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Ease of Doing Business Reforms in Vietnam: Implications for Total Factor Productivity in Manufacturing Industries

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Abstract

This paper focuses on TFP analysis in the context of the impressive reforms of the ease of doing business in Vietnam using a novel and unique micro dataset of manufacturing enterprises between 2000 and 2010 for the analysis. The first phase of the reforms (2000-2005) observed the implementation of business start-up simplification, and the central governance of business regulations was decentralized to provincial authorities in the second phase (2006-2010). Results of this research are as follows. First, on average, larger firm-size and higher TFP growth rate were mostly observed in manufacturers at the TFP frontier (the fourth quartile of TFP). Second, the average ratio of female workers was higher in leading TFP manufacturers than in less productive firms in low-technology industries, especially in the second phase of the reforms. Third, the TFP catch-up of the least productive firms to the frontier firms was faster in the second phase (2006-2010) compared to the first phase (2000-2005) across all industries and economic regions. However, larger TFP gaps still existed in high-technology industries. Last but not least, the first-difference estimation of panel data comprising 63 provinces (in the second phase of the reforms) shows that local governments that performed better in the ease of doing business significantly fostered provincial manufacturing TFP in either for upper or lower productive provinces in Vietnam. Furthermore, a province gained significant spillovers from nearby elite provinces with leading productivity.

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August 12, 2016

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Keywords: Vietnam, Total Factor Productivity, Productivity Dispersion, Economic Reforms.

JEL classification: D24, H79, L60, O53, P21.

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1 Introduction

Total Factor Productivity (TFP) has been regarded as a key driver of economic growth (Comin (2010)). TFP explains the growth of output that does not derive from the number of inputs used, but from the levels of technology efficiency (innovation), management and quality of inputs exploited in production (Syverson (2011), and Van Beveren (2012)). Therefore, governments, especially in developing countries, have made great efforts in implementing economic reforms to stimulate productivity.

With the availability of TFP estimation methods and micro-data, important results are revealed in TFP dispersion and TFP determinations in developing countries such as China and India (Syverson, 2011). TFP gaps may indicate implications for TFP catch-up of least productive firms to frontier firms.[1] Attention is also paid to a nexus between the performance of manufacturing in terms of TFP and crucial econonomic topics such as agglomeration effects, FDI spillovers, economic reforms (e.g: trade liberalization, business regulations for the ease of doing business, and the roles of institutions), etc.[2] Notably, Isaksson (2007) indicates institutions as one of the drivers of TFP growth since the formation of capital and the enhancement of resource allocation are only effective under the control of good institutions. Dixit (2009, p.1) clearly defines economic governance as "structure and functioning of the legal and social institutions that support economic activity and economic transactions by protecting property rights, enforcing contracts, and taking collective action to provide physical and organizational infrastructure". Earlier, in a study by North (1994), it is stated that institutional regulations could stimulate the productivity as they reduce transaction costs for enterprises. Later, Djankov et al. (2006) refer to the growth in per capita income thanks to improved economic governance that induces a reduction in business costs.

Vietnam is an emerging economy that has made impressive economic reforms since the Doimoi (Renovation) in 1986 (Leung, 2015). The economy has restructured from agriculture to manufacturing industries (McCaig and Pavcnik (2013)), and light industries have been at the forefront (Mishra et al., 2014). Remarkably, the new Law on Enterprises came into effect in 2000 to cut the **"red tape"**. Since then, the administration procedures for start-up businesses was simplified. As remarked by UNIDO (2011a), the reform of business registration benefits both state and private enterprises since it fosters more creation

[1] Interestingly, much interest has been paid to factors such as: competition (Syverson, 2004), sunk cost (Collard-Wexler, 2011), industry's resource reallocation and de-licensing (Hsieh and Klenow, 2009), and characteristics of inputs including human measure (schooling and gender) (Fox and Smeets, 2011) that might narrow the TFP difference between the leading firms (firms at 90th, or 75th quantiles of TFP) and the firms left behind (firms at 10th or 25th quantiles of TFP).

[2] For example: estimation of agglomeration effects (Combes et al. (2012), or learning by exporting (De Loecker (2007), De Loecker (2013)), spillover effects from FDI (Halpern and Murakozy (2007), Abraham et al. (2010), Newman et al. (2015), and Anwar and Nguyen (2014)), industry switching (Newman et al., 2012), job reallocation (De Loecker and Konings, 2006). Scholars are interested in the investigation of TFP in the context of economic reforms (e.g: impacts of international trade liberalization (Topalova and Khandelwal (2010), Francois and Hoekman (2010)), and more specifically in economic governance reforms (Acemoglu et al. (2005), Acemoglu and Robinson (2008), Djankov et al. (2006), Malesky and Taussig (2009), McCulloch and Malesky (2011), Alder et al. (2012), and Ghosh (2013))

and development of enterprises, and an extension of business community. Importantly, in 2006, the government took a further step to set up local **"one-stop shops"** to decentralize the control on business registration and foreign investment licenses of enterprises from the central authorities (in municipalities) to the local authorities of 63 provinces. [3] These steps of reforms enhanced the transparency and effectiveness of administrative regulations for business in Vietnam. They are followed by the official participation of Vietnam into the World Trade Organization in early 2007.

In the scope of this study, the ease of doing business reforms are referred to as the reforms of business registration, and the quality improvement of provincial governance in creating better business environment. Hence, the reforms in the country during 2000-2010 can be divided into two phases. The early phase was from 2000-2005, and the second phase happened during 2006-2010.

After 11 years of the reforms, Vietnam moved out of the least developing country list, and became a lower middle-income developing country in 2011. The evidence of rapid growth in manufacturing labour productivity during the structural reforms in Vietnam (1990-2008) is reviewed in detail by McCaig and Pavcnik (2013). Additionally, various papers have recently estimated the industry-level and firm-level TFP.[4] However, few studies show evidence of inclusive development in Vietnam, such as whether more female employees worked for high productivity enterprises? Recent research has not investigated the difference in TFP between urbanized areas (municipal) and less developed areas (non-municipal) in Vietnam. Moreover, the TFP catch-up of least productive firms to frontier productivity firms within each manufacturing industries and across economic regions in Vietnam has not yet reported. Current literature also pays no due attention to whether the gaps in TFP were narrowed after the economic reforms in the country.

The decentralization of central regulations on enterprise business has paved a new way for provincial authorities to practice the application of policy reforms locally. According to Dixit (2009), the practice of law is more important for the economic growth than the issuance of the law itself. Hence, analysing Vietnamese manufacturing TFP in the light of local economic governance support for the ease of doing business during 2000-2010 might provide interesting results. Has Vietnam learnt from the two economic legends in Asia, Hong Kong and Singapore, where the performance of the governments gained "top mark" from private enterprises (Weder and Brunetti, 2000)? Whether the better performance of decentralized authorities plays any roles in local manufacturing productivity in Vietnam? Few research investigates the impacts of provincial governance enhancement on technical

[3] According to Dixit (2015), **"one-stop shops"** is more efficient even when the corruption is unavoidable.

[4] For example: Nguyen et al. (2008) were pioneers in using the Vietnamese Enterprise Survey to investigate the FDI spillovers in services in Vietnam with the TFP estimated by OLS method. Later, Thangavelu (2010) applied semi-parametrics methods to estimate TFP of foreign firms, and evaluate TFP in the context of the financial constraints; Newman et al. (2012) used the index method to calculate TFP and investigate the switching behaviour of manufacturing firms in Vietnam. Ha and Kiyota (2014) also measured the TFP index linked with trade liberalization in Vietnam. Anwar and Nguyen (2014) used OLS to estimate TFP of manufacturing firms for eight economic regions in Vietnam with the implications for region development policies.

efficiency of local manufacturing in Vietnam and in other developing countries.

This paper thus aims to investigate the pattern of TFP in manufacturing industries in Vietnam (including TFP gaps) across industries, and key economic regions in the context of economic reforms between 2000 and 2010 (in two sub-periods: 2000-2005 and 2006-2010). It also analyses the impacts of better local governance on innovation and technical efficiency on 63 provinces in the country. The contributions of this research to the literature are as follows:

First, a unique up-to-date unbalanced panel dataset is compiled for 2-digit manufacturing industries drawn from the Vietnamese Enterprise Survey (2000-2010).[5] The survey is conducted by the Vietnamese General Statistics Office (GSO) annually. This complete and unique dataset provides additional rich information for more precise analysis in the case of Vietnamese manufacturing for an eleven year period. To analyse the improvement in the provincial economic governance, the micro dataset is merged with a provincial dataset (provided online by GSO at www.gso.gov.vn), and with the provincial competitiveness index (measured by the Vietnam Chamber of Commerce and Industry). Previous study that analysed firm-level data with the PCI was conducted by Malesky (2010)). However, because PCI is an index which reflects the assessment of provincial government quality in general, it is more appropriate to combine it with a provincial aggregated dataset for the analysis.

Second, the TFP is measured from the modification of the IVs estimator (Wooldridge (2009) and Petrin and Levinsohn (2012)) in which time effects are applied to control for business cycles to shape the production function more precisely. More importantly, this approach could exclude the measurement errors of value added and unpredicted TFP shocks. TFP is estimated for each phases of the economic reforms.

Third, for the first time, quantitative analysis is presented for average firm sizes, female to male employment ratio, capital intensity, and TFP growth rate across $ln(TFP)$ quartiles. Moreover, TFP differences in each industry across key economic regions are also investigated for the two sub-periods. Interesting results show that higher numbers of female workers entered into the labour force of the leading productive firms, but in low-technology intensity industries, especially in the second phase of reforms. The fact that the TFP gaps were narrowed in the second phase implies the faster catch-up of least productive firms to frontier firms after the early phase of the reforms.

Last but not least, this paper examines the crucial role that provincial economic governance (for the ease of doing business) plays in fostering local manufacturing TFP, in conjunction with other TFP key drivers such as FDI spillovers, labour density, absorptive capacity, and industrialization. The first differencing panel model for 63 provinces in Vietnam is applied for the investigation. Empirical results show the positive impacts of better provincial authorities on local productivity for both upper and lower productivity provinces.

[5]When estimating industry production function, we combined several industries together, and drop three industries due to the small number of observations. The number of industries is then collapsed to seventeen. See more details in the Data Appendix

This paper is arranged as follows: the first part gives an overview of the development of industries in the context of relevant government policies. The second part contains a literature review. The third part presents the theoretical framework of the IV estimator for industry specific production parameters and the TFP measurement at firm-level. The fourth part describes the dataset and exhibits selected stylized facts. The fifth part presents and discusses the results. The last part draws implications for further studies and conclusions.

2 Overview of the Ease of Doing Business Reforms in Vietnam

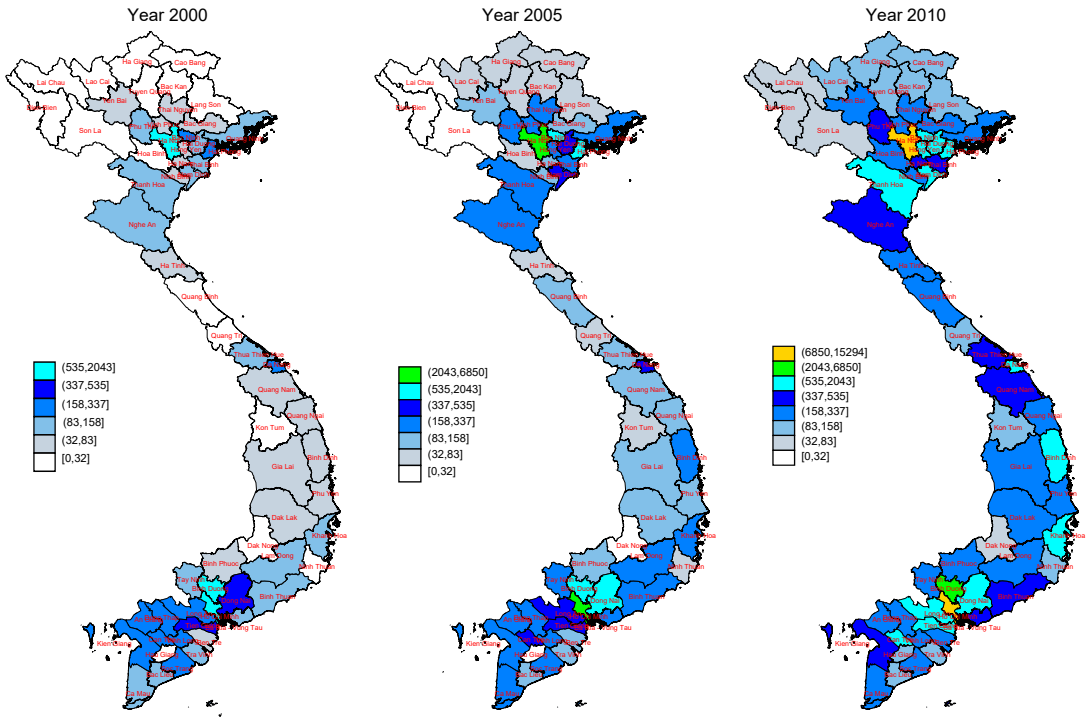
The existing literature widely discusses the economic reforms in Vietnam (for example, see Leung (2015), and McCaig and Pavcnik (2013)). More details about the reform of business registration in Vietnam for the period between 2003 and 2011 could be found in a report by UNIDO (2011a). This section briefly sketches out an overview of the reforms of the ease of doing business that is relevant to the manufacturing industries in Vietnam.[6] For the 2000-2010 period, this study divides the business reforms in Vietnam into 2 phases: (i) in the first phase of the reforms (2000-2005), the Vietnamese government has implemented series of policies to simplify the registration of new firms ("red tape cut"); (ii) in the second phase (2006-2010), the country created local "one-stop shop" which have decentralized economic governance to the provincial level since 2006 in order to ease the doing of business. Besides that, there have been intensive efforts to support infrastructure for industries since the Doimoi(Renovation) in 1986.

The most impressive policies with relevance to the manufacturing industries were the introduction of the first Law on Enterprises in 1999, and the introduction of its amendment in 2005. The 1999 Law on Enterprises cut a major number of administrative procedures for the establishment of new firms. The 2005 Law on Enterprises is seen as the unification of the 1999 Law on Enterprises and the 2003 Law on State Owned Enterprises. Furthermore, the new Law on Investment in 2005 introduced more types of foreign investment to Vietnam, and allowed foreign investors to apply to provincial authorities for investment licenses (except for some conditional or prohibited industries). As a result, the cumbersome requirement documents for new firm registration, and the contradictory in regulations for Private enterprises, State-owned enterprises and Foreign-owned enterprises have been impressively cut. UNIDO (2011b) reported that average time for formal business establishment in the periods between 1991-1999, 2000-2005, 2009-2011 respectively was 6-12 months, 50 days, and 5 days. Figure 3 exhibits an increase in the number of manufacturers by provinces in Vietnam for the year 2000, 2005 and 2010. In 2000, big clusters of manufacturers were seen in Hanoi, Hochiminh city and their satellites cities while North West, North Central Coast, and Central Highland regions saw very small number of firms. The map of year 2005 shows that number of manufacturers spread out

[6] See a complete review of the economic reforms in Vietnam documented by McCaig and Pavcnik (2013).

in other areas rather than the two biggest cities and their satellites (See Figure 3). Especially, after 5 years implementing the decentralization, the rising number of manufacturing producers is observed more clearly in the map of year 2010 (See Figure 3).

Figure 1: Number of Firms by Province, 2000, 2005 & 2010



Source: Firm-level data was drawn from the Vietnam Enterprise Survey (Vietnam General Statistic Office, 2000, 2005, and 2010). Administrative boundaries are based on Global Administrative Areas data (www.gadm.org). Several Vietnamese islands (e.g. Hoang Sa and Truong Sa) are not displayed due to the limitation of the GADM administrative boundaries data.

In addition, important support is given to the manufacturing industries in Vietnam by the National Master Plan and relevant policies for the establishment and management of Industrial Zones (IZs), Export Processing Zones (EPs), and High-tech Zones (HZs). Francois and Davies (2015) note that EPZs are popularly implemented as an important industrial policy mix in low per capita income countries for FDI attraction and export stimulation. In Vietnam, better infrastructure and reasonable land rents are offered to the firms established inside these zones. Income tax reduction is also applied for employees working in the zones. In 2008, the government set up local control for enterprises that operate in the zones. From 1991 to 2011, there were nearly 300 IZs, EPZs, and HZs established in Vietnam (Ministry of Investment and Planning, 2011).

3 Literature Review

3.1 Production Function Estimation

Much literature has surveyed the TFP measurement methods, such as studies of Van Biesebroeck (2004), Ackerberg et al. (2007), and Van Beveren (2012). These surveys indicate the advantages of semi-parametric (by Olley and Pakes (1996), Levinsohn and Petrin (2003)), and instrumental variables estimation, system of linear equations by Wooldridge (2009)) over ordinary least squares, fixed effects, and instrumental variables (with external instruments). The main findings show that the novelty of semi-parametric method and its extensions could solve the endogeneity between inputs and unobserved productivity. The robustness to measurement errors is also noted for semi-parametric method (Van Biesebroeck (2004)).

To solve the bias issue of ordinary least square estimation for production function, Olley and Pakes (1996) first decomposed production function residuals into the firm's productivity and the random and zero-mean measurement errors, then used the inverse function of investment as the proxy for the unobserved productivity. Levinsohn and Petrin (2003) proposed to exploit intermediate inputs as the alternative proxy in case of lumpy investment. As claimed by Ackerberg et al. (2006), multicollinearity could happens when labour is correlated with the proxy, then the labour coefficient cannot be identified. To overcome this issue, Wooldridge (2009) and later Petrin and Levinsohn (2012) suggested applying IVs estimator using the own lags of labour for its instruments.

De Loecker (2013) and De Loecker and Warzynski (2012) developed the framework of Olley and Pakes (1996) and Levinsohn and Petrin (2003) by incorporating the export status of firms (or the export volume of each firm) into the non-parametric function of inputs for unobserved productivity. De Loecker and Warzynski (2012) considered both the Cobb-Douglas and the translog production function in their paper, and they estimate mark-up for firms in an imperfect competition market. De Loecker and Warzynski (2012) found that exporting firms obtained higher productivity with gained markup. As being noted by De Loecker and Warzynski (2012), the Chilean data used in the study has rich information in trade while the Vietnamese enterprise survey does not include yearly information of firm-level export activity.

In addition, the Difference and System Generalized Method of Moments was introduced by Blundell and Bond (2000). This method is applied especially for the case of dynamic models with persistent data and serial correlation in the error terms. The method sheds a light on the estimation of dynamic model for production function when (i) serial correlation exists in productivity shocks (the shocks are assumed to be i.i.d across observations., (ii) demands of inputs are influenced by these shocks, (iii) external instruments are not available, (iv) the model has heteroskedaticity, (v) there is a panel with large number of observations and a short time series (Bond (2002)).

The model of Blundell and Bond (2000) was further commented on for practice by Bond (2002) in the case of the autoregressive model for investment rate and production

function estimation. The Blundell and Bond (2000) method was then applied by Van Beveren (2012) for the case of a single product in the manufacture of food and beverages in Belgium. [7]

Importantly, it is noted that while methods of Olley and Pakes (1996), Levinsohn and Petrin (2003) and Wooldridge (2009) are relevant to each other because they applied semi-parametric (i.e: using unknown function of capital stocks and intermediate inputs/investment as the proxy for the unobserved productivity), the method proposed by Blundell and Bond (2000) does not use semi-parametric, but a dynamic model to manage the persistent data. Ackerberg et al. (2006) attempted to link the two trends of methodologies in production function estimation to correct for the multicollinearity issue between labour inputs and the non-parametric terms in Levinsohn and Petrin (2003) and Olley and Pakes (1996). Ackerberg et al. (2006) reset the timing of firms' inputs choice in seeking the assumption of non-collinearity between labour inputs and other inputs. The method proposed byAckerberg et al. (2006) has two-steps in which coefficients of labour inputs and capital are estimated in the second step.

3.2 Total Factor Productivity (TFP) Measurement and Application

Thanks to the increasing availability of micro-data and a wide range of methods for production function estimation, various studies are applied to measure TFP at firm-level in the light of interesting economic topics. First, the common steps in TFP measurement are: (i) to apply the most appropriate method to estimate the production function parameters in a specific industry;[8] and (ii) to use parameters estimated to measure TFP. Second, the TFP measured will be considered to be either directly the object for dispersion and tendency analysis, [9] or the dependent variable in estimating the impacts of trade policy reforms [10], or the impacts of trade liberalization on jobs and productivity growth, [11] ag-

[7]Roodman (2009a) proposes an user written command *xtabond*2 that can apply the system GMM for micro-data using Stata. The paper of Roodman (2009a) also provides a complete guideline for the application with appropriate tests in difference contexts. For instant, Roodman (2009b) suggested that in case of test for overidentification, the Hansen-J test is for homogeneity, Sargan test is for heteroskedaticity; test for auto-correlations with different levels of lags, and flexible options, such as: robustness to heterokedasticity, choice of different lag levels, etc. The discussion for system GMM application when there are too many instruments is in the paper of Roodman (2009b).

[8]Van Biesebroeck (2004) surveyed methods of production function estimation (Index, semi-parametric (Olley and Pakes (1996)), system GMM (Blundell and Bond (2000)), etc) and conducted estimations which applied these methods on simulated dataset. The author concluded that semi-parametric method is least sensitive to the measurement errors in dataset while index method require the highest accuracy of input data.

[9]see Syverson (2011) for the survey of literature in determinants of TFP; Syverson (2004) for the case study of the US, and Hsieh and Klenow (2009) for the case studies of India and China

[10]see Francois and Hoekman (2010) for the complete review of literature on trade in services, see Amiti and Konings (2007), and Topalova and Khandelwal (2010) for case studies of India and Indonesia respectively)

[11]see Francois et al. (2011)

glomeration effects, [12] and FDI spillovers. [13] Additionally, Isaksson (2007, abstract) lists determinants of TFP as follows: "education, health, infrastructure, imports, institutions, openness, competition, financial development, geographical predicament, and absorptive capacity".

Several empirical studies are listed in table 1.

Table 1: Summary of selected empirical research

Year	Author(s)	Topic	TFP Estimation	Dataset	Time frame	Sample
2015	Newman et al	FDI spillovers	Instrumental Variables, JW	Vietnam	2009-2012	more than 30 workers, Manufacturing
2014	Ha & Kyota	Trade liberalization	TFP Index	Vietnam	2000-2009	more than 20 workers, Manufacturing
2014	Anwar & Nguyen	FDI spillover by regions	OLS	Vietnam	2000-2005	Manufacturing
2013	Tran & Pham	FDI spatial spillover	LP, Stochastic Frontier	Vietnam	2001-2005	Manufacturing
2008	Nguyen et al	FDI spillovers	OLS	Vietnam	2000-2005	Services
2015	Arnold et al	Liberalization in Services effects	Semi-parametrics (OP, DL)	India	1993-2005	Manufacturing
2012	Combes et al	Productivity advantages of Large cities	OLS, LP	France	1994-2002	
2012	De Loecker & Warzynski	Markup & Export Status	extended LP & OP	Slovenia	1994-2000	Manufacturing
2012	Levinsohn & Petrin	Aggregate TFP growth	Instrumental Variables	Chile	1979-1986	Manufacturing
2012	Van Beveren	Review of TFP	OLS/OP/LP/System GMM	Belgium	1996-2005	Food & Beverages
2011	Collard-Wexler	Productivity dispersion and Plant Selection	OLS & Control function	the US	1963-1997	Manufacturing
2010	Topalova & Khandelwal	Trade liberalization	LP	India	1987-2001	Manufacturing
2009	Hsieh & Klenow	Misallocation	Index	China & India		Manufacturing
2009	Arnord & Javorcik	FDI ownership effects	TFP Index	Indonesia	1983-1996	Manufacturing
2007	Amitti & Konings	Trade liberalization	OP	Indonesia	1991-2001	Manufacturing
2006	De Loecker & Konings	Job Reallocation & Aggregate Growth	OP	Slovenia	1994-2000	Manufacturing
2004	Syveson	Productivity Dispersion	Index	the US	1977	Manufacturing

Regarding the studies on TFP difference, Syverson (2011) summarized research on patterns of TFP in light of competition (Syverson, 2004), sunk cost (Collard-Wexler, 2011), and input quality (Fox and Smeets, 2011), etc. Syverson (2011) also indicated the determinants of firm-level TFP such as: managerial experience/talent, quality of inputs, information technology and R&D, learning-by-doing, production innovation, firm's relative size, firm's vertical and horizontal linkage, etc.

TFP dispersion is explained differently in the literature. Fox and Smeets (2011) showed that for eight Danish industries, both human capital measures (schooling and gender) and wage bill equally influence the ratio of 90th and 10th productivity percentiles. However, Collard-Wexler (2011) was in favour of sunk cost for the explanation of TFP difference while Syverson (2004) considered competition the key driver of the TFP gap. Industry de-licensing and size restriction policies were taken into account for the TFP difference analysis in India (Hsieh and Klenow, 2009). However, Hsieh and Klenow (2009) found no significant evidence of a link between TFP dispersion and de-licensing, labour market regulation, geographic measures and industry concentration for either China or India. Despite the fact that TFP in manufacturing industries in developing countries, such as China and India, has been discussed widely, there is little evidence shown for Vietnamese manufacturing, especially with implications for economic governance reforms.

In exploring agglomeration effects on TFP, Combes et al. (2012) found evidence of higher TFP growth in larger size cities in France. The authors noted that agglomeration economies are magnified by the natural local advantages. They also refer to the self-selection of firms in the tough competition of big cities as the reason for higher productivity in these urban areas. Nevertheless, Glaeser and Resseger (2010) confirmed that the positive

[12] see Combes and Gobillon (2015) for the literature survey, and Combes et al. (2012) for the case study of France

[13] see Nguyen et al. (2008), and Newman et al. (2014) for the case study of Vietnam; see Anwar and Nguyen (2014) for FDI spillovers by regions.

agglomeration effects only in cities that are relatively high-skilled.

Importantly, in a review of institutions and productivity growth history,North (1994) explained productivity growth as a result from a reduction in transaction costs and transformation costs. North (1994) indicated that the enhancement of institutions is the key driver of transaction cost elimination. Isaksson (2007) emphasizes the crucial impacts of better institutions on TFP, especially its benefits for the effectiveness of capital formation and resource allocation. The study of Isaksson (2007) also referred to other factors that influence TFP such as infrastructure, human capital, financial development, etc. Clarifying the concepts of economic governance which includes both legislation and institution, Dixit (2009) highlighted the more important roles of policy application by institutions over government laws for productivity growth.

In empirical studies, Francois and Manchin (2007) showed the evidence of governance quality on export levels in the panel of bilateral trade flows, while McCulloch et al. (2013) attemptted to search for the roles of Indonesian district governance in the local per capita income. However, McCulloch et al. (2013) did not find robust evidence. The reinforcement of labour productivity by economic governance is investigated by Djankov et al. (2006) with the focus on how regulation for the ease of doing business reduces business costs. The nexus between Indian manufacturing industries' TFP (estimated by Levinsohn and Petrin (2003) method) and economic reforms (de-licensing) was investigated by Ghosh (2013). Ghosh (2013) split the study time frame into pre and post reform periods, and considered the TFP growth in the context of financial development, tariff escalation, labour market changes, FDI flows, and the role of union as the institutional proxy. However, Ghosh (2013) did not find an improvement in manufacturing TFP after the de-lisencing in India. The author did not consider the economic governance in detail.

For the case of Vietnam, Malesky (2010) investigated how provincial government support the attraction of FDI flows. The study used the Provincial Competitiveness Index as the assessment of better government quality in Vietnam. According to Malesky (2010), the index is similar to indices referred to in common literature. The discussion of Brunetti et al. (1998) on the linkage between the institutional uncertainty and growth and investment also used indicator from the world-wide survey on private enterprises. Brunetti et al. (1998) reported that economic growth and investment were reduced by the government that lacked of incredibility.

Recent studies of TFP in the Vietnamese manufacturing have mostly focused on the FDI spillovers (Nguyen et al. (2008), Anwar and Nguyen (2010), Anwar and Nguyen (2014), and Newman et al. (2015)), or international trade openness (Ha and Kiyota (2014)). The roles of provincial governance on business formalization and FDI attraction in Vietnam were documented respectively by Malesky and Taussig (2009) and Malesky (2010). Nevertheless, few research shows evidence of the influence of economic governance on provincial manufacturing TFP in developing countries given the impacts of other factors such as FDI spillovers, agglomeration effects, absorptive capacity, especially for Vietnam during the impressive economic reforms (2000-2010).

4 Data Description and Statistical Indicator

4.1 Data Description

4.1.1 Firm-level Data

This paper uses the rich firm-level data on the manufacturing industry drawn from the Vietnam Enterprise Survey for an eleven year period (2000–2010) and which has been conducted annually by the Vietnam General Statistics Office (GSO).[14] Each firm is identified by a unique id key which are then compiled into an unbalanced panel.[15]

The industries in the dataset are classified using the 2-digit Vietnam Standard Industrial Classification 1993 (hereafter named VSIC 1993) provided by the Vietnamese General Statistics Office.[16] To overcome the constraint in the number of observations in some industries, I merge related industries: industry 29 with industry 30, industry 31 with industry 32, industry 33 with industry 34. Industry 15 (the Manufacuture of Food) includes 4-digit classification 1511-1512 (See Appendix A.1 for more details). Industries with the high concentration (i.e: consider the Herfindahl Index using labour share), such as: 16 (Tobacco), 23 (Oil and Refinery Oil products), and 37 (Recycling), are excluded (a similar practice can be found in Newman et al. (2015)).

The survey contains annual information of legally registered enterprises (including business establishments) which were still doing business until December 31^{st} in the year previous to the year reported. The firm-level information in the survey includes: establishment year, revenue, profit, expenditure, wage bills, number of employees, firm types, net fixed assets, debt, equity, etc.

Table 2: Firm-level Data Description, 2000-2010

Variable	**Measurement**	**2000-2005**		**2006-2010**		**2000-2010**	
		Mean	**N**	**Mean**	**N**	**Mean**	**N**
Labour	Number of labour	3.63	78,225	3.14	161,927	3.30	240,622
Value added	Profit +wage +depreciation	20.02	71,896	19.84	150,153	19.90	222,517
Capital stock	Net book value of fixed asset	20.59	71,830	20.35	153,061	20.44	225,360
Inputs	Total cost - wage - investment	21.52	64,446	21.42	133,166	21.46	198,075

*Source:*Data drawn from the Vietnam Enterprise Survey (2000-2010). Industries listed in Appendix A.1.
Notes: The depreciation ratio is 10%. Value added, capital stocks, materials and services are deflated values. All variables are in ln.

Table 2 depicts how key variables are constructed using the Survey on Vietnamese Firms. The measurement of value added uses firm-level information of total profit, total wage, and depreciation. The depreciation ratio is assumed to be 10%. Different deflators are used to convert the nominal values in the current price to the base year price which is

[14]The data has been aggregated and published annually in the Vietnam Statistical Yearbook. See more details in: www.gso.gov.vn. Huong Nguyen would like to thank her colleagues: Hanh Pham at the Middlesex University (the UK) for sharing the raw firm-level data, and Stephan Kyburz at the University of Bern for sharing the provincial administrative boundary data of Vietnam from the Global Administrative Areas data (www.gadm.org).

[15]The identification for firms in the dataset using the code assigned by the GSO for each firms through years. The tax code was not used because this method records many missing observations.

[16]VSIC 1993 is in line with the International Standard Industrial Classification (ISIC Rev.3) which was introduced by the United Nations. http://unstats.un.org/unsd/cr/ctryreg/ctrydetail.asp?id=1448

year 2000. Specifically, the producer price index (PPI) of each industry is used to deflate output and value added. [17] Capital stocks are converted to the price of base year 2000 by the gross fixed capital formation deflator. [18] Annual GDP deflators are used for nominal values of materials and services.[19]

4.1.2 Province-level Data

Table 3: Province-level Data Description, 2006-2010

Variable	Measurement	Mean	Min	Max
Provincial TFP	Weighted provincial total factor productivity	1.54	0.03	5.50
PCI (%)	Unweighted provincial competitiveness index	55.61	41.64	76.02
Labour Density (LAB)	Log of Number of Residents with age 15 years onwards/km^2	2.89	0.20	38.88
Log(FDI)	Log of Number of FDI projects/number of firms	-4.75	-7.66	-1.43
Log(MANU)	Log of Share of provincial manufacturing in national manufacturing	-0.80	-4.61	3.14
Log(STU)	Log of Number of students in colleges and universities	8.79	4.88	13.41

*Note:*Provincial TFP is scaled down by divided by 10^6. Missing values for some years in number of students in Dak Nong are calculated by the average of two nearest years. Missing values in number of students in Dien Bien for several years are replaced by number of students in vocational school in the same province.
*Source:*Provincial-level data is downloaded from www.gso.gov.vn. PCI is downloaded from http://eng.pcivietnam.org.

4.2 Statistical Indicator

As discussed in Section 2, the year 2006 (when the new Law on investment was introduced along with the amendment to the 1999 Law on Enterprises) is an important milestone in the policy reforms during 2000-2010. Hence for the presentation of relevant statistical indicators, two phases of policy reform: early phase 2000-2005, and later phase 2006-2010 are chosen for the comparison of changes in economic stylized facts.

4.2.1 Expansion of Number of Firms, Growth in Labour and Real Wage

In the light of more cohesion and greater ease of doing business, the flourishing trend in the number of registered manufacturing firms from 2000–2010 is shown in Figure 2. Sharp increase in the number of firms observed since 2006 (shown by the steeper slope). [20]

Figure 2 also exhibits the growth in labour and average real wage (base year 2000) for the research time frame. Interestingly, growth in employment in the manufacturing saw a more rapid rise than the growth in average real wage, especially after 2006.

In addition, Table 4 shows the percentage share of workers employed by the industries (in total labour force) increased steadily from 11,8% (2005) to 14,1%(estimated in 2014). With the development of the industries, more jobs were created during the period studied. Specifically, the number of workers in manufacturing increased 32.09% during 2005-2010,

[17]Source: I calculated the Index with base year 2000 by using the annual Producer Price Index (PPI) by Industry provided by the General Statistic Offices of Vietnam at www.gso.gov.vn

[18]The calculation of deflators use the annual nominal gross fixed capital formation values of Vietnam from the World Bank, www.worldbank.org

[19]Source: The World Economic Outlook, www.imf.org

[20]This trend is also in line with the boom in total number of registered enterprises (for all sectors) in Vietnam. According to UNIDO (2011b), by end of 2005, about 170,000 enterprises registered in Vietnam in comparison to 39,000 enterprises registered between 1990 and 1999.

Figure 2: Number of Firms, Growth in Labour & Average Real Wage, by Year, 2000-2010

Source: Author's Calculation using the Vietnam Enterprise Survey (2000-2010).
Note: Selected industries are 2-digit VSIC 1993 (Appendix A.1).

and 12.47% during 2010-2014 (calculation from data in Table 4). This indicates the more crucial role of the manufacturing industries in the Vietnam economy in terms of job creation.

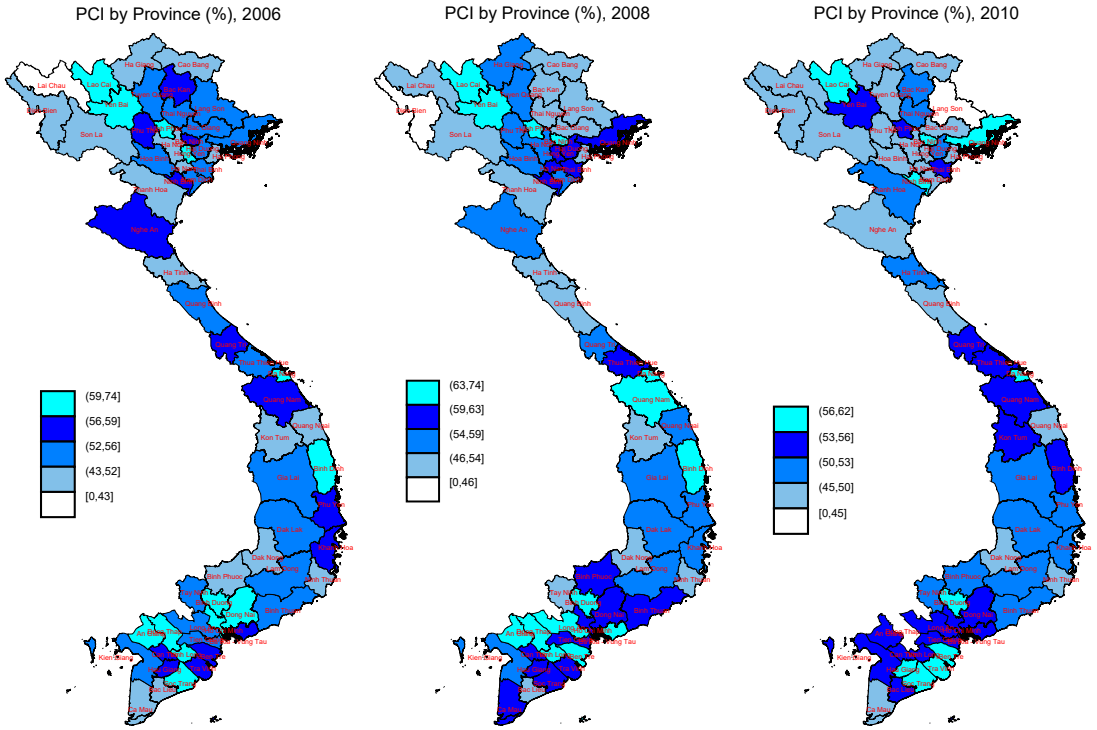
Table 4: Employment in the Manufacturing Industries, 2005-2014

Year	2005	2010	2014 Preliminary
Share in labor force (%)	11,8	13,5	14,1
Number of workers (thousand)	5.031,2	6.645,8	7.414,8

Source: The General Statistics Office of Vietnam, website: https://www.gso.gov.vn/default.aspx?tabid=714

4.2.2 Provincial Competitiveness by Province, 2006, 2008 & 2010

Figure 3: Provincial Competitiveness Index by Province, 2006, 2008 & 2010



Source: PCI is the unweighted provincial price index which is downloaded from http://eng.pcivietnam.org/. The increasing ranges of PCI are arranged as follows: (i) less than 10% of the observations, (ii) (10%-25%], (iii) (25%-50%],(iv) (50%-75%], (75%-100%]. Groups (iii) and (iv) are higher than median in the year. Administrative boundaries are based on Global Administrative Areas data (www.gadm.org). Several Vietnamese islands (e.g. Hoang Sa and Truong Sa) are not displayed due to the limitation of the GADM administrative boundaries data.

5 Methodology

This section firstly discusses the algorithm to estimate production function for a specific industry proposed by Wooldridge (2009) and Petrin and Levinsohn (2012).[21] As discussed in detail in Section 2, the year 2006 is the milestones in the economic reforms of Vietnam, hence production function is estimated in two sub-periods 2001-2005 (the first phase of development), and 2006-2010 (the second phase of development) [22]. Secondly, the section presents how TFP and TFP difference are measured using the parameters estimated from the production function. The results of ln(TFP) are then used to group the dataset into quartiles. For each quartile in the two sub-periods, we investigate its pattern of average firm size (log of capital), female employment ratio rate, leverage ratio (debt/equity), and TFP growth rate.

5.1 Estimation of Production Function

Wooldridge (2009) aims to consistently and efficiently estimate the production function parameters by using the system of two equations (generalized method of moments, GMM). The author also introduces the IVs estimator which is the special case of GMM when one

[21] The framework by Levinsohn and Petrin (2003) is added for reference in the Appendix **??**.

[22] Because of the lag variable required in the estimation, sub period 1 includes year 2000, sub period 2 includes year 2005

of the equations is exactly identified.

The IVs estimator is chosen to estimate the production function of the selected Vietnamese manufacturing industries for several reasons:

(i) The setting shows advantages over 2-stage semi-parametric methods (by Olley and Pakes (1996), Levinsohn and Petrin (2003)), and other methods such as OLS, fixed effects, and Instrumental Variables with external instruments as it enables the estimation of the production function without concern for the endogeneity issue between inputs and unobserved productivity as raised by Ackerberg et al. (2006);[23]

(ii) Most importantly, the framework is a straight forward step to measure TFP that excludes measurement errors and unpredicted shocks to productivity (See details in Equation 10 and Sub-section 5.2).

(iii) The framework fits well with the dataset of the Vietnamese manufacturing industries compiled from the Vietnamese Enterprise Survey. Specifically, it requires information about observed variables such as value-added, capital stocks, number of workers, and intermediate inputs which are available in the dataset.

(iv) However, the limitation of the method to the 2-stage semi-parametric method by Olley and Pakes (1996) and Levinsohn and Petrin (2003) is that it requires a larger number of observations. For example, it is not possible to obtain the production function estimation for each 4-digit industries.

The algorithm of Wooldridge (2009) is basically similar to the assumptions in the method of Levinsohn and Petrin (2003) (and Olley and Pakes (1996)'s method):

(i)The intermediate inputs have increasingly monotonicity in unobserved productivity; (ii) The unobserved productivity follows Markov rule; (iii) The unknown function of productivity is approximated by the third order polynomials function of capital stocks and intermediate inputs (Levinsohn and Petrin, 2003), or investment flows (Olley and Pakes, 1996);(iv) Assumption of constant return to scale in this frame work is relaxed (Petrin and Levinsohn, 2012).

Importantly, to modify the framework of Wooldridge (2009) and Petrin and Levinsohn (2012), I include year fixed effects in the estimation of the production function to control for business cycles. Besides, the cluster-robust standard errors at firm-level is considered for the robust inference (Cameron and Miller, 2015). Moreover, as discussed regarding economic reform in Sub-section 2, year 2006 is regarded as the benchmark for important policy reforms (for instance: decentralization of new business registration and investment licensing came into effect through the amended Law on Enterprises and the new Law on Investment in 2006). Therefore, I estimate the TFP for two sub-periods 2001-2005 (the early phase of the reforms) and 2006-2010 (the second phase of the reforms).

Further details of the TFP estimation algorithm are found in the Appendix A.2.

[23]See details in papers by Petrin and Levinsohn (2012), and Van Beveren (2012).

5.2 Measurement of TFP and TFP Gap

Equation 1 presents how ln(TFP) can be calculated from parameters estimated from the IVs estimator by Wooldridge (2009) and Petrin and Levinsohn (2012). It rules out the measurement errors of value-added (ϵ_{ijt}) and unpredicted shocks of TFP (a_{ijt}) that might be included in the TFP (see also Equation 10).

$$\hat{\omega_{ijt}} = \hat{va_{ijt}} - \hat{\beta}_l l_{ijt} - \hat{\beta}_k k_{ijt} \tag{1}$$

Where:

$\hat{\omega_{ijt}}$: the log of estimated TFP of firm i in industry j at year t. $\hat{va_{ijt}}$ is the value-added estimated from the production function. l_{ijt}, k_{ijt}: log values of number of labours and real accumulated capital stocks respectively. $\hat{\beta}_l$: labour parameter, $\hat{\beta}_k$: capital parameter estimated from the production function of industry j.

The gap in TFP is measured as the difference in TFP between frontier firms (at 90th, or 75th percentile of TFP for each industry) and least productive firm (respectively at 10th, or 25th percentile of TFP) :

$TFPgap_{90/10} = ln(TFP)_{p90}$ - $ln(TFP)_{p10}$[24]
$TFPgap_{75/25} = ln(TFP)_{p75}$ - $ln(TFP)_{p25}$

Where (for each industry, and (or) within each region):
$ln(TFP)_{p90}$: ln(TFP) of the frontier (firm at 90th percentile)
$ln(TFP)_{p10}$: ln(TFP) of the least productive (firm at 10th percentile)
$ln(TFP)_{p75}$: ln(TFP) of firm at 75th percentile
$ln(TFP)_{p25}$: ln(TFP) of firm at 25th percentile

As TFP is expressed in log values, the gap has interesting implication. It can be inverted to the ratio between the output produced by the TFP frontier and the output produced by the least productive, assumed that both using the same inputs (Syverson, 2011): $Ratio = e^{TFPgap}$

Patterns of average firm size (log of real capital stocks), human capital measures (female to male ratio in the workforce), leverage ratio (debt/equity), and TFP growth would be investigated for each TFP quartile (the limitation of the panel data used in this study is the information of skilled labour is missing for most of years). The TFP gap across industries and key economic regions would also be explored.

[24]Hsieh and Klenow (2009) exclude firms with 1% highest and 1% lowest values of ln(TFP) to prevent the outliers. However, I still keep all the observations for the randomness.

5.3 Estimation of Impacts of Provincial Governance Quality on Provincial TFP

This section first constructs the provincial manufacturing TFP in Vietnam. To calculate average provincial TFP, while Combes et al. (2012) use the arithmetic mean of firm-level TFP by province, this study measures provincial weighted average TFP using firm-level TFP and firm's labour share in each province. The provincial weighted average TFP not only reflects the technology efficiency level of each province, but also takes into account the importance of the firm size in term of labour. The results are then used to analyse the impacts of the provincial authority's performance on the improvement of the local manufacturing efficiency.

Weighted average total factor productivity of province p at time t is calculated as follows:

$$TFP_{pt} = \sum_i \alpha_{ipt} \times TFP_{ipt}$$

Where:
TFP_{pt} is the provincial TFP.
$\alpha_{ipt} = \dfrac{L_{ipt}}{L_{pt}}$ is the labour share of firm i in province p.
TFP_{ipt} is the TFP of firm i in province p at time t.

North (1994) reviewed the role of institutions in productivity enhancement and discussed the lowering of firm's transaction cost due to the improved performance of the government authority. Notably, Djankov et al. (2006) confirmed that growth is brought about by the ease of doing business which reduces business cost for firms. Moreover, previous studies in agglomeration economies commonly indicate that total factor productivity is higher in bigger cities in France (Combes et al. (2012)), and larger size cities gains more labour productivity (Glaeser (2010)). In addition, literature shows that more skilful individuals tend to cluster in urban cities (Combes et al. (2012), and Berry and Glaeser (2005)). Importantly, in the studies of the Vietnamese manufacturing, Newman et al. (2015), Anwar and Nguyen (2014), or Nguyen et al. (2008) found the positive spillovers of FDI in Vietnam. Following the literature, Equation 2 considers the influence of the improvement in local government quality on provincial technology efficiency in the context of labour density (agglomeration effects), and FDI spillovers. Other variables are added to control for the economics capacity of the province, such as the share of provincial manufacturing on national manufacturing output, and number of undergraduates and colleges.

$$TFP_{pt} = \alpha_0 + \alpha_{pci} PCI_{p,t} + \alpha_x X_{p,t-1} + \alpha_p PROV_p + \epsilon_{pt} \quad (2)$$

Where: TFP_{pt} is the weighted average provincial TFP of province p at time t. It implies the level of technology efficiency in manufacturing of the province. [25]

[25] Similar approach of TFP level analysis can be found in Newman et al. (2015).

$X_{p,t-1}$ includes lagged variables controlling for:

(i) Agglomeration effects are proxied by labour density (number of residents whose age is 15 years upwards per km^2 by province, $LAB_{p,t-1}$).

(ii) FDI spillovers by province (the presence of foreign firms in each province: ratio of foreign projects registered over total number of firms locating in the province, $FDI_{p,t-1}$).

(iii) Absorptive capacity of the province (number of university and college students by province $STU_{p,t-1}$. [26]

(iv) Manufacturing intensity is measured by the share of provincial manufacturing output in national total manufacturing output, $MANU_{p,t-1}$). This variable can also be proxied for the industrialization of each province.

(v) Distance $Dist_{pq,t}$ from province p to an elite province q is measured by the shortest geodetic distance between two centroids of province p and province q. I then use an inverse weighted approach to sum up $TFP_{q,t-1}$ over q in year $t-1$. The elite province q is the province that gained $TFP_{q,t}$ higher than the fourth quartile (75th) of TFP value in year t. Using the weight by the inverse of distance assumes the decay effects of the distance to elites on TFP. [27]

$$DIST_{pq,t-1} = \sum_{q,q\neq p} \frac{TFP_{q,t-1}}{Dist_{pq,t-1}} \tag{3}$$

Lagged variables of X are exploited to ensure the causal link between the dependent variables (change in TFP level, and the TFP growth) with explanatory variables so that Equation 2 and Equation 4 can prevent endogeneity issues that may occur between the current $TFP_{p,t}$ and the $X_{p,t}$.

The province fixed effects $PROV_p$ control for the time-invariant effects in each province. This could be provincial characteristics such as business culture, natural advantages, and location advantages, etc. Notably, the province effects could influence the choice of location of firms (either foreign or domestics), and labours. In other words, $E[X_{p,t-1}PROV_p] \neq 0$. Hence to remove the province fixed effects is essential. Equation 4 shows the first differencing is used to remove these effects. First differencing is chosen as it could reduce the serial correlation when excluding lagged values from both sides.

In the literature, the interaction of the province effects variable and the year effects variable is used to absorb the effects of decentralization to the province (for an example, see Ahrend et al. (2014)). However, the interaction could not indicate specifically how the impacts of changes in provincial policies were. To evaluate the impacts in more details, I include the provincial competitive index PCI_{pt} instead of using the interaction of province and time effects. The change in the index could be used as the proxy for the improvement in quality of the provincial economics governance. The index has been measured since

[26] In the case of Daknong province, as there are several missing values for some years, we calculate the values of the missing years by the average value of the two nearest years. Dienbien also has missing values, I replace missing values with number of students in vocational school.

[27] For examples of research in inverse weighted distance approach, see Keller (2002), Halpern and Murakozy (2007), and Bodman and Le (2013).

2005 using annual survey of private enterprises (including both domestic and FDI firms) by the Vietnam Chamber of Commerce and Industry. [28]

$PCI_{p,t}$ is regarded as the voice of enterprise communities to assess their local governance, and for local governments to review and improve the quality of economics governance.[29] The index is the combination of indicators for the assessment of provincial governance reform:(i) Cost for business start-up, (ii) Accessibility of land and security of business premises, (iii) Transparency of business environment and information, (iv) Informal charges, (v) Waiting time for bureaucratic compliance, (vi) Crowding out of private enterprise due to favourable policies for foreign and state-owned firms, (vii) Creative and proactive provincial leadership, (viii) Quality of support services,(ix) Local labour training and education support policies,(x) Dispute settlement procedure. [30]

In Equation 2, PCI is observed at time t. The timing of $PCI_{p,t}$ follows Acemoglu et al. (2006, p.6) such that good quality of government at time t induces better economics performance at time t. This setting is reasonable as the improvement of local governance during the year reduces cost for enterprises (North, 1994). In addition, Greenstone et al. (2010) noted that firms choose a location to maximize their profit, hence provinces with better governance will be under their consideration when they make location choice.

It is doubtful for the concern of endogeneity between $TFP_{p,t}$ and $PCI_{p,t}$. First, $PCI_{p,t}$ is the index reflecting the opinions of randomly chosen enterprises for the quality of the local governance during year t while $TFP_{p,t}$ is realized at the end of year t.[31]. Second, as noted in annual PCI reports,[32] the quality of local governance changes slowly and stably, hence it is assumed that $PCI_{p,t}$ could not be influenced quickly by $TFP_{p,t}$ in the same year. In short, in our estimation, the timing of $PCI_{p,t}$ happened before the realized of $TFP_{p,t}$.

The condition for the unbiased estimation of Equation 2 and Equation 4 is that independent variables are orthogonal with the error terms ϵ_{pt}.

First differencing Equation 2 yields:[33]

$$\triangle TFP_{pt} = \alpha_0 + \alpha_{pci}\triangle PCI_{p,t} + \alpha_x \triangle X_{p,t-1} + \triangle \epsilon_{pt} \tag{4}$$

The robustness check is conducted by running regression of the same dependent variables (change in level of TFP) on the current and future values of independent variables.

[28]The first year survey was only implemented with selected provinces. Relevant information can be downloaded from the website of the Vietnam Chamber of Commerce and Industry, http://eng.pcivietnam.org/gioi-thieu-pci-c2.html.

[29]See the most recent reports on PCI at http://eng.pcivietnam.org/.

[30]See Malesky (2010) for more discussion of the index, and annual report on PCI at www.pcivietnam.org.

[31]TFP is estimated using realized input values of firms at the end of year t. See further details ins ection 4.1.1, and section 5.1. TFP is also assumed to be observed only by the firm itself.

[32]See details at www.pcivietnam.org.

[33]Year effects are not included in Equation 2 and Equation 4 because in estimating the TFP, the effects were already controlled. The interaction between year and municipality is added to control for different time trends between municipal and non-municipal areas. The interaction between year and province is not added as the change in provincial-level policies are proxied by $PCI_{p,t}$. Moreover, the provincial level dataset is constrained by number of observations.

6 Empirical Result

6.1 Capital Intensity, Leverage Ratio, Gender Ratio in Employment and TFP growth in TFP Quartiles by Industry

First, the dataset is divided into quartiles based on firm-level ln(TFP) (the first quartile: 0-25%; the second quartile: 25%-median; the third quartile: median-75%, the fourth quartile: 75%-100%). This section then explores in detail the pattern of average (i) firm size (log of capital), (ii) capital intensity (log of capital/wage), (iii) gender ratio of employment (female employees/total employees), and (iv) TFP growth in quartiles of ln(TFP) for each industry in two sub-periods. Those factors are mentioned commonly in previous studies as the key drivers of firm-level TFP growth (see, for example Isaksson (2007) for a review of factors influencing TFP growth such as capital intensity, and Fox and Smeets (2011) for a discussion of gender ratio roles in influencing TFP gap).

In both sub-periods (early phase: 2000-2005, and second phase: 2006-2010), producers at TFP frontier (the fourth quartile) were on average in a larger sized firm. More productive manufacturers mostly obtained a higher rate of growth (except for industries: 22 (low-technology), and 24, 29, 33 (high technology) in the first phase; and except for 18, 20, 22 (low-technology), and 24, 29, and 36 (high technology) in the second phase of the reforms).

Interestingly, leading productivity groups in some industries observed higher female to male ratio in their employment. Specifically, the higher female ratio saw in low-technology industries such as the manufacture of food (both phases), textile (the first phase), wearing apparel (both phases), products of wood (both phases), products of furniture and other n.e.c manufacturing (both phases).

The leverage ratio which implies greater accessibility to credits observed a rising trend on average, but did not show the increasing trend in all TFP frontier groups in a specific industry.

In both sub-periods, capital intensity was higher in the better performing groups in high-technology industries.

6.2 TFP Gap by Industry and Key Economic Region

Table 6 provides more information about the TFP gaps between the 75th and 25th percentiles, and 90th and 10th percentiles across industries in four key economic regions (Northern, Central, Mekong River Delta, and Southern) in two phases of the reforms (sub-periods). These key economic regions were assigned by the government since 1997 to take advantages of the local region's natural resources and comparative advantages as well as to support for other satellite provinces.

Notably, industries in low technology intensity (ranked 1) recorded lower gaps compared to higher technology intensity (ranked 2: medium-low, ranked 3: medium-high, and ranked 4: high-technology). Most importantly, it is shown in Table 6 that TFP disparity in the early phase of the reforms (2000-2005) was much larger than in the second

Table 5: Capital Intensity, Gender Ratio in Labour, Leverage Ratio, and TFP growth by Quartiles of ln(TFP), 2001-2010

Industry	15	17	18	19	20	21	22	24	25	26	27	28	29	31	33	34	36	All
Sub-period 1 (2001-2005)																		
The First Quartile																		
Log(capital)	19.20	19.66	19.28	19.86	18.39	19.54	18.71	18.63	19.40	18.70	19.69	18.74	19.21	19.34	19.24	18.93	18.70	19.01
Female ratio	0.41	0.55	0.68	0.53	0.26	0.38	0.41	0.37	0.34	0.42	0.20	0.23	0.21	0.32	0.34	0.20	0.28	0.37
Capital Intensity	2.04	1.18	0.33	0.46	0.87	1.11	0.60	0.35	1.12	0.98	1.20	0.66	0.75	0.56	0.20	0.72	0.70	0.86
Leverage ratio	0.46	1.02	0.45	0.91	1.21	1.22	0.51	0.22	1.01	0.39	1.51	0.64	0.89	2.59	1.70	0.71	0.29	0.77
TFP growth (%)	0.03	-0.09	0.09	0.05	-0.03	-0.06	0.09	0.06	-0.12	-0.04	-0.28	-0.04	-0.09	0.06	0.28	-0.02	-0.04	-0.02
The Second Quartile																		
Log(capital)	20.21	20.58	20.35	21.56	19.13	20.34	19.50	20.19	20.59	19.73	20.42	19.51	19.97	20.95	20.46	19.91	19.46	20.01
Female ratio	0.47	0.62	0.77	0.69	0.29	0.35	0.40	0.34	0.35	0.41	0.15	0.22	0.20	0.30	0.30	0.17	0.33	0.38
Capital Intensity	1.30	0.89	-0.36	-0.02	0.61	1.00	0.52	0.59	1.17	0.76	0.89	0.53	0.40	0.92	0.47	0.41	0.24	0.61
Leverage ratio	1.98	3.29	2.58	0.43	1.26	2.34	4.14	1.91	2.03	0.98	3.65	1.13	-3.66	5.16	1.09	1.66	1.69	1.82
TFP growth (%)	0.05	-0.01	0.20	0.09	0.03	0.07	0.15	0.18	-0.07	0.05	-0.10	0.01	0.02	0.15	0.07	0.09	0.07	0.06
The Third Quartile																		
Log(capital)	21.39	22.19	21.91	22.76	19.93	21.32	20.66	22.11	21.65	21.09	21.62	20.51	21.35	22.68	22.39	21.83	20.88	21.32
Female ratio	0.62	0.65	0.82	0.79	0.36	0.31	0.43	0.34	0.35	0.37	0.15	0.22	0.20	0.39	0.43	0.25	0.45	0.42
Capital Intensity	0.77	1.19	0.10	-0.03	0.45	1.20	0.61	1.16	1.32	0.68	1.33	0.64	0.72	1.14	1.46	0.92	0.34	0.74
Leverage ratio	2.37	2.83	2.01	13.98	5.49	2.13	-0.61	1.24	2.63	2.18	28.19	1.73	3.25	1.88	0.83	1.48	2.32	3.18
TFP growth (%)	0.08	0.02	0.18	0.10	0.09	0.10	0.16	0.13	-0.03	0.06	-0.12	0.07	0.08	0.13	0.28	0.11	0.11	0.09
The Fourth Quartile																		
Log(capital)	23.25	24.42	23.40	24.20	21.69	23.13	22.68	23.75	23.76	23.53	24.14	22.76	23.13	24.43	24.85	24.29	22.83	23.31
Female ratio	0.72	0.65	0.83	0.80	0.46	0.34	0.43	0.40	0.42	0.30	0.16	0.23	0.25	0.45	0.53	0.26	0.51	0.45
Capital Intensity	0.69	1.73	0.20	0.08	0.46	1.51	0.85	1.12	1.78	1.24	1.76	1.22	0.94	1.33	1.85	1.63	0.40	1.03
Leverage ratio	3.20	4.13	1.97	2.13	4.58	0.63	0.69	2.02	2.26	8.44	2.26	5.47	2.94	2.96	-7.01	3.83	2.72	3.61
TFP growth (%)	0.12	0.04	0.20	0.12	0.10	0.12	0.11	0.12	-0.04	0.07	-0.08	0.09	0.05	0.14	0.11	0.16	0.12	0.09
Sub-period 2 (2006-2010)																		
The First Quartile																		
Log(capital)	19.57	19.52	19.02	19.29	19.01	20.11	18.77	19.11	19.85	19.81	20.37	19.02	19.09	19.44	18.48	19.82	18.88	19.32
Female ratio	0.48	0.60	0.69	0.61	0.36	0.39	0.41	0.40	0.39	0.38	0.21	0.23	0.23	0.34	0.35	0.25	0.33	0.39
Capital Intensity	1.54	0.83	0.20	-0.01	0.89	1.51	0.66	0.78	1.33	1.21	1.36	0.68	0.62	0.79	-0.19	1.07	0.57	0.86
Leverage ratio	1.07	1.46	2.52	1.22	1.35	3.01	0.93	0.48	1.17	0.79	-6.37	1.05	1.19	1.18	3.04	2.13	1.24	1.18
TFP growth (%)	-0.07	-0.22	0.20	0.01	-0.19	-0.21	-0.10	-0.06	-0.11	-0.03	-0.16	-0.04	0.04	-0.02	0.13	-0.04	0.13	-0.05
The Second Quartile																		
Log(capital)	20.27	20.27	19.71	20.74	19.44	20.66	19.31	19.94	20.39	20.50	20.81	19.41	19.84	20.60	19.65	20.70	19.69	19.98
Female ratio	0.53	0.57	0.71	0.62	0.37	0.36	0.41	0.35	0.40	0.38	0.19	0.23	0.22	0.37	0.39	0.26	0.35	0.39
Capital Intensity	1.23	1.04	0.02	0.20	0.76	1.49	0.79	0.72	1.25	0.97	1.29	0.58	0.66	0.85	0.20	0.93	0.59	0.79
Leverage ratio	1.97	1.80	1.78	3.02	1.29	1.70	1.08	2.51	2.21	1.62	1.82	1.63	1.79	0.73	7.05	4.44	1.45	1.83
TFP growth (%)	-0.01	0.00	0.26	0.08	-0.12	-0.08	-0.05	0.08	0.01	0.04	-0.05	0.03	0.15	0.08	0.21	0.07	0.19	0.04
The Third Quartile																		
Log(capital)	21.45	21.33	20.82	22.00	19.81	21.19	19.93	21.46	21.31	21.29	21.47	19.99	20.60	22.23	20.51	21.71	20.76	20.86
Female ratio	0.59	0.57	0.76	0.69	0.36	0.36	0.42	0.35	0.40	0.35	0.21	0.22	0.22	0.38	0.38	0.28	0.41	0.41
Capital Intensity	1.07	1.11	-0.29	0.07	0.61	1.31	0.79	1.19	1.35	0.82	1.42	0.54	0.61	1.19	0.18	0.84	0.49	0.75
Leverage ratio	3.85	0.45	2.88	2.76	1.80	1.79	3.18	2.93	3.20	1.73	37.97	2.06	1.77	2.48	1.57	5.58	7.31	3.79
TFP growth (%)	-0.02	-0.02	0.25	0.08	-0.06	-0.01	0.03	0.09	0.04	0.08	-0.08	0.07	0.17	0.14	0.27	0.12	0.18	0.07
The Fourth Quartile																		
Log(capital)	23.34	23.72	22.73	23.57	21.07	22.49	21.40	23.52	23.32	22.96	23.45	22.22	22.82	23.95	22.89	24.34	22.88	22.76
Female ratio	0.62	0.58	0.80	0.72	0.36	0.34	0.43	0.35	0.42	0.27	0.20	0.26	0.28	0.43	0.61	0.27	0.49	0.42
Capital Intensity	1.06	1.80	-0.09	0.11	0.67	1.34	0.70	1.34	1.65	1.09	1.84	1.24	1.01	1.23	0.84	1.74	0.68	1.04
Leverage ratio	2.82	3.93	2.92	2.16	3.01	3.44	168.65	2.21	7.51	2.31	3.72	13.41	2.78	17.87	6.44	6.63	9.63	17.34
TFP growth (%)	0.01	0.03	0.21	0.09	-0.01	0.03	0.02	0.07	0.05	0.08	0.07	0.10	0.16	0.17	0.29	0.13	0.11	0.08

Source: Author's compilation using the Vietnamese Enterprise Survey 2000-2005. List of selected industries is in Appendix A.1.

phase (2006-2010). The TFP catch-up might be induced by the more competition in the industries after the economic reforms.[34]

To be more specific, taking the exponential of 0.74, which is the average TFP$gap_{75/25}$ of the manufacture of wood products in the Northern key economic region (2001-2005), we could obtain the output ratio is 2.09:1 for 75th:25th percentile firms. In the second sub-period, the ratio drops to 1.33:1. For the group of highest technology intensity in the Northern region, the manufacture of chemical products reported the ratio at extremely high value 13.5:1, and then 2.41:1 respectively in the first and the second sub-periods. The huge gap in TFP between the two periods was narrowed down. This probably indicates

[34]The Northern key economic region includes Hanoi, Haiphong, Vinhphuc, Bacninh, Hung Yen, Quangninh, Haiduong. The Central key economic region consists of Danang, Thuathienhue, Quangnam, Quangngai, Binhdinh. The Mekong River Delta economic region covers the area of Cantho, Angiang, Kiengiang, Camau. Cities in the Southern economic region are Hochiminh, Dongnai, Baria-Vungtau, Binhduong, Binhphuoc, Tayninh, Longan, Tiengiang.

the evidence of the faster catch-up of the least productive firms in the second phase of reforms. These findings of catch-up are shown for all regions including non-key economics areas.

In the literature, as documented by Syverson (2004), the case of 4-digits industry in the US (1977) shows that the TFP gap was 0.651. This implies the output ratio of 90th percentile firm and 10th percentile firms was 1.92 given firms using the same input. The ratio calculated for the US manufacturing (1963-1977) by Collard-Wexler (2011) was 4:1 (TFP was predicted as residuals from the OLS method) and 2:1 (used method of Ackerberg et al. (2006)). In other research, Hsieh and Klenow (2009) report the 75th:25th percentiles' output ratio equal to 5.0:1 in India (1995), 3.6:1 in China (2005), and 3.2:1 in the US (1997) for manufacturing in general.

Table 6: TFP Gap by Industry and Key Economic Region, 2001-2010

Rank	Industry	Northern				Central				Southern				Mekong Delta				Others			
		2001-2005		2006-2010		2001-2005		2006-2010		2001-2005		2006-2010		2001-2005		2006-2010		2001-2005		2006-2010	
		75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10	75/25	90/10
1	Product of Wood	0.74	1.50	0.29	0.57	1.08	1.84	0.30	0.77	1.08	2.06	0.35	0.71	0.50	0.83	0.40	0.76	0.86	1.70	0.32	0.62
1	Furniture, manufacturing N.e.c	0.77	1.50	0.30	0.62	1.32	2.50	0.45	0.88	1.19	2.15	0.45	0.84	1.60	2.20	0.21	0.59	0.96	2.03	0.30	0.62
1	Food products	0.80	1.90	0.43	0.78	0.91	1.92	0.60	0.85	1.12	2.41	0.57	1.07	1.25	3.01	0.70	1.25	1.31	2.42	0.52	1.03
1	Paper products	0.89	1.70	0.35	0.76	0.82	1.75	0.42	0.69	1.03	2.13	0.39	0.83	1.01	1.57	0.46	0.83	1.35	2.12	0.39	0.79
1	Tanning & Dressing of Leather	1.12	2.25	0.32	0.58	1.48	2.44	0.41	0.73	1.04	1.98	0.36	0.68	0.64	1.81	0.52	0.75	1.38	2.25	0.26	0.62
1	Publishing, Printing & Reproduction of Recorded Media	1.13	2.05	0.24	0.57	1.00	1.62	0.45	0.73	1.25	2.25	0.29	0.67	1.05	2.14	0.29	0.59	1.08	1.74	0.29	0.57
1	Textiles	1.25	2.27	0.40	0.91	1.48	2.69	0.37	0.84	1.25	2.38	0.44	0.90	0.95	2.16	0.35	1.13	1.34	2.24	0.47	0.93
1	Wearing Apparel Dressing, Dying of Fur	1.44	2.28	0.32	0.62	1.23	2.03	0.37	0.64	1.01	1.98	0.30	0.52	1.26	2.52	0.24	0.52	0.87	1.85	0.29	0.55
2	Basic metals	1.03	2.00	0.41	0.94	0.65	1.50	0.34	0.71	1.42	2.77	0.40	1.19	1.33	1.52	0.92	1.14	1.14	2.61	0.37	0.82
2	Rubber & Plastic product	1.04	2.26	0.40	0.81	0.99	2.25	0.39	0.72	1.28	2.24	0.43	0.82	1.57	2.09	0.31	0.53	0.92	1.45	0.33	0.73
2	Fabricated Metal products	1.08	2.11	0.29	0.70	0.64	1.42	0.28	0.54	1.10	2.15	0.37	0.77	0.67	1.27	0.20	0.39	0.78	1.76	0.28	0.54
2	Other non-metalic products	1.54	2.80	0.54	1.08	1.35	2.94	0.41	0.97	1.39	2.60	0.54	1.09	1.96	3.14	0.96	1.31	1.36	2.35	0.43	0.83
3	Motor Vehicles, Trailers, Semitrailers Other transport equipments	1.82	3.15	0.83	1.53	1.29	2.43	0.59	1.35	1.98	3.20	0.56	1.16	0.88	2.18	0.47	0.90	1.16	2.21	0.57	1.13
3	Chemical products	2.32	3.41	0.88	1.81	1.63	2.86	0.85	1.67	2.04	3.27	1.00	1.80	1.84	3.87	0.78	1.84	2.14	3.60	1.02	1.82
4	Machinary, Equipment, Office, Accounting &Computing machine	1.67	2.65	0.60	1.02	0.85	1.10	0.31	0.87	1.30	2.34	0.47	0.91	1.10	2.53	0.57	0.92	1.24	2.33	0.40	0.83
4	Medical, precision and optical instrument	1.69	3.39	0.55	1.05	0.72	0.72	0.44	0.51	2.85	4.01	0.63	1.19	N/A	N/A	N/A	N/A	1.12	1.74	0.59	1.01
4	Electrical Machinery & Apparatus; TV, communication equipment	2.06	3.47	0.99	1.61	1.18	1.18	0.74	1.31	2.05	3.55	0.93	1.67	0.77	0.81	0.46	0.57	1.45	2.80	0.72	1.13

Notes: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2000–2010 for two sub-periods. 90/10 is the TFP gap between firm at 90th and 10th percentiles. 75/25 is the TFP gap between firm at 75th and 25th percentiles. Rank is the group of technology intensity: 1 (Low technology), 2(Medium-low technology), 3(Medium-high technology), and 4 (High technology). The rank is arranged by the author, basically following the OECD's concepts of ISIC Rev3 technology intensity.

6.3 Impacts of Provincial Governance Quality on Provincial TFP

This part investigates whether quality of provincial governance influenced the weighted average productivity by provinces. The investigation takes a closer look at the reforms of provincial authority ("one-stop shop") in the ease of doing business. This performance of local governments is proxied by the Provincial Competitiveness Index.

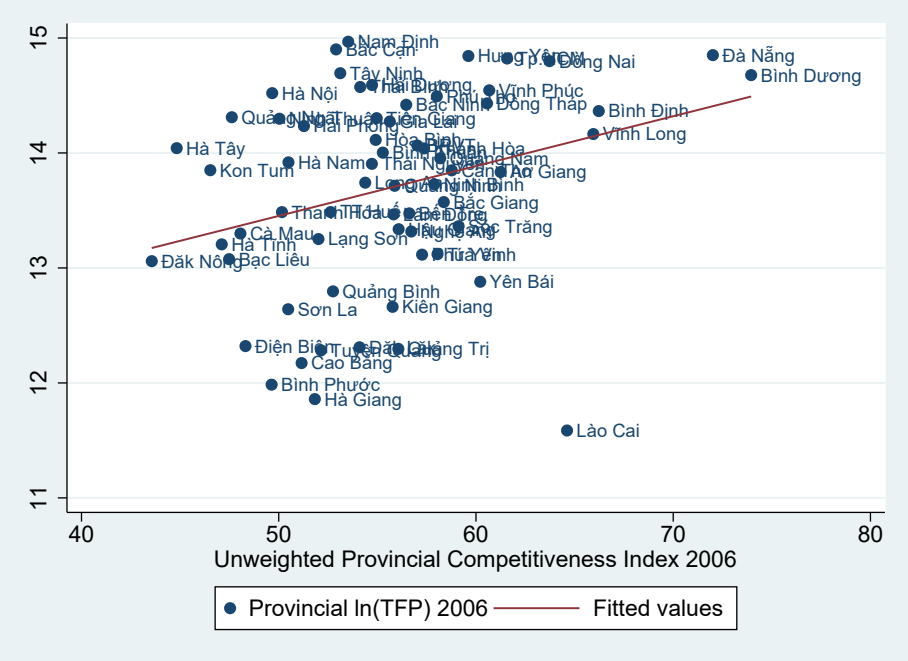
6.3.1 Correlation Between Provincial TFP and Provincial Competitiveness Index

Figures 4 & 5 exhibit the positive correlation between the weighted average TFP by province and the provincial competitiveness index (both are in log values) for year 2006 and year 2010.

Interestingly, Figure 4 &5 indicate pattern of the local governance quality between 2006 and 2010. The leading provincial authorities in business reforms in 2006 were in Da Nang, Dong Nai, Binh Duong, Binh Dinh, Vinh Long, Lao Cai. The list of the best local authorities in 2010, which includes Dong Thap, Da Nang, Binh Duong, Tra Vinh, and Lao Cai did not change greatly in comparison to year 2006. Big cities such as Hanoi, Hochiminh city, were unfortunately not included. However, in the list of the left-behind provinces in PCI (2006): Kon Tum, Quang Ngai, Dak Nong, Dien Bien, Ha Tinh, and Bac Lieu. Only Quang Ngai and Dak Nong were still in the least competitive provinces (2010). Other least PCI provinces (2010) are Lang Son, Lai Chau, Hung Yen, and Bac Kan.[35]

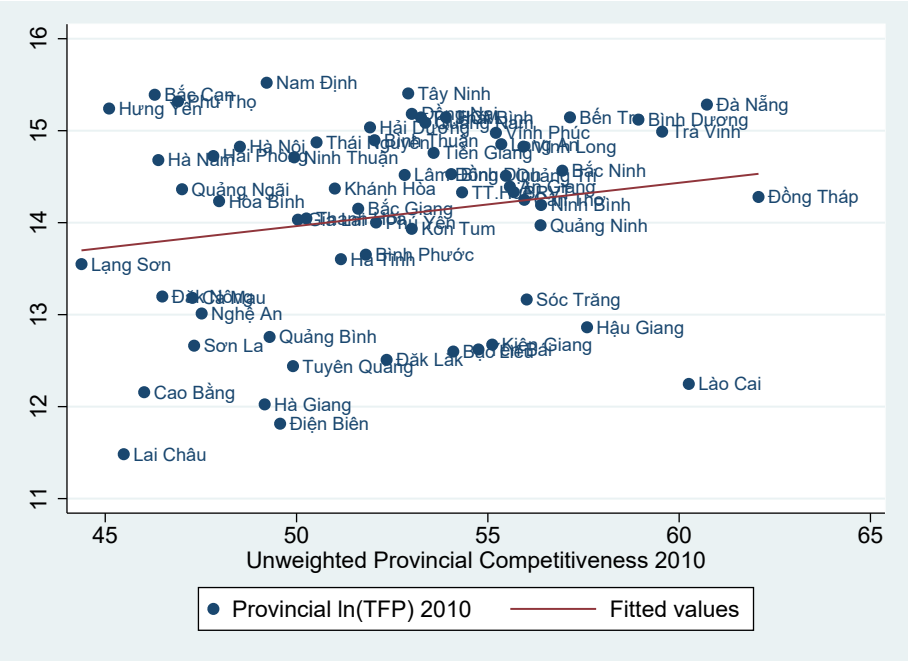
[35] Additional investigation in the nexus between the density of the province and the provincial TFP is presented in Appendix A.3.

Figure 4: Correlation between PCI and Provincial TFP, 2006



Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010. Selected 2-digit industries in Appendix A.1.

Figure 5: Correlation between PCI and Provincial TFP, 2010



Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010. Selected 2-digit industries in Appendix A.1.

6.3.2 Baseline Results

The result from the first differencing model, which controls for provincial labour density and the FDI spillovers, confirms the significant impacts of local governance quality on the improvement of productivity (see Table 7, column (1) and (2)). The results also exhibit the significance of FDI spillovers which is proxied by the ratio of number of FDI projects over total number of firms by provinces (in all sectors). The coefficients of FDI spillovers variable are higher than the coefficient induced from the variable that is proxied for better quality of the local governance. On the other hand, the coefficient of labour density is positive but insignificant.[36] Column (3) in Table 7 indicates the insignificance of lagged provincial TFP in the model when using the first differencing. Non-linear linkage between economic growth rate and development index is common in previous studies (for example, see : Samargandi et al. (2015) for the case of financial development index). Nevertheless, column (4) in Table 7 shows that adding the square of provincial governance quality does not fit the model. Hence there is little evidence of non-linear relationship between TFP level and the economics governance index in the case of Vietnam.

Table 8 exhibits more details of the empirical results for different groups.[37]

The findings in column (1) and column (2) in Table 8 show that local governance with upper PCI would significantly induces influences on provincial productivity while column (3) & (4) indicate that upper productivity provinces benefited more from the quality of local governance. Column (5) & (6) (Table 8) further confirm that provinces with advanced TFP and better quality of governance significantly benefited more from the local governance in ease of doing business than lower productivity provinces. Nevertheless, insignificant results for provincial governance quality in column (7) & (8) (Table 8) demonstrate that either upper or lower productivity provinces with lower governance quality did not gain benefits from the business regulation reforms of local authorities.

[36] Literature at country-level indicated that better institutions positively influence long-run growth in GDP per capital (for instant, see Le (2009), and Rodrik et al. (2004)). Differently, McCulloch and Malesky (2011) did not find robust evidence between the improvement of authority at district level and the economic performance in Indonesia. In a case study of China, the research of Wilson (2016) did not show significant impacts of the improvement in government quality on provincial growth in China during the post-Mao period (1985-2005).

[37]
Column (1) Upper PCI: provinces that had PCI higher than the median value in each year.
Column (2) Lower PCI: provinces that had PCI lower or equal than the median value in each year.
Column (3) Upper productivity: provinces that gained TFP higher than median value in each year.
Column (4) Lower productivity: provinces that obtained TFP lower than or equal to the median value in each year.
Column (5) Upper PCI & Upper TFP: provinces had better quality of governance and upper productivity in each year.
Column (6) Upper PCI & Lower TFP.
Column (7) Lower PCI & Lower TFP.

Table 7: Baseline Estimation A

Provincial TFP	$\triangle TFP_{p,t}$	(1)	(2)	(3)	(4)
Provincial governance quality	$\triangle PCI_{p,t}$	0.023*	0.025*	0.024*	-0.01
		(2.29)	(2.54)	(2.50)	(-0.11)
Labour density	$\triangle LAB_{p,t-1}$	0.005	0.005	0.001	0.004
		(1.23)	(0.91)	(0.18)	(0.80)
FDI projects/number of firms	$\triangle FDI_{p,t-1}$	0.367+	0.329+	0.292	0.332+
		(1.85)	(1.66)	(1.56)	(1.68)
Number of students in colleges and universities	$\triangle STU_{p,t-1}$	-0.015	-0.013	-0.006	-0.014
		(-0.29)	(-0.27)	(-0.12)	(-0.29)
Share in national manufacturing output	$\triangle MANU_{p,t-1}$	0.308	0.322	0.27	0.309
		(0.92)	(0.92)	(0.79)	(0.84)
Provincial TFP	$\triangle TFP_{p,t-1}$			-0.168	
				(-1.32)	
Provincial governance quality (square)	$\triangle PCI_{p,t-1}$				0.00
					(0.40)
Year # Municipality			Yes	Yes	Yes
Cluster (Province)		Yes	Yes	Yes	Yes
N		183	183	182	183
R-sq		0.11	0.147	0.229	0.148

Note: t statistics in parentheses; + p $< 0.1; *p < 0.05; **p < 0.01; ***p < 0.001$.
Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010 and provincial data downloaded from www.gso.gov.vn. The weighted average provincial TFP level is scaled down by being divided by 10^6. Upper productive provinces are those have TFP > median. Lower productive provinces are those have TFP $\leq$ median. The unweighted Provincial Competitiveness Index is downloaded from http://eng.pcivietnam.org.

Table 8: Baseline Estimation B

Provincial TFP	$\triangle TFP_{p,t}$	(1) Upper PCI	(2) Lower PCI	(3) Upper TFP	(4) Lower TFP	(5) Upper PCI Upper TFP	(6) Upper PCI Lower TFP	(7) Lower PCI Upper TFP	(8) Lower PCI Lower TFP
Provincial governance quality	$\triangle PCI_{p,t}$	0.038**	0.008	0.051**	0.015+	0.064**	0.016+	0.032	0.013
		(2.73)	(0.47)	(3.01)	(1.92)	(3.19)	(1.68)	(1.05)	(0.90)
Labour density	$\triangle LAB_{p,t-1}$	0.134	0.008+	0.003	-0.362	0.131	-0.231	0.016	-0.691
		(1.62)	(1.65)	(0.36)	(-0.78)	(1.09)	(-0.77)	(1.56)	(-0.39)
FDI projects/number of firms	$\triangle FDI_{p,t-1}$	-0.022	0.641*	0.343	0.152	-0.277	0.054	1.050	0.267
		(-0.09)	(2.22)	(0.78)	(1.09)	(-0.65)	(0.42)	(1.49)	(1.09)
Number of students in colleges and universities	$\triangle STU_{p,t-1}$	-0.031	-0.014	-0.006	-0.017	0.118	-0.107*	-0.085	0.042
		(-0.47)	(-0.21)	(-0.06)	(-0.40)	(0.78)	(-1.97)	(-0.56)	(1.27)
Share in national manufacturing output	$\triangle MANU_{p,t-1}$	0.537	0.142	0.267	0.270+	1.114	0.372	-0.374	0.267
		(1.27)	(0.34)	(0.42)	(1.71)	(1.11)	(1.17)	(-0.59)	(1.02)
Year # Municipality		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster (Province)		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N		92	91	93	90	53	39	40	51
R-sq		0.269	0.210	0.169	0.034	0.387	0.330	0.260	0.099

Note: t statistics in parentheses; + p $< 0.1; *p < 0.05; **p < 0.01; ***p < 0.001$.
Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010 and provincial data downloaded from www.gso.gov.vn. The weighted average provincial TFP level is scaled down by being divided by 10^6. Upper PCI are PCI which is higher than median value. Lower PCI are PCI which is lower than median value. Upper productive provinces are those have TFP > median. Lower productive provinces are those have TFP $\leq$ median. The unweighted Provincial Competitiveness Index is downloaded from http://eng.pcivietnam.org.

In Table 9, I added a control variable $DIST_{p,t-1}$ which is the sum of inverse weighted distance from a province to elite provinces and elite provinces' TFP (see Equation 3). Elites are provinces that gained TFP values higher than the TFP value of 75th quartile.

The significant results in Column 1 in Table 9 indicate that spillovers from nearer elites

Table 9: Baseline Estimation C

Provincial TFP	$\triangle TFP_{p,t}$	(1) Baseline	(2) Upper PCI	(3) Lower PCI	(4) Upper TFP	(5) Lower TFP	(6) Upper PCI Upper TFP	(7) Upper PCI Lower TFP	(8) Lower PCI Upper TFP	(9) Lower PCI Lower TFP
Provincial governance quality	$\triangle PCIp,t$	0.017+	0.034*	-0.008	0.038*	0.012+	0.060*	0.016+	-0.006	0.008
		(1.69)	(2.34)	(-0.48)	(2.06)	(1.72)	(2.5)	(1.65)	(-0.22)	(0.64)
Labour density	$\triangle LABp,t-1$	0.009+	0.108	0.016*	0.009	-0.562	0.121	-0.321	0.027*	-1.184
		(1.87)	(1.28)	(2.2)	(1.03)	(-1.29)	(0.92)	(-1.18)	(2.45)	(-0.64)
FDI projects/number of firms	$\triangle FDIp,t-1$	0.317+	0.009	0.574*	0.396	0.143	-0.226	0.056	1.064+	0.218
		(1.76)	(0.04)	(2.35)	(0.97)	(1.08)	(-0.55)	(0.41)	(1.87)	(0.99)
Number of students in colleges/universities	$\triangle STUp,t-1$	-0.023	-0.036	-0.024	-0.025	-0.018	0.121	-0.107+	-0.103	0.035
		(-0.47)	(-0.60)	(-0.34)	(-0.24)	(-0.43)	(0.78)	(-1.85)	(-0.57)	(1.21)
Share in national manufacturing output	$\triangle MANUp,t-1$	0.302	0.397	0.19	0.199	0.277+	0.882	0.36	-0.306	0.251
		(0.93)	(1.00)	(0.49)	(0.35)	(1.74)	(0.82)	(1.16)	(-0.57)	(1.00)
Weighted distance to elite provinces	$\triangle DISTp,t-1$	2.809*	1.908+	4.333*	2.946+	1.419	0.906	0.866	6.461**	1.847
		(2.54)	(1.67)	(1.96)	(1.93)	(1.32)	(0.63)	(0.58)	(2.71)	(1.38)
Year # Municipality		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster (Province)		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N		183	92	91	93	90	53	39	40	51
R-sq		0.193	0.263	0.265	0.251	0.064	0.389	0.33	0.429	0.13

Note: t statistics in parentheses; + p $< 0.1; *p < 0.05; **p < 0.01; ***p < 0.001$.
Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010 and provincial data downloaded from www.gso.gov.vn. The weighted average provincial TFP level is scaled down by being divided by 10^6. Upper PCI are PCI which is higher than median value. Lower PCI are PCI which is lower than median value. Upper productive provinces are those have TFP > median. Lower productive provinces are those have TFP $\leq$ median. The unweighted Provincial Competitiveness Index is downloaded from http://eng.pcivietnam.org.

are positive in the context of positive impacts from FDI spillovers, labour density, and the improvement of local governance. The strongest technology diffusion from nearby elite provinces are observed in provinces with lower PCI (Column 3, Table 9), more specifically, in lower PCI but upper TFP provinces (Column 8, Table 9).

7 Conclusion

The early phase (2000-2005) of the economic reforms in Vietnam saw the impressive implementation of "cutting the red tape". This policy has reduced the administrative barriers for enterprises to enter manufacturing industries. Stylized facts show that during this phase, there were impressive increases in the number of manufacturers and in the growth in the labour force working in the industries.

In the second phase (2006-2010), "cutting the red tape" continues to reduce documents required in business regulations. Furthermore, "one-stop shops" were established to decentralize the central authorities control on business regulations to provincial authorities. The centralization provides more convenient and efficient public administrative services to enterprises as well as encourages better interaction between local authorities and entrepreneurs.

In both phases, most TFP leading manufacturers (firms at the fourth quartile of TFP) produced on average in a larger firm-size, and performed at a higher TFP growth rate. Nevertheless, a higher leverage ratio or capital intensity were observed neither in TFP frontier firms in all industries, nor in a specific phase of the economic reforms. It is worth noting that the second phase of the reforms saw an increase in the participation of female workers in the labour force of firms leading productivity in low-technology industries. Interesting findings reveal that the TFP gap between the least productive and the frontier firms was narrowed much more in the second phase of the reforms across industries and economic regions. However, slower catch-up in TFP was still seen more in high-technology industries than in low-technology industries in the second phase.

Interestingly, this paper does find evidence of the improvement in local governance quality on provincial manufacturing TFP during the second phase of the reforms. Importantly, lower productive provinces also observed the positive effects of the better local governance on their TFP. In addition, the impacts of advanced local governance on provincial manufacturing productivity are shown in the context of significant technology diffusion from nearby leading TFP provinces.

The limitation of the study is that the investigation of the quality of local governance only focused in the ease of doing business. Taxation regulations and regulations for international and regional practices in specific are not yet discussed. Further research may be conducted to explore whether taxation control which is decentralized to the local governments can stimulate productivity.

A Appendix

A.1 List of selected industries

Industry	VSIC1993
Food Products	15
Textiles	17
Wearing Apparel; Dressing & Dying of Fur	18
Tanning & Dressing of Leather	19
Products of Wood	20
Paper products	21
Publishing, Printing & Reproduction of Recorded Media	22
Chemical Products	24
Rubber & Plastic Products	25
Other Non-metallic Products	26
Basic Metals	27
Fabricated Metal Products	28
Machinery & Equipment, Office, Accounting & Computing Machinery	29 + 30
Electrical Machinery & Apparatus N.e.c; Television & Communication Equipment	31 + 32
Medical, Precision & Optical Instruments	33
Motor Vehicles, Trailers & Semi-trailers & Other Transport Equipment	34 +35
Furniture; Manufacturing N.e.c	36

Source: The 2-digit classification is VSIC 1993 provided by the General Statistics of Vietnam. The Food industry includes 4-digit classification from 1511 - 1520.

A.2 Algorithm of Production Function Estimation by Instrumental Variables (Wooldridge (2009) and Petrin and Levinsohn (2012))

Following the theoretical framework documented by JW, I first setting up a production function:[38]

$$va_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \epsilon_{it} \tag{5}$$

Where: va_{it} is the log of value added, l_{it} is the log of number of labours, k_{it} is the log of capital stocks. Similar to Olley and Pakes (1996) and Levinsohn and Petrin (2003), Wooldridge (2009)separates the error terms into ω_{it} which is the unobserved productivity of firm, and ϵ_{it} which is the measurement errors of the value added and the unpredictable shocks. ϵ_{it} is orthogonal on current and past inputs):

$$E[\epsilon_{it}|k_{it}, l_{it}, m_{it}, k_{i,t-1}, l_{i,t-1}, m_{i,t-1}, k_{i1}, l_{i1}, m_{i1}] = 0; t = 1, 2...T \tag{6}$$

The assumption in equation 6 can be strengthen by adding the serial independence of ϵ_{it}, i.e: ϵ_{it} is random, is uncorrelated with its past values, and has zero mean.

Demand of intermediate inputs is: $m_{it} = m(\omega_{it}, k_{it})$. When m_{it} strictly increases in ω_{it}, it allows for the inversion of $m(.)$, yields: $\omega_{it} = f(m_{it}, k_{it})$. [39]

[38] To be in line with Levinsohn and Petrin (2003) method, I use the notation va_{it} which is the log of value added while Wooldridge (2009)states the dependent variable is the log of output in general.

[39] This is the assumption documented by Levinsohn and Petrin (2003). When the method of Olley and Pakes (1996) is applied, the investment is used instead of the intermediate inputs.

Because unobserved productivity ω_{it} follows the Markov rule:

$$\omega_{it} = E[\omega_{it}|\omega_{i,t-1}] + a_{it} = g[f(m_{i,t-1}, k_{i,t-1})] + a_{it} \tag{7}$$

Orthogonal condition of a_{it} is given by: [40]

$$E[a_{it}|k_{it}, k_{i,t-1}, l_{i,t-1}, m_{i,t-1}] = 0 \tag{8}$$

The shocks a_{it} is uncorrelated with k_{it} because capital stock is chosen at period $t-1$. The uncorrelation of a_{it} with other variables in lagged values are obviously owing to the timing of choices were made in the past.

In this light, Wooldridge (2009) sets up two simultaneous equations which jointly estimate the coefficients of capital stocks and labour inputs:

$$va_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + f(k_{it}, m_{it}) + \epsilon_{it} \tag{9}$$

$$va_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + g[f(k_{i,t-1}, m_{i,t-1})] + a_{it} + \epsilon_{it} \tag{10}$$

Orthogonal condition for equation 9 is given in equation 6. Orthogonal condition for equation 10 is:

$$E[(\epsilon_{it} + a_{it})|k_{it}, l_{it}, m_{it}, k_{i,t-1}, l_{i,t-1}, m_{i,t-1}, k_{i1}, l_{i1}, m_{i1}] = 0 \tag{11}$$

In these two equations 9 and 10, there are unknown forms of $f(.)$ and $g(.)$. Wooldridge (2009) suggests the same method from Levinsohn and Petrin (2003) and Olley and Pakes (1996), where $f(.)$ includes polynomials of the inputs up to third order. $g(.)$ contains the low-order polynomials in lag of ω_{it}, which can be approximated by the polynomials of lag of inputs in practice. Combined with the orthogonal condition from equation 11, sets of instruments could be assigned for equation 9 and 10.

$$Z_{it1} = [1, k_{it}, l_{it}, f(k_{it}, m_{it})] \tag{12}$$

$$Z_{it2} = [1, k_{it}, l_{i,t-1}, g[f(k_{i,t-1}, m_{i,t-1})] \tag{13}$$

Specifically, in Z_{it1}, $f(k_{it}, m_{it})$ includes all polynomials of k_{it}, m_{it} up to the third order, but does not include k_{it} for the identification of k_{it} in equation 9. [41]

[40] a_{it} is assumed to be orthogonal to k_{it} and all past values of (k_{it}, l_{it}, m_{it}).

[41] This is also similar to the first stage of Levinsohn and Petrin (2003) or Olley and Pakes (1996).

In Z_{it2}, $g(.)$ includes the (up to) third polynomials in lag of capital stocks and materials and $q_{i,t-1}$. $q_{i,t-1}$ is defined as the low-order polynomials in the function of lags of k_{it}, m_{it}. The second set of instruments does not include l_{it}, m_{it}. Wooldridge (2009) suggests Z_{it1} and Z_{it2} can also be applicable for equation 10.

Wooldridge (2009) notes that equation 10 could be estimated using instrument variable (IV) when $f[g(.)]$ is completely unspecified. The author also states that lags would be added to test the overidentification restrictions but at the cost of loosing observations. Petrin and Levinsohn (2012) practice the application of the exact identification in 10. Simply, Petrin and Levinsohn (2012) instrument l_{it} with its own lag, and other exogenous variables shown in the orthogonal condidition in equation 11 act as their own instruments.

A.3 Linkage between Province's Density and Provincial TFP

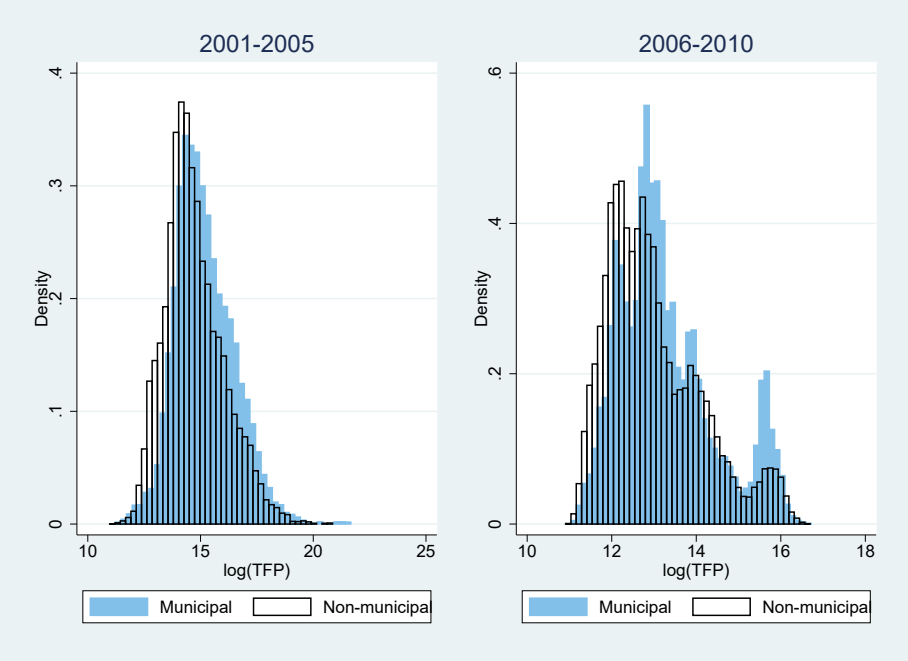
This section examines whether TFP were different across municipal and non-municipal area. Five municipalities of Vietnam are Ha Noi Capital (Red River Delta region), Hai Phong (Red River Delta region), Da Nang (South Central Coast region), Can Tho (Mekong River Delta region), Ho Chi Minh city (Southeast region). Those cities play a key roles as a regional center of economics, politics, geography, and culture. Therefore, they are the biggest clusters of workers, experts, producers, and services suppliers in the country. Market demand is higher, infrastructure is also more developed, technology is more advanced in municipalities than other areas. Unsurprisingly, Figure 6 shows that the distributions of ln(TFP) in municipalities shift more to the right in both sub-periods. In other words, on average, technology efficiency of municipal areas were higher than non-municipal areas. Denser areas (and more developed), such as municipal cities, filtered for higher productivity producers. The result is in line with findings of Syverson (2004) and Combes et al. (2012). There might be several reasons explaining for the results. Specifically, (i) these municipal provinces have advantages of natural resource and location as the linkages to other provinces: (ii) historically, manufacturing clusters were shaped in those cities; (iii) more urbanized areas generate higher agglomeration effects; (iv) tougher competition induces the self-selection of firms and keep firms with high efficiency staying in the market (see Syverson (2004) and Combes et al. (2012)).

In more details, higher productivity was also shown in relation with the density of labour. Figure 7a plots the province's density ratio (log value of number of citizens older than 15 years-old per km^2) against the ln value of weighted average TFP by province (TFP_{pt}) (method measuring provincial TFP is explained in Section 5.3).

Consistently, positive correlation between the density ratio province and the average productivity are shown for 5 years (2006-2010).[42] In other words, firms in more urbanized cities on average gained more efficiency. The results are similar to the finding of TFP in big cities in France by Combes et al. (2012). Nevertheless, in stead of using average TFP as Combes et al. (2012), this paper calculates weighted average TFP which counts for the

[42] As we do not have data for labour density before 2005, we only draw the graph for the second subperiod.

Figure 6: Distribution of ln(TFP) across Municipal and non-municipal areas, 2001-2010

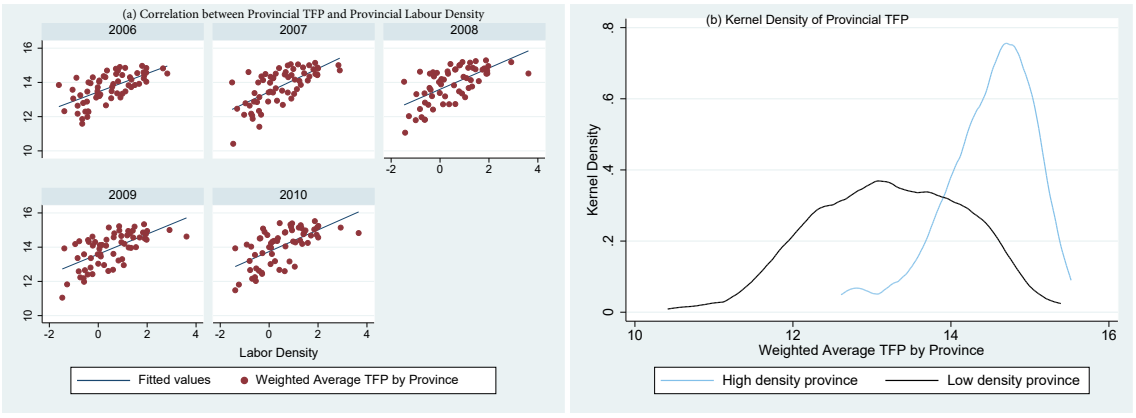


Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2000–2010 for two sub-periods. Municipal areas are Hanoi, Haiphong, Danang, Cantho, and Hochiminh city.

size of firm in term of their employment.

Interestingly, Figure 7a indicates that there are two outliers of the labour density ratio ($ratio > 2$) which are Hanoi capital and Hochiminh city. However, log average TFP of these outliers were similar as several medium density cities (density ratio ranged from 0 to 2), and also lagged behind some other medium density cities. The evidence of medium density provinces with leading TFP was shown much clearer in Figure 7a.

Figure 7: Linkages between Provincial Weighted Average Productivity, Provincial Labour Density, and Provincial Firm Density, 2006-2010



Source: Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010. Selected 2-digit VSIC 1993 industries are listed in the Appendix A.1. (a) Number of citizens (older than 15 year-old) by year and data of land area by province are downloaded from www.gso.vn. (b)Density of firms is number of firms by province. High density areas had higher number of firms than medium number of firm in the country. Low density ares had less number of firms than medium number of firm. Variables are in log values.

Additional, provinces with higher density of firms (number of manufacturers were larger than the country's medium number) observed higher TFP on average (Figure 7b). More firms participated in the manufacturing in one province not only enhanced competitiveness but also increased substitutes for suppliers. This resulted in stronger agglomeration effects within the province (Syverson, 2004). Remarkably, in Figure 7b, the second sub-period observed the up-wards shift and the less dispersion in TFP distribution of the more advanced areas.

A.4 Robustness check

This part presents the results of the regression on current and future variables in stead of lagged variables in the baseline specification. The regressions of robustness checks confirms for the findings in the baseline results (Table 10).

Table 10: Results of Placebo Test

(a) $\triangle TFP_{p,t}$			(b) $\triangle TFP_{p,t}$		
Provincial governance quality	$\triangle PCI_{p,t+1}$	-0.011	Provincial governance quality	$\triangle PCI_{p,t+2}$	-0.010
		(-1.17)			(-0.92)
Labour density	$\triangle LAB_{p,t}$	-0.020+	Labour density	$\triangle LAB_{p,t+1}$	0.004
		(-1.91)			(0.46)
FDI projects/number of firms	$\triangle FDI_{p,t}$	-0.179	FDI projects/number of firms	$\triangle FDI_{p,t+1}$	-0.022
		(-1.41)			(-0.12)
Number of students in colleges and universities	$\triangle STU_{p,t}$	0.049	Number of students in colleges and universities	$\triangle STU_{p,t+1}$	0.016
		(1.11)			(0.54)
Share in national manufacturing output	$\triangle MANU_{p,t}$	-0.325+	Share in national manufacturing output	$\triangle MANU_{p,t+1}$	0.169
		(-1.81)			(0.51)
Year # Municipality		Yes	Year # Municipality		Yes
Cluster (Province)		Yes	Cluster (Province)		Yes
N		182	N		122
R-sq		0.162	R-sq		0.017

Note: t statistics in parentheses; + p < 0.1; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$. *Source:* Author's compilation using data drawn from the Vietnamese Enterprise Survey 2005-2010 and provincial data downloaded from www.gso.gov.vn. The Provincial Competitiveness Index are downloaded from http://eng.pcivietnam.org.

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