Openness to Foreign Firms, Industrialization and Aggregate Growth *

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Abstract

This paper investigates the impact of openness to foreign firms on aggregate productivity in the context of Vietnam, a fast-growing economy. The analysis focuses on Vietnam's policy reforms between 2000 and 2015, aimed at reducing barriers for foreign firms in the manufacturing sector. I use firm-level data and develop a multi-sector model of structural transformation and production heterogeneity in which domestic and foreign firms make decisions on entry and technology investment while facing different institutional distortions. Consistent with the reforms' objective, I find that measured distortions affecting foreign firms were initially larger but substantially decreased to domestic levels over time. The model shows that this reduction in measured distortions to foreign firms substantially increases manufacturing productivity by 64 percent via two channels: (1) improving resource allocation across foreign and domestic firms and (2) incentivizing technology upgrades and more entry of higher-productivity foreign firms. Using difference-in-difference estimation leveraging staggered policy rollouts across locations, I also find significant indirect positive effects of the reforms on agricultural and service productivity. These indirect effects further amplify economy-wide productivity gains through structural transformation.

Keywords: foreign firms, productivity, distortions, misallocation, structural transformation.
JEL classification: E02, E24, F2, F63, O11, O14, O4, O53.

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1 Introduction

Understanding the impact of foreign direct investment (FDI) and activities of multinational enterprises (MNEs) on economic growth and development has been a long-standing question in academic literature, yet it remains a puzzling issue. While theoretical models suggest that financial openness, including FDI, can provide more capital at a lower cost and stimulate growth in developing countries (McGrattan and Prescott, 2009; Burstein and Monge-Naranjo, 2009), empirical research has often found limited evidence linking FDI to sustained economic growth (Alfaro, 2017; Kose et al., 2009). To contribute to this discussion, I examine the role of openness to foreign firms in driving economic growth, in the context of major policy reforms, aimed at reducing barriers to foreign firms' operation in Vietnam's manufacturing sector during the early 2000s. The reforms in Vietnam have been associated with a period of sustained high growth and rapid industrialization, offering a valuable context to explore the economic implications of foreign firms openness.

Using detailed firm-level panel data from Vietnam, I document empirical evidence of substantial reduction in various measures of distortions faced by foreign firms during this period, aligning with the objectives of the policy reforms. Using a multi-sector general equilibrium model with firm heterogeneity, I find that this reduction in measured distortions to foreign firms substantially increases manufacturing productivity by 64%, explaining 62% of the actual productivity growth in manufacturing. This is driven by two main channels: (1) improving resource allocation between foreign and domestic firms, and (2) incentivizing technology upgrades and the entry of higher-productivity foreign firms. Furthermore, the aggregate impact of these reforms extends beyond the manufacturing sector, having indirect effects on other non-reformed sectors. Using difference-in-difference estimations that leverage the staggered rollout of policy reforms across various locations over time, I find significant positive indirect effects of the reforms on productivity in agriculture and services in the local economy. Quantitative results further suggest that the indirect effects substantially amplify the aggregate impact of the reduction in distortions to foreign firms, leading to a 30% gain in the economy-wide productivity, accounting for 40% of the actual observed aggregate productivity growth.

Vietnam provides a valuable and relevant context for this study, having transitioned from a closed to a market-oriented economy since 1986. Over the years, Vietnam has implemented several major policy reforms, including trade reforms, financial liberalization reforms, and a series of amendments to the Foreign Investment Law. An important milestone in Vietnam's economic liberalization was its admission to the World Trade Organization (WTO) in 2007, which required the country to implement the most comprehensive set of market liberalization policies promoting openness to foreign firms in the early 2000s. The landmark legislation of this period was the Unified Investment Law in 2005, which removed unequal treatment between foreign and domestic firms in the manufacturing sector. However, despite these policy reforms, significant barriers to foreign firms remain in sectors other than manufacturing. During this period, Vietnam consistently experienced high economic growth, strong industrialization, and a massive influx of foreign firms, with most entry occurring in the manufacturing sector.

I compile data for empirical analysis from several sources: firm-level data from the Vietnam Enterprise Survey, covering all registered firms; household-level data from the Vietnam Household Living Standard Survey; and manually collected data on all industrial zones in Vietnam. I document two main stylized facts. First, there has been a substantial reduction in two key measures of distortions — the average distortions between foreign and domestic firms and the distortion elasticity to productivity within foreign firms — alongside improvements in foreign firm-level productivity. Second, by exploiting the staggered rollout of openness to foreign firms reforms in the manufacturing sector through the establishment of industrial zones across various locations, I find empirical evidence of significant indirect productivity effects on non-reformed sectors, including reductions in agricultural employment and expansions in the services sector following the establishment of the first industrial zones at the local level.

To investigate the quantitative role of reforms in reducing misallocation distortions towards foreign firms, I develop a multi-sector model of structural transformation incorporating production heterogeneity in manufacturing sector with distortions, technological upgrading, and firm entry, building on the works of Duarte and Restuccia (2010), Hopenhayn (1992), and Restuccia and Rogerson (2008). This model features a closed economy with three sectors: agriculture, manufacturing, and services, each producing homogenous goods within their sector. Preferences in the model drive structural transformation through two key effects: an income effect on agricultural consumption and a substitution effect between manufacturing and services. In the manufacturing sector, firms have access to a decreasing returns technology with labor input. Firm productivity is determined by two sources: productivity-enhancing investments, which involve the costly adoption of advanced technologies, and an exogenous component drawn from a distribution. The model includes two types of firms—domestic and foreign—that face different costs for technology upgrading, distinct distributions of exogenous productivity, and different distortion structures. Firms enter the market by paying a fixed entry cost in labor units and then realize their type (domestic or foreign). Based on their firm type, they make decisions about technology investment and draw their exogenous productivity and distortion components. Production decisions are made according to these factors, and firms exit the market at an exogenous rate. Agricultural and services goods are produced by representative firms using linear labor technology. A novel feature of this model is that productivity in agriculture and services includes both an exogenous component and an indirect productivity effect from the manufacturing sector. The analysis focuses on a stationary competitive equilibrium, where the distributions of resource allocation and firm types are stationary.

I parameterize distortions to include a systematic component correlated with firm productivity and a random component drawn from a log-normal distribution. The model is calibrated to both micro-level (producer-level) and aggregate data for the Vietnamese economy in 2000 and 2015 as two benchmark economies. Key parameters that govern distortions and productivity are estimated directly from firm-level data. The parameters for indirect productivity effects from manufacturing to agriculture and services are estimated using a staggered difference-in-differences analysis, leveraging the staggered rollout of industrial zones as a proxy for reforms targeting foreign firms over time. Critical parameters related to technological upgrading costs for foreign and domestic firms in manufacturing, as well as the exogenous components of agricultural and services productivity, are jointly calibrated to match the observed sectoral employment shares and aggregate productivity. The model well replicates untargeted moments, including productivity growth in agriculture and services, as well as the productivity growth of foreign and domestic firms within the manufacturing sector. This serves as a validity check for the model's ability to account for structural transformation and productivity growth in Vietnam during the sample period from 2000 to 2015.

I employ the calibrated model to quantitatively evaluate the impact of observed reduction in the distortions faced by foreign firms on productivity growth and structural transformation. The counterfactual experiment changes only the distortions affecting foreign firms in the manufacturing sector to 2015 values, while keeping all other parameters at 2000 values. Two primary sources of distortions are considered: the average level of distortions faced by foreign firms relative to domestic firms and the elasticity of distortions with respect to productivity across foreign firms. By reducing both types of distortions to foreign firms, manufacturing productivity increases by 64%, accounting for 62% of the observed changes between 2000 and 2015. This effect operates through two channels: (1) 42% is attributed to improved resource allocation between foreign and domestic firms, and (2) the remaining 58% results from enhanced incentives for technology investment by foreign firms. The direct impact on manufacturing productivity, along with the process of structural transformation, translates into an 8% increase in aggregate productivity, which accounts for 12% of the observed growth. When considering the indirect productivity effects on agriculture and services, aggregate productivity growth rises by 30%, contributing to 40% of the observed growth. The indirect effects amplify the aggregate impact of the reforms by a factor of 3.33, indicating that the broader influence of sector-specific reforms on industrialization and overall growth is substantial. Without considering the indirect productivity effects, the model predicts limited labor reallocation away from agriculture and a contraction of the manufacturing sector. Consequently, excluding the indirect effects would substantially underestimate the impact of the reforms on aggregate productivity, as the reformed sector shrinks and there is no effect on productivity growth in the other two sectors.

Related literature. This paper contributes to four key strands of literature. First, it adds to the research on the impact of Foreign Direct Investment (FDI) and Multinational Enterprises (MNEs) on developing countries (Alfaro, 2017; Kose et al., 2009). While theoretical models suggest FDI can drive economic growth via capital, technology transfers, and knowledge spillovers (McGrattan and Prescott, 2009; Burstein and Monge-Naranjo, 2009), empirical evidence on its long-term effects remains mixed (Harrison and Rodríguez-Clare, 2010; Alfaro and Chen, 2018). My paper differs from related work, such as McCaig et al. (2022), by focusing on actual openness to foreign firms reforms in Vietnam and assessing their quantitative macroeconomic impacts, showing that these reforms reduce distortions, enhance productivity, and generate indirect productivity effects beyond the targeted sector.

Second, this paper contributes to the literature on resource misallocation (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009) and related areas such as producer dynamics, technology adoption, and aggregate productivity (Parente and Prescott, 1994; Bhattacharya et al., 2013; Hsieh and Klenow, 2014; Bento and Restuccia, 2017). My research makes two key contributions. First, I link specific policies affecting foreign firms to sources of misallocation, corroborating findings from Bau and Matray (2023) on the impact of FDI openness reforms in India. I examine how reductions in distortions towards foreign firms in Vietnam correlate with reforms, employing a general equilibrium framework to assess the quantitative impacts of barriers to foreign firms on growth and development. Second, unlike most studies that focus on cross-country comparisons or hypothetical scenarios, my paper evaluates the costs of misallocation in the context of actual reforms and growth experiences.

Third, this paper contributes to the literature on the determinants of structural transformation and its implications for growth and development (Kongsamut et al., 2001; Gollin et al., 2002; Ngai and Pissarides, 2007; Duarte and Restuccia, 2010; Boppart, 2014; Herrendorf et al., 2014; Comin et al., 2021). I present two key contributions. First, while previous studies often link structural transformation to sectoral productivity, my paper is among the first to connect micro-level distortions and reforms to both sectoral productivity and structural transformation. The model developed here provides a framework for quantitatively assessing the impact of sector-specific reforms on structural transformation and aggregate growth. Second, I provide new evidence on the spillover effects of productivity across sectors, showing that these effects are vital for understanding the broader impact of sector-specific reforms on industrialization and overall growth. This finding underscores the need to further explore the channels driving intersectoral linkages.

Lastly, this paper contributes to the literature on policies affecting economic development in Vietnam. While previous studies have examined agricultural policies (Benjamin and Brandt, 2004; Ayerst et al., 2020; Le, 2020; Ayerst et al., 2023), trade policies (McCaig and Pavcnik, 2015, 2018, 2021), and FDI barriers (Athukorala and Tran, 2012), my research focuses on the macroeconomic consequences of policies promoting openness to foreign firms. I connect these policy reforms to evidence of reduced distortions and demonstrate their substantial aggregate impact through a general equilibrium framework.

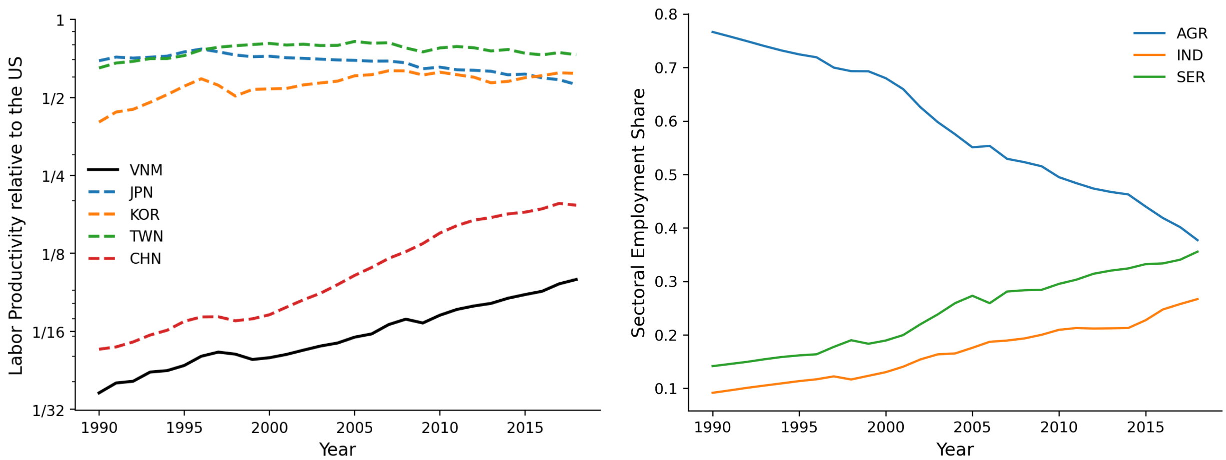
This paper is structured as follows. Section 2 presents the economic and institutional context of Vietnam focusing on foreign firms over time. Section 3 outlines the data sources and variable construction used in the study. The stylized facts are presented in Section 4, followed by the model in Section 5 and quantitative analysis in Section 6. Finally, Section 7 concludes the paper.

2 Economic and Institutional Background

This section provides an overview of the economic and institutional context of Vietnam over time. I first present Vietnam's economic growth experience and demonstrate that this growth coincides with substantial increases in the activities of foreign firms, which play a critical role in driving this growth. Second, I discuss the institutional context, focusing on regulatory barriers faced by foreign firms, and analyze the major policy reforms implemented in the early 2000s aiming at reducing these barriers.

Figure 1: Growth and Structural Transformation in Vietnam

(a) Labor Productivity relative to the U.S. (b) Structural Transformation



Notes: Data on labor productivity are computed from PPP output and employment data in the PWT 10.01. Data on sectoral employment shares are from the GGDC/UNU-WIDER's Economic Transformation Database.

2.1 Economic Growth and the Role of Foreign Firms in Vietnam

Since the Doi Moi reform in 1986, Vietnam has undergone a transition from a centrally planned economy to a market-oriented one. The country's labor productivity has grown at a consistent rate of 4% annually, closing the gap with leading economies. As shown in Figure 1a, the relative labor productivity of Vietnam has increased from around 3.6% compared to the United States in 1990 to around 10% in 2020. Along with China, Vietnam has experienced convergence towards the United States and the frontier Asian economies (Japan, Korea, and Taiwan) between 1990 and 2020. Figure 1b demonstrates that Vietnam is undergoing a continuous process of structural transformation and industrialization, with a decline in the share of employment in agriculture from around 77% to 38%, leading to an increase in the services and industry sectors.

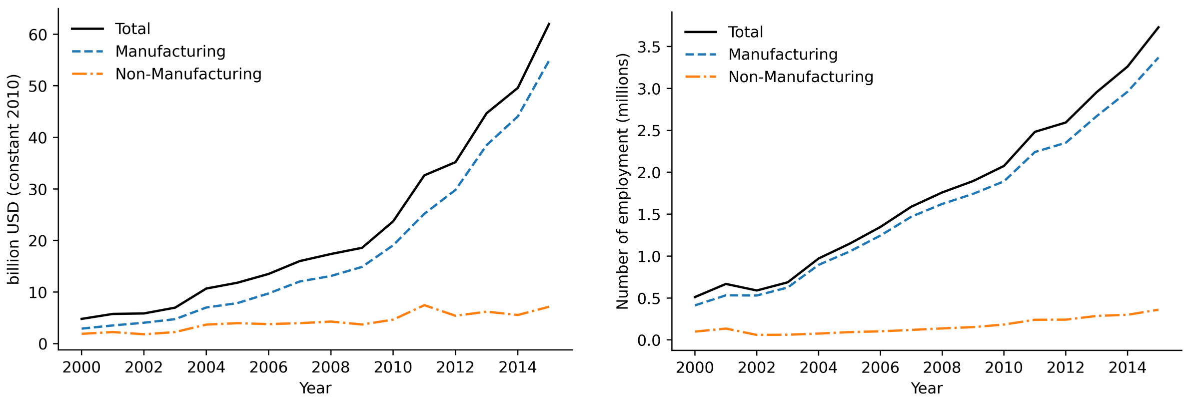
Rapid industrialization. During the period from 2000 to 2015, Vietnam's manufacturing sector underwent substantial industrialization, marked by a substantial increase in output, employment, and capital investment. Over these fifteen years, output in the manufacturing sector rose by 13-fold, employment increased by 4-fold, and capital investment expanded by 6-fold, illustrating a period of rapid growth and industrialization.

Substantial increase in foreign firms' activities. Figure 2 present the growth of foreign firms in Vietnam over time. The output of foreign firms has grown by 13 times from 2000 to 2015, while employment has increased by 7 times over the same period. The capital stock of foreign firms has also grown by 4 times from 2000 to 2015 as shown in Figure 9. Despite the substantial growth in foreign firms' activities, the increase in foreign firms' activities has been mostly concentrated in the manufacturing sector, with little changes in the other non-manufacturing sectors over time.

The expansion of foreign firms has been the primary driver of growth in Vietnam's manufacturing sector. These firms have made substantial contributions to both output and inputs, accounting for 67% of the increase in output, 62% of the rise in employment, and 55% of the growth in capital. Over the past two decades, the employment share of foreign firms within the formal manufacturing sector has also increased, rising from only around 26% in 2000 to around 55% in 2015. These numbers highlight the important impact that foreign firms have had on the industrialization process in Vietnam.

Figure 2: Output and Employment of Foreign Firms in Vietnam

(a) Output (b) Employment



Notes: Data on output and employment are aggregated from the firm-level data in the Vietnam Enterprise Survey. The real measure of output is computed by deflating the nominal values using Vietnam's Producer Price Index provided by the General Statistics Office (GSO). Employment is reported in millions of workers, while output is reported in 2010 constant billions of USD.

2.2 Institutional Context and Policy Reforms Governing Foreign Firms

Since the implementation of the first Foreign Investment Law in 1987, several reforms have been implemented to lower barriers and attract foreign firms. In 1990 and 1996, significant amendments were made to the law, including the extension of tax holidays for investments in priority sectors, the establishment of export processing zones with special incentives for export-oriented foreign firms, and the delegation of investment project approvals to local authorities (Athukorala and Tran, 2012).

Despite repeated efforts to implement reforms, substantial barriers persisted for foreign firms to enter and operate in Vietnam during the early 2000s. Compared to the standard requirements followed by domestic firms, foreign firms faced many extra barriers. In 2005, the introduction of the Unified Investment Law (2005) represented a crucial milestone in overcoming these barriers. This landmark legislation facilitated the rapid elimination of barriers to foreign firms, eliminating major disparities between foreign and domestic firms.

The Unified Investment Law (2005) addressed two main sets of barriers that impeded the flow of foreign firms into Vietnam: barriers to approval and registration process and barriers to operation activities. The reform consisted of important changes in both the legal framework and its execution. The legal framework has been modified to simplify procedures, provide more detailed guidance, reduce bureaucratic paperwork, and standardize and codify regulations (Do, 2014). Meanwhile, implementation has involved delegating approval and monitoring authority from the centralized government to the provincial level. This decentralization of authority has been critical in successfully implementing reforms, as it provides provinces with incentives to attract and facilitate the regulatory process for foreign firms (Vo and Nguyen, 2012). Provinces now have a more significant role in the approval and monitoring of foreign firms' activities, which has resulted in more efficient and streamlined procedures, and a reduction in red tape.

Barriers to approval and registration process. The approval and registration process for foreign firms in Vietnam was challenging, as evidenced by the centralized government-level approval of most investment projects, which required numerous licenses and permits from different departments (Do, 2014). Additionally, the process was lengthy and inefficient, leading to uncertainties and delays. The laws surrounding regulating foreign firms were too general, lacking clear guidelines for interpretation and implementation among government agencies involved in project appraisal and management. The prolonged and complex process made it challenging for investors to forecast the outcome of their investment, which could lead to further costs and risks.

One key change introduced by the Unified Investment Law (2005) is the introduction of a simplified and decentralized investment approval system to reduce approval and registration costs, opening up access to Vietnamese market (UNCTAD, 2008). The new three-tier process included business registration for projects under 1 million USD, approval at the provincial level for projects between 1 million USD and 20 million USD, and approval from the central government for projects exceeding this amount. Projects under 300 billion dong (20 million

USD) were exempt from formal approval if they were not in a restricted sector (Athukorala and Tran, 2012).

Barriers to operation activities. The operation activities of foreign firms in Vietnam were restricted by various barriers, including heavy regulation and strict monitoring of operating activities. Foreign firms had to comply with local content requirements and export performance requirements, which limited their operations. The regulations also required foreign firms to commit to the initial agreement as specified in the registration process. Any changes to their operations or products required government reapproval, which could lead to further delays and increased costs and added to the uncertainty faced by foreign firms Do (2014). In addition, foreign firms faced limited access to the domestic market, as special licenses were required to access it. Incentives were mostly offered to export-oriented foreign firms only.

The 2005 Unified Investment Law abolished the requirements for foreign firms to use domestic inputs (local content requirement) and the export performance requirement. The law also provided investors with complete freedom in choosing the form of their business entities, allowing them to perform reorganization, mergers, and acquisitions activities to support their business objectives (Do, 2014). In addition, the 2005 Unified Investment codified and standardized investment regulations for both domestic and foreign firms into one set of regulations, providing equal treatment to both domestic and foreign firms. The law also introduced more flexible dispute resolution procedures, allowing foreign investors the freedom to choose between a domestic or an international arbitration body in the event of an investment dispute.

The above barriers exposed foreign firms Vietnam to various economic costs that can impede their entry and operations. These costs include higher legal fees and regulatory costs, which can be attributed to the complex regulatory environment and red tape in the country (UNCTAD, 2008). Another cost is the challenge of dealing with bureaucracy and corruption, which can add significant time and expense to a business's operations. Additionally, foreign firms face high uncertainty in obtaining approvals for various business activities, which can result in delays and increase costs. The strict monitoring from the government adds to the costs of operations and makes foreign firms more vulnerable to business shocks. Additionally, the local content requirement and economic performance requirement pose high variable costs for various types of inputs, making it more expensive for foreign firms to operate in the Vietnamese market. The high cost of accessing the domestic market is another barrier that discourages foreign firms from expanding their operations in Vietnam.

Implementation by decentralization of authority. While changes in the law are crucial, effective implementation is essential, as emphasized by Vo and Nguyen (2012). The manufacturing sector is distinctive because its production and operations are tied to specific geographical locations. This spatial specificity makes it easier for the government to monitor and implement reforms within designated areas, allowing for targeted adjustments and reducing political concerns about foreign firms' influence on a national scale.

Most reforms aimed at foreign firms are concentrated within industrial zones (IZs) and export processing zones (EPZs), which are designated areas offering special incentives and regulations. These zones are central to Vietnam's strategy for attracting more foreign firms and enhancing their productivity and efficiency. By focusing reforms within these zones, the government can create a more favorable environment for foreign firms and boost their economic contributions.

In addition to legislative reforms, the central government has progressively authorized the establishment of more industrial zones. The number of these zones has grown dramatically, from just 1 in 1991 to 65 in 2000, and more than 325 by 2015. Initially, the first industrial zones were set up as experimental projects in regions distant from the central government. Observing their success, the central government expanded the policy to include more locations over time.

Furthermore, regulatory authority for managing industrial zones has been decentralized to local governments, which has significantly enhanced both their power and incentives. This decentralization empowers local governments to customize regulations and approve investment projects, allowing them to tailor policies to better attract foreign firms. With increased authority, local governments can create more favorable conditions for foreign firms by reducing barriers and streamlining processes. Additionally, this shift in power provides local governments with strong incentives to attract foreign investment. As foreign firms enter these zones, they generate employment opportunities and stimulate the local economy, which directly benefits local communities and enhances the political standing of local officials. This also fosters greater competition among local governments to enhance the business environment and attract more foreign firms.

3 Data

The data used in this paper are combined from multiple sources. The main dataset for my analysis is a detailed panel firm-level dataset called Vietnam Annual Enterprise Survey. I also employed other data sources for aggregate variables.

3.1 Data Sources

Vietnam Annual Enterprise Survey is annual enterprise survey conducted by General Statistics Office (GSO) since 2000, covering all registered firms. The survey provides firm-level information about financial statements and characteristics. The information used in this study are firm's industry (3-digit Vietnam Standard Industrial Classification (VSIC) equivalent to 3-digit North American Industry Classification System (NAICS)), revenue, employment, labor compensation (wages and benefits), fixed assets, ownership. I define capital stock as the book value of fixed asset net of depreciation. I used the industry-level producer price indices (PPIs) to deflate oeprating revenue, use the manufacturing producer price index

(PPI) to deflate capital and use consumer price index (CPI) to deflate wages.

The Vietnam Household Living Standard Survey (VHLSS) is a household survey conducted by the General Statistics Office (GSO) biennially from 2002 to 2018. It provides detailed household-level information on income, consumption, and demographic characteristics. I use this data to construct measures of agricultural employment and productivity, as well as average household income at the province level.

Vietnam Industrial Zone Database is a manually collected dataset on all industrial zones in Vietnam. The dataset provides information on the location, size, and year of establishment of each industrial zone. I use this data to construct a measure of the number of industrial zones in each province.

Vietnam Statistical Yearbook is annual publication by the General Statistics Office, comprises basic data reflecting the general socio-economic dynamic and situation of the whole country, socio-economic regions, and localities. Producer price indices (PPIs) at industry level and consumer price index (CPI) used in this study are from this source.

GGDC/UNU-WIDER's Economic Transformation Database provide comprehensive, long-term, and internationally comparable sectoral data on output and employment in 51 countries between 1990 and 2018. This paper uses data on value-added and employment at sectoral level for Vietnam, Korea, Japan and Taiwan.

Penn World Table version 10.01 is a database with information on relative levels of income, output, input and productivity, covering 183 countries between 1950 and 2019. I use data on PPP aggregate output and employment.

3.2 Variable Construction

We use the data to describe the distribution of firm-level productivity and measures of misallocation. We construct two variables that measure firm-level productivity and distortion. We refer to firm-level distortions as the firm's wedge since it is a model-based measure of the difference between the firm's realized market allocation and the hypothetical first-best allocation, in which wedges are equalized across firms. In this regard, the measure is the same as the marginal revenue product of factor inputs in Hsieh and Klenow (2009). We derive model-based measures of productivity and wedges as:

$$\mathrm{TFP}_{i,t} = \frac{y_{i,t}}{\ell_{i,t}^{\gamma}}, \qquad\qquad wedge_{i,t} = \frac{y_{i,t}}{\ell_{i,t}}. \tag{1}$$

I construct measures of output y and employment ℓ. I measure output as the firm's operating revenue deflated by producer price index at sectoral level. I do not use value added because we find that material costs are not consistently reported in the Enterprise Survey over time. Employment is measured as the number of employees hired by the firm.

Appendix C reports the robustness of the main results to alternative-model measures and construction of productivity and wedges in equation (1), although I note that the implied wedge in equation (1) holds in commonly-used production technologies. In particular, I show that the main findings hold if I construct total factor productivity that adjusts for human and physical capital as inputs.

4 Empirical Findings

This section presents two sets of empirical findings. First, I examine the measured distortions and productivity of foreign and domestic firms over time. Regarding distortions, I find evidence of a reduction in two key measures affecting foreign firms: the average distortions faced by foreign firms relative to domestic firms and the correlated distortions within foreign firms. In terms of productivity, I find that the productivity distribution of foreign firms is better to that of domestic firms and has substantially improved over time in the manufacturing sector during this period. Second, by employing staggered difference-in-differences estimation, I provide evidence of the indirect effects of the reforms aimed at foreign firms in the manufacturing sector, demonstrating that these reforms have broader and more significant implications for structural transformation, aggregate growth, and average household income beyond the reformed sectors.

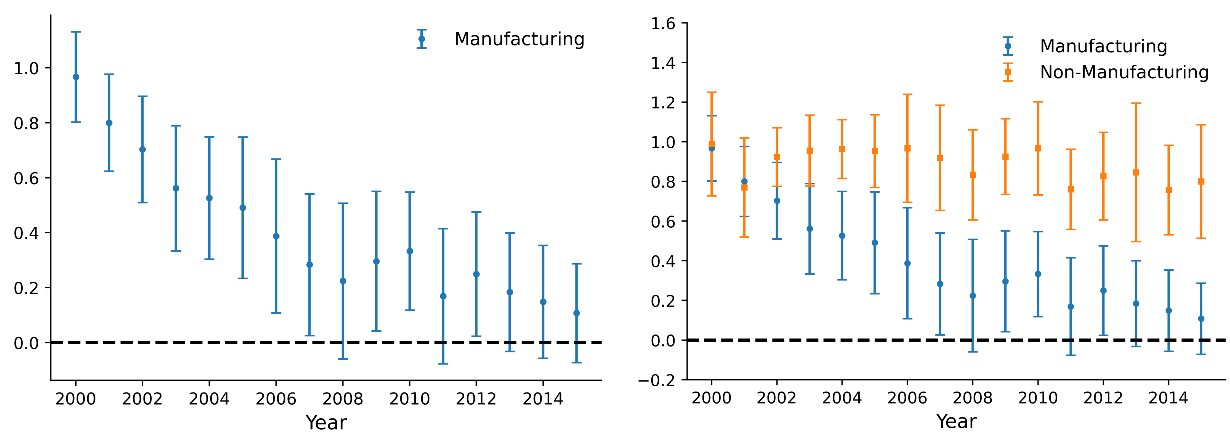
4.1 Distortions and Productivity in Manufacturing

In this subsection, I document stylized facts on the changes in two key measures of distortions and productivity for foreign and domestic firms in Vietnam from 2000 to 2015. First, I provide evidence of the convergence in the average distortion levels between foreign and domestic firms in the manufacturing sector. Next, I examine the evolution of the elasticity of distortions to productivity within both foreign and domestic firms over time. Lastly, I present the changes in the distribution of total factor productivity (TFP) among foreign and domestic firms in the manufacturing sector.

Distortions between foreign and domestic groups. Without output and labor distortions between the 2 groups, the wedges are equalized between foreign and domestic firms. This result can be generalized to any Cobb-Douglas production function using labor and other inputs.

Figure 3: Wedge (log) Differences between Foreign and Domestic Firms

(a) Manufacturing (b) Manufacturing and Non-Manufacturing



Notes: The dots represent the estimated values of parameters β_t in regression (2). The band represents the 95% confidence interval.

The objective is to estimate the difference in the wedges of foreign relative to domestic firms over time. Two sets of regressions are conducted: firms in manufacturing and firms in non-manufacturing sectors. Identification is achieved by regressing the log of wedges on foreign-year dummies while controlling for sector-year fixed effects:

$$\log(Wedge_{it}) = \sum_t \theta_t^* \, foreign_{it} + \sum_t \sum_j \gamma_{jt} \, Sector_{jt} + \epsilon_{it}. \tag{2}$$

Figure 3 shows the estimated value of the log difference in the wedges between foreign and domestic firms over time. There's evidence of the convergence of measured wedges of foreign firms to domestic levels in manufacturing sectors over time. This convergence trend also persists for each cohort of firms observed over time. However, significant disparities in the wedges between foreign and domestic firms still exist in non-manufacturing sectors.

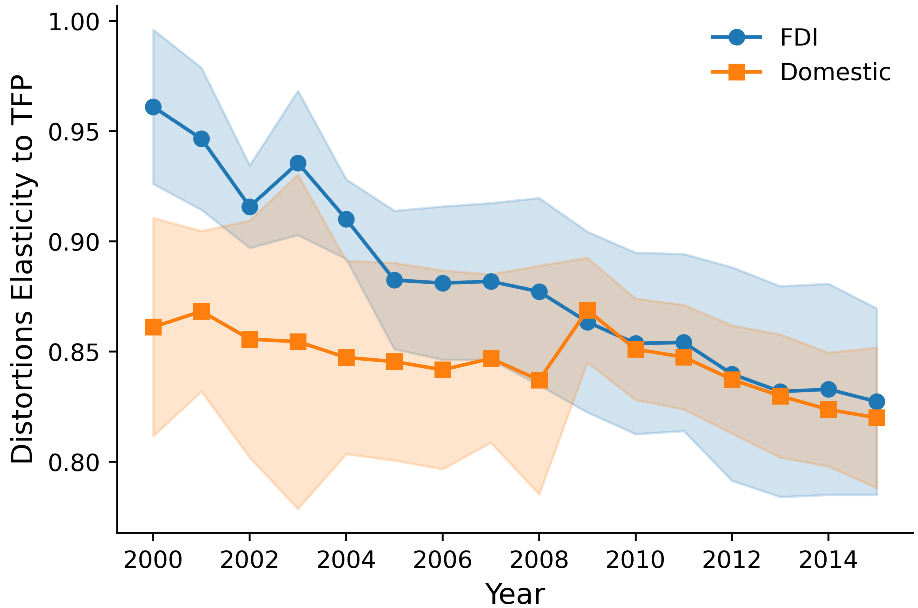
Correlated distortions within group. An important measure of misallocation highlighted in previous literature is correlated distortions (e.g., Restuccia and Rogerson (2008), Restuccia and Rogerson (2017), Bento and Restuccia (2017), Ayerst et al. (2024)). Correlated distortions refer to the relationship between distortions and productivity. These distortions not only lead to resource misallocation among incumbent firms but also have dynamic consequences, impacting firm dynamics and technology adoption. The literature has identified several sources of specific policies and institutions that create a systematic relationship between wedges and productivity, such as firing taxes (Hopenhayn, 2014), financial frictions (Buera et al., 2013), and size-dependent regulations (Guner et al., 2008).

Following standard practices in the literature, the measure of correlated distortions is the elasticity of distortions with respect to productivity. I estimate this using the following regression on sample of domestic firms:

$$\log(Wedge_{it}) = \sum_t \rho_t \log(TFP_{it}) + \sum_t \sum_j \gamma_{jt} \, Sector_{jt} + \epsilon_{it}. \tag{3}$$

This regression is run separately for two subsamples: foreign and domestic firms. Figure 4 shows the estimated elasticity of wedges with respect to productivity for these two groups

Figure 4: Distortion Elasticity to TFP: Foreign and Domestic Firms



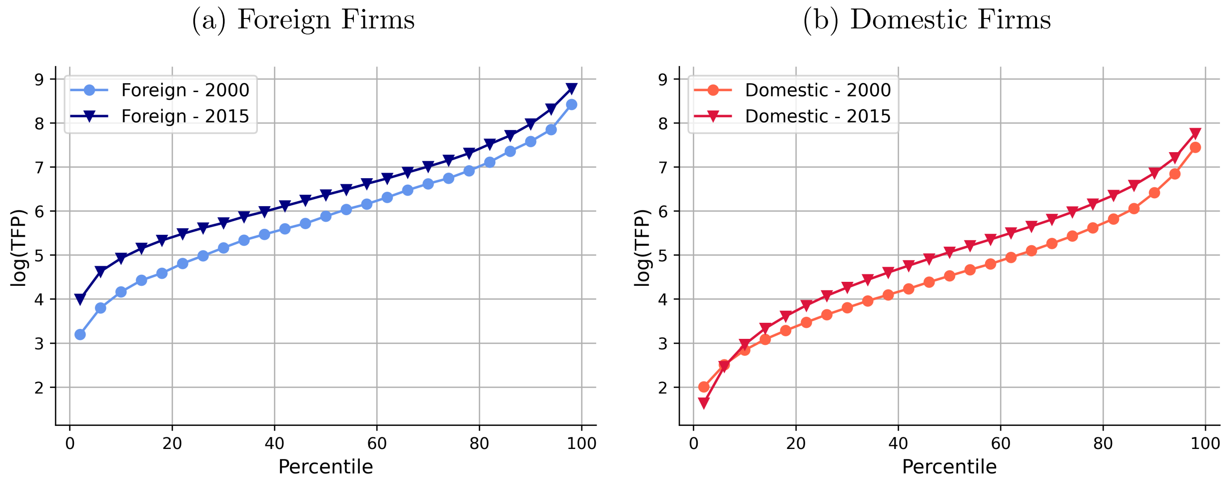
Notes: The dots represent the estimated values for parameters ρ_t in the regression (3) for domestic and foreign firms, respectively. The band represents the 95% confidence interval.

within the manufacturing sector over time. The elasticity of distortions is significantly higher for foreign firms compared to domestic firms. However, it decreases notably for foreign firms, from 0.95 in 2000 to around 0.85 in 2015, while the distortion elasticity for domestic firms remains relatively stable at around 0.75 during this period.

TFP distribution of foreign and domestic firms. Figure 5 shows the TFP distribution of foreign and domestic firms in 2000 and 2015. The figures plot TFP across percentiles, from the 1st to the 99th. In both periods, foreign firms exhibit a better TFP distribution compared to domestic firms. On average, foreign firms have a TFP that is 1.77 log points higher than domestic firms in 2000, and 1.86 log points higher in 2015. The TFP distribution improves over time for both domestic and foreign firms, with an average annualized growth rate of approximately 2.74% and 3.63% for domestic and foreign firm, respectively.

The improvement in the TFP distribution of foreign firms has been primarily driven by the entry of high-productivity new entrants. The number of foreign firms in the manufacturing sector rose almost fivefold, from around 1,400 firms in 2000 to 6,700 firms in 2015. On

Figure 5: TFP (in log) by Percentiles: Foreign and Domestic Firms in 2000 and 2015



Notes: The figure plots 25 percentile points from the 1st to the 99th. The left panel shows the TFP distribution of foreign firms in 2000 and 2015. The right panel shows the TFP distribution of domestic firms in 2000 and 2015.

average, new foreign entrants in 2015 had productivity levels 1.7 times higher than those of entrants in 2000, largely contributing to the overall improvement in the TFP distribution among foreign firms. Figure 13 shows the TFP distribution of new entrants in 2000 and 2015. While the TFP distribution of foreign entrants has improved substantially, there has been no improvement in the TFP distribution of domestic entrants over this period.

4.2 Indirect Effects on Agriculture and Services

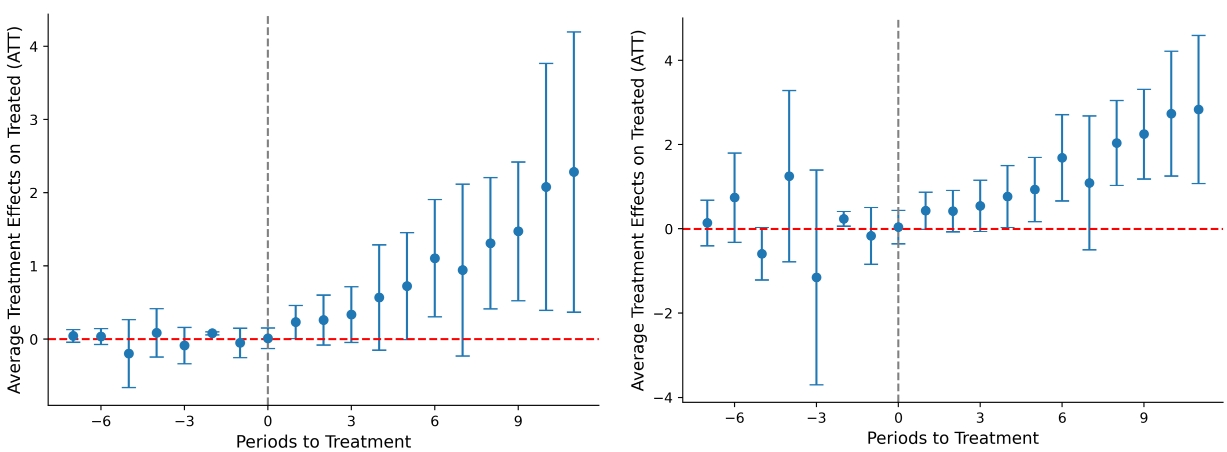
On an aggregate level, there is evidence of both industrialization and increased productivity in manufacturing, occurring alongside reforms targeting foreign firms in the manufacturing sector. In the standard structural transformation literature, an increase in manufacturing productivity typically leads to a decrease in the size of the manufacturing sector due to substitution effects, assuming no productivity improvements in other sectors. If this holds true, the impact of reforms in the manufacturing sector would be limited, as sector sizes would remain relatively unchanged.

However, more evidence is needed to determine whether these reforms have influenced the size of the manufacturing and other sectors. This paper leverages the staggered rollout of policies aimed at reducing distortions across different locations in Vietnam over time, specifically through the establishment of industrial zones. A staggered difference-in-differences analysis will be conducted following the estimation method by Callaway and Sant'Anna (2021) to provide evidence on the impacts of these manufacturing reforms on structural transformation and overall income. Detailed discussions on identification and estimation strategy are provided in C.3.

The findings show that reforms in manufacturing, through the establishment of industrial zones, lead not only to the expansion of foreign firms but also to structural transformation patterns consistent with aggregate trends, including significant reductions in agricultural employment and the expansion of services. Additionally, the establishment of industrial zones in manufacturing sectors corresponds with a significant increase in average household income at the local level.

Figure 6: Direct Effects on Foreign Firms in Manufacturing

(a) Number of Firms (log) (b) Employment (log)



Notes: The dots represent the estimated average treatment effect on the treated (ATT) of establishing the first industrial zone (IZ) at the district level. The band represents the 95% confidence interval. The dash line represents zero treatment effect. The x-axis represents the years before and after the establishment of the first Industrial Zone.

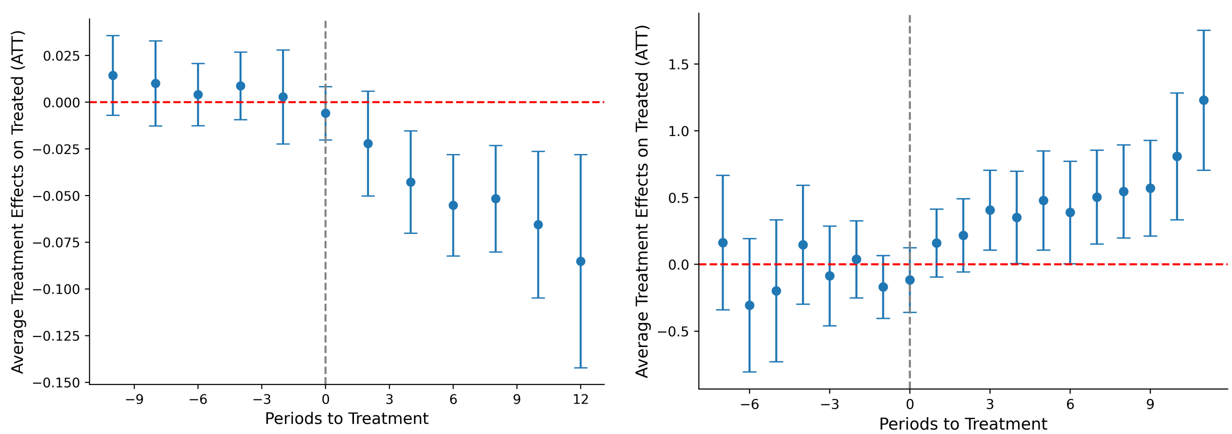
Direct effects on foreign firms in manufacturing sector. Figure 6 shows the staggered difference-in-differences estimation of treatment effects of establishing the first industrial zone (IZ) at district level. Before the establishment of the first IZ, there are no statistically significant differences in the number and employment of foreign manufacturing firms between treated and not-yet-treated locations, indicating no pre-existing trends among the treated units. After the establishment of the first IZ, there's statistically significant increases in the number and employment of foreign manufacturing firms. The effects is persistent and increases over time following the treated period.

Indirect effects on agricultural and services sectors. Figure 7 shows the staggered difference-in-differences estimation of average treatment effects on the treated (ATT) of establishing the first industrial zone (IZ) at local level. Two seperate regressions are conducted for agricultural and services sectors. Due to the different data availablilty, while the outcome for agriculture is employment share at province level, the outcome for services is number of employment at district level.

Figure 7: Indirect Effects on Employment in Agriculture and Services

(a) Agricultural Employment Share

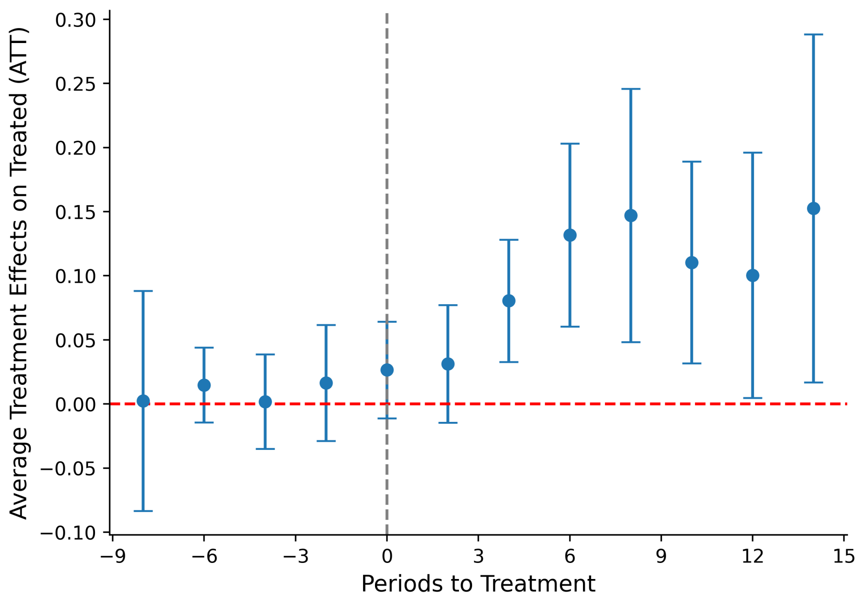
(b) Services Employment (log)



Notes: The dots represent the estimated average treatment effect on the treated (ATT) of establishing the first industrial zone (IZ) at the province level in panel (a) and district level in Panel (b). The band represents the 95% confidence interval. The dash line represents zero treatment effect. The x-axis represents the years before and after the establishment of the first Industrial Zone.

Figure 7a presents the staggered difference-in-differences estimation of the treatment effects of establishing the first industrial zone (IZ) on the agricultural employment share at the provincial level. Prior to the establishment of IZs, there are no statistically significant differences in agricultural employment shares between treated and not-yet-treated locations, indicating no pre-existing trends among the treated units. However, after the first IZ is established, there is a statistically significant decline in the agricultural employment share in the treated provinces. This effect is persistent and intensifies over time following the treatment period.

Figure 8: Effects on Household Income (log)



Notes: The dots represent the estimated average treatment effect on the treated (ATT) of establishing the first industrial zone (IZ) at the province level. The band represents the 95% confidence interval. The dash line represents zero treatment effect. The x-axis represents the years before and after the establishment of the first Industrial Zone.

Figure 7b shows the estimation of the average treatment effect on the treated (ATT) for the services employment share. Similar to the agricultural sector, there are no statistically significant differences in services employment between treated and not-yet-treated locations before the establishment of IZs. After the first IZ is established, a statistically significant increase in services employment is observed. This effect is also persistent and grows stronger over time following the treatment period.

In subsection C.4, I present additional evidence showing that the indirect effects on agriculture and services remain quantitatively consistent across alternative estimation strategies. Specifically, I estimate the effects of foreign firm employment on local agricultural and services outcomes using an instrumental variable approach. The results indicate that higher foreign firm employment at the local level leads to a significant decrease in agricultural employment and an increase in services employment, as shown in Table 10.

Effect on household income. Figure 8 shows the staggered difference-in-differences estimation of treatment effects of establishing the first industrial zone (IZ) at province level. Before the establishment of the first IZ, there are no statistically significant differences in the average household income between treated and not-yet-treated provinces. After the establishment of the first IZ, there's statistically significant increase in the average household income at the treated province. The effects are persistent and increase over time following the treated period.

5 Model

I develop a multi-sector general equilibrium consisting of agriculture, manufacturing and services. Firms are representative in agriculture and services sectors. Manufacturing sector consists of domestic and foreign firms different in productivity and distortions. I focus on a stationary competitive equilibrium of the model in order to examine the impacts of the reforms on long-term aggregate outcomes.

5.1 Economic Environment

In each period, three commodities are produced: agriculture (a), manufacturing (m) and services (s).

Preferences and endowments. The economy is populated by an infinitely-lived representative household of measure one. The household is endowed with one unit of time each period and supply labor inelastically to the market. The household has Stone-Geary preferences over agricultural (C_a) and non-agricultural goods (C_n):

$$U(C_a, C_n) = alog(C_a - \bar{a}) + (1 - a)log(C_n),$$

where a and $1 - a$ are utility weights for agricultural and non-agricultural consumption, $\bar{a}$ is the subsistence consumption of agricultural goods. Consumption of non-agricultural good C_n follows a standard CES aggregation over manufacturing and services consumption:

$$C_n = \left(C_m^{\frac{\sigma-1}{\sigma}} + C_s^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

where $\sigma > 0$ is the elasticity of substitution between manufacturing and services. According to findings from Huneeus and Rogerson (2023) and Nguyen (2024), there's a limited income effect between manufacturing and services in the early stages of development. Therefore, I abstract from any income effect between manufacturing and services in this analysis.

Technologies in agriculture and services. Agricultural (Y_a) and services (Y_s) goods are produced by a mass of representative firms following constant returns to scale production functions:

$$Y_i = A_i L_i, \quad i \in \{a, s\}, \tag{4}$$

where A_i is labor productivity in sector i, L_i is labor input in sector i. The sectoral labor productivity is equal to

$$log(A_i) = log(Z_i) + \phi_i log(Z_m) \tag{5}$$

where Z_i is a sector-specific exogenous technology parameter; Z_m is the labor productivity of manufacturing; and ϕ_i captures the indirect productivity effect from manufacturing to sector i. The parameter A_i corresponds to labor productivity in the data and changes over time could be driven by changes in sector TFP or capital intensity. This source of variation is not critical for my analysis and there's a limitation on the capital stock data for agricultural and services sectors.

Technologies in manufacturing. At each date, a homogeneous manufactured good is produced by a mass of firms operating under decreasing returns to scale, described by the production function:

$$y_i = a_i^{1-\gamma} \ell_i^{\gamma}, \quad \gamma \in (0,1),$$

where y_i is the output, ℓ_i is the labor input, and a_i is the productivity of firm i. The productivity a_i of firm i consists of two components:

$$\log(a_i) = \log(z_i) + \log(s_i),$$

where z_i represents an exogenous component of the firm's productivity, drawn from a distribution after entry, and s_i is an endogenous component of productivity, which is chosen by the firm upon entry by incurring a technology investment cost.

There are two types of firms in the manufacturing sector: foreign and domestic, which differ in their productivity distributions and the cost structure of technology investment. Firm type is determined upon entry. Domestic and foreign firms draw the exogenous component of productivity from the distributions $F(z)$ and $F^*(z)$, respectively. To achieve a productivity level of s, domestic firms incur a technology investment cost by hiring $\left(\psi^{\frac{1}{1-\gamma}} s\right)^{\kappa}$ units of labor, while foreign firms incur a cost of hiring $\left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^{\kappa}$ units of labor.

Entry and exit in manufacturing. Firms exit the market at an exogenous rate λ each period. New entrants pay an entry cost c_e, measured in units of labor. After paying the entry cost, firms draw a probability P^* of being a foreign firm and a probability $1 - P^*$ of being a domestic firm. The parameter P^* represents a government policy that determines the fraction of foreign firms in the economy. I denote the mass of entrants by E, the mass of operating domestic firms by M, and the mass of operating foreign firms by M^*.

Upon realizing their firm type, firms decide whether to invest in productivity s_i by incurring a technology investment cost. Next, firms draw the exogenous component of productivity z_i, which depends on their firm type.

5.2 Market Structure

Agriculture and services good markets. I assume a continuum of homogeneous firms in agricultural and services sectors that are competitive in output and factor markets. At each date, given the price p_i of commodity i and wage rate w, a representative firm in sector $i \in \{a, s\}$ chooses the labor input L_i to maximize profits.

$$\max_{L_i} \quad p_i A_i L_i - w L_i, \quad i \in \{a, s\}.$$

Manufacturing good market. Firms face idiosyncratic distortions, modeled as proportional revenue taxes τ_i, following Restuccia and Rogerson (2008). In line with Bento and Restuccia (2017) and Restuccia (2019), I assume these idiosyncratic distortions have a systematic component related to the firm's productivity — $a_i^{-\rho}$ for domestic firms and $a_i^{-\rho^*}$ for foreign firms — along with a firm-specific random component ϵ_i. Specifically, the firm-level distortions $\tau_i(z_i, \epsilon_i)$ and $\tau_i^*(z_i, \epsilon_i)$ for domestic and foreign firms, respectively, are given by:

$$1 - \tau(a_i, \epsilon_i) = \left(\frac{a_i^{-\rho} \epsilon_i}{1 - \bar{\tau}} \right)^{1-\gamma}, \quad \text{if firm } i \text{ is domestic,}$$
$$1 - \tau^*(a_i, \epsilon_i) = \left(\frac{(1 - \theta^*) a_i^{-\rho^*} \epsilon_i}{1 - \bar{\tau}^*} \right)^{1-\gamma}, \quad \text{if firm } i \text{ is foreign,}$$

where ρ and ρ^* are the elasticities of distortions with respect to the firm's TFP within each group, determining the systematic component of distortions. The term ϵ_i represents the random component of distortions, drawn from an i.i.d. distribution. Intuitively, ρ and ρ^* distort the productivity gradient of firm size, while ϵ_i captures the effect of distortions on firm size that is independent of the firm's productivity. The parameter $1 - \theta^*$ captures the average difference in distortion levels between foreign and domestic firms. Taxes are collected by the government and redistributed as a lump-sum transfer T to households.

To separate the effects of distortions into those correlated within groups, captured by (ρ, ρ^*), and the overall distortion levels between the two groups, captured by $1-\theta^*$, I follow an approach in Bento and Restuccia (2017) by normalizing the distortions using the average distortion terms $1-\bar{\tau}$ and $1-\bar{\tau}^*$, which are weighted by revenue for domestic and foreign firms, respectively:

$$\frac{1}{1-\bar{\tau}} = \int_z \int_\epsilon \frac{1}{(sz)^{-\rho}\epsilon} \frac{y}{\bar{Y}} \, dF(z) \, dG(\epsilon),$$

$$\frac{1}{1-\bar{\tau}^*} = \int_z \int_\epsilon \frac{1}{(sz)^{-\rho^*}\epsilon} \frac{y^*}{\bar{Y}^*} \, dF^*(z) \, dG^*(\epsilon),$$

where $\bar{Y}$ and $\bar{Y}^*$ denote the average output of domestic and foreign firms in manufacturing sector in equilibrium.

5.3 Equilibrium

I consider a stationary competitive economy in which households and firms take prices as given, prices are constant, and the distribution of resource allocations and firm types are stationary. The price of the manufacturing good is normalized to one.

Incumbent firms in manufacturing. An incumbent firm is characterized by productivity a and distortion τ. Each period, the firm chooses the optimal labor ℓ to maximize expected per-period profit $\pi(a, \tau)$:

$$\pi(a_i, \tau_i) = \max_{\ell \geq 0} \quad (1-\tau_i) a_i^{1-\gamma} \ell^\gamma - w\ell.$$

The solution to the firm's problem implies the optimal labor and output decisions:

$$\ell(a_i, \tau_i) = (1 - \tau_i)^{\frac{1}{1-\gamma}} a_i \left(\frac{\gamma}{w}\right)^{\frac{1}{1-\gamma}},$$
$$y(a_i, \tau_i) = (1 - \tau_i)^{\frac{\gamma}{1-\gamma}} a_i \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}.$$

Note that domestic and foreign firms face different elasticities of distortion with respect to TFP, denoted by ρ and ρ^*, respectively. As a result, the productivity gradient of firm size will differ between domestic and foreign firms.

The operating value of an incumbent firm is

$$W(a, \tau) = \pi(a, \tau) + (1 - \lambda)\frac{W(a, \tau)}{1 + r} = \frac{\pi(a, \tau)}{1 - R}, \tag{6}$$

where $R = (1 - \lambda)/(1 + r)$.

Entering firms in manufacturing. A firm that enters the market draws probability P^* of being foreign firm and probability $P = 1 - P^*$ of being domestic firm. Domestic firm will decides the level of technology investment to maximize the expected value:

$$\begin{aligned} V &= \underset{s\geq 0}{max} \quad \mathbb{E}_{z,\epsilon}\left[W(sz, \tau(sz, \epsilon))\right] - \left(\psi^{\frac{1}{1-\gamma}} s\right)^{\kappa} w \\ &= \underset{s\geq 0}{max} \quad \int_z \int_\epsilon W(sz, \tau(sz, \epsilon)) dG(\epsilon) dF(z) - \left(\psi^{\frac{1}{1-\gamma}} s\right)^{\kappa} w, \end{aligned}$$

Foreign firm will decides the level of technology investment to maximize the expected value:

$$\begin{aligned} V^* &= \underset{s^*\geq 0}{max} \quad \mathbb{E}_{z^*,\epsilon^*}\left[W(s^*z^*, \tau^*(s^*z^*, \epsilon^*))\right] - \left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^{\kappa} w \\ &= \underset{s^*\geq 0}{max} \quad \int_{z^*} \int_{\epsilon^*} W(s^*z^*, \tau^*(s^*z^*, \epsilon^*)) dG^*(\epsilon^*) dF^*(z^*) - \left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^{\kappa} w, \end{aligned}$$

At the beginning of each period, the entry value is given by

$$V_e = (1 - P^*)V + P^*V^* - c_e w \leq 0. \tag{7}$$

In equilibrium, potential entrants will enter the market to the point where there is no positive value of entering.

Firm distribution. As I abstract from firm dynamics other than entry and exit, the firm distribution in equilibrium is the same as the distribution of entrants over firm type j (domestic or foreign), exogenous productivity (z) and random component of distortions (ϵ). I denote the mass of firms as $\mu(j,z,\epsilon)$. The law of motion for $\mu(j,z,\epsilon)$ is given by

$$\mu'(j,z,\epsilon) = \begin{cases} (1-\lambda)\mu(j,z,\epsilon) + E(1-P^*)dF(z)dG(\epsilon) & \text{if } j = \text{Domestic}, \\ (1-\lambda)\mu(j,z,\epsilon) + EP^*dF^*(z)dF^*(z)dG^*(\epsilon) & \text{if } j = \text{Foreign}. \end{cases}$$

The stationary distribution is given by

$$\mu(j,z,\epsilon) = \begin{cases} \frac{E}{\lambda}(1-P^*)dF(z)dG(\epsilon) \equiv \mu(z,\epsilon) & \text{if } j = \text{Domestic}, \\ \frac{E}{\lambda}P^*dF^*(z)dG^*(\epsilon) \equiv \mu^*(z,\epsilon) & \text{if } j = \text{Foreign}. \end{cases} \tag{8}$$

In a stationary equilibrium, the masses of domestic (M) and foreign (M^*) firms are given by

$$M = \frac{(1-P^*)E}{\lambda} \quad \text{and} \quad M^* = \frac{P^*E}{\lambda}. \tag{9}$$

Definition of equilibrium. A stationary competitive equilibrium comprises wage w and prices (p_a, p_m, p_s); income I and consumption (C_a, C_m, C_s) for households; production labor for agriculture L_a and services L_s; decision and value functions for manufacturing firms: labor demand $\ell(a,\tau)$, output $y(a,\tau)$, profits $\pi(a,\tau)$, value of incumbent firm $W(a,\tau)$, technology investment productivity of domestic entrant s, technology investment productivity of foreign entrant s^*, value of domestic entrant V, value of foreign entrant V^*, value of entry V_e, a distribution of domestic firm $\mu(z,\epsilon)$, a distribution of foreign firm $\mu^*(z,\epsilon)$, mass of domestic firms M, mass of foreign firms M^* and mass of entrants E; government transfer T such that:

(i) Given prices, income I and transfers T, the allocation C solves the household's problem.

(ii) Given prices and wage, decision function $\ell(a, \tau)$ solves the incumbent firm's problem, determining the optimal per-period profits $\pi(a, \tau)$, output $y(a, \tau)$ and incumbent's value $W(a, \tau)$.

(iii) Given prices and wages, the technology investment decisions s and s^* solve the problems for domestic and foreign entrant firms, respectively, determining the value of domestic entrants V and foreign entrants V^*.

(iv) Free-entry condition holds: $V_e = 0$.

(v) Invariant distribution of firms μ given by equation (8), which implies the mass of firms is constant and given by equation (9).

(vi) Goods markets clear:

$$Y_a = C_a; \quad Y_s = C_s,$$

$$M \int_z \int_\epsilon y(sz, \tau(sz, \epsilon)) dG(\epsilon) dF(z) + M^* \int_z \int_\epsilon y(s^* z, \tau(s^* z, \epsilon)) dG^*(\epsilon) dF^*(z) = C_m.$$

(vii) Labor market clears:

$$\begin{aligned} L_a + L_s + M \int_z \int_\epsilon \ell(sz, \tau(sz, \epsilon)) dG(\epsilon) dF(z) \\ + M^* \int_z \int_\epsilon \ell(s^* z, \tau(s^* z, \epsilon)) dG^*(\epsilon) dF^*(z) \\ + E \left[(1 - P^*) \left(\psi^{\frac{1}{1-\gamma}} s \right)^\kappa + P^* \left(\psi^{* \frac{1}{1-\gamma}} s^* \right)^\kappa \right] + E c_e = 1. \end{aligned}$$

$(viii)$ Government budget balances:

$$\begin{aligned} M \int_z \int_\epsilon \tau(sz, \epsilon) y(sz, \tau(sz, \epsilon)) dG(\epsilon) dF(z) \\ + M^* \int_z \int_\epsilon \tau(s^* z, \epsilon) y(s^* z, \tau(s^* z, \epsilon)) dG^*(\epsilon) dF^*(z) = T. \end{aligned}$$

6 Quantitative Analysis

In this section, I first present the calibration and estimation of the model to match micro and aggregate data for Vietnam. Using the calibrated model, I then conduct a counterfactual experiment to assess the impact of reducing distortions to foreign firms in the manufacturing sector on both sectoral and aggregate productivity from 2000 to 2015. I begin by showing the effect of distortion reductions on manufacturing productivity, decomposing the results into two channels: (1) the static misallocation channel, which reflects gains from reallocating resources to more productive firms, and (2) the dynamic technology upgrading channel, which captures gains from firms' technology investments. Next, I examine the broader impact of reducing distortions on aggregate productivity, breaking it down into (1) direct effects on the manufacturing sector and (2) indirect effects on the agriculture and services sectors. Finally, I present additional results on the effects of different types of distortions and the role of indirect productivity effects on structural transformation.

6.1 Calibration and Estimation

I calibrate a distorted benchmark economy to match micro and aggregate data for Vietnam in two periods: 2000 and 2015. I parameterize the distribution of $\log z$, $\log z^*$, $\log \epsilon$ and $\log \epsilon^*$ to be normal with zero means and standard deviations σ_z, σ_z^*, σ_ϵ, and σ_ϵ^*, respectively.

The model requires the calibration of 21 parameters. My calibration strategy involves three steps. First, I normalize or assign values from outside evidence to a set of eight parameters. Second, I estimate the two productivity spillover parameters, ϕ_a and ϕ_s, using a staggered difference-in-differences estimation. This estimation leverages the staggered rollouts of policy reforms toward foreign firms, particularly through the establishment of industrial zones across different locations over time. Third, I calibrate the remaining twelve parameters to match the key macro and micro moments in the data for Vietnam in the years 2000 and 2015.

External calibration. A set of eight parameters are either normalized or assigned values based on outside evidence. The decreasing returns to scale is set to $\gamma = 0.8$, a common value in the misallocation literature (Guner et al., 2008; Restuccia and Rogerson, 2008). The exit rate is set to $\lambda = 0.10$ (Davis et al., 1998), the real interest rate to $r = 0.04$, and the curvature of the technology investment cost function to $\kappa = 2$ (Acemoglu et al., 2018). I normalize the cost of entry to $c_e = 1$.

Parameters related to preferences are assigned values typically used in the structural transformation literature (Duarte and Restuccia, 2010; Comin et al., 2021; Huneeus and Rogerson, 2023): the agricultural consumption weight $a = 0.02$, the subsistence level of agricultural consumption $\bar{a} = 0.5$, and the elasticity of substitution between manufacturing and services $\sigma = 0.4$.

Estimation of indirect productivity effects across sectors parameters. I employ the establishment of Industrial Zones (IZs) by the central government at different locations over time as the basis for my identification strategy to evaluate their effects on the local economy. Leveraging this staggered roll-out, I adopt a staggered difference-in-differences estimation approach, following the method outlined by Callaway and Sant'Anna (2021). The core idea is to designate provinces/districts in periods with no IZs as the control group.

The productivity spillover parameters ϕ_a and ϕ_s are estimated from the staggered difference in difference estimation. The productivity spillover from manufacturing to agriculture is estimated to be $\phi_a = 0.22$, whereas the productivity spillover from manufacturing to services is estimated to be $\phi_s = 0.32$.

Table 1 shows the staggered difference in difference estimation of the treatment effects of establishing the first industrial zone (IZ) on sectoral labor productivity at the local levels. After the establishment of the first IZ, there's statistically significant increase in productivity in manufacturing and services in the treated districts. Agricultural productivity is also found to increase significantly following the establishment of IZ at province level.

Table 1: Staggered Difference-in-Differences Estimation of Effects on Sectoral Productivity

	Labor Productivity		
Dep. Var.	Manufacturing	Services	Agriculture
Pre - First IZs	-0.160	0.068	0.016
	(0.898)	(0.149)	(0.065)
Post - First IZ	0.657^{***}	0.212^{***}	0.145^{***}
	(0.295)	(0.096)	(0.043)
N	7100	7100	438
Controls	Yes	Yes	Yes
Region FE	Yes	Yes	Yes

Notes: Unit of observations in regression 1-2 is district-year and in regression 3 is province-year. Estimation of treatment effect follows Callaway and Sant'Anna (2021). Controls include log distance to sea, log population, log area and log initial wage. Significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$. Standard errors, clustered at the region levels, are shown in parentheses.

As the establishment of IZs only directly affects the manufacturing sector, I infer that the increases in productivity in agriculture and services are spillover from increase in manufacturing productivity. The productivity spillover elasticity from manufacturing to services is estimated to be 0.32 (0.212/0.657), whereas the productivity spillover elasticity from manufacturing to agriculture is estimated to be 0.22 (0.145/0.657).

Calibration to Vietnamese economy in 2000 and 2015. The eight parameters θ^*, ρ, ρ^*, σ_ϵ, σ_ϵ^*, σ_z, σ_z^*, and P^* are estimated directly from corresponding data moments. Specifically, θ^* is matched to the average ratio of wedges between foreign and domestic firms estimated in the data. The distortion elasticities with respect to productivity, ρ and ρ^*, are estimated by regressing the log of the measured wedge on the log of the measured TFP, as specified in the regression equation (3). The standard deviations of the random distortion components, σ_ϵ and σ_ϵ^*, are obtained from the standard deviations of the residuals in this regression. The standard deviations of the exogenous productivity components, σ_z and σ_z^*, are directly measured from the standard deviation of the log TFP of domestic and foreign firms. The share of foreign firms, P^*, is calculated directly from firm-level data, remaining around 10% during this period.

Table 2: Estimation from Data Moments in 2000 and 2015

Parameter	Corresponding Moments	Value	
		2000	2015
θ^*	Distortions ratio of FF/DF	0.55	0.20
ρ	Distortions elasticity of DF	0.85	0.83
ρ^*	Distortions elasticity of FF	0.93	0.84
σ_z	sd(log TFP) of DF	5.56	6.23
σ_z^*	sd(log TFP) of FF	4.80	4.80
σ_ϵ	sd(log distortions | log TFP) of DF	1.32	1.34
σ_ϵ^*	sd(log distortions | log TFP) of FF	1.24	1.80
P^*	Share of FF firms	0.10	0.10

Table 2 presents the calibrated parameter values along with the model and data moments for the Vietnamese economy in 2000 and 2015. The average distortions affecting foreign firms relative to domestic firms, denoted by θ^*, have decreased from 0.55 to 0.20 over time. This decline signifies a substantial reduction in the average level of distortions between foreign and domestic groups.

The calibrated parameter values for distortion elasticities, ρ and ρ^*, range from 0.83 to 0.93. These values align with findings from other studies using different Orbis datasets, such as Ayerst et al. (2024) for Vietnam, and are consistent with the distortion elasticities observed in Vietnam's farms as reported in Ayerst et al. (2023), where elasticities range from 0.80 to 0.90. It is noteworthy that distortion elasticities and dispersion are generally higher for foreign firms compared to domestic firms.

Over time, the correlated distortions within foreign firms have decreased from 0.93 to 0.84, while those within domestic firms have slightly decreased from 0.85 to 0.83. Despite these reductions, correlated distortions remain high for both foreign and domestic firms. In an efficient economy, the elasticity of wedges to TFP should be zero, whereas measured elasticities in more developed countries are typically found to be less than 0.50 (Bento and Restuccia, 2017; Fattal-Jaef, 2022; Ayerst et al., 2024).

The standard deviations of random components of distortions, σ_ϵ and σ^*_ϵ, have increased over time, from 1.32 to 1.34 for domestic firms and from 1.24 to 1.80 for foreign firms. The standard deviations of exogenous productivity components, σ_z and σ^*_z, have increased over time, from 5.56 to 6.23 for domestic firms and remained constant at 4.80 for foreign firms. The share of foreign firms, P^*, has remained constant at 10% over time.

The remaining four parameters — Z_a, Z_s, ψ, and ψ^* — are jointly calibrated to match moments from Vietnamese data for the years 2000 and 2015. The targeted moments include: (1) the agricultural employment share, (2) the services employment share, (3) aggregate labor productivity, and (4) the employment share of foreign manufacturing firms. These parameters are intended to capture the structural transformation and aggregate growth of Vietnamese economy during this period. Specifically, the agricultural employment share decreased from 0.70 to 0.45, the services employment share increased from 0.20 to 0.40, and aggregate labor productivity rose from 1.00 to 1.90. Additionally, the employment share of foreign manufacturing firms substantially increased from 0.03 to 0.09.

Table 3: Calibration to Vietnamese Economy in 2000 and 2015

Parameter	Value	Targeted Moments	Model	Data
Year 2000				
Z_a	0.62	Agricultural employment share	0.70	0.70
Z_s	1.13	Services employment share	0.20	0.20
ψ	1.37	Aggregate labor productivity	1.00	1.00
ψ^*	0.41	FF employment share	0.03	0.03
Year 2015				
Z_a	0.83	Agricultural employment share	0.45	0.45
Z_s	1.08	Services employment share	0.40	0.40
ψ	0.88	Aggregate labor productivity	1.90	1.90
ψ^*	0.28	FF employment share	0.09	0.09

Table 3 reports the calibrated parameter values alongside the model and data moments for the Vietnamese economy in 2000 and 2015. The exogenous component of agricultural productivity increased from 0.62 to 0.83, while the exogenous component of services productivity decreased from 1.13 to 1.08. The technology upgrading cost level for domestic firms was found to be higher compared to foreign firms in both periods, reflecting the higher productivity distribution of foreign firms. Specifically, the technology upgrading cost level for domestic firms decreased from 1.37 to 0.88, whereas for foreign firms, it decreased from 0.41 to 0.28.

Model validation. As the calibration primarily targets sectoral employment shares and aggregate growth, sectoral labor productivity growth and firm-level TFP growth are not directly targeted. Table 4 reports the changes in productivity implied by the model alongside data values for validation. This includes annualized growth rates of aggregate labor productivity, as well as labor productivity growth rates for manufacturing, agriculture, and services, and the growth of average TFP for foreign and domestic firms.

The model closely aligns with the data for these untargeted moments. Specifically, the model-generated growth rates for labor productivity in manufacturing, agriculture, and services are 5.39%, 3.14%, and 1.27%, respectively, which are very close to the observed data. The average TFP growth rates for foreign and domestic firms are 3.54% and 2.59%, respectively, also closely matching the data. Additionally, the model implies growth rates of 1.96% for the exogenous component of agricultural productivity and -0.03% for services productivity. This indicates that the indirect productivity effects are significant drivers of observed productivity growth in these sectors, accounting for approximately 37% and 124%, respectively.

6.2 Impacts of the Reduction in Distortions to Foreign Firms

In this part, I assess the direct effect of reducing distortions to foreign firms on manufacturing productivity. Specifically, I update only the parameters θ^* and ρ^* to their 2015 calibrated values, while keeping all other parameters at their 2000 levels. This counterfactual experiment isolates the impact of reducing distortions faced by foreign firms on productivity growth at

Table 4: Productivity Growth (2000-2015): Model vs. Data

Untargeted Moments	Annualized Growth Rate (%)	
	Model	Data
Manufacturing labor productivity A_m	5.39	5.11
Agricultural labor productivity A_a	3.14	3.87
Services labor productivity A_s	1.27	1.29
Average productivity growth - Domestic $\bar{a}_m$	2.59	2.74
Average productivity growth - Foreign $\bar{a}_m^*$	3.54	3.62

Notes: The reported moments are not targeted in the calibration. I report the annualized growth rates assuming a 15-year period.

both the sectoral and aggregate levels. I first report the direct effect on manufacturing productivity growth, followed by the aggregate effect on economy-wide productivity growth.

Direct impact on manufacturing productivity. Table 5 reports the direct effect of reducing distortions to foreign firms on the change in manufacturing productivity. The reduction in distortions to foreign firms generates 64% increase in manufacturing productivity, compared to 120% increase in the benchmark economy. The observed reduction in distortions alone accounts for 62% of the actual changes in manufacturing productivity.

In the model, there are two channels through which the reduction in distortions to foreign firms affects productivity growth: (1) the reduction in static misallocation and (2) the technology channel. Static misallocation refers to the effect of reducing distortions to foreign firms on resource misallocation across the same set of producers. I find that the reduction in static misallocation generates a 23% increase in manufacturing productivity, accounting for 42% of the total productivity growth. The second channel is the technology channel, which captures the effects of changes in firm-level technology investment decisions resulting from the reduction of distortions. With lower distortions in both the average level θ^* and the elasticity with respect to productivity ρ^*, foreign firms have stronger incentives to invest in technology. These changes in technology investment lead to a 33% increase in manufacturing productivity, accounting for the remaining 58% of the gains due to reduction of distortions

Table 5: Direct Impact of the Reduction in Distortions to Foreign Firms (θ^*, ρ^*)

	Manufacturing Labor Productivity	*Contribution (%)*
Benchmark economies		
Benchmark - 2000	1.00	–
Benchmark - 2015	2.20	*100*
Experiment		
Only change (θ^*, ρ^*)	1.64	*62*
Decomposition by channels		
Static misallocation	1.23	*42*
Technology	1.33	*58*

Notes: The table presents the manufacturing labor productivity relative to the benchmark economy in 2000. Static misallocation refers to the change in manufacturing productivity resulting from changes in foreign firms' distortions (θ^*, ρ^*) while keeping the productivity distribution fixed at the 2000 levels. Technology denotes the change in manufacturing productivity that arises from changes in firm-level technology investment decisions.

to foreign firms.

Aggregate impact on economy-wide productivity. I report the aggregate effect of reducing distortions to foreign firms on economy-wide productivity. I update only the parameters θ^* and ρ^* to their 2015 calibrated values, while keeping all other parameters at their 2000 levels. This allows me to isolate the effect of reducing distortions towards foreign firms on economy-wide productivity growth.

Table 6 presents the results of the aggregate impact of reducing distortions to foreign firms on economy-wide productivity. In the baseline scenario, aggregate productivity in the economy increases by 90% between 2000 and 2015.

To assess the aggregate effects of reducing distortions to foreign firms, I consider two cases: (1) the direct effect alone and (2) the inclusion of the indirect productivity effect. The direct effect refers to the impact of reducing distortions on manufacturing productivity, while the indirect productivity effect captures how changes in manufacturing productivity influence productivity growth in agriculture and services.

Table 6: Aggregate Impact of the Reduction in Distortions to Foreign Firms (θ^*, ρ^*)

	Economy-wide Labor Productivity	*Contribution (%)*
Benchmark economies		
Benchmark - 2000	1.00	–
Benchmark - 2015	1.90	*100*
Experiments - Only change (θ^*, ρ^*)		
Direct effect	1.08	*12*
Direct + Indirect effects	1.30	*40*

Notes: The table presents the economy-wide productivity relative to the benchmark economy in 2000. The contributions are calculated as the percentage of the actual changes in economy-wide productivity. The direct effect captures the impact of reducing distortions to foreign firms on manufacturing productivity. The indirect productivity effect captures the positive indirect effects of manufacturing productivity on productivity in agriculture and services.

When focusing only on the direct effect through improvements in manufacturing productivity and the process of structural transformation, reducing distortions to foreign firms increases aggregate productivity in the economy by 8%. This accounts for 12% of the actual productivity growth observed. When including the indirect productivity effect, which captures the influence of changes in manufacturing productivity on productivity growth in agriculture and services, the impact of reducing distortions on economy-wide productivity growth is significantly amplified by 30%. Taking these indirect effects into account can enhance the overall impact on economy-wide productivity by a factor of 3.33.

6.3 Impacts on Productivity by Types of Distortions

I further study the impacts on sectoral and aggregate productivity growth by decomposing by different types of measured distortions: (1) the average distortion level between foreign and domestic firms θ^*, (2) the correlated distortions among foreign firms ρ^*, and (3) the correlated distortions among domestic firms ρ. The counterfactual experiments are conducted by updating each parameter individually to its 2015 calibrated value, while keeping all other parameters at their 2000 levels.

Table 7: Impacts on Aggregate and Sectoral Productivity by Distortion Types (θ^*, ρ^*, ρ)

Labor Productivity	BE - 2000	BE - 2015	Only changes in values of		
			(θ^*)	(θ^*, ρ^*)	(θ^*, ρ^*, ρ)
Aggregate effect					
Economy-wide	1.00	1.90	1.08	1.30	1.31
Contribution (%)		*100*	*12*	*40*	*41*
Direct effect					
Manufacturing	1.00	2.20	1.15	1.64	1.65
Contribution (%)		*100*	*17*	*62*	*63*
Indirect effects					
Agriculture	1.00	1.60	1.03	1.11	1.12
Contribution (%)		*100*	*6*	*23*	*24*
Services	1.00	1.23	1.04	1.17	1.17
Contribution (%)		*100*	*21*	*78*	*79*

Notes: The table presents the aggregate and sectoral productivity relative to the benchmark economy in 2000. The first and second columns present the aggregate and sectoral productivities of benchmark economies in 2000 and 2015. Three counterfactual experiments represent scenarios where: first, only θ^* is updated to its 2015 value; second, (θ^*, ρ^*) are updated to their 2015 values; and third, all three parameters (θ^*, ρ^*, ρ) are updated to their 2015 values, with all other parameters remaining as in the 2000 benchmark economy. The contributions are calculated as the percentage of the changes between benchmark economies in 2000 and 2015.

Table 7 presents the results of the counterfactual experiment. The first column reports the actual growth rates from 2000 to 2015 in the benchmark economies. The three counterfactuals represent scenarios where: first, only θ^* is updated to its 2015 value; second, (θ^*, ρ^*) are updated to their 2015 values; and third, all three parameters (θ^*, ρ^*, ρ) are updated to their 2015 values, with all other parameters remaining as in the 2000 benchmark economy.

The results indicate that the reduction in the average distortion level between foreign and domestic firms, θ^*, leads to an increase of 8% and 15% in aggregate and manufacturing productivity, respectively. This accounts for 12% and 17% of the baseline changes in productivity in the aggregate economy and manufacturing sector, respectively. The effect is substantially larger when the distortion elasticity among foreign firms, ρ^*, is reduced, leading to an increase of 30% and 64% in aggregate and manufacturing productivity, respectively.

This implies that the reduction in correlated distortions among foreign firms accounts for around 70% (28/40) and 73% (45/62) of the total effects of reducing distortions to foreign firms on aggregate and manufacturing productivity growth, respectively. The reduction in correlated distortions among domestic firms, ρ, has a minimal impact on productivity growth, contributing only additional 1% increase both in aggregate and manufacturing productivity.

A similar conclusion applies to the indirect productivity effects. The reduction in between-group distortions, θ^*, results in a 3% increase in agricultural productivity and 4% in services productivity. However, the indirect productivity effects are substantially larger when correlated distortions among foreign firms, ρ^*, are reduced, leading to a 11% in agriculture and 17% in services productivity. This suggests that the reduction in correlated distortions among foreign firms plays a much larger quantitative role. In contrast, the reduction in correlated distortions among domestic firms, ρ, has a minimal impact, contributing only 1% increase in productivity in both agriculture and services.

6.4 Role of Indirect Productivity Effects on Structural Transformation

I present counterfactual experiments to further assess the impacts of reducing distortions to foreign firms on structural transformation, specifically through indirect productivity effects. Three counterfactual experiments are conducted, maintaining the parameters consistent with the 2000 economy, except for the distortion parameters for foreign firms: distortion level θ^* and distortion elasticity ρ^*, which are updated to 2015 values. The three experiments involve: (1) assuming no indirect productivity effect on agriculture, (2) assuming no indirect productivity on services, and (3) assuming no indirect productivity effects on both agriculture and services. The key outcomes are changes in sectoral employment shares compared to the 2000 economy. These counterfactual experiments are equivalent to the effects in the standard structural transformation models without indirect productivity effects.

Table 8 presents the results of the counterfactual experiments, including scenarios with adjustments to distortions towards foreign firms (θ^*, ρ^*) and comparisons to the benchmark economy in 2015. The table reports changes relative to the benchmark economy in 2000 across three outcomes: the manufacturing employment share, the agricultural employment share and the services employment share.

Table 8: Impacts of the Reduction in Distortions to Foreign Firms (θ^*, ρ^*) on Structural Transformation

Δ Employment Share	BE - 2015	Reform	Without indirect effects on		
		(θ^*, ρ^*)	Only AGR	Only SER	Both
Manufacturing (ΔL_m)	5.00	-0.05	-1.90	-0.71	-2.43
Agriculture (ΔL_a)	-25.00	-6.77	0.06	-6.81	0.03
Services (ΔL_s)	20.00	6.82	1.84	7.52	2.41

Notes: The table presents the change in sectoral employment shares for each economy relative to the benchmark economy in 2000. The second column shows the benchmark economy in 2015. The third column represents the scenario where parameters θ^* and ρ^* are updated to their 2015 values, while other parameters remain as in the 2000 benchmark economy. The counterfactuals illustrate the impacts of these reforms while shutting down the indirect productivity effects on agriculture, services, and both sectors. The contributions of each channel are calculated as one minus the percentage of the changes between benchmark economies in 2000 and 2015.

Column 2 presents the baseline changes between 2000 and 2015, incorporating all reforms in manufacturing sector and other exogenous changes for benchmark comparison. Column 3 focuses on the impacts of reforms aimed at reducing distortions to foreign firms. Columns 4, 5, and 6 display the impacts of shutting down the indirect productivity effects to agriculture, services, and both sectors, respectively.

The baseline reform results in a slight decrease of 0.05 percentage points in the manufacturing employment share, a large decrease of approximately 6.77 percentage points in the agricultural employment share, and a large increase of about 6.82 percentage points in the services employment share. While the direction of structural transformation aligns with the broader economy, except for manufacturing, the magnitude is still smaller than the changes observed in the 2015 benchmark economy: agricultural employment decreased by 25 percentage points, manufacturing increased by 5 percentage points, and services increased by

20 percentage points. This suggests that factors beyond the reforms also played a significant role in driving structural transformation and aggregate growth.

However, when the indirect productivity effects are removed, the patterns of structural transformation are remarkably different. Specifically, shutting down the indirect productivity effects on both agriculture and services leads to a 2.43 percentage point decrease in manufacturing employment, a 0.03 percentage point increase in agricultural employment, and a 2.41 percentage point increase in services employment. In a standard model without the indirect productivity effects, the employment share of manufacturing sector would substantially shrink without any significant labor reallocation away from agriculture, resulting in a markedly different structural transformation pattern compared to the benchmark economy.

Columns 4 and 5 examine the impacts of shutting down the indirect productivity effects on agriculture and services separately. Removing the indirect productivity effect on agriculture leads to an increase in agricultural employment share, a decrease in manufacturing, and a small increase in services. Shutting down the indirect productivity effect on services has a smaller impact, leading to a less pronounced decrease in manufacturing employment and a smaller increase in services employment.

7 Conclusions

This paper examines the impact of reforms aimed at increasing openness to foreign firms on aggregate productivity growth in Vietnam. Empirically, I provide evidence of reductions in two key measures of distortions: the average distortions between foreign and domestic firms and the correlated distortions among foreign firms during the period 2000 to 2015. These reductions align with a gradual series of comprehensive reforms implemented by the Vietnamese government over this period. Quantitatively, using a multi-sector general equilibrium model, I find that reducing distortions towards foreign firms has a substantial aggregate effect, accounting for 62% of manufacturing productivity growth and 40% of overall aggregate productivity growth. The direct effect of lowering distortions to foreign firms extends beyond manufacturing and has a larger aggregate impact through indirect productivity effects on other sectors. The productivity "spillover" effects to agriculture and services could amplify aggregate productivity gains by a factor of 3.33 compared to the direct effect on manufacturing alone.

The findings of this paper have important policy implications. While previous studies often measure openness to foreign firms by the quantity of FDI capital inflows or stock, this paper's findings suggest that "how" foreign firms are attracted is crucial. Economic growth is not driven by the mere quantity of foreign firms or capital inflows but by the enhancement of productivity through improved resource allocation and the entry of higher-quality foreign firms. These types of reforms, by reducing distortions, have an amplified aggregate impact through indirect productivity effects on other sectors. The policy implications, as evidenced by the case of Vietnam, underscore the importance of focusing on reducing barriers for foreign firms, particularly policies that distort against high-productivity foreign firms, and fostering an economic environment conducive to attracting and retaining productive foreign firms.

My analysis has several important implications for future research. First, reducing distortions affecting foreign firms, which benefit from advanced technology and management practices, offers substantial potential gains. Among various forms of distortions, those correlated with productivity generate significantly larger aggregate losses by not only causing resource misallocation among incumbents but also reducing incentives for technological upgrading. In the case of foreign firms, such distortions impact the productivity distribution, leading to the entry of less productive firms. More work is needed to identify the specific policies driving these distortion patterns in less developed countries, which may require more detailed analysis within specific country contexts. Second, the indirect productivity effects from manufacturing on other sectors are crucial for driving structural transformation and aggregate productivity growth in Vietnam; missing this channel would significantly underestimate the overall impact of manufacturing sector reforms. Future research should focus on understanding the specific channels of correlated distortions and indirect productivity effects, and quantifying their impacts on structural transformation and aggregate productivity growth.

References

Acemoglu, D., Akcigit, U., Alp, H., Bloom, N., and Kerr, W. (2018). Innovation, Reallocation and Growth. *American Economic Review*, 126(4):1374–1443.

Alfaro, L. (2017). Gains from Foreign Direct Investment: Macro and micro Approaches. *The World Bank Economic Review*, 30(Supplement_1):S2–S15.

Alfaro, L. and Chen, M. X. (2018). Selection and Market Reallocation: Productivity Gains from Multinational Production. *American Economic Journal: Economic Policy*, 10(2):1–38.

Athukorala, P.-c. (2006). Trade Policy Reforms and the Structure of Protection in Vietnam. *World Economy*, 29(2):161–187.

Athukorala, P.-c. and Tran, Q. T. (2012). Foreign Direct Investment in Industrial Transition: The Experience of Vietnam. *Journal of the Asia Pacific Economy*, 17(3):446–463.

Ayerst, S., Brandt, L., and Restuccia, D. (2020). Market Constraints, Misallocation, and Productivity in Vietnam Agriculture. *Food Policy*, 94:101840. Understanding Agricultural Development and Change: Learning from Vietnam.

Ayerst, S., Brandt, L., and Restuccia, D. (2023). Distortions, Producer Dynamics, and Aggregate Productivity: A General Equilibrium Analysis. Technical report.

Ayerst, S., Nguyen, D. M., and Restuccia, D. (2024). The micro and macro productivity of nations. Technical report, National Bureau of Economic Research.

Bau, N. and Matray, A. (2023). Misallocation and Capital Market Integration: Evidence From India. *Econometrica*, 91(1):67–106.

Benjamin, D. and Brandt, L. (2004). Agriculture and Income Distribution. *Econ. Growth Poverty Househ. Welf. Vietnam*, 842:133.

Bento, P. and Restuccia, D. (2017). Misallocation, Establishment Size, and Productivity. *American Economic Journal: Macroeconomics*, 9(3):267–303.

Bhattacharya, D., Guner, N., and Ventura, G. (2013). Distortions, Endogenous Managerial Skills and Productivity Differences. *Review of Economic Dynamics*.

Boppart, T. (2014). Structural Change and the Kaldor Facts in a Growth Model with Relative Price Effects and non-Gorman Preferences. *Econometrica*, 82(6):2167–2196.

Buera, F. J., Moll, B., and Shin, Y. (2013). Well-intended policies. *Review of Economic Dynamics*, 16(1):216–230.

Burstein, A. T. and Monge-Naranjo, A. (2009). Foreign Know-How, Firm Control, and the Income of Developing Countries. *The Quarterly Journal of Economics*, 124(1):149–195.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-Differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Comin, D., Lashkari, D., and Mestieri, M. (2021). Structural Change with Long-run Income and Price Effects. *Econometrica*, 89(1):311–374.

Davis, S. J., Haltiwanger, J. C., Schuh, S., et al. (1998). Job creation and destruction. *MIT Press Books*, 1.

Do, N. H. (2014). History of establishment and development of Foreign Investment Law in Vietnam. Technical report, Vietnam Ministry of Planning and Investment.

Duarte, M. and Restuccia, D. (2010). The Role of the Structural Transformation in Aggregate Productivity. *The Quarterly Journal of Economics*, 125(1):129–173.

Fattal-Jaef, R. (2022). Entry Barriers, Idiosyncratic Distortions, and the Firm Size Distribution. *American Economic Journal: Macroeconomics*, 14(2):416–68.

Gollin, D., Parente, S., and Rogerson, R. (2002). The Role of Agriculture in Development. *American Economic Review*, 92(2):160–164.

Guner, N., Ventura, G., and Xu, Y. (2008). Macroeconomic Implications of Size-Dependent Policies. *Review of economic Dynamics*, 11(4):721–744.

Harrison, A. and Rodríguez-Clare, A. (2010). Chapter 63 - Trade, Foreign Investment, and Industrial Policy for Developing Countries. In Rodrik, D. and Rosenzweig, M., editors, *Handbooks in Economics*, volume 5 of *Handbook of Development Economics*, pages 4039–4214. Elsevier.

Herrendorf, B., Rogerson, R., and Valentinyi, A. (2014). Growth and Structural Transformation. In *Handbook of Economic Growth*, volume 2, pages 855–941. Elsevier.

Hopenhayn, H. A. (1992). Entry, Exit, and Firm Dynamics in Long Run Equilibrium. *Econometrica: Journal of the Econometric Society*, pages 1127–1150.

Hopenhayn, H. A. (2014). Firms, Misallocation, and Aggregate Productivity: A Review. *Annual Review of Economics*, 6(1):735–770.

Hsieh, C.-T. and Klenow, P. J. (2009). Misallocation and Manufacturing TFP in China and India. *The Quarterly Journal of Economics*, 124(4):1403–1448.

Hsieh, C.-T. and Klenow, P. J. (2014). The Life Cycle of Plants in India and Mexico. *The Quarterly Journal of Economics*, 129(3):1035–1084.

Huneeus, F. and Rogerson, R. (2023). Heterogeneous Paths of Industrialization. *The Review of Economic Studies*, page rdad066.

Kongsamut, P., Rebelo, S., and Xie, D. (2001). Beyond Balanced Growth. *The Review of Economic Studies*, 68(4):869–882.

Kose, M. A., Prasad, E., Rogoff, K., and Wei, S.-J. (2009). Financial Globalization: A Reappraisal. *IMF Staff papers*, 56(1):8–62.

Le, K. (2020). Land Use Restrictions, Misallocation in Agriculture, and Aggregate Productivity in Vietnam. *Journal of Development Economics*, 145:102465.

McCaig, B. and Pavcnik, N. (2015). Informal Employment in a Growing and Globalizing Low-Income Country. *American Economic Review*, 105(5):545–550.

McCaig, B. and Pavcnik, N. (2018). Export Markets and Labor Allocation in a Low-Income Country. *American Economic Review*, 108(7):1899–1941.

McCaig, B. and Pavcnik, N. (2021). Entry and Exit of Informal Firms and Development. *IMF Economic Review*, 69:540–575.

McCaig, B., Pavcnik, N., and Wong, W. F. (2022). FDI Inflows and Domestic Firms: Adjustments to New Export Opportunities. Technical report, National Bureau of Economic Research.

McGrattan, E. R. and Prescott, E. C. (2009). Openness, Technology Capital, and Development. *Journal of Economic Theory*, 144(6):2454–2476. Dynamic General Equilibrium.

Ngai, L. R. and Pissarides, C. A. (2007). Structural Change in a Multisector Model of Growth. *American Economic Review*, 97(1):429–443.

Nguyen, D. M. (2024). Heterogeneous Paths of Structural Transformation. *Available at SSRN 4743025.*

Parente, S. L. and Prescott, E. C. (1994). Barriers to Technology Adoption and Development. *Journal of Political Economy*, 102(2):298–321.

Restuccia, D. (2019). Misallocation and aggregate prodcutivity across time and space. *Canadian Journal of Economics*, 52(1):5–32.

Restuccia, D. and Rogerson, R. (2008). Policy Distortions and Aggregate Productivity with Heterogeneous Establishments. *Review of Economic Dynamics*, 11(4):707–720.

Restuccia, D. and Rogerson, R. (2017). The Causes and Costs of Misallocation. *Journal of Economic Perspectives*, 31(3):151–74.

UNCTAD (2008). Investment Policy Review of Viet Nam. Technical report.

Vo, T. T. and Nguyen, A. D. (2012). Experiences of Vietnam in FDI promotion: Some lessons for Myanmar. *Economic Reforms in Myanmar: Pathways and Prospects, edited by Hank Lim and Yasuhiro Yamada, BRC Research Report*, 10.

A Institutional Context

A.1 Economic Background

Foreign direct investments (FDI) inflows in Vietnam. In 1986, Vietnam saw the onset of foreign direct investments (FDI) following the Doi Moi. Figure 9a demonstrates a rapid increase in net inflows of FDI during the 1990s, reaching nearly 3-4 billion USD (in constant 2010 values) from nearly 0. This aligns with Vietnam's gradual policy changes aimed at attracting FDI during this period. However, the inflows of FDI slowed down during the late 1990s and early 2000s, settling at around 2 billion USD (constant 2010). After major policy reforms in the years 2000-2006, FDI inflows saw a substantial surge, reaching 10-14 billion USD (constant 2010) from 2006 onwards.

The rise in capital by foreign firms since 2006 is shown in Figure 9b to have been primarily driven by foreign firms in the manufacturing sector. While the total capital stocks of foreign firms in Vietnam exhibit a similar pattern between manufacturing and non-manufacturing sectors until 2006, the capital stocks of foreign firms in manufacturing have significantly increased since 2006, while remaining relatively flat in other non-manufacturing sectors. This is consistent with the policy reforms that targeted the manufacturing sector and attracted more foreign firms into the sector. Other sectors, including agriculture, construction, mining, utilities, and services, have seen little change in the entry of foreign firms.

A.2 International Trade Reforms

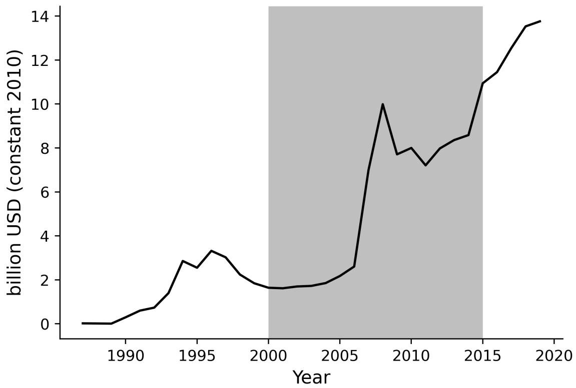
This process began with Vietnam's accession to the ASEAN Free Trade Area in 1995 and continued with the signing of the Vietnam-United States Bilateral Trade Agreement in 2001. These agreements led to a significant reduction in tariffs, both in terms of average import-weighted duty rates and maximum tariff rates. By the end of 2007, less than 1% of total tariff lines have rates above 50%, with about a third of all tariff lines having zero tariffs (Athukorala, 2006).

The reduction in tariffs resulting from trade reforms represents a major advantage for FDI firms in Vietnam. As FDI firms are often highly involved in both import and export activities, the high tariffs that previously existed represented a significant cost to these firms in terms of inputs and outputs. The reduction in tariffs, as a result of trade reforms, serves to lower these costs and provide a more favorable environment for FDI in the country.

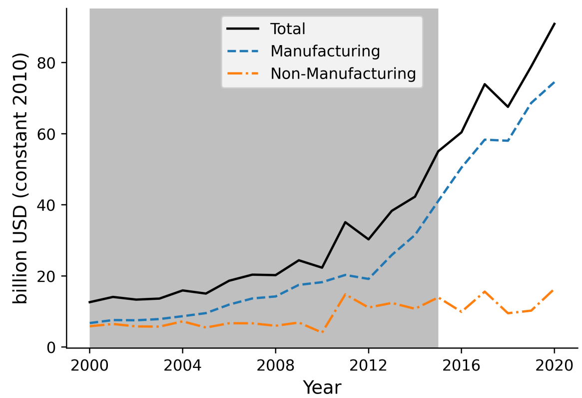
The trade reforms in Vietnam have undergone a gradual evolution concurrent with reforms in the Foreign Investment Law. These reforms have had a multifaceted impact beyond the mere reduction of trade barriers, necessitating greater accountability from the Viet-

Figure 9: Foreign Direct Investments into Vietnam over time

(a) Foreign direct investment net inflows



(b) Capital of foreign firms by sectors



Notes: Data on net inflows (current U.S. Dollars) of foreign direct investment (FDI) used in this study are from the International Monetary Fund's Balance of Payments database. To account for inflation, the Consumer Price Index provided by the U.S. Bureau of Labor Statistics is used to convert the series into constant 2010 U.S. dollars. The aggregate capital of foreign firms by sector is obtained by summing the capital of all foreign firms in the Vietnam Annual Enterprise Survey. This value is then adjusted for inflation using the Vietnam's Producer Price Index in manufacturing and converted into constant 2010 U.S. dollars using the exchange rate between the Vietnamese Dong and the U.S. Dollar. The shaded area represents the sample period from 2000 to 2015.

namese government. Notably, Vietnam's accession to the World Trade Organization (WTO) in 2007 brought forth substantial benefits, including improved market access, heightened foreign investment, and increased global economic integration. Accession to the WTO required Vietnam to undertake a series of comprehensive reforms and demonstrate its commitment to implementing international trade rules and regulations, such as safeguarding intellectual property rights, ensuring transparency in government procurement, and lowering trade barriers. Vietnam had to also establish a legal and regulatory framework consistent with WTO rules, involving the revision of its trade-related legislation, customs, and trade procedures. Moreover, Vietnam had to build institutional capacity to ensure full compliance with WTO rules, necessitating the strengthening of its administrative capabilities, the development of new regulations, and the training of government officials (UNCTAD, 2008).

Due to the lack of firm-level data on trade, this paper does not document or model trade reforms. However, it is important to acknowledge that reducing trade barriers is a significant policy measure in the context of lowering barriers for foreign firms. Foreign firms, which are more engaged in international trade compared to domestic firms, face substantial costs from both export and import tariffs. These trade barriers constitute a portion of the measured distortions affecting foreign firms. While this paper abstracts from modeling trade as part of these barriers, it remains a crucial component of the policy reforms towards openness to foreign firms in Vietnam.

B Data Details

I describe the details of the construction for the final dataset.

B.1 Firm-level Data

The final firm-level dataset covers the period from 2000 to 2015, with observations at the firm-year (i, t) level. The baseline model requires measures for firm-level output y_{it} and labor input ℓ_{it}. Output is calculated as the real value of a firm's reported operating revenues, deflated using the sectoral producer price index (PPI) provided by the General Statistics Office (GSO). Sector classification is at the 2-digit level according to the Vietnam Standard Industrial Classification (VSIC). Labor input is measured as the total number of employees in the firm.

Observations are excluded based on the following criteria:

- **Missing Data.** Firm-year observations with missing values for key variables, including output, labor input, and sectoral classification, are removed.

- **Data Trimming.** To reduce the influence of outliers, the top and bottom 1% of the distribution of measured productivity and distortions are trimmed, in accordance with standard practices in the literature.

B.2 Household-level Data

I utilize the Vietnam Household Living Standard Surveys (VHLSS) to construct the household level dataset. The VHLSS is a nationally representative survey conducted biennially by the General Statistics Office (GSO). The survey provides detailed information on household demographics, income, and expenditure. Key variables of interest include the industry of individual employment, the value of agricultural output, household income, and locations. The real value of agricultural output is deflated using a common agricultural price deflator, while household income is deflated using the Consumer Price Index (CPI) provided by the GSO.

B.3 Industrial Zones data

I manually collect data from different databases on industrial zones. The data comprise of comprehensive information on the locations, establishment years and area of Industrial

Zones (IZs) in Vietnam. I then link this data to the firm-level dataset to identify firms located within locations with the IZs. The data on IZs are used to construct the treatment variable for the empirical analysis.

I construct the datasets for the staggered difference-in-differences analysis as follows. For outcomes in the manufacturing and services sectors, I aggregate firm-level data to create district-level datasets for output and employment. This data is then merged with information on industrial zones (IZs) to distinguish between treated and control districts. Labor productivity for both sectors is calculated by dividing real output by employment for each district-year. The final dataset is compiled at the district-year level, covering the period from 2000 to 2015.

For agricultural outcomes and average income, I aggregate individual-level data from the Vietnam Household Living Standard Surveys (VHLSS) to create province-level datasets for agricultural employment share, agricultural output, and average household income. Agricultural labor productivity is computed as the ratio of real output to employment for each province-year. This data is merged with IZs information to identify treated and control provinces. The final dataset is compiled at the province-year level, spanning from 2000 to 2015.

C Empirical Findings

C.1 Robustness: Measured Distortions

I provide more robustness on the measured distortions. I consider alternative measures of distortions: (1) include wage bills w as inputs instead employment, (2) include both capital k and employment ℓ as inputs. The results for both average distortion level between foreign and domestic firms θ^* and the correlated distortions among foreign firms ρ^* are robust to these alternative measures.

The first specfication addresses the concern that foreign firms may hire more skilled workers, leading to higher wage bills w. Using wage bills w as measure of labor could account for the heterogeneity in human capital or worker efficiency across firms. However, wage bills may also capture the wedges due to labor market frictions which might be a part of the institutional distortions. Specifically, the wedges and productivity are measured as follows:

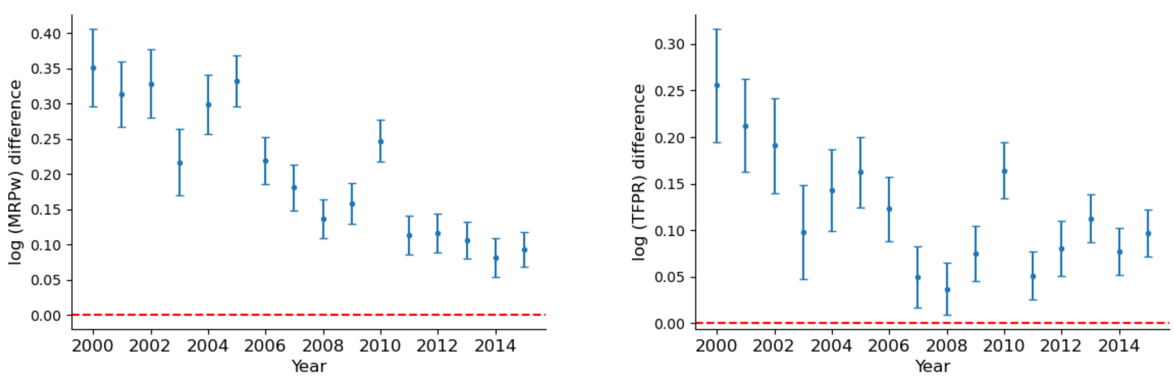
$$\text{TFP}_{i,t} = \frac{y_{i,t}}{w_{i,t}^{\gamma}}, \qquad \qquad wedge_{i,t} = \frac{y_{i,t}}{w_{i,t}}.$$

The second specification considers the possibility that foreign firms may use more capitalintensive production processes. Including both capital and employment as inputs could account for the heterogeneity in capital intensity across firms. The results are consistent with the baseline findings, indicating that the reduction in distortions towards foreign firms has a substantial impact on productivity growth in the manufacturing sector. Specifically, the wedges and productivity are measured as follows:

$$\text{TFP}_{i,t} = \frac{y_{i,t}}{(k_{i,t}^{\alpha}\ell_{i,t}^{1-\alpha})^{\gamma}}, \qquad wedge_{i,t} = \frac{y_{i,t}}{k_{i,t}^{\alpha}\ell_{i,t}^{1-\alpha}}.$$

Figure 10: Robustness: Wedge (log) Differences between Foreign and Domestic Firms

(a) Wage Bills as Inputs (b) Employment and Capital as Inputs



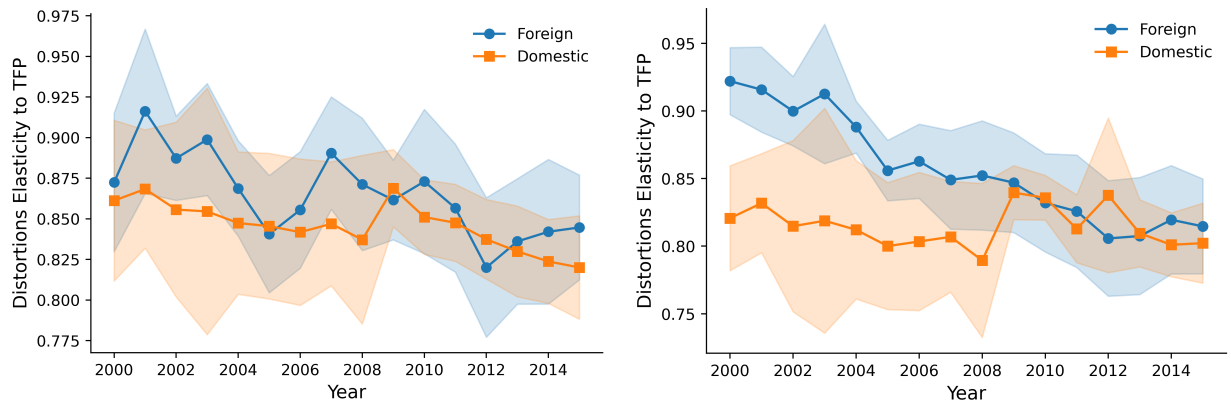
Notes: The dots represent the estimated values of parameters β_t in regression (2). The band represents the 95% confidence interval.

The results for average wedge level between foreign and domestic firms θ^* under these two alternative specfications are presented in Figure 10. The results for elasticity of wedges to productivity among foreign firms ρ^* are presented in Figure 11. The resultrs for both measures of distortions are consistent with the baseline findings, suggesting that differences in human capital and physical capital intensity between foreign and domestic firms are not the main driver of my results in the baseline specification.

I further present additional results on the measured distortions across cohorts in Figure 12. The results demonstrate that the average wedge between foreign and domestic firms decreases for both surviving firms within the same cohort and for new entrants.

Figure 11: Robustness: Elasticity of Distortions among Foreign Firms

(a) Wage Bills as Inputs (b) Employment and Capital as Inputs



Notes: Notes: The dots represent the estimated values for parameters ρ_t in the regression (3) for domestic and foreign firms, respectively. The band represents the 95% confidence interval.

C.2 TFP distribution of entrants

C.3 Staggered Difference-in-Differences Estimation

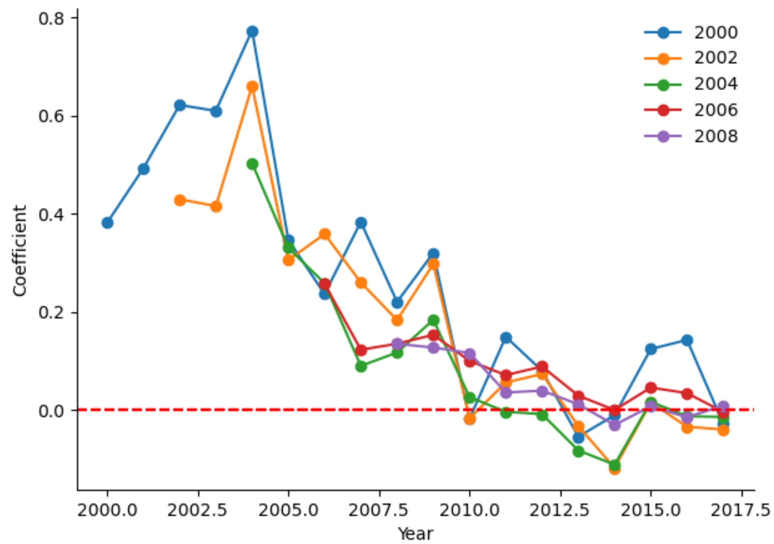
Identification strategy. In this analysis, I employ the establishment of Industrial Zones (IZs) by the central government at different locations over time as the basis for my identification strategy to evaluate their effects on the local economy. Leveraging this staggered roll-out, I adopt a Staggered difference-in-differences estimation approach, following the method outlined by Callaway and Sant'Anna (2021). The core idea is to designate provinces/districts in periods with no IZs as the control group.

I focus on a range of outcome variables to capture the diverse impacts of industrial zones (IZs). First, I consider the direct effects, such as the number of firms, employment, and labor productivity of manufacturing firms at the local level. Additionally, I examine indirect effects on employment and labor productivity in agriculture and services. Finally, I assess the overall impact on average household income.

Estimation method. Following the Callaway and Sant'Anna (2021), I adopt their methods for staggered difference-in-differences estimation, aggregation, and inference. My analysis utilizes panel data, focusing on locations denoted as i in each year denoted as t, such as district-year or province-year as the unit of observation.

$Y_{i,t}$ represents the outcome variable for unit i at time t. $D_{i,t} = 1$ indicates that unit i is treated at time t, while it is 0 otherwise. $G_{i,g} = 1$ signifies that unit i is initially treated at time g, and 0 otherwise. I designate a comparison group, denoted as $C = 1$, which consists of units

Figure 12: Robustness: Wedge (log) Differences between Foreign and Domestic Firms by Cohorts



Notes: The dots represent the estimated values for parameters ρ_t in the regression (3) for domestic and foreign firms, respectively. The band represents the 95% confidence interval.

that have never been treated. Furthermore, my analysis accounts for staggered treatment adoption, where the presence of treatment at time t ($D_{i,t} = 1$) implies its continuation at time $t+1$ ($D_{i,t+1} = 1$).

The parameter of interest is defined as the Average Treatment Effect on the Treated (ATT), given by

$$ATT(g,t) = \mathbb{E}\left[Y_t(g) - Y_t(0)|G_g = 1\right], \text{ for } t \geq g.$$

Under the Parallel Trend (PT) Conditional on Observables Assumptions, I have two key conditions. First, for each time period t and treatment starting period g, where $t \geq g$, I assume

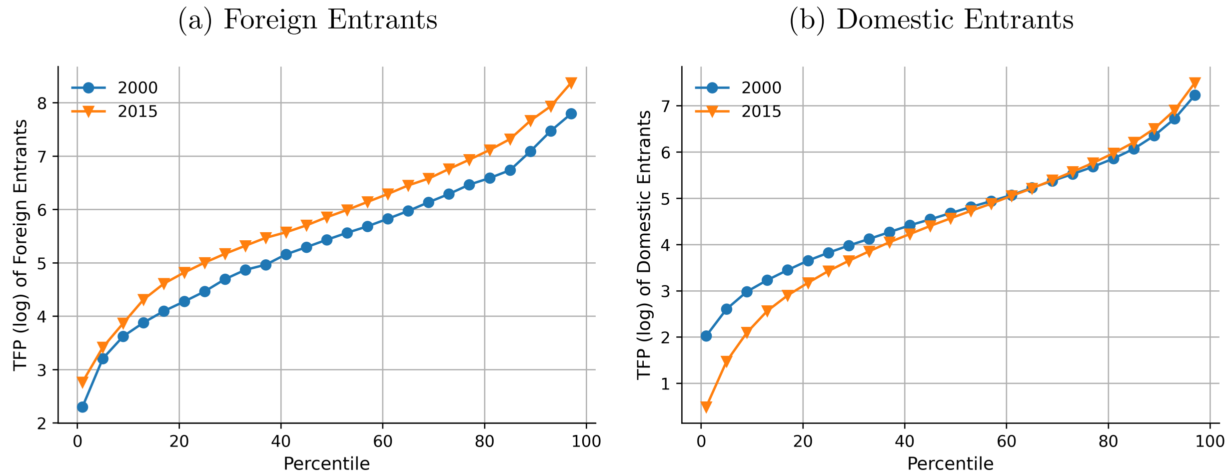
$$\mathbb{E}\left[Y_t(0) - Y_{t-1}(0)|X, G_g = 1\right] = \mathbb{E}\left[Y_t(0) - Y_{t-1}(0)|X, C = 1\right].$$

Second, for each pair of time periods s and t, and treatment starting period g, where $t \geq g$ and $s \geq t$, I assume

$$\mathbb{E}\left[Y_t(0) - Y_{t-1}(0)|X, G_g = 1\right] = \mathbb{E}\left[Y_t(0) - Y_{t-1}(0)|X, D_s = 0, G_g = 0\right].$$

Next, I proceed with estimation and aggregation procedures. Estimation is conducted using two different comparison groups: "never-treated" and "not-yet-treated". For the "never-

Figure 13: TFP (in log) by Percentiles: Foreign and Domestic Entrants in 2000 and 2015



Notes: The figure plots 25 percentile points from the 1st to the 99th. The left panel shows the TFP distribution of foreign entrants in 2000 and 2015. The right panel shows the TFP distribution of domestic entrants in 2000 and 2015.

treated" group, the estimator is given by

$$ATT^{nev}_{unc}(g,t) = \mathbb{E}\left[Y_t - Y_{g-1}|G_g = 1\right] - \mathbb{E}\left[Y_t - Y_{g-1}|C = 1\right].$$

Similarly, for the "not-yet-treated" group, the estimator is

$$ATT^{ny}_{unc}(g,t) = \mathbb{E}\left[Y_t - Y_{g-1}|G_g = 1\right] - \mathbb{E}\left[Y_t - Y_{g-1}|D_t = 0, G_g = 0\right].$$

Aggregation involves computing dynamic treatment effects for groups of units exposed for exactly e periods, given by

$$\theta^*_D(e) = \sum_{g=2}^{T} \mathbf{1}\{g+e \leq T\} ATT(g, g+e) P(G-g|G+e \leq T, C \neq 1).$$

Lastly, inference is carried out using a doubly robust DiD estimator based on Inverse Probability Weighting (IPW) and Ordinary Least Squares (OLS).

Balance test. To have a control group that are more similar to treated units, I exclude districts that are farther than 20 km from the treated districts. Table 9 shows the balancing test comparing several important characteristics including distance to sea, area, population, initial wage in 2000 between control and treated group. There's no statistically significant differences between control and treated group on all of the four variables.

Table 9: Balance Test

	Has IZs		Difference	
	Yes	No	(1)	(2)
Distance to sea (log)	2.95	3.18	−0.21	−0.24
			(0.47)	(0.48)
Area (log)	5.40	5.58	−0.16	−0.10
			(0.11)	(0.17)
Population (log)	6.37	6.02	0.14	0.09
			(0.16)	(0.27)
Initial wage (log)	1.83	1.84	−0.03	−0.05
			(0.15)	(0.21)
N	336	65	401	401
Region FE			No	Yes

Notes: Comparisons of various characteristics between districts which have established IZs before 2017 and those which haven't. The sample is limited to districts that are within a 20 km radius of treated districts. Columns 1-2 report estimated differences from regressing each outcome on an indicator of having IZs. Columns 4 include region fixed effect. Error terms are clustered at the region level.

Direct effects on all firms in manufacturing sector. Figure 14 shows the staggered difference-in-differences estimation of treatment effects of establishing the first industrial zone (IZ) at district level. After the establishment of the first IZ, there's statistically significant increases in the number and employment of all manufacturing firms. The effects is persistent and increases over time following the treated period. However, the increases in employment by domestic firms in manufacturing sector are not statistically significant. This indicates that most of increases on manufacturing employment following establishment of IZs are driven by foreign firms.

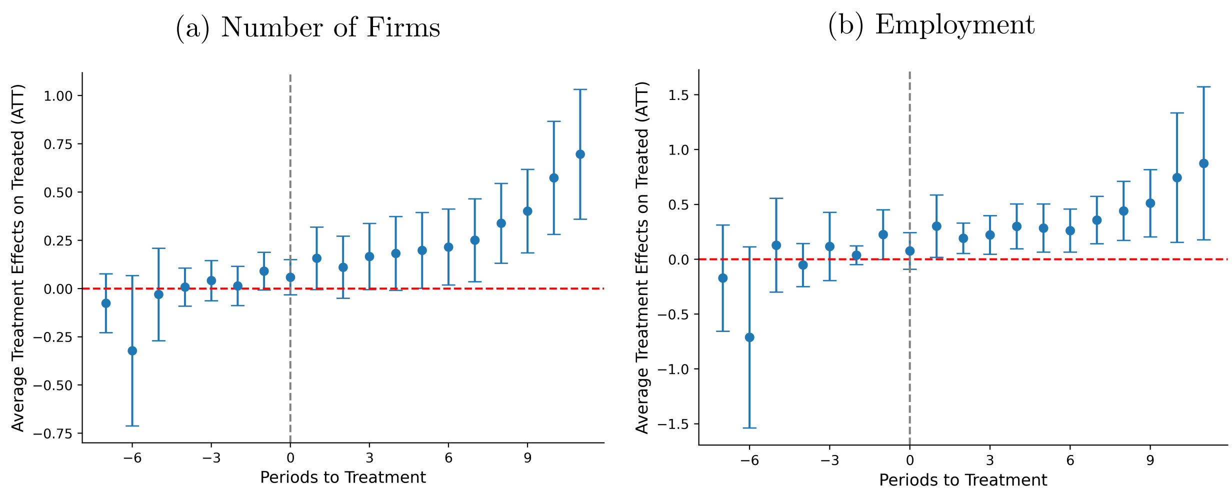
C.4 Shift-share Instrumental Variables Estimation

To assess the causal indirect effects of changes in foreign employment in the manufacturing sector on employment and labor productivity in agriculture and services at the local level, I implement a shift-share instrumental variables (IV) approach as a robustness exercise.

Main regression and endogeneity The main regression of interest is specified as:

$$Y_{it} = \beta_0 + \beta_1 \log(\text{Foreign emp})_{it} + \beta_2 X_{it} + \epsilon_{it}, \tag{10}$$

Figure 14: Direct Effects on Manufacturing Firms



Notes: The dots represent the estimated average treatment effect on the treated (ATT) of establishing the first industrial zone (IZ) at the district level. The band represents the 95% confidence interval. The dash line represents zero treatment effect. The x-axis represents the years before and after the establishment of the first Industrial Zone.

where Y_{it} denotes the outcome variable of interest, $\log(\text{Foreign emp})_{it}$ represents the log of foreign employment in the manufacturing sector, and X_{it} is a vector of control variables. Observations are recorded at the local level i for each time period t.

The outcome variables include sectoral employment and labor productivity in agriculture and services at the local level. A key endogeneity issue in estimating the causal effect of foreign employment on sectoral outcomes is the likely correlation between foreign employment and unobserved factors (e.g., infrastructure, human capital, or business conditions) that also influence sectoral employment and productivity, potentially biasing the causal estimates.

Instrumental variables approach To address endogeneity, I employ a shift-share instrumental variables approach, constructing the instrument as follows:

- **Shift** ($\Delta \mathbf{Emp}_t^c$): This term captures changes in foreign employment by firms from different home countries c to Vietnam at time t.
- **Share** ($\omega_{i,t-1}^c$): This term reflects the share of foreign firm employment from different home countries c at the local level i (e.g., province or district) in the preceding period $t-1$.

The shift-share instrument is then the product of these components, aggregated across

Table 10: Causal Estimation of Foreign Employment on Sectoral Employment

	OLS Model		2SLS Model	
Dependent Variable: Employment in	(1) Agriculture	(2) Services	(3) Agriculture	(4) Services
Panel A: Second-stage results				
log(Foreign emp)	-0.019^{***}	0.18^{***}	-0.018^{**}	0.22^{***}
	(0.006)	(0.017)	(0.008)	(0.019)
Panel B: First-stage results				
Shift-share IV			0.03^{***}	0.05^{***}
			(0.004)	(0.002)
Observations	312	3418	312	3418
Controls	✓	✓	✓	✓
Region FE	✓	✓	✓	✓
KP F-Statistic			55	670

Notes: Unit of observations in regression (1,3) is province-year and in regression (2,4) is district-year. Controls include log distance to sea, log area and log initial wage. Significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$. Standard errors, clustered at the province/district levels, are shown in parentheses.

Table 11: Causal Estimation of Foreign Employment on Sectoral Labor Productivity

	OLS Model		2SLS Model	
Dependent Variable: Labor Productivity in	(1) Agriculture	(2) Services	(3) Agriculture	(4) Services
Panel A: Second-stage results				
log(Foreign emp)	-0.01	0.05***	0.06**	0.07***
	(0.015)	(0.005)	(0.025)	(0.006)
Panel B: First-stage results				
Shift-share IV			0.03***	0.05***
			(0.004)	(0.002)
Observations	310	3209	310	3209
Controls	✓	✓	✓	✓
Region FE	✓	✓	✓	✓
KP F-Statistic			76	672

Notes: Unit of observations in regression (1,3) is province-year and in regression (2,4) is district-year. Controls include log distance to sea, log area and log initial wage. Significance levels are denoted as *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$. Standard errors, clustered at the province/district levels, are shown in parentheses.

home countries c for each location i and time t:

$$IV_{it} = \sum_c \Delta \mathrm{Emp}_t^c \times \omega_{i,t-1}^c. \tag{11}$$

The shift-share instrumental variables (IVs) are employed to instrument for the log of foreign employment in the manufacturing sector in the main regression. These instruments leverage variation across locations in exposure to foreign employment from different home countries. For validity, the shift-share IVs must satisfy both the exclusion and relevance restrictions. The exclusion restriction requires that either the shift or the share component is exogenous to the outcome variables. Here, this condition assumes that shifts in aggregate foreign employment from different home countries are exogenous to local economic outcomes. The relevance restriction is satisfied if the shift-share IVs are correlated with the log of foreign employment in the manufacturing sector, potentially due to co-location patterns of foreign firms from various home countries.

Estimation results. The results of the shift-share instrumental variables estimation are presented in Table 10 and Table 11. The results show that an increase in foreign employment in manufacturing sector has a negative effect on employment in agriculture sector and a positive effect on employment in services sector. The effects are statistically significant and robust to different specifications. The results also show that an increase in foreign employment in manufacturing sector has a negative effect on labor productivity in agriculture sector and a positive effect on labor productivity in services sector. The effects are statistically significant and robust to different specifications.

D Model Details

This part provides detailed solutions to the model presented in Section 5. I normalize the price of manufacturing good p_m to one. The wage w, the price of agricultural good p_a and the price of services p_s are consequently in units of manufacturing good.

Manufacturing incumbents. Given wage w, an incumbent firms in manufacturing sector with productivity a and distortion τ chooses labor input ℓ to maximize profits:

$$\max_{\ell} \quad \pi = (1-\tau)a^{1-\gamma}\ell^{\gamma} - w\ell.$$

Solving the first-order condition yields the labor demand function as follows:

$$\ell(a,\tau) = (1-\tau)^{\frac{1}{1-\gamma}} a \left(\frac{\gamma}{w}\right)^{\frac{1}{1-\gamma}}.$$

The optimal output and profit function of the incumbent firm with productivity a and distortion τ is given by:

$$y(a,\tau) = (1-\tau)^{\frac{\gamma}{1-\gamma}} a_i \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}},$$

$$\pi(a,\tau) = (1-\gamma)(1-\tau)^{\frac{1}{1-\gamma}} a_i \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}.$$

The operating value function of the incumbent firm with productivity a and distortion τ is given by:

$$W(a,\tau) = \frac{\pi(a,\tau)}{1-R} = \frac{(1-\gamma)(1-\tau)^{\frac{1}{1-\gamma}} a \left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}}{1-R}$$

Manufacturing entrants. Given wage w, domestic entrant firms will choose technology investment level s to maximize their life-time expected value:

$$
\begin{aligned}
V = \underset{s\geq 0}{max} \quad & \int_z \int_\epsilon W(sz, \tau(sz,\epsilon))dG(\epsilon)dF(z) - \left(\psi^{\frac{1}{1-\gamma}} s\right)^\kappa w \\
= \underset{s\geq 0}{max} \quad & \int_z \int_\epsilon \frac{(1-\gamma)(1-\tau(sz,\epsilon))^{\frac{1}{1-\gamma}}(sz)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}}{1-R} dG(\epsilon)dF(z) - \left(\psi^{\frac{1}{1-\gamma}} s\right)^\kappa w \\
= \underset{s\geq 0}{max} \quad & \frac{(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}}{(1-R)(1-\bar{\tau})} \int_z \int_\epsilon (sz)^{1-\rho} \epsilon dG(\epsilon)dF(z) - \left(\psi^{\frac{1}{1-\gamma}} s\right)^\kappa w \\
= \underset{s\geq 0}{max} \quad & \frac{(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \mathbb{E}_z[z^{1-\rho}]\mathbb{E}_\epsilon[\epsilon]}{(1-R)(1-\bar{\tau})} s^{1-\rho} - \left(\psi^{\frac{1}{1-\gamma}} s\right)^\kappa w,
\end{aligned}
$$

where $\mathbb{E}_z[z^{1-\rho}]$ is the expected value of $z^{1-\rho}$ given $z \sim F(z)$ and $\mathbb{E}_\epsilon[\epsilon]$ is the expected value of ϵ given $\epsilon \sim G(\epsilon)$.

Similarly, given wage w, foreign entrant firms will choose technology investment level s^* to maximize their life-time expected value:

$$
\begin{aligned}
V^* = \underset{s^*\geq 0}{max} \quad & \int_{z^*} \int_{\epsilon^*} W(sz, \tau(s^*z^*,\epsilon^*))dG^*(\epsilon^*)dF^*(z^*) - \left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^\kappa w \\
= \underset{s^*\geq 0}{max} \quad & \int_{z^*} \int_{\epsilon^*} \frac{(1-\gamma)(1-\tau^*(s^*z^*,\epsilon^*))^{\frac{1}{1-\gamma}}(s^*z^*)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}}{1-R} dG^*(\epsilon^*)dF^*(z^*) - \left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^\kappa w \\
= \underset{s^*\geq 0}{max} \quad & \frac{(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}}}{(1-R)(1-\bar{\tau}^*)} \int_{z^*} \int_{\epsilon^*} (s^*z^*)^{1-\rho^*} \epsilon^* dG^*(\epsilon^*)dF^*(z^*) - \left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^\kappa w \\
= \underset{s\geq 0}{max} \quad & \frac{(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \mathbb{E}_{z^*}[z^{*1-\rho^*}]\mathbb{E}_{\epsilon^*}[\epsilon^*]}{(1-R)(1-\bar{\tau}^*)} s^{*1-\rho^*} - \left(\psi^{*\frac{1}{1-\gamma}} s^*\right)^\kappa w,
\end{aligned}
$$

where $\mathbb{E}_{z^*}[z^{*1-\rho^*}]$ is the expected value of $z^{*1-\rho^*}$ given $z^* \sim F^*(z^*)$ and $\mathbb{E}_{\epsilon^*}[\epsilon^*]$ is the expected value of ϵ^* given $\epsilon^* \sim G^*(\epsilon^*)$.

To simplfy the notation, I denote

$$
\begin{aligned}
\Omega &\equiv \frac{(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \mathbb{E}_z[z^{1-\rho}]\mathbb{E}_\epsilon[\epsilon]}{(1-R)(1-\bar{\tau})}, \\
\Omega^* &\equiv \frac{(1-\gamma)\left(\frac{\gamma}{w}\right)^{\frac{\gamma}{1-\gamma}} \mathbb{E}_{z^*}[z^{*1-\rho^*}]\mathbb{E}_{\epsilon^*}[\epsilon^*]}{(1-R)(1-\bar{\tau}^*)}.
\end{aligned}
$$

First-order conditions for solving the maximization problems of domestic and foreign entrants are given by:

$$\text{Domestic entrants:} \quad (1-\rho)\Omega s^{-\rho} = \psi^{\frac{\kappa}{1-\gamma}} \kappa s^{\kappa-1} w,$$

$$\text{Foreign entrants:} \quad (1-\rho^*)\Omega^* s^{-\rho^*} = \psi^{*\frac{\kappa}{1-\gamma}} \kappa s^{*\kappa-1} w.$$

The optimal technology investment decisions of domestic and foreign entrants are given by:

$$\text{Domestic entrants:} \quad s = \left[\frac{(1-\rho)\Omega}{\psi^{\frac{\kappa}{1-\gamma}} \kappa w}\right]^{\frac{1}{\kappa+\rho-1}},$$

$$\text{Foreign entrants:} \quad s^* = \left[\frac{(1-\rho^*)\Omega^*}{\psi^{*\frac{\kappa}{1-\gamma}} \kappa w}\right]^{\frac{1}{\kappa+\rho^*-1}}.$$

Given the optimal technology investment decisions of domestic and foreign entrants, we can then solve for the optimal value function of domestic and foreign entrants as a function of wage w denoted as $V(w)$ and $V^*(w)$.

Free entry condition. We can next derive the expected value of a potential entrant firm in the manufacturing sector given by

$$V_e(w) = (1-P^*)V(w) + P^* V^*(w) - c_e w.$$

We can solve for the equilibrium wage w from the free-entry condition:

$$V_e(w) = 0.$$

Sectoral labor productivity. Given equilibrium wage w, we can solve for average output for foreign and domestic incumbent firms in manufacturing sector as follows:

$$\bar{y} = \int_z \int_\epsilon y(sz, \tau(sz, \epsilon)) dG(\epsilon) dF(z),$$

$$\bar{y}^* = \int_{z^*} \int_{\epsilon^*} y^*(s^* z^*, \tau^*(s^* z^*, \epsilon^*)) dG^*(\epsilon^*) dF^*(z^*).$$

The average labor demands for domestic and foreign firms in manufacturing sector are given by:

$$\bar{\ell} = \int_z \int_\epsilon \ell(sz, \tau(sz, \epsilon)) dG(\epsilon) dF(z),$$

$$\bar{\ell}^* = \int_{z^*} \int_{\epsilon^*} \ell^*(s^* z^*, \tau^*(s^* z^*, \epsilon^*)) dG^*(\epsilon^*) dF^*(z^*).$$

The labor productivity A_m in manufacturing sector are given by:

$$A_m = \frac{(1-P^*)\bar{y} + P^*\bar{y}^*}{(1-P^*)\bar{\ell} + P^*\bar{\ell}^* + c_e}.$$

We can then solve for the labor productivity for agriculture and services sectors as follows:

$$A_a = Z_a A_m^{\phi_a} \quad \text{and} \quad A_s = Z_s A_m^{\phi_s}.$$

Agricultural and services firms' problems. Given the price of agricultural good p_a and price of services p_s, agricultural and services firms choose labor input to maximize profits:

$$\underset{L_a}{max} \quad p_a A_a L_a - w L_a,$$

$$\underset{L_s}{max} \quad p_s A_s L_s - w L_s.$$

We can then solve for the prices by the first-order conditions:

$$p_a = \frac{w}{A_a},$$

$$p_s = \frac{w}{A_s}.$$

Household's income. The income of household comes from three sources: (1) wage income, (2) profit income from owning firms, and (3) transfer from government. The household's income is given by:

$$\begin{aligned} I &= w + \Pi + T \\ &= w + MP \int_{z,\epsilon} \pi(z,\epsilon) dG_z(z) dG_\epsilon(\epsilon) + MP^* \int_{z,\epsilon} \pi^*(z,\epsilon) dG^*_z(z) dG^*_\epsilon(\epsilon) + T. \end{aligned}$$

Household's problem. Household's problem can be solved in two steps. First, we can solve for the optimal consumption of agricultural (C_a) and non-agricultural goods (C_n) given wage w and prices (p_a, p_n). Next, given the optimal non-agricultural consumption, we can then solve for the optimal consumption of manufacturing good C_m and services (C_s).

Given wage w and prices (p_a, p_n), the household chooses the consumption of agricultural good C_a and non-agricultural good C_n to maximize utility subject to the budget constraint:

$$\underset{C_a, C_n}{max} \quad a log(C_a - \bar{a}) + (1-a) log(C_n) \quad \text{s.t.} \quad p_a C_a + p_n C_n = I.$$

From the first-order conditions, we can solve for agricultural and non-agricultural expenditure as share of household's income:

$$\frac{p_a C_a}{I} = a + \frac{(1-a)p_a \bar{a}}{I}$$

$$\frac{p_n C_n}{I} = (1-a) - \frac{(1-a)p_a \bar{a}}{I}$$

Agricultural consumption C_a can then be derived as:

$$C_a = \frac{aI + (1-a)\bar{a}}{p_a}$$

Given optimal expenditure on non-agricultural goods, we can then solve for consumption of manufacturing good C_m and services C_s as follows:

$$\underset{C_m, C_s}{max} \quad c_n = \left(C_m^{\frac{\sigma-1}{\sigma}} + C_s^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} \quad \text{s.t.} \quad C_m + p_s C_s = p_n C_n = (1-a)(I - p_a \bar{a})$$

The first-order conditions are given by:

$$\left(C_m^{\frac{\sigma-1}{\sigma}} + C_s^{\frac{\sigma-1}{\sigma}}\right)^{\frac{1}{\sigma-1}} C_m^{\frac{-1}{\sigma}} = 1$$

$$\left(C_m^{\frac{\sigma-1}{\sigma}} + C_s^{\frac{\sigma-1}{\sigma}}\right)^{\frac{1}{\sigma-1}} C_s^{\frac{-1}{\sigma}} = p_s$$

This yields expenditure share for services and manufacturing

$$\frac{p_s C_s}{C_m + p_s C_s} = \frac{p_s^{1-\sigma}}{1 + p_s^{1-\sigma}} \equiv \frac{p_s^{1-\sigma}}{p_n^{1-\sigma}}$$

$$\frac{C_m}{C_m + p_s C_s} = \frac{1}{1 + p_s^{1-\sigma}} \equiv \frac{1}{p_n^{1-\sigma}}$$

We can solve for optimal consumption of manufacturing good C_m and services C_s as follows:

$$C_s = \frac{p_s^{-\sigma}}{1 + p_s^{1-\sigma}}(1-a)(I - p_a \bar{a})$$

$$C_m = \frac{1}{1 + p_s^{1-\sigma}}(1-a)(I - p_a \bar{a})$$

Agricultural and services labor demand. From the agricultural and services consumption, we can solve for optimal labor demand in agriculture and services sectors as follows:

$$L_a = \frac{C_a}{A_a} \quad \text{and} \quad L_s = \frac{C_s}{A_s}.$$

Mass of manufacturing entrants. Mass of manufacturing incumbents M and entrants E can be solved from the market clearing condition in the manufacturing sector:

$$M = \frac{C_m}{(1 - P^*)\bar{y} + P^* \bar{y}^*} \quad \text{and} \quad E = \frac{M}{\lambda}.$$

We can then solve for all the other variables in the model.