 0$, it must be the case that the denominator decreases when $\Theta > 0$. In addition, if $\Theta > 0$, then the numerator increases if productivity increases. Therefore, as productivity increases, the probability of hiring an informal worker decreases in this case. By the same argument, the probability decreases if $\frac{\partial m}{\partial \varphi} = \Theta < 0$.

Proof of Proposition 3

$\tilde{l}$ is implicitly determined by the equation

$$a + b - w_I - m = -\delta \frac{\sigma - 1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{-\frac{1}{\sigma}} \int_{\alpha_m}^{\alpha_M} G(\alpha) d\alpha \quad (47)$$

It is easy to see that if $G^*(\alpha) > G(\alpha)$, then $\int_{\alpha_m}^{\alpha_M} G(\alpha) d\alpha < \int_{\alpha_m}^{\alpha_M} G^*(\alpha) d\alpha$. Therefore, my change in the distribution lowers the right hand side of this equation.

Define $y \equiv \frac{\sigma-1}{\sigma} \varphi^{\frac{\sigma-1}{\sigma}} \tilde{l}^{-\frac{1}{\sigma}}$ and substitute into the equilibrium condition. Then, the derivative, $\frac{d}{dy} \left(-\delta y \int_{\frac{w+m}{y}}^{\frac{w+m-b}{y}} G(\alpha) d\alpha \right)$ equals

$$\delta h - \delta \left(-bG \left(\frac{w+m}{y} \right) \right) - \delta(w+m-b) \left(G \left(\frac{w+m-b}{y} \right) - G \left(\frac{w+m}{y} \right) \right) \quad (48)$$

where $h = -y \int_{\frac{w+m}{y}}^{\frac{w+m-b}{y}} G(\alpha) d\alpha$. $w+m > b$ and $\left(G \left(\frac{w+m-b}{y} \right) - G \left(\frac{w+m}{y} \right) \right) < 0$ imply that the third term is positive.

Saint-Paul (1997) shows in the first chapter that $\delta h > -\delta \left(-bG \left(\frac{w+m}{y} \right) \right)$. Therefore, $\delta h + \delta \left(-bG \left(\frac{w+m}{y} \right) \right) > 0$. Combined, this implies that $\frac{d}{dy} \left(-\delta y \int_{\frac{w+m}{y}}^{\frac{w+m-b}{y}} G(\alpha) d\alpha \right) > 0$.

Because y decreases as $\tilde{l}$ increases, this implies that as $\tilde{l}$ increases, the right hand side of equilibrium condition (47) decreases.

If the distribution changes such that $G^*(\alpha) > G(\alpha)$, then the integral in the equilibrium condition for given bounds increases. This implies that the right hand side of the equilibrium condition will decrease. To offset this, $\tilde{l}$ must decrease.

A.2 Data appendix

Table 6 Descriptive statistics

	Pre BTA (2002)			Post BTA (2003-2005)			2010-2013		
	Mean	St. Dev.	N	Mean	St. Dev.	N	Mean	St. Dev.	N
Total employment	187.37	569.03	9628	187.27	688.45	40096	156.21	780.44	121588
Number of informal workers	20.20	122.36	8623	19.37	121.41	36716	35.69	131.06	93849
Share of informal workers	0.14	0.26	8596	0.13	0.26	36662	0.42	0.34	93849
Probability of informal employment	0.49	0.50	8596	0.42	0.49	36662	0.85	0.36	93849

Notes: For pre-BTA and post-BTA the statistics are calculated using data at the beginning of the year; the year-end data is used for the 2010-2013 period. The number of observations varies due to missing variables.

B Chapter 3

B.1 The trade model

It can be easily proved that $\hat{y}_{n,t} = \hat{n}_t$ and $\hat{y}_{d,t} = \hat{l}_t = \hat{h}_t$. The hat is used to denote the percentage deviation from the steady state of the variables. The log-linearized conditions of the model around the steady state are the following. Home¹⁸:

$$\hat{c}_t = \hat{y}_{m,t} + \zeta \hat{p}_{m,t} \quad (2.1L)$$

$$\hat{c}_t = \hat{y}_{n,t} + \zeta \hat{p}_{n,t} \quad (2.2L)$$

$$\hat{p}_{m,t} = B \hat{p}_{n,t} \quad (2.3L)$$

$$\hat{y}_{m,t} + \hat{p}_{m,t} = \hat{c}_{d,t} + \hat{p}_{d,t} \quad (2.4L)$$

$$\hat{y}_{m,t} + \hat{p}_{m,t} = \hat{c}_{f,t} + \hat{p}_{f,t} \quad (2.5L)$$

$$\hat{w}_{l,t} = \hat{p}_{d,t} \quad (2.20L)$$

$$\hat{w}_{h,t} = \hat{p}_{d,t} \quad (2.21L)$$

$$\hat{w}_{n,t} = \hat{p}_{n,t} \quad (2.26L)$$

$$\kappa \hat{y}_{d,t} = \hat{p}_{d,t} - \hat{c}_t \quad (2.7L)$$

$$\kappa \hat{y}_{n,t} = \hat{p}_{n,t} - \hat{c}_t \quad (2.13L)$$

Combining the assumption that $\theta = 1$, indicating $Y_{m,t} = C_{d,t}^\eta C_{f,t}^{1-\eta}$, and the budget constraint Equation 3.32 to show that $C_{d,t} = \eta Y_{d,t}$. The log-linearized equations are as following:

$$\hat{y}_{m,t} = \eta \hat{c}_{d,t} + (1 - \eta) \hat{c}_{f,t}$$

¹⁸The equation number represents the corresponding number of the non-linearized version. For example, Equation 2.1L is the log-linear version of Equation 3.1

$$\hat{c}_{d,t} = \hat{y}_{d,t}$$

$$\hat{c}_{d,t}^* = \hat{y}_{d,t} - \hat{\tau}_t^* \quad (2.34L)$$

$$\hat{\tau}_t = \rho \hat{\tau}_{t-1} + \epsilon_t \quad (2.29L)$$

Foreign:

$$\hat{c}_t^* = \hat{y}_{m,t}^* + \zeta \hat{p}_{m,t}^*$$

$$\hat{c}_t^* = \hat{y}_{n,t}^* + \zeta \hat{p}_{n,t}^*$$

$$\hat{p}_{m,t}^* = B \hat{p}_{n,t}^*$$

$$\hat{y}_{m,t}^* + \hat{p}_{m,t}^* = \hat{c}_{d,t}^* + \hat{p}_{d,t}^*$$

$$\hat{y}_{m,t}^* + \hat{p}_{m,t}^* = \hat{c}_{f,t}^* + \hat{p}_{f,t}^*$$

$$\hat{w}_{l,t}^* = \hat{p}_{f,t}^*$$

$$\hat{w}_{h,t}^* = \hat{p}_{f,t}^*$$

$$\hat{w}_{n,t}^* = \hat{p}_{n,t}^*$$

$$\kappa \hat{y}_{f,t}^* = \hat{p}_{f,t}^* - \hat{c}_t^*$$

$$\kappa \hat{y}_{n,t}^* = \hat{p}_{n,t}^* - \hat{c}_t^*$$

$$\hat{y}_{m,t}^* = \eta \hat{c}_{d,t}^* + (1 - \eta) \hat{c}_{f,t}^*$$

$$\hat{c}_{f,t} = \hat{y}_{f,t}^* - \hat{\tau}_t$$

$$\hat{\tau}_t^* = \rho \hat{\tau}_{t-1}^* + \epsilon_t$$

The law of one price:

$$\hat{p}_{d,t} - \hat{p}_{f,t} = \hat{p}_{d,t}^* - \hat{p}_{f,t}^* - \hat{\tau}_t - \hat{\tau}_t^* \quad (2.31L)$$

B.2 The FDI model

Equilibrium

The equilibrium condition of the model are the following:

$$Y_{m,t} = \gamma(p_{m,t})^{-\zeta} C_t \quad (49)$$

$$Y_{n,t} = (1 - \gamma)(p_{n,t})^{-\zeta} C_t \quad (50)$$

$$1 = \left[\gamma p_{m,t}^{1-\zeta} + (1 - \gamma) p_{n,t}^{1-\zeta} \right]^{\frac{1}{1-\zeta}} \quad (51)$$

$$Y_{d,t} = \left(\frac{p_{d,t}}{p_{m,t}} \right)^{-\theta} Y_{m,t} \quad (52)$$

$$vY_{f,t} = \eta_t^\theta \left(\frac{p_{f,t}}{p_{m,t}} \right)^{-\theta} Y_{m,t} \quad (53)$$

$$Y_{m,t} = \left[Y_{d,t}^{\frac{\theta-1}{\theta}} + \eta_t (vY_{f,t})^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \quad (54)$$

$$Y_{d,t} = l_{d,t}^{\alpha_d} h_{d,t}^{1-\alpha_d} \quad (55)$$

$$Y_{f,t} = l_{f,t}^{\alpha_f} h_{f,t}^{1-\alpha_f} \quad (56)$$

$$Y_{n,t} = n_t \quad (57)$$

$$w_{ld,t} l_{d,t} = \alpha_d \frac{\varepsilon - 1}{\varepsilon} p_{d,t} Y_{d,t} \quad (58)$$

$$w_{hd,t} h_{d,t} = (1 - \alpha_d) \frac{\varepsilon - 1}{\varepsilon} p_{d,t} Y_{d,t} \quad (59)$$

$$w_{lf,t} l_{f,t} = \alpha_f \frac{\varepsilon - 1}{\varepsilon} p_{f,t} Y_{f,t} \quad (60)$$

$$w_{hf,t} h_{f,t} = (1 - \alpha_f) \frac{\varepsilon - 1}{\varepsilon} p_{f,t} Y_{f,t} \quad (61)$$

$$w_{n,t} = A_n p_{n,t} \quad (62)$$

$$l_{d,t}^\kappa = \frac{w_{ld,t}}{C_t} \left(\frac{\mu - 1}{\mu} \right) \quad (63)$$

$$l_{f,t}^\kappa = \frac{w_{lf,t}}{C_t} \left(\frac{\mu - 1}{\mu} \right) \quad (64)$$

$$h_{d,t}^\kappa = \frac{w_{hd,t}}{C_t} \quad (65)$$

$$h_{f,t}^\kappa = \frac{w_{hf,t}}{C_t} \quad (66)$$

$$n_t^\kappa = \frac{w_{n,t}}{C_t} \quad (67)$$

$$\ln\left(\frac{\eta_t}{\eta}\right) = \varphi \ln\left(\frac{\eta_{t-1}}{\eta}\right) + u_t \quad (68)$$

Log-linearization

It is true that $\hat{y}_{n,t} = \hat{n}_t$, $\hat{y}_{d,t} = \hat{l}_{d,t} = \hat{h}_{d,t}$, and $\hat{y}_{f,t} = \hat{l}_{f,t} = \hat{h}_{f,t}$. The log-linear versions of the model are the following.

$$\hat{c}_t = \hat{y}_{m,t} + \zeta \hat{p}_{m,t} \quad (8.1L)$$

$$\hat{c}_t = \hat{y}_{n,t} + \zeta \hat{p}_{n,t} \quad (8.2L)$$

$$\hat{p}_{m,t} = B \hat{p}_{n,t} \quad (8.3L)$$

$$\hat{y}_{m,t} = \hat{y}_{d,t} + \theta \hat{p}_{d,t} - \theta \hat{p}_{m,t} \quad (8.4L)$$

$$\hat{y}_{m,t} = \hat{y}_{f,t} + \theta \hat{p}_{f,t} - \theta \hat{p}_{m,t} - \theta \hat{\eta}_t \quad (8.5L)$$

$$\hat{y}_{m,t} = K \hat{y}_{d,t} + (1 - K) \left(\hat{y}_{f,t} + \frac{\theta}{\theta - 1} \hat{\eta}_t \right) \quad (8.6L)$$

$$\hat{w}_{ld,t} = \hat{p}_{d,t} \quad (8.10L)$$

$$\hat{w}_{hd,t} = \hat{p}_{d,t} \quad (8.11L)$$

$$\hat{w}_{lf,t} = \hat{p}_{f,t} \quad (8.12L)$$

$$\hat{w}_{hf,t} = \hat{p}_{f,t} \quad (8.13L)$$

$$\hat{w}_{n,t} = \hat{p}_{n,t} \quad (8.14L)$$

$$\kappa \hat{y}_{d,t} = \hat{p}_{d,t} - \hat{c}_t \quad (8.15L)$$

$$\kappa \hat{y}_{f,t} = \hat{p}_{f,t} - \hat{c}_t \quad (8.16L)$$

$$\kappa \hat{y}_{n,t} = \hat{p}_{n,t} - \hat{c}_t \quad (8.19L)$$

$$\hat{\eta}_t = \varphi \hat{\eta}_{t-1} + u_t \quad (8.20L)$$

Vita

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