Institute for Economic Studies, Keio University

Keio-IES Discussion Paper Series

ミスアロケーション，生産性，および貿易自由化：ベトナムの製造業のケース

Doan Thi Thanh Ha、清田耕造

2015 年 5 月 29 日
DP2015-007
http://ies.keio.ac.jp/publications/3970

Institute for Economic Studies, Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
ies-office@adst.keio.ac.jp
29 May, 2015

ミスアロケーション，生産性，および貿易自由化：ベトナムの製造業のケース

Doan Thi Thanh Ha、清田耕造

IES Keio DP 2015-007

2015 年 5 月 29 日

JEL Classification: O47, F14, D22

キーワード: ミスアロケーション；全要素生産性；貿易自由化；世界貿易機関；ベトナム

【要旨】

本研究は，貿易自由化と資源の配分非効率（ミスアロケーション）の関係を分析したものである．分析では，2000-09 年のベトナムの製造業の企業に注目した．本研究は次の三つの疑問に答えようと試みた．1) ベトナムのミスアロケーションの程度は中国やインドのそれと大きく異なっているのか？2) もしミスアロケーションがなければ，どの程度の TFP 成長が見込めるのか？3) WTO 加盟後，ベトナムのミスアロケーションは低下したか？分析の結果は次の通りである．1) ベトナムのミスアロケーションの程度は中国やインドのそれと同程度（やや小さい）．2) もしミスアロケーションが米国と同程度になれば，30%強の TFP 成長が見込める（中国，インドよりは小さい）．3) WTO 加盟後，ミスアロケーションは拡大しているが，これは貿易自由化のプラスの効果を金融危機のマイナスの効果が相殺してしまっていることに起因している．貿易自由化は財に関する歪みの解消には寄与しており，資本に関する歪みを是正することで，生産性のさらなる向上が見込まれる．

Doan Thi Thanh Ha
横浜国立大学大学院国際社会科学府経済学専攻　博士課程
〒240-0067
神奈川県横浜市保土ヶ谷区常盤台79-4
hato.doan@gmail.com

清田耕造
慶應義塾大学産業研究所
〒223-0061
東京都港区三田2-15-45
kiyota@sanken.keio.ac.jp

謝辞：本研究は、科学研究費（26220503, 26285058），文部科学省私立大学戦略的基盤形成支援事業より研究助成を受けている。心より感謝申し上げる。

Misallocation, Productivity, and Trade Liberalization: The Case of Vietnamese Manufacturing*

Doan Thi Thanh Ha

Graduate School of International Social Sciences, Yokohama National University
and
Faculty of International Economics and Business, Foreign Trade University

Kozo Kiyota†

Keio Economic Observatory, Keio University

Abstract

This paper attempts to measure the contribution of resource misallocation to aggregate manufacturing TFP, focusing on Vietnamese manufacturing firms for the period 2000–09. Our research questions are threefold. 1) To what extent are resources misallocated in Vietnam? 2) How large would the productivity gains have been in the absence of distortions? 3) Did the degree of misallocation decline after entry into the World Trade Organization (WTO)? The answers to these questions are as follows. First, misallocation in Vietnam is comparable to that in China and India. Second, there would have been substantial improvement in aggregate TFP in the absence of distortions. Finally, the accession to the WTO contributed to reducing the distortions in output markets. However, this positive effect was offset by increasing distortions in capital markets. These results together suggest that further reforms in capital markets could improve aggregate TFP in Vietnam through reduced misallocation.

Key words: Misallocation; Total factor productivity; Trade liberalization; WTO; Vietnam
JEL classification codes: O47; F14; D22

---

*We wish to thank Iwan J. Azis, Flora Bellone, Minsoo Lee, Qing Liu, Atsushi Ohyama, Yoichi Sugita, Kenichi Ueda, seminar participants at Hokkaido University, IDE-JETRO, Keio University, Kwansei Gakuin University, Okinawa University, Osaka University, the University of Tokyo, and participants at the East Asian Economic Association, 2015 Spring Meeting of the Japanese Economic Association, and the Yokohama Workshop on International Trade and Growth. Thanks also to Kaoru Hosono and Miho Takizawa for providing information on misallocation in Japan. Kiyota gratefully acknowledges financial support received from the JSPS Grant-in-Aid (26220503, 26285058) and the MEXT-Supported Program for the Strategic Research Foundation at Private Universities. The usual disclaimers apply.

†Corresponding author: Keio Economic Observatory, Keio University, 2-15-45, Mita, Minato-ku, Tokyo 108-8345, Japan; E-mail: kiyota@sanken.keio.ac.jp; Tel: +81-3-5427-1480.

1 Introduction

Differences in per capita income across countries result mainly from differences in total factor productivity (TFP).[1] Therefore, clarifying the underlying causes of low productivity in developing countries is one of the central concerns in various fields of economics such as development economics, international economics, and macroeconomics. Given the fact that production efficiency is heterogeneous across firms, some recent studies on this issue argue that aggregate TFP depends not only on the TFP of individual firms but also on the allocation of resources across firms.[2] In other words, low productivity in developing countries can be attributable to the misallocation of resources across heterogeneous firms.

What are the underlying factors causing misallocation? Recent studies have pointed out that resource misallocation can be attributable to policy distortions, such as heavy taxes/subsidies, and market imperfections, such as credit market imperfections. The removal of such distortions can bring about substantial benefits for the economy. For example, Restuccia and Rogerson (2008) developed a growth model with heterogeneous establishments and calibrated it using US data. They showed that policies that lead to price differences faced by individual producers could lead to sizeable decreases in output and TFP in the range of 30–50 percent. Similarly, using establishment-level data in China, India, and the US, Hsieh and Klenow (2009) found that, if China and India were to move to the US efficiency level, TFP would be boosted by 39.3 percent for China and 46.9 percent for India. Therefore, the relationship between misallocation and policy distortions is an important aspect of aggregate TFP in developing countries.

Among the various policy distortions, trade barriers seem to be an important source of misallocation because they tend to be higher in developing countries than in developed

[1] "Large differences in output per worker between rich and poor countries have been attributed, in no small part, to differences in total factor productivity" (Hsieh and Klenow, 2009, p. 1403); "cross-country income differences mostly result from differences in total factor productivity" (Waugh, 2010, p. 2095). McMillan and Rodrik (2011) also argued for the importance of resource reallocation in enhancing productivity growth in developing countries.

[2] See Restuccia and Rogerson (2013) for a survey. Another source of distortions is credit market constraints, which we will discuss in more detail in Sections 4.3 and 4.4.

countries.[3] Trade liberalization is expected to diminish misallocation, reallocating resources from less productive to more productive firms (e.g., Melitz, 2003). This paper attempts to measure resource misallocation in Vietnamese manufacturing firms for the period 2000–09. An advantage of the use of Vietnamese data is that the data cover the year 2007, when Vietnam joined the World Trade Organization (WTO). This enables us to compare the misallocation before and after trade liberalization.

Our motivation comes from two strands of research. One is the literature that focuses on distortions that reflect the difference between the actual and efficient outcomes. Such distortions are called "wedges" in the literature. A seminal paper is Hsieh and Klenow (2009), which estimates wedges from data on value added and factor inputs for manufacturing establishments in China, India, and the US. They found that the distortions were much larger in China and India than in the US. Moreover, as mentioned above, Hsieh and Klenow (2009) found that the removal of distortions has an insignificant effect on aggregate TFP in China and India. Following Hsieh and Klenow (2009), several studies have provided a similar picture: large TFP gains could be expected from the removal of distortions.[4] However, the relationship between tariff reduction and misallocation has not been fully examined in the literature yet.

The other strand is the analysis of the impacts of trade liberalization on aggregate TFP. There is strong evidence linking trade barriers and aggregate TFP.[5] However, little attention has been paid to the impacts of trade liberalization on misallocation measured by the variation in wedges.[6] As a recent theoretical study by Epifani and Gancia (2011) pointed

[3]According to the World Bank (2014), for example, average tariff rates for high-, middle-, and low-income countries are 3.9, 8.6, and 11.5 percent, respectively. Restuccia and Rogerson (2013) also argued that trade barriers could be one of the factors generating misallocation.

[4]See Camacho and Conover (2010) for the case of Colombia; Busso, Madrigal, and Pages-Serra (2012) for Latin America; Bellone and Mallen-Pisano (2013) for France; Hosono and Takizawa (2013) for Japan; and de Vries (2014) for Brazil. Furthermore, Bach (2014) examined misallocation in Vietnam. However, his study did not address the issue of trade liberalization.

[5]See, for example, Pavcnik (2002) for the case of Chile, Lileeva and Trefler (2010) for Canada, and Ha and Kiyota (2014) for Vietnam.

[6]A number of studies have examined the effects of trade liberalization on resource reallocation. Strictly speaking, however, that misallocation is different from reallocation. On the one hand, reallocation means the changes in resource allocation, which can be defined between time $t-1$ and t. On the other hand, misallocation means allocative inefficiency, which can be defined at a specific point in time t.

out, heterogeneity in markups induced by trade barriers can be a source of misallocation of resources because, for example, trade barriers affect the degree of competition and thus markups. Less-competitive industries may underproduce while more-competitive industries may overproduce, which results in the resource misallocation. Trade liberalization thus can be expected to solve this problem. Furthermore, from a welfare point of view, the changes in resource allocation through trade liberalization are not trivial (e.g., Melitz and Redding, 2015). For a deeper understanding of the effects of trade liberalization on aggregate TFP, an empirical analysis on the relationship between trade liberalization and variation in wedges is necessary.

Building upon these two strands of the literature, this paper attempts to measure the degree of misallocation in Vietnamese manufacturing between 2000 and 2009. The major contributions of this paper are twofold. First, to the best of our knowledge, this paper is the first study that examines the relationship between tariff reduction and misallocation directly. While Camacho and Conover (2010) also examined the relationship between trade liberalization and misallocation in Colombia, their analysis simply compared misallocation before and after trade liberalization without controlling for any other factors. Because the changes in misallocation could be attributable to various factors, their estimates could be biased.[7] Second, this study examines the factors that affect output and capital wedges separately. As we will discuss, such analysis is helpful if the effects on output wedges are offset by those on capital wedges. This study thus contributes to the literature through a more precise analysis of the effects of trade liberalization on misallocation.

Our research questions are threefold. 1) To what extent are resources misallocated in Vietnam? 2) How large would the productivity gains have been in the absence of distortions? 3) Did the degree of misallocation decline after entry into the WTO? Answering these questions, this paper goes one step further by providing a deeper understanding of the gains from trade. The rest of this paper is organized as follows. In Section 2, we describe Hsieh and Klenow's (2009) methodology. Section 3 describes the Vietnamese firm-level data used

[7]Similarly, Eslava, Haltiwanger, Kugler, and Kugler (2013) focused on the effects of trade reform. However, their focus is on the exit of establishments, not misallocation itself.

in our study. Section 4 presents our main findings. Section 5 discusses the robustness of our results. Concluding remarks and policy implications are presented in Section 6.

2 Measurement of Misallocation

Hsieh and Klenow (2009) formulated an analytical framework to estimate misallocation. Although some studies such as Bartelsman, Haltiwanger, and Scarpetta (2013) developed an alternative framework, this paper employs Hsieh and Klenow's (2009) framework for the following three reasons. First, their framework is tractable in the sense that it is simple and its data requirement is minimal. This is a significant advantage in estimating misallocation in Vietnam because of the limited data availability, as we will discuss in the next section.

Second, the framework allows us to decompose the source of misallocation into distortions in output markets and in capital markets. Such a decomposition is useful if the distortions come from different sources. Finally, a comparison with other countries is relatively easy because of the numerous related studies (see footnote 4). Hsieh and Klenow's (2009) methodology is summarized below.

Consider an economy with S manufacturing industries. Each industry produces output, Y_s, using M_s differentiated goods produced by individual firm i with a CES technology ($s = 1, ..., S$). Output in industry s is then given by:[8]

$$Y_s = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad \sigma > 1, \tag{1}$$

where σ is the elasticity of substitution between varieties and Y_{si} is the output of the differentiated good produced by firm i in industry s, using capital and labor, based on the following Cobb–Douglas technology:

$$Y_{si} = A_{si} {K_{si}}^{\alpha_s} {L_{si}}^{1-\alpha_s}, \tag{2}$$

[8]We suppress the time subscript to avoid heavy notation although we utilize firm-level panel data in the empirical analysis.

where A_{si}, K_{si}, and L_{si} denote productivity, capital, and labor of firm i in industry s, respectively; α_s represents the capital share, which is different across industries but the same across firms within an industry.

To assess the extent of misallocation, Hsieh and Klenow (2009) follow Foster, Haltiwanger, and Syverson (2008) in making a distinction between physical productivity, denoted by TFPQ, and revenue productivity, denoted by TFPR:

$$TFPQ_{si} \triangleq A_{si} = \frac{Y_{si}}{K_{si}^{\alpha_s} {L_{si}}^{1-\alpha_s}} \tag{3}$$

and

$$TFPR_{si} \triangleq P_{si} A_{si} = \frac{P_{si} Y_{si}}{K_{si}^{\alpha_s} {L_{si}}^{1-\alpha_s}}, \tag{4}$$

respectively, where P_{si} represents the firm-specific output price.

In addition to firm heterogeneity in terms of productivity (as in Melitz (2003)), firms potentially face different output and capital distortions. More specifically, Hsieh and Klenow (2009) incorporated two types of firm-level wedges into this framework. One raises the marginal product of capital and labor by the same proportion, which is denoted by τ_{Ysi}. The other increases the marginal product of capital relative to labor, which is denoted by τ_{Ksi}. These wedges are given from the firm's viewpoint, and we do not make any assumptions about what generates them. With these wedges, the expected profits of the firm are written as:[9]

$$\pi_{si} = (1 - \tau_{Ysi}) P_{si} Y_{si} - w L_{si} - (1 + \tau_{Ksi}) R K_{si}, \tag{5}$$

where w and R denote the common wages and rental price facing all firms, respectively. In the presence of distortions, firms will produce a different quantity compared with what they would produce without these wedges (i.e., efficient case).

Solving the profit maximization problem under a monopolistic competition framework

[9] Distortions to output and to capital relative to labor are an observationally equivalent characterization of those to the absolute levels of capital and labor. For more details, see Hsieh and Klenow (2009, Appendix III).

and the equilibrium allocation of resources across industries, we have:

$$
\begin{aligned}
P_{si} &= \frac{\sigma}{\sigma-1}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}\left(\frac{w}{1-\alpha_s}\right)^{1-\alpha_s} A_{si}^{-1}\frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}, && (6)\\
1-\tau_{Ysi} &= \frac{\sigma}{\sigma-1}\frac{wL_{si}}{(1-\alpha_s)P_{si}Y_{si}}, && (7)\\
1+\tau_{Ksi} &= \frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{RK_{si}}. && (8)
\end{aligned}
$$

From equation (6), we have:

$$
TFPR_{si} = \xi_s \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}, \tag{9}
$$

where

$$
\xi_s = \frac{\sigma}{\sigma-1}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}\left(\frac{w}{1-\alpha_s}\right)^{1-\alpha_s}. \tag{10}
$$

Noting that ξ_s is different across industries but is constant within an industry, equation (10) implies:

$$
TFPR_{si} \propto \frac{(1+\tau_{Ksi})^{\alpha_s}}{1-\tau_{Ysi}}. \tag{11}
$$

This equation means that the large deviation of firm TFPR from ξ is a sign that the firm faces large distortions. Denote industry TFP as TFP_s.

Define industry TFP as a weighted geometric average of firm i's $TFPQ_{si}$:

$$
TFP_s \triangleq \left[\sum_{i=1}^{M_s}\left(TFPQ_{si}\frac{\overline{TFPR}_s}{TFPR_{si}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}, \tag{12}
$$

where $\overline{TFPR}_s$ is the geometric average of the average marginal revenue product of labor and capital in industry s:

$$
\begin{aligned}
\overline{TFPR}_s &\triangleq \frac{\sigma}{\sigma-1}\left[\frac{R}{\alpha_s\sum_{i=1}^{M_s}\frac{1-\tau_{Ysi}}{1+\tau_{Ksi}}\frac{P_{si}Y_{si}}{P_sY_s}}\right]^{\alpha_s}\left[\frac{w}{(1-\alpha_s)\sum_{i=1}^{M_s}(1-\tau_{Ysi})\frac{P_{si}Y_{si}}{P_sY_s}}\right]^{1-\alpha_s} \qquad (13)\\
&= \frac{\sigma}{\sigma-1}\left(\frac{\overline{MRPK}_s}{\alpha_s}\right)^{\alpha_s}\left(\frac{\overline{MRPL}_s}{1-\alpha_s}\right)^{1-\alpha_s},
\end{aligned}
$$

where $MRPK_s$ and $MRPL_s$ are the average marginal revenue products of labor and capital in industry s, respectively. There are two remarks regarding equation (12). First, the higher the dispersion in TFPR, the lower the industry TFP will be. Hsieh and Klenow (2013) showed that when TFPQ and TFPR were jointly log-normally distributed and that when there is only variation in $\log(1-\tau_{Ysi})$, aggregate TFP can be expressed as follows:[10]

$$\log TFP_s = \frac{1}{\sigma-1}\left[\log M_s + \log E\left(TFPQ_{si}^{\sigma-1}\right)\right] - \frac{\sigma}{2}\text{var}\left(\log TFPR_{si}\right). \qquad (14)$$

This equation suggests that industry TFP will decline if the elasticity of substitution σ and/or TFPR dispersion increase.

Second, without any distortions (i.e., $\tau_{Ksi} = \tau_{Ysi} = 0$), TFPR will be equalized across firms within industry s. From equation (10), $TFPR_{si} = \xi_s \ \forall \ i$ if $\tau_{Ksi} = \tau_{Ysi} = 0$. This in turn implies that $TFPR_{si} = \xi_s = \overline{TFPR}_s \ \forall \ i$.[11] Denote industry TFP without any distortions as $\overline{TFPQ}_s$. From equation (12), we can obtain:

$$\overline{TFPQ}_s \triangleq \bar{A}_s = \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}, \qquad (15)$$

which is called "efficient" industry TFP.

Note that in order to obtain "efficient" TFP, one needs information on firm-level TFPQ (i.e., A_{si}). One problem is the limited availability of firm-level price data, P_{si}, which are not available in many countries including Vietnam.[12] Hsieh and Klenow (2009) rewrote equation (3) as:

$$TFPQ_{si} = A_{si} = \kappa_s \frac{(P_{si}Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}}, \quad \text{where} \quad \kappa_s = \frac{(P_s Y_s)^{-\frac{1}{\sigma-1}}}{P_s}. \qquad (16)$$

Noting that κ_s is a scaling constant by industry and does not affect the relative differences

[10] A similar property is obtained even when there is variation in $\log(1-\tau_{Ksi})$, although the equation becomes more complicated. For more details, see Hsieh and Klenow (2013).

[11] Note that even when TFPR is equalized across firms, TFPQ can be different across firms because productive firms charge lower prices (see equation (6)). In other words, if $A_{si} > A_{sj}$ and $P_{si} < P_{sj}$, $P_{si}A_{si}$ could be equal to $P_{sj}A_{sj}$ for $i \neq j$.

[12] There are a few countries in which firm-level (or plant-level) price data are available. For example, Eslava, Haltiwanger, Kugler, and Kugler (2004) utilized plant-level price data for Colombia to estimate plant-level TFPQ.

between firms within industry s, it can be normalized to unity (i.e., $\kappa_s = 1$). This manipulation enables us to estimate TFPQ without firm-level price data. Note that from equations (4) and (16), $TFPQ_{si} > TFPR_{si}$ if $\kappa_s = 1$ and $P_{si}Y_{si} \geq 1$. In Hsieh and Klenow's (2009) framework, therefore, the dispersion of TFPQ tends to be larger than that of TFPR.

3 Data

3.1 Source

This paper utilizes firm-level data from the *Annual Survey on Enterprises* collected by the General Statistics Office of Vietnam (GSO).[13] The survey was conducted in the year 2000 for the first time and annually afterwards, to provide researchers and policy makers with comprehensive information on Vietnamese firms. These data cover registered firms operating in private industries, including agriculture, industry and construction, and services.

The survey covers all state-owned enterprises and foreign-owned firms without any firm size threshold. However, as for domestic private firms, those with fewer than 10 workers are chosen by random sampling.[14] Household business activities are also not covered in this survey.[15] The survey information includes the type of ownership, assets and liabilities, number of employees, sales, capital stock, the industry that the firm belongs to, and obligations to the government (for example, taxes) from January to December of that year.

The data have some disadvantages. Some of the input data, such as materials, are only available for some years. Information on working hours and capital utilization rates is also unavailable. Firms' year of establishment and export status are not available every year.

[13]We use the same data used in Ha and Kiyota (2014). This section is based on Section 3 of Ha and Kiyota (2014). Note also that the use of firm-level data is more consistent with the theory than the use of plant-level data. This is because, as Nishimura, Nakajima, and Kiyota (2005) pointed out, resource allocation within a firm is determined as a result of managerial decisions. Moreover, such information as research and development or headquarter activities are typically classified as service activities, which are not covered in the manufacturing survey.

[14]This threshold was used in surveys before 2010. From 2010, different regions set different firm size thresholds. As a result of changes in the sampling method, it is difficult for us to extend our sample period beyond 2009.

[15]The survey covered 62.2 percent of total employment in manufacturing in 2009. The data on total employment in manufacturing are obtained from the GSO online database on population and employment at `http://www.gso.gov.vn`

This paper utilized firms with information on inputs, outputs, and cost shares. There are some reentry firms that disappeared and reappeared later, which are omitted in our analysis. Some firms changed industry and/or ownership during the sample period.[16] We drop firms with fewer than 10 employees, regardless of their ownership, to avoid the effects of the random sampling.

3.2 Variables and parameters

The main variables that we use are the two-digit Vietnam Standard Industry Classification industry code, ownership type, value-added, employment, total labor costs and capital stock. Following Hsieh and Klenow (2009), we use wage bills instead of working hours to capture the potential differences in employees' quality.[17] Capital stock is total fixed assets recorded at the end of each year. Both wage bill and capital stock are deflated by the manufacturing GDP deflator.[18]

To compute dispersion, we follow other research in setting key parameters σ and R as follows. We assume that the elasticity of substitution σ equals 3 and R is 10 percent, comprising a 5 percent depreciation rate and a 5 percent interest rate. We also follow Hsieh and Klenow (2009) to set α_s to be one minus the labor share in the corresponding industry in the US. Under Hsieh and Klenow's framework, the output elasticities of capital and labor (i.e., α_s and $1 - \alpha_s$) do not embed distortions. Given the assumption that the US economy is less distorted than the Vietnamese economy, the use of the US shares can be justified.

The US labor share is obtained from the NBER-CES Manufacturing Industry Database, which is a joint product of the National Bureau of Economic Research and the US Census Bureau's Center for Economic Studies.[19] Industry classification is based on the North American Industrial Classification System (NAICS) version 1997. Based on the data, we

[16] If a firm has switched industry, the industry to which the firm belonged for the majority of the surveyed years is regarded as that firm's industry. If a firm belonged to more than one industry for equal amounts of time, we assign the industry code of the industry that the firm belonged to most recently.

[17] The use of wage bills as labor input implies that $w = 1$. See Camacho and Conover (2010, p. 10).

[18] As Aw, Chen, and Roberts (2001) pointed out, it is preferable to utilize the investment goods price deflator rather than the manufacturing GDP deflator to obtain real capital stock. However, as Ha and Kiyota (2014) discussed, the investment goods price deflator is not available for our data set.

[19] Data can be downloaded from NBER's website at `http://www.nber.org/nberces/`

first match the NAICS code with the four-digit Vietnam Standard Industrial Classification (VSIC) code using concordance tables between NAICS, ISIC revision 3, and VSIC. We then aggregate total payroll and total value-added by two-digit VSIC sectors. To compute the labor share, we take the ratio of total payroll over total value-added by sector. Because total payroll in the database does not include fringe benefits and employer's contribution to social security, this labor share only reflects two-thirds of the aggregate labor share in the whole manufacturing sector. Therefore, we follow Hsieh and Klenow (2009) to inflate the labor shares by 3/2 to obtain US labor elasticities.

As firms' output price is not available, we have obtained TFPQ by raising nominal output to the power of $\sigma/\sigma - 1$, assuming that demand relationships hold. If a firm's real output is high, one would expect its price to be low so that consumers demand more output. Following Ziebarth (2013), the dispersion of TFP is defined as the deviation of the log of TFP from its industry mean: $\log(TFPR_{si}/\overline{TFPR}_s)$ and $\log(TFPQ_{si} \cdot M_s^{\frac{1}{\sigma-1}}/\overline{TFPQ}_s)$, where $\overline{TFPR}_s$ and $\overline{TFPQ}_s$ are from equations (13) and (15), respectively.[20] We trim 2 percent of firm productivity and distortions by cutting values below the 1st percentile and above the 99th percentile from the distribution of $\log(TFPR_{si}/\overline{TFPR}_s)$ and $\log(TFPQ_{si} \cdot M_s^{\frac{1}{\sigma-1}}/\overline{TFPQ}_s)$. Then we recalculate $\overline{TFPQ}_s$, $\overline{TFPR}_s$, and $\overline{TFP}_s$, respectively. As robustness checks, Section 5 examines whether the results are sensitive to the value of σ, α_s, and the threshold level of trimming.

4 Results

4.1 To what extent are resources misallocated in Vietnam?

To answer this question, we compare the dispersions of TFP in Vietnam with those in India, China, Japan, and the US. The dispersions of TFPR are reported in Table 1 while those of TFPQ are reported in Table 2. Both tables indicate standard deviation, differences between the 90th and 10th percentiles, differences between the 75th and 25th percentiles, and average

[20]Note that some of the effects of the changes in prices are controlled for by taking the ratio.

per capita GDP during the sample period.[21] Data on China, India, and the US are retrieved from Hsieh and Klenow (2009). Data on Japan are retrieved from Hosono and Takizawa (2013).

=== Tables 1 & 2 ===

These tables indicate that the standard deviation of TFPR for Vietnam is 0.79, which is comparable to those for China (0.68) and India (0.68), and is larger than those for Japan (0.55) and the US (0.45). Similar patterns are also confirmed for the differences between the 75th and 25th percentiles and those between the 90th and 10th percentiles.[22] Although more careful examination is needed in a direct comparison, the results suggest that distortions in developing countries, including Vietnam, tend to be large as opposed to those in developed countries.

4.2 How large would the productivity gains be without distortions?

What productivity gains can be expected without distortions? To answer this question, we estimate TFP gains when the marginal products of labor and capital are equalized across firms within each industry. For each industry, the gains are computed as the ratio of actual TFP obtained from equation (12) to the "efficient" TFP obtained from equation (15). We then aggregate the gains across industries using industry value-added shares as the weights.

[21] Noting that both TFPR and TFPQ are divided by their industry means, these statistics can be interpreted as the coefficients of variation.

[22] The difference between the 75th and 25th percentile firms is 0.97, which corresponds to a TFP ratio of $e^{0.97} = 2.63$. Similarly, the difference between the 90th and 10th percentile firms is 2.00, which corresponds to a TFP ratio of $e^{2.00} = 7.39$. These figures are much larger than those of the US. For more details, see Syverson (2011).

In particular, we compute:

$$\frac{Y}{Y^*} \triangleq \prod_{s=1}^{S}\left(\frac{TFP_s}{\overline{TFPQ}_s}\right)^{\theta_s} = \prod_{s=1}^{S}\left\{\frac{1}{\overline{TFPQ}_s}\left[\sum_{i=1}^{M_s}\left(TFPQ_{si}\frac{\overline{TFPR}_s}{TFPR_{si}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}\right\}^{\theta_s}$$
$$= \prod_{s=1}^{S}\left[\sum_{i=1}^{M_s}\left(\frac{A_{si}\overline{TFPR}_s}{\bar{A}_s TFPR_{si}}\right)^{\sigma-1}\right]^{\frac{\theta_s}{\sigma-1}}, \qquad (17)$$

where Y^* is an "efficient" output, which corresponds to "efficient" TFP; θ_s is the value-added share of industry s: $\sum_s \theta_s = 1$. As the total amount of inputs is fixed, the output gains come solely from the reallocation of resources in the absence of distortions.

Table 3 represents the TFP gains from equalizing TFPR across firms within each industry. The gains are measured relative to the TFP gains in the US in 1997.[23] To report the percentage TFP gains in Vietnam relative to those in the US, we take the ratio of Y^*/Y to the US equivalent in 1997, subtract 1, and multiply by 100. If Vietnam hypothetically moves to "US efficiency," substantial gains are expected: 30.7 percent. The gains are smaller than those for China (39.2 percent) and India (46.9 percent) but larger than those for Japan (3.0 percent).[24] Although this is a hypothetical exercise and thus should not be taken literally, the results suggest that substantial productivity gains are expected in Vietnam by the kind of reallocation considered here.

=== Table 3 ===

4.3 Did misallocation decline after entry to the WTO?

If trade liberalization contributes to decrease misallocation, the dispersion in TFPR will decline after entry to the WTO. To examine the changes in the dispersion in TFPR, Table 4 reports standard deviations, differences between the 90th and 10th percentiles, and dif-

[23] Hsieh and Klenow (2009) called this comparison a conservative analysis because the US gains are largest in 1997.

[24] One may be concerned that the dispersion of TFPR is larger (Table 1), whereas the gains are smaller (Table 3) in Vietnam than in China and India. This is because Y/Y^* reflects not only $\overline{TFPR}_s/TFPR_{si}$, but also $A_{si}/\bar{A}_s$. The result thus suggests that physical productivity is lower in Vietnam than in China and India.

ferences between the 75th and 25th percentiles of TFPR in Vietnam, by year.[25] For more details about the sample selection, see Ha and Kiyota (2014). Based on the fact that Vietnam joined the WTO in 2007, we expect that the dispersion of TFPR declined from 2007.

=== Table 4 ===

Contrary to expectations, the dispersion of TFPR does not show any systematic patterns before or after entry to the WTO. The arithmetic average of the standard deviations is 0.78 for 2000–06, which is slightly smaller than the average standard deviation for 2007–09 (0.79). If the dispersion is measured by the differences between the 90th and 10th percentiles, the dispersion is larger for 2007–09 than for 2000–06.

As mentioned above, a simple comparison before and after entry to the WTO may not be able to reveal the effects of trade liberalization correctly because misallocation can be affected by various factors. Besides, unobserved industry heterogeneity may also affect the results. To control for the effects of other factors on the dispersion of TFPR, following Guadalupe and Wulf (2010), we run the following regression:

$$\begin{aligned} \mathrm{sd}(\log(TFPR_{si}/\overline{TFPR}_s)) &= \gamma \text{Average tariff rate}_s \times \mathrm{WTO}_t \\ &\quad + \lambda \text{Average liquidity ratio}_s \times \text{Financial Crisis}_t \\ &\quad + \mathbf{X}'_{st}\beta + d_t + \eta_s + \eta_s \times t + \varepsilon_{st}, \end{aligned} \tag{18}$$

where $\mathrm{sd}(TFPR_i)_{st}$ is the dispersion of $TFPR_i$ in industry s in year t; Average tariff rate$_s$ is an average most-favored-nation (MFN) tariff rate in industry s before 2007;[26] WTO$_t$ is a dummy variable that equals 1 if $t \geq 2007$ and 0 otherwise; Average liquidity ratio$_s$ is the industry average of the ratio of short-term assets to total assets before 2008;[27] Financial Crisis$_t$

[25] One may be concerned that the number of firms changed dramatically in some years. Although the number of firms in the *Annual Survey on Enterprises* increased dramatically, a part of this change is attributable to our sample selection, because we use firms for which information on inputs, outputs, and cost shares is available. Section 5 examines the robustness of our results, using balanced panel data.

[26] Note that the MFN tariff is what countries commit to impose on imports from other WTO members. Therefore, the MFN tariff rate is used so that we can disentangle the impact of the WTO accession from that of other free trade agreements coming into effect during the 2000s.

[27] Short-term assets include cash, cash-equivalents, short-term financial investment, receivables, inventories, and other short-term assets. Liquidity could be used to measure the ease with which firms respond to financial

is a dummy variable that equals 1 if $t \geq 2008$ and 0 otherwise; $\mathbf{X}_{st}$ includes control variables; d_t is the year dummy, η_s is the unobserved industry fixed effect; $\eta_s \times t$ is the industry-specific time trend; and ε_{st} is an error term.

The coefficient of interest, γ, captures the differential effect of the liberalization on firms according to their trade exposure prior to 2007. As was pointed out by Guadalupe and Wulf (2010), this is a standard differences-in-differences specification that exploits trade liberalization in which Average tariff rate$_s$ (the "treatment") is continuous. If the accession to the WTO has contributed to the decline in misallocation, γ will be significantly negative.

Our data cover not only the year 2007 when Vietnam joined the WTO, but also the years 2008–09 when the global financial crisis hit the Vietnamese economy. One may thus be concerned about the effect of credit market constraints associated with the financial crisis (e.g., Restuccia and Rogerson, 2013). To control for such an effect, we include the interaction term between the average liquidity ratio (prior to 2008) and the financial crisis dummy. The coefficient λ captures the differential effect of the global financial crisis on firms according to their liquidity constraint prior to the financial crisis. If misallocation expands among liquidity constrained firms after the global financial crisis, λ will be significantly negative.

The dispersion of TFPR is measured by the standard deviation, as in Tables 1 and 4. The annual average MFN tariff rate is available at the industry level and obtained from the *World Integrated Trade Solution* (WITS) developed by the World Bank.[28] As for the control variables, we use the number of workers (log value) in the industry, the Herfindahl–Hirschman Index (HHI), the value-added share of state-owned enterprises, and the US bilateral tariff rates on Vietnamese imports.

The number of workers is used to control for industry size because the dispersion of TFPR could be larger in industries with a larger number of firms (and thus a larger number of employees). HHI is included to control for market structure. More concentrated mar-

shocks. Firms with greater liquidity are more likely to be able to accommodate exogenous financial shocks and thus are more resilient to financial crises (e.g., Campello, Graham, and Harvey, 2010). The measurement of financial constraints is an important issue (e.g., Hadlock and Pierce, 2010) but it is difficult for us to employ alternative measures because of limited data availability.

[28]Changes in average MFN tariff rates are presented in Table A1.

kets are more likely to be distorted because of the stronger market power of firms. The value-added share of state-owned enterprises captures the possible effect of state ownership on distortions.[29] The number of workers, HHI, and the share of state-owned enterprises are computed from the sample.[30] The US bilateral tariff rates on Vietnamese imports are included to control for the possible effects of the US–Vietnam bilateral trade agreement (BTA). The annual average bilateral tariff rate is available at the industry level and obtained from the WITS developed by the World Bank.

A few points of caution related to the regression equation should be made here. The first relates to the WTO dummy. While Vietnam established regional as well as bilateral free trade agreements throughout the sample period, we observe a substantial reduction in tariffs following 2007 when Vietnam gained WTO membership. Therefore, we use this year as a benchmark.[31] Second, tariff rates themselves could be determined endogenously. For example, the declining industries may have high tariff levels. Trefler (2004) addressed this concern by controlling for industry-specific trends. Therefore, the potential endogeneity biases can be absorbed by the industry secular trends $\eta_s \times t$. Third, Average tariff rate$_s$ and Average liquidity ratio$_s$ are not included because of the perfect collinearity with industry fixed effect η_s. Finally, we estimate in levels rather than first differences because the data cover a relatively short period.

Table 5 presents the regression results.[32] Four findings stand out from this table. First, the coefficient of Average tariff rate$_s$ $\times$ WTO$_t$ is insignificant in almost all specifications. Second, similarly, Average liquidity ratio$_s$ $\times$ Financial Crisis$_t$ is insignificant in almost all

[29]A state-owned enterprise (SOE) is defined as an enterprise for which state capital accounts for more than 50 percent of the charter capital.

[30]In the GSO's *Annual Enterprise Survey* from 2002, there are five types of SOEs: 1) Central SOE, 2) Local SOE, 3) Central SOE Limited Company, 4) Local SOE Limited Company, and 5) Joint Stock Company (JSC) with state capital of more than 50 percent. The categorization of SOEs is consistent between 2002 and 2009. Before 2002, there was no distinction between JSCs with state capital of no more than 50 percent and JSCs with state capital of more than 50 percent. Therefore, we omit years 2000 and 2001 from our regression when we include the value-added shares of SOEs.

[31]Previous studies such as Rose (2004) introduced a WTO dummy that equals 1 at the year of accession, and 0 otherwise. One may be concerned that Vietnamese firms anticipated the WTO accession and, therefore, the change might appear before 2007. To address this concern, we will conduct a placebo test.

[32]The fixed-effect model is chosen because the Hausman specification test rejects the null hypothesis that the random effect is orthogonal to the independent variables.

specifications. These results together imply that neither entry into the WTO nor the global financial crisis had significant effects on the dispersion of TFPR.

=== Table 5 ===

Third, state ownership, size of the industry, market structure, and the US tariff have no effects on the dispersion of TFPR, as none of the coefficients of these variables is significant. It may be surprising that US tariff rates had significant effects on misallocation. Indeed, the result seems to be inconsistent with that of McCaig and Pavcnik (2014) who found significant effects of the US–Vietnam BTA on labor allocation. Note, however, that McCaig and Pavcnik (2014) mainly found labor reallocation from informal household businesses to the formal enterprises. Because our data do not cover household business activities and firms with fewer than 10 workers, the difference in the results may be attributable to the differences in the coverage of the data.

Finally, trade liberalization does not seem to be anticipated. We replace the WTO dummy in Average tariff $\text{rate}_s \times \text{WTO}_t$ with WTO_{t-1} (equals 1 from 2006 onwards), keeping the same set of controls (which is a standard placebo test for differences-in-differences). On the one hand, if the liberalization was anticipated, this new variable would capture a discrete shock before it occurred. On the other hand, if it is zero, it provides support to the maintained hypothesis that the shock was unanticipated. The result shows that the coefficient is insignificant. The result suggests that the effect of anticipation is negligibly small for many of the Vietnamese firms. In other words, the Vietnamese firms only started to respond after 2007.

It is then natural to ask why the dispersion of TFPR did not decline after trade liberalization. The next section will address this issue in more detail.

4.4 Does trade liberalization affect both output and capital wedges?

To examine further the effect of the WTO accession on distortions, we investigate the effects of trade liberalization on output and capital wedges separately. As equation (11) indicates, TFPR depends on both output and capital wedges. A concern may be that trade liberalization affects only one of the wedges. Because trade liberalization directly affects output (and input) prices, its effect is likely to appear in a decline in output wedges rather than a decline in capital wedges.[33] To address this concern, we first decompose the distortions in output and capital markets and examine how they change over the period.

Table 6 presents the mean, median, and standard deviation of $1 - \tau_{Ysi}$ and $(1 + \tau_{Ksi})^{\alpha_s}$ in equations (7) and (8). Two messages are evident from this table. First, both the mean and median of $1 - \tau_{Ysi}$ experience significant declines beginning in 2007. The standard deviation also decreased from 2.47 to 1.74 in 2007. Second, both the mean and median of $(1 + \tau_{Ksi})^{\alpha_s}$ increased steadily from 2000 to 2009. Moreover, its standard deviation increased dramatically from 2008. This result suggests that more firms faced distortions in capital markets after the global financial crisis. The results seem to suggest that trade liberalization affects the distortions in output markets even during the global financial crisis, although the increases in the distortions in capital markets offset the positive effect of trade liberalization.[34]

=== Table 6 ===

One may then ask whether the wedges themselves (i.e., τ_{Ysi} and τ_{Ksi}) declined after the trade liberalization. To see the relationship between trade liberalization and two wedges while controlling for firm heterogeneity, similar to equation (18), we run the following regression:

$$\begin{aligned} |\tau_{j,ist}| &= \gamma \text{Average tariff rate}_s \times \text{WTO}_t + \lambda \text{Average liquidity ratio}_i \times \text{Financial Crisis}_t \\ &\quad + \mathbf{X}'_{ist}\beta + d_t + \varphi_i + \eta_s \times t + \varepsilon_{ist}, \end{aligned} \tag{19}$$

where $|\tau_{j,ist}|$ is the absolute value of the output wedges ($j = Y$) and capital wedges ($j = K$) for firm i in industry s in year t; Average tariff rate$_s$ is the average MFN tariff rate in

[33]Note that output is measured by value added (i.e., net output). The output wedges in this paper reflect the distortions in both output and intermediate input markets.

[34]One may be concerned that there is a large gap between the mean and median of the capital wedges. This may reflect measurement error of the capital stock. We discuss this issue in Section 5.

industry s before 2007; WTO_t is a dummy variable that equals 1 if $t \geq 2007$ and 0 otherwise; Average liquidity ratio_s is the industry average of the ratio of short-term assets to total assets before 2008; Financial Crisis_t is a dummy variable that equals 1 if $t \geq 2008$ and 0 otherwise; $\mathbf{X}_{ist}$ includes control variables; φ_i is a firm fixed effect; $\eta_s \times t$ is the industry-specific time trend; and ε_{it} is an error term.

We focus on $|\tau_Y|$ and $|\tau_K|$ rather than $1 - \tau_Y$ and $1 - \tau_K$ because theoretically both τ_Y and τ_K could take positive and negative values. We expect a significantly negative γ if the accession to the WTO contributes to the decline in the output and capital wedges. Similarly, we expect a significantly negative λ if the output and capital wedges increase among liquidity constrained firms after the global financial crisis. As for the control variables, we utilize the number of workers (log value) to control for firm size, and HHI to control for market structure, as in the previous section.[35]

The left panel of Table 7 presents the estimation results for the output wedges. Standard errors are clustered by firm. Four findings are evident from the results. First, the coefficient of Average tariff $\text{rate}_s \times \text{WTO}_t$ indicates significantly negative coefficients in all specifications. This result suggests that trade liberalization through the WTO contributed to declines in the output wedges. Second, the coefficient of Average liquidity $\text{ratio}_i \times$ Financial Crisis_t is insignificant once we control for the year fixed effect. This result implies that the global financial crisis does not have significant effects on the output wedges.

=== Table 7 ===

Third, the coefficients of firm size are significantly negative, implying that the smaller firms face larger distortions in the output market. Finally, the coefficient of Average tariff $\text{rate}_s \times \text{WTO}_{t-1}$ has an insignificant coefficient. The results suggest that the liberalization was an unanticipated shock for many of the firms.

The right panel of Table 7 presents the estimation results for the capital wedges. There are four major findings. First, Average tariff $\text{rate}_s \times \text{WTO}_t$ has an insignificant coefficient once

[35] Most of the firms did not change ownership status throughout the period. Therefore, the (time-invariant) effect of state ownership is absorbed by the firm fixed effect φ_i.

we control for the year fixed effect. This result implies that trade liberalization does not affect the capital wedges. Second, the coefficients of Average liquidity $\text{ratio}_i \times \text{Financial Crisis}_t$ are significantly negative in all specifications. These results suggest that liquidity constrained firms were more likely to face higher capital wedges during the global financial crisis period.

Third, the coefficients of firm size are significantly positive, implying that the larger firms faced larger distortions in capital markets. This result implies that large firms are treated differently from small firms in capital markets. Finally, the coefficient of Average tariff $\text{rate}_s \times \text{WTO}_{t-1}$ has an insignificant coefficient, suggesting that many firms did not anticipate the liberalization and thus can be treated as experiencing a "shock."

These results together suggest that the positive effect of trade liberalization was offset by the negative effect of the global financial crisis. A recent study by Midrigan and Xu (2014) found that the financial frictions generate dispersions in the returns to capital across existing firms, which results in productivity losses from misallocation.[36] Our results are consistent with their finding. Another possible source of distortion is zombie lending and/or subsidies: bank lending or government subsidies might allow many unprofitable firms to continue operating rather than exit. For example, during the banking crisis around 1997 in Japan, less productive firms were more likely to survive because of zombie lending.[37] Ha and Kiyota (2014) found a relatively strong negative net entry effect for 2008–09 in Vietnam, which seems to support this possibility.

In sum, the results suggest that tariff reduction after the accession to the WTO contributed to the decline in the output wedges. However, the increases in the capital wedges, which are possibly attributable to the global financial crisis, offset the positive effects of trade liberalization. As a result, overall misallocation did not decrease after the WTO accession. These results imply that trade liberalization is not a panacea. Further reforms in capital markets could improve aggregate TFP in Vietnam through a reduction in misallocation.

[36]Similarly, Abiad, Oomes, and Ueda (2008) found that financial liberalization was associated with improved allocative efficiency in India, Jordan, Korea, Malaysia, and Thailand.

[37]For more details about zombie lending, see Caballero, Hoshi, and Kashyap (2008).

5 Robustness Check

5.1 Different parameter values

One may be concerned that our analysis is sensitive to the choice of parameter values because our results are based on specific parameter values such as $\sigma = 3$. To address this concern, we reconduct all the analyses, setting different parameter values. Because it is tedious to examine all the results, this section examines 1) how sensitive the estimated TFPR and TFP gains (reported in Section 4.2 and in Table 3) are to the choice of parameter values, and 2) the correlation between alternative and baseline TFPR.

We first examine whether the results are sensitive to the value of the elasticity of substitution: σ. In the baseline analysis, following Hsieh and Klenow (2009), we set $\sigma = 3$. This implies that the markup is 1.5 ($= 3/(3-1)$). As a robustness check, we set $\sigma = 2$ and $\sigma = 6$, and the corresponding markups are 2 ($= 2/(2-1)$) and 1.2 ($= 6/(6-1)$), respectively. The second and third columns in Table 8 present the results. The TFP gains are somewhat sensitive to the value of the elasticity of substitution. The TFP gains are 15.6 percent when $\sigma = 2$ and 83.3 percent when $\sigma = 6$.[38] Nevertheless, the estimated TFPR is qualitatively similar to the baseline results. Table 8 also reports the correlation with baseline TFPR. The correlation with baseline TFPR is 0.997 when $\sigma = 2$ and 0.994 when $\sigma = 6$. These high correlations suggest that the results are quantitatively different from, but qualitatively similar to, the baseline results.[39]

=== Table 8 ===

We also examine how sensitive the results are to the value of the technology parameter (i.e., capital share α_s). We examine two different technologies. One is $\alpha_s = 1/3$ as in Ziebarth (2013) and the other is the Vietnamese cost share, which is defined as the industry-year average capital share of the sample firms. The results are presented in the fourth and

[38]This result is consistent with equation (14), which implies that the TFP gains will be large if the elasticity of substitution is large.

[39]It may also be important to allow the elasticities to vary across industries. Although Broda, Greenfield, and Weinstein (2006) estimated the elasticity of substitution for various countries, Vietnam is not covered in their analysis. We thus leave this exercise for future research.

fifth columns in Table 8. The TFP gains are 19.1 percent when $\alpha_s = 1/3$ and 69.2 percent when we assume Vietnamese technology. The correlation with the baseline TFPR is 0.927 when $\alpha_s = 1/3$ and 0.933 when we assume Vietnamese technology. Similar to the value of the elasticity of substitution, the results are quantitatively different from, but qualitatively similar to, the baseline results.

One may also be concerned that the technology parameter α_s is heterogeneous across firms even within industries. To address this concern, we use the firm-level capital share so that the capital share can vary across firms.[40] The results are presented in the sixth column in Table 8, which are similar to the baseline results, both quantitatively and qualitatively. The TFP gains are 29.6 percent. The correlation with the baseline TFPR is 0.923. These results together suggest that our results are not sensitive to the value of the technology parameter.

5.2 Measurement error

Another concern may be that the data are not precise and thus Vietnamese firm-level data are subject to measurement error problems. Although we cannot rule out arbitrary measurement error, we can try to gauge whether our results are attributable to some specific forms of measurement error. We focus on two forms of measurement error. First, serious measurement error, possibly because of reporting error, tends to appear as outliers. We trimmed 2 percent from the tails (below the 2nd percentile and above the 98th percentile), instead of 1 percent as in the baseline analysis, and examined how sensitive the results are to the trim values. The seventh column in Table 8 reports the results. The TFP gains are 22.9 percent. The correlation with the baseline TFPR remains high at 0.997.

Second, the measurement error could also affect firm "exit." Reporting error could cause missing values, which is regarded as "exit" in the sample. Even efficient firms could exit because of such reporting errors. If such a form of measurement error is serious in the

[40] Note that ξ_s can vary across firms if the capital share is different across firms (see equation (10)). Therefore, TFPR will not necessarily be proportional to the capital and output wedges. We thus present the results for reference only.

Vietnamese data, the coefficient from a regression of plant exit on TFPR will be biased downward.

To address this issue, we run a regression of the dummy exit on TFPR and TFPQ. The results are presented in Table 9. There are two major findings in this table. First, TFPR has a significantly negative correlation with exit status. A one-log-point decrease in TFPR results in a 1.2 percent higher probability of exit. This figure is comparable to the case of China and the US (1.1 percent) and smaller than that of India (1.9 percent) in Hsieh and Klenow (2009, Table 8). If the probability of exit is the same across countries, the result suggests that the effect of the measurement error is not serious in Vietnam.[41]

=== Table 9 ===

Second, the correlation between TFPQ and firm exit is also significantly negative. In particular, a one-log-point decrease in TFPQ results in a 3.8 percent probability of exit. This figure is comparable to that for the US (3.9 percent) but smaller than that for China (5.0 percent). If the relationship between TFPQ and firm exit is the same across countries, the results imply that measurement error for Vietnam is comparable to that for the US. In sum, our results do not seem to be affected substantially by various forms of measurement error.[42]

6 Concluding Remarks

This paper employs the Hsieh and Klenow (2009) framework to investigate misallocation and productivity linkage in Vietnamese manufacturing during the 2000–09 period using firm-level data. Our major findings are threefold. First, misallocation in Vietnam is comparable to that in China and India. This result is consistent with the common knowledge that resources

[41]Note that the analysis covers not only the global financial crisis period but also other periods. The results thus do not necessarily rule out the possibility of zombie lending and/or subsidies.

[42]We also estimate the TFP gains for firms that survive throughout the sample period (i.e., balanced panel). This exercise reduces the sample size substantially (N = 15,977). The estimated TFP gains are 19.9 percent, and the correlation with baseline TFP is 0.965. We can conclude that the results from the balanced panel are similar qualitatively to the baseline results.

in developing countries are not efficiently allocated. Second, there would be substantial improvement in TFP if no distortions existed. If Vietnam hypothetically moved to "US efficiency," its TFP would be boosted by 30.7 percent. Finally, the accession to the WTO contributed to reducing the distortions in output markets. However, this positive effect was offset by increasing distortions in capital markets, which are possibly attributable to the global financial crisis. These results together suggest that further reforms in capital markets could improve aggregate TFP in Vietnam through reduced misallocation.

In conclusion, there are several research issues for the future that are worth mentioning. First, although our study is based on Hsieh and Klenow's framework, their framework itself relies upon a number of restrictive assumptions such as CES/Cobb–Douglas functional forms.[43] It is thus important to extend the analysis to a more general framework, while minimizing the data requirements. Second, our sample period may not be long enough to examine the effects of trade policy because the effects could appear over a longer time span. As a result of the changes in the sample selection of the firm-level data in Vietnam, it is difficult for us to extend the period of our analysis. However, our approach is applicable to other countries. An extension of our analysis to other countries, therefore, is an important avenue for future research. Some of these issues will be investigated in the next stage of our research.

References

Abiad, Abdul, Nienke Oomes, and Kenichi Ueda (2008) "The Quality Effect: Does Financial Liberalization Improve the Allocation of Capital?" *Journal of Development Economics*, 87(2): 270–282.

Aw, Bee Yan, Xiaomin Chen, and Mark J. Roberts (2001) "Firm-level Evidence on Productivity Differentials and Turnover in Taiwanese Manufacturing," *Journal of Development Economics*, 66(1): 51–86.

[43]For example, a recent study by Dhingra and Morrow (2014) showed that demand side elasticities determined how resources are misallocated.

Bach, Thang (2014) "Misallocation and Growth in An Entry Liberalization Period," paper presented at the Royal Economic Society, January 2014.

Bartelsman, Eric, John Haltiwanger, and Stefano Scarpetta (2013) "Cross-Country Differences in Productivity: The Role of Allocation and Selection," *American Economic Review*, 103(1): 305–334.

Bellone, Flora and Jeremy Mallen-Pisano (2013) "Is Misallocation Higher in France than in the United States?" manuscript, University of Nice-Sophia-Antipolis.

Broda, Christian, Joshua Greenfield, and David Weinstein (2006) "From Groundnuts to Globalization: A Structural Estimate of Trade and Growth," NBER Working Paper, No.12512.

Busso, Matias, Lucia Madrigal, and Carmen Pages-Serra (2012) "Productivity and Resource Misallocation in Latin America," *The B.E. Journal of Macroeconomics*, 13(1): 903–932.

Caballero, Ricardo J., Takeo Hoshi, and Anil K. Kashyap (2008) "Zombie Lending and Depressed Restructuring in Japan," *American Economic Review*, 98(5): 1943–1977.

Camacho, Adriana and Emily Conover (2010) "Misallocation and Productivity in Colombia's Manufacturing," IDB Working Paper Series, 6783, Inter-American Development Bank.

Campello, Murillo, John R. Graham, and Campbell R. Harvey (2010) "The Real Effects of Financial Constraints: Evidence from A Financial Crisis," *Journal of Financial Economics*, 97(3): 470–487.

de Vries, Gaaitzen J. (2014) "Productivity in A Distorted Market: The Case of Brazil's Retail Sector," *Review of Income and Wealth*, 60(3): 499–524.

Dhingra, Swati and John Morrow (2014) "Monopolistic Competition and Optimum Product Diversity Under Firm Heterogeneity," manuscript, London School of Economics.

Eslava, Marcela, John Haltiwanger, Adriana Kugler, and Maurice Kugler (2004) "The Effects of Structural Reforms on Productivity and Profitability Enhancing Reallocation:

Evidence from Colombia," *Journal of Development Economics*, 75(2): 333–371.

Eslava, Marcela, John Haltiwanger, Adriana Kugler, and Maurice Kugler (2013) "Trade, Technical Change and Market Selection: Evidence from Manufacturing Plants in Colombia," *Review of Economic Dynamics*, 16(1): 135–158.

Epifani, Paolo and Gino Gancia (2011) "Trade, Markup Heterogeneity and Misallocations," *Journal of International Economics*, 83(1): 1–13.

Foster, Lucia, John Haltiwanger, and Chad Syverson (2008) "Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability?" *American Economic Review*, 98(1): 394–425.

Guadalupe, Maria and Julie Wulf (2010) "The Flattering Firm and Product Market Competition: The Effect of Trade Liberalization on Corporate Hierarchies," *American Economic Journal: Applied Economics*, 2(4): 105–127.

Ha, Doan Thi Thanh and Kozo Kiyota (2014) "Firm-level Evidence on Productivity Differentials and Turnover in Vietnamese Manufacturing," *Japanese Economic Review*, 65(2): 193–217.

Hadlock, Charles J. and Joshua R. Pierce (2010) "New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index," *Review of Financial Studies*, 23(5): 1909–1940.

Hosono, Kaoru and Miho Takizawa (2013) "Misallocation and the Dynamics of Establishment," *Financial Review*, 1(112): 180–209. (In Japanese)

Hsieh, Chan-Tai and Peter J. Klenow (2009) "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 124(4): 1403–1448.

Hsieh, Chan-Tai and Peter J. Klenow (2013) "Misallocation and Manufacturing TFP in China and India: Correction Appendix," manuscript, Stanford University.

Lileeva, Alla and Daniel Trefler (2010) "Improved Access to Foreign Markets Raises Plant-level Productivity...For Some Plants," *Quarterly Journal of Economics*, 125(3): 1051–1099.

McCaig, Brian and Nina Pavcnik (2014) "Export Markets and Labor Allocation in A Low-income Country," NBER Working Paper, No. 20455.

McMillan, Margaret and Dani Rodrik (2011) "Globalization, Structural Change and Productivity Growth," in Marc Bacchetta and Marion Jansen (eds.), *Making Globalization Socially Sustainable*, Geneva, Switzerland: World Trade Organization and International Labour Office.

Melitz, Marc J. (2003) "The Impact of Intraindustry Trade Reallocations and Aggregate Industry Productivity," *Econometrica*, 71(6): 1695–1725.

Melitz, Marc J. and Stephen J. Redding (2015) "New Trade Models, New Welfare Implications," *American Economic Review*, 105(3): 1105–1146.

Midrigan, Virgiliu and Daniel Yi Xu (2014) "Finance and Misallocation: Evidence from Plant-Level Data," *American Economic Review*, 104(2): 422–458.

Nishimura, Kiyohiko G., Takanobu Nakajima, and Kozo Kiyota (2005) "Does the Natural Selection Mechanism Still Work in Severe Recessions? – Examination of the Japanese Economy in the 1990s," *Journal of Economic Behavior and Organization*, 58(1): 53–78.

Pavcnik, Nina (2002) "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants," *Review of Economic Studies*, 69(1): 245–276.

Restuccia, Diego and Richard Rogerson (2008) "Policy Distortions and Aggregate Productivity with Heterogeneous Plants," *Review of Economic Dynamics*, 11(4): 707–720.

Restuccia, Diego and Richard Rogerson (2013) "Misallocation and Productivity," *Review of Economic Dynamics*, 16(1): 1–10.

Rose, Andrew K. (2004) "Do We Really Know That the WTO Increases Trade?" *American Economic Review*, 94(1): 98–114.

Syverson, Chad (2011) "What Determines Productivity?" *Journal of Economic Literature*, 49(2): 326–365.

Trefler, Daniel (2004) "The Long and Short of the Canada–U.S. Free Trade Agreement," *American Economic Review*, 94(4): 870–895.

Waugh, Michael E. (2010) "International Trade and Income Differences," *American Economic Review*, 100(5): 2093–2124.

World Bank (2014) *World Development Indicators*, On-line, Washington, D.C.: World Bank.

Ziebarth, Nicolas L. (2013) "Are China and India Backward? Evidence from the 19th Century U.S Census of Manufactures," *Review of Economic Dynamics*, 16(1): 86–99.

Table 1. Dispersion of TFPR in China, India, Japan, the United States, and Vietnam

	Vietnam	China	India	Japan	United States
	2000-2009	1998-2005	1987-1994	1981-2008	1977-1997
S.D.	0.79	0.68	0.68	0.55	0.45
75-25	0.97	0.89	0.80	0.70	0.47
90-10	2.00	1.72	1.66	1.40	1.08
GDP per capita (constant 2005 US$)	685	1,299	400	31,108	30,501

Note: The numbers for China, India, and the United States are arithmetic averages of Hsieh and Klenow (2009, Table 2). The numbers for Japan are obtained from Hosono and Takizawa (2013). TFPR is the log value, scaled by industry TFPR. Industries are weighted by value-added shares. For more detail, see main text. GDP per capita is annual average over each sample period.

Source: Author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam. Per-capita GDP is obtained from World Bank (2014).

Table 2. Dispersion of TFPQ in China, India, Japan, the United States, and Vietnam

	Vietnam	China	India	Japan	United States
	2000-2009	1998-2005	1987-1994	1981-2008	1977-1997
S.D.	1.42	1.00	1.19	0.98	0.83
75-25	2.01	1.34	1.56	1.27	1.16
90-10	3.70	2.57	3.03	2.48	2.15

Note: The numbers for China, India, and the United States are arithmetic averages of Hsieh and Klenow (2009, Table 1). The numbers for Japan are obtained from Hosono and Takizawa (2013, Table 1). TFPQ is the log value, scaled by industry TFPR. Industries are weighted by value-added shares. For more detail, see main text.

Sources: Hsieh and Klenow (2009, Table 1) and author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 3. TFP Gains from Equalizing TFPR Relative to 1997 U.S. Gains

	Vietnam	China	India	Japan
	2000-2009	1998-2005	1987-1994	1981-2008
%	30.7	39.3	46.9	3.0

Note: The numbers for China, India and the United States are arithmetic averages of Hsieh and Klenow (2009, Table 6). The numbers for Japan are from Hosono and Takizawa (2013, Table 2).

Sources: Hsieh and Klenow (2009, Table 6) and author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 4. Dispersion of TFPR in Vietnam, by Year

Year	N	S.D.	p10	p25	p75	p90	75-25	90-10
2000	5,484	0.71	-0.88	-0.41	0.43	0.86	0.85	1.74
2001	5,398	0.75	-1.06	-0.55	0.39	0.81	0.94	1.86
2002	6,550	0.77	-0.99	-0.49	0.42	0.88	0.92	1.88
2003	7,346	0.79	-1.03	-0.50	0.46	0.94	0.97	1.97
2004	8,248	0.82	-1.08	-0.52	0.49	1.01	1.01	2.09
2005	12,360	0.83	-1.17	-0.63	0.42	0.92	1.05	2.10
2006	10,507	0.83	-1.07	-0.48	0.54	1.03	1.02	2.10
2007	13,098	0.84	-1.13	-0.54	0.50	1.02	1.03	2.14
2008	16,556	0.71	-0.89	-0.45	0.40	0.87	0.85	1.76
2009	15,054	0.82	-1.08	-0.49	0.50	1.03	1.00	2.11
Total	100,601	0.79	-1.05	-0.51	0.46	0.95	0.97	2.00

Note: Statistics are for the deviation of log(TFPR) from industry means. N is the number of firms. S.D. is standard deviation. 75-25 is the difference between 75th and 25th percentiles, and 90-10 the 90th vs. 10th percentiles. Industries are weighted by value-added shares.

Source: Author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 5. Dispersion of TFPR and the Accession to the WTO

Dependent variable: Standard deviation of TFPR, by industry					
	(1)	(2)	(3)	(4)	(5)
Average tariff rate * WTO dummy	0.001	-0.000	-0.003	-0.004**	
	(0.001)	(0.001)	(0.002)	(0.002)	
Average liquidity ratio	-0.032	0.291*	0.024	-0.043	-0.038
* Financial crisis dummy	(0.027)	(0.163)	(0.165)	(0.136)	(0.147)
Average tariff rate * WTO(-1) dummy					0.002
(placebo)					(0.002)
US bilateral tariff on Vietnamese imports				0.002	-0.000
				(0.001)	(0.002)
ln(Employment)				-0.069	-0.074
				(0.074)	(0.075)
Herfindahl-Hirschman Index (HHI)				0.493	0.564
				(0.403)	(0.426)
Share of state-owned enterprises				0.140	0.121
				(0.144)	(0.138)
N	198	198	198	168	168
R-squared	0.011	0.101	0.429	0.486	0.456
Industry-fixed effect	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	No	Yes	Yes	Yes	Yes
Industry-specific time trend	No	No	Yes	Yes	Yes

Note: Robust standard errors are in parentheses. ***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively. WTO dummy equal one from 2007 onward while WTO(-1) dummy equal one from 2006 onward (placebo test). Due to the availability of the information on state ownership, columns (4)-(5) cover the period for 2002-09 while other columns (1)-(3) covers the period for 2001-09 due to the availability of the information on state ownership. Constant is included (but not reported to save space).

Source: Author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 6. Distortions in Output and Capital Markets, by Year

	Distortions in output market			Distortions in capital market		
Year	Mean	Median	S.D.	Mean	Median	S.D.
2000	1.97	1.74	1.71	2.55	1.71	4.92
2001	2.01	1.73	2.02	2.74	1.68	7.86
2002	2.15	1.87	2.27	2.90	1.84	5.13
2003	2.14	1.90	1.75	3.19	1.95	5.79
2004	2.26	1.90	2.59	3.60	2.12	6.78
2005	2.25	1.89	2.34	3.88	2.17	9.16
2006	2.18	1.83	2.47	4.09	2.29	8.55
2007	2.02	1.77	1.74	4.21	2.35	8.45
2008	1.75	1.53	1.53	3.82	2.04	13.16
2009	1.74	1.46	1.90	3.58	1.92	20.54
Average	2.01	1.69	2.04	3.62	2.04	11.47

Note: Distortions in output and capital markets are computed, based on equations (7) and (8) in the main text, respectively. For more detail, see main text.

Source: Author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 7. Output Wedges, Capital Wedges, and the Accession to the WTO

Dependent variable:	Output wedges					Capital wedges				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Average tariff rate * WTO dummy	-0.009***	-0.008***	-0.005**	-0.007***		0.147***	0.092	-0.067	-0.090*	
	(0.001)	(0.002)	(0.003)	(0.003)		(0.042)	(0.123)	(0.050)	(0.047)	
Average liquidity ratio	-0.370***	0.047	0.051	0.049	0.056	-3.797***	-16.316***	-17.529***	-16.444***	-16.373***
* Financial crisis dummy	(0.029)	(0.083)	(0.086)	(0.086)	(0.086)	(1.311)	(3.704)	(3.789)	(3.666)	(3.677)
Average tariff rate * WTO(-1) dummy					-0.003					0.003
(placebo)					(0.003)					(0.053)
US bilateral tariff on Vietnamese imports				0.003	0.002				0.033	0.025
				(0.002)	(0.002)				(0.056)	(0.056)
ln(Employment)				-0.076***	-0.075***				3.881***	3.889***
				(0.019)	(0.019)				(0.438)	(0.438)
Herfindahl-Hirschman Index (HHI)				0.979	0.324				19.583	10.965
				(1.191)	(1.177)				(17.730)	(16.436)
N	78,037	78,037	78,037	77,749	77,749	78,037	78,037	78,037	77,749	77,749
R-squared	0.013	0.015	0.018	0.018	0.018	0.001	0.003	0.012	0.005	0.005
Firm-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Industry-specific time trend	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes

Note: Satandard errors are clustered by firm. ***, **, and * are statistically significant at 1%, 5%, and 10% levels, respectively. WTO dummy equal one from 2007 onward while WTO(-1) dummy equal one from 2006 onward (placebo test). Constant is included (but not reported to save space).

Source: Author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 8. Robustness Check: TFP Gains from Equalizing TFPR Relative to 1997 U.S. Gains

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Baseline	Robustness check 1	Robustness check 2	Robustness check 3	Robustness check 4	Robustness check 5	Robustness check 6
Elasticity of substitution	sigma = 3	sigma = 2	sigma = 6	sigma = 3	sigma = 3	sigma=3	sigma = 3
Technology (capital sahre)	United States	United States	United States	1/3	Vietnam	Firm-specific	United States
Trim	1%	1%	1%	1%	1%	1%	2%
TFP Gains (%)	30.7	15.6	83.3	19.1	69.2	29.6	22.9
N	100,601	100,601	100,612	100,848	100,879	100,830	97,263
Correlation with baseline TFPR	1.000	0.997	0.994	0.927	0.933	0.923	0.997

Note: Baseline is obtained from Table 3.

Sources: Hsieh and Klenow (2009, Table 6) and author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table 9. TFPR, TFPQ, and Exit

Dependent variable: Exit dummy		
TFPR	-0.012***	
	(0.002)	
TFPQ		-0.038***
		(0.001)
Constant	0.234***	0.181***
	(0.001)	(0.002)
N	100,601	100,601
R-squared	0.0004	0.0146

Note: Regressions are weighted least squares, with industry value-added share being the weight. Robust standard errors are in parentheses. *** is statistically significant at 1% level. Results are pooled for all years between 2000 and 2009.

Source: Author's calculation, based on the *Annual Survey on Enterprises* by the General Statistics Office of Vietnam.

Table A1. Annual Average MFN Tariff Rate, by Industry and by Year

(%)

		Year									
	Industry	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Manufacture of food products and beverages	NA	30.6	30.5	31.9	32.1	31.9	31.9	31.9	24.0	22.9
2	Manufacture of tobacco products	NA	65.0	65.0	65.0	65.0	65.0	65.0	65.0	81.3	83.3
3	Manufacture of textiles	NA	32.3	32.2	32.6	32.6	32.6	32.6	32.6	10.0	10.0
4	Manufacture of wearing apparel; dressing and dyeing of fur	NA	47.7	47.4	47.7	47.7	47.7	47.7	47.7	20.1	20.0
5	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	NA	30.2	30.3	28.9	28.9	28.9	28.9	28.9	22.9	21.2
6	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	NA	13.1	13.1	12.7	12.7	12.7	12.7	12.7	11.0	10.2
7	Manufacture of paper and paper products	NA	17.4	17.7	18.5	18.5	18.5	18.5	18.5	15.0	13.9
8	Publishing, printing and reproduction of recorded media	NA	20.1	19.6	19.1	19.1	19.1	19.1	19.1	14.4	13.2
9	Manufacture of coke, refined petroleum products and nuclear fuel	NA	2.5	2.7	4.9	4.9	4.9	4.9	4.9	2.8	5.1
10	Manufacture of chemicals and chemical products	NA	3.5	3.4	3.8	3.8	3.8	3.8	3.8	2.9	2.8
11	Manufacture of rubber and plastics products	NA	16.3	16.4	16.9	16.9	16.9	16.9	16.9	14.7	13.9
12	Manufacture of other non-metallic mineral products	NA	20.5	20.6	22.2	22.3	22.2	22.2	22.2	19.0	18.3
13	Manufacture of basic metals	NA	2.8	3.0	3.1	3.1	3.1	3.1	3.1	2.1	2.1
14	Manufacture of fabricated metal products, except machinery and equipment	NA	16.7	17.0	17.9	17.9	17.9	17.9	17.9	15.5	14.9
15	Manufacture of machinery and equipment n.e.c.	NA	6.3	6.4	6.5	6.5	6.5	6.5	6.5	4.9	4.6
16	Manufacture of office, accounting and computing machinery	NA	5.4	5.4	5.2	5.2	5.2	5.2	5.2	3.3	2.7
17	Manufacture of electrical machinery and apparatus n.e.c.	NA	11.7	12.1	12.5	12.5	12.5	12.5	12.5	10.4	9.9
18	Manufacture of radio, television and communication equipment and apparatus	NA	17.6	15.2	14.6	14.6	14.6	14.6	14.6	9.6	9.7
19	Manufacture of medical, precision and optical instruments, watches and clocks	NA	10.2	10.1	10.0	10.0	10.0	10.0	10.0	7.5	6.9
20	Manufacture of motor vehicles, trailers and semi-trailers	NA	36.7	34.8	32.8	32.8	32.8	32.8	32.8	21.6	24.1
21	Manufacture of other transport equipment	NA	12.0	12.0	15.1	15.1	15.1	15.1	15.1	13.9	13.3
22	Manufacture of furniture; manufacturing n.e.c.	NA	24.1	24.1	24.1	24.1	24.1	24.1	24.1	20.6	19.4
23	Recycling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Source:
World Bank (2014) *World Integrated Trade Solution* (WITS).