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Does Rising Import Competition Harm Local Firm Productivity in Less Advanced Economies? Evidence from Vietnam's Manufacturing Sector

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Abstract

This paper examines whether rising import penetration has an effect on the productivity of domestic firms. The study uses data on a 10-year unbalanced panel of firms in the manufacturing sector in Vietnam from 2000 to 2009. Panel and instrumental variable methods are used to control for firm heterogeneity and endogeneity of import penetration. We find significantly negative effects of import competition on local firms' productivity. Further investigation on the basis of firm size and industry technology levels shows that SMEs are more adversely affected, but that industry technology level does not matter.

JEL Classification

F19; L25; P45

Keywords

import penetration
productivity
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1. Introduction

Perhaps the biggest shock to international trade in the late 20th and early 21st centuries is the international trade boom, especially Chinese exports due to globalization. The explicit impact of the export boom is that consumers around the world enjoy lower prices especially for low-tech goods. However, countries that produce products facing direct competition from Chinese exports may be adversely affected.

Vietnam, in a particular position bordering China, is more affected by cheap imports from that country. During the period 1998-2011, China export growth on average was 19 percent per annum (Appendix Table 1), and Vietnam's import from China increased quickly (Appendix Table 2). China has become the biggest source of Vietnam's imports. In 2011, the import volume from this country is almost double that of the second largest source of Vietnam's imports, Korea, and even higher than the total import volume from ten ASEAN countries (GSO Trade Statistics, 2012).

Vietnam's imports in world trade have increased in recent years, from 0.22 percent in 1998 to 0.6 percent in 2009. Vietnam's import from China has risen even faster from four percent in 1998 to almost a quarter of Vietnam's total import volume in recent years (Appendix Table 2). This context has motivated us to consider whether and how local firms adjust to rising import penetration in terms of productivity.

The impacts of imports on productivity have been investigated primarily at the country or industry level. Studies at the aggregate level show that imports are widely believed to be one of the main channels for technology diffusion and economic development (for example, Coe and Helpman 1995, Grossman and Helpman 1995). International trade is also an important channel through which foreign innovation, technology flow and flow of ideas across borders (Acharya and Keller 2009, Doan and Stevens 2012, Freeman and Kleiner 2005). As a result, the productivity of a country may be improved through exporting and importing activities.

Studies using aggregate level data have some shortcomings. First, the exact mechanisms of the role of imports in domestic productivity growth could be obscured by using aggregated or country level data (Brambilla, Khandelwal and Schott 2010). Firm heterogeneity may affect firm productivity and innovation, but is not possibly controlled by using aggregate data (Kasahara and Rodrigue 2008). Furthermore, Halpern, Koren, and Szeidl (2005) show that the studies at macro-level may suffer from the problems of omitted variables and reverse causality biases.

With more availability of micro level data, researchers are today turning to firm level analyses when considering the role of imports on productivity growth. Some studies show that imports have a positive impact on TFP (for example, Fernandes 2007 Halpern and

Körösi 2001). However, when considering within other markets, imports may have either a negative or no impact on productivity, depending on firm competitiveness and context (for example, Van Biesebroeck 2003, Vogel and Wagner 2011, Edwards and Jenkins 2013). Hence, generalized inferences are impossible.

An increasing interest in examining the effect of import penetration on firm performance is observed in some developed countries, but little work has been carried out in developing countries. The finding on firm behaviour and performance in developed countries may not hold for the developing world, especially poor countries where firms are typically less technologically advanced, have a low level of development, and lack the capacity and resources to innovate and compete with imports.

The lack of evidence of the impact of imports on productivity at the firm-level in developing countries is another motivation for this study to test that hypothesis in Vietnam; i.e. how the productivity of firms in industries changes with rising import penetration. The exercise is carried out on a sample of Vietnamese manufacturing firms through the period 2000-2009. Vietnam is an interesting case of a country at a lower level of economic development, but which has experienced economic transition and strong growth in both imports and exports since signing the BTA with the US in 2001 and gaining WTO accession in 2007. Vietnamese firms typically have low technology and a low level of development so that higher tech level products from more developed countries or cheap imports especially from China may create fierce competition and have negative effects on firm performance.

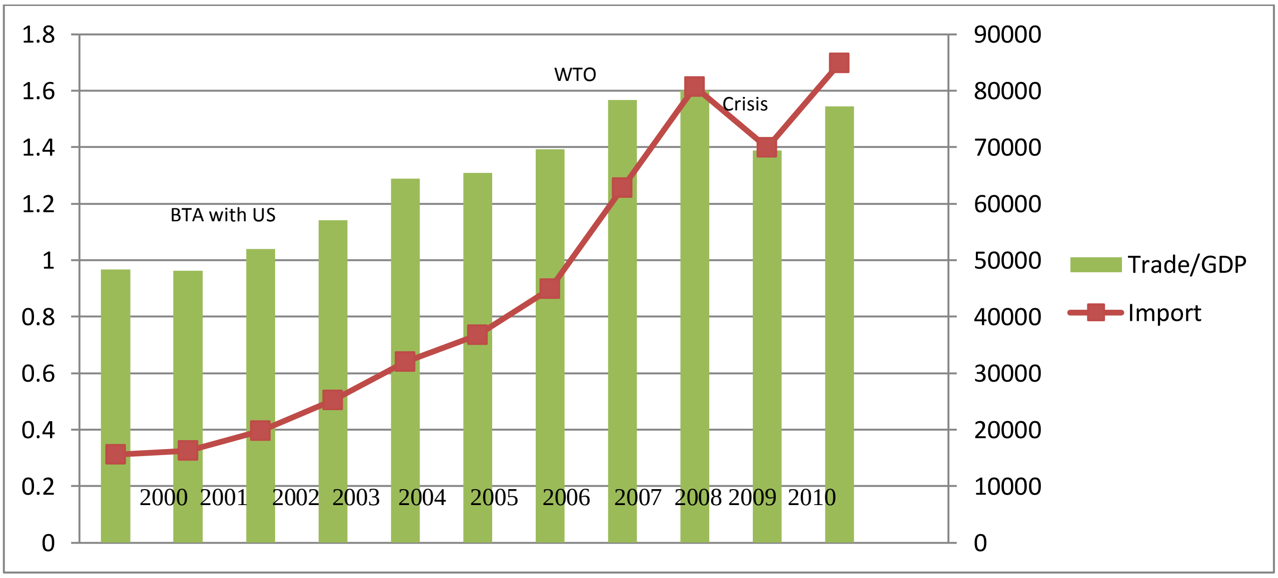
Although there are several studies of import competition on firm performance, the present study is meaningful as it makes a number of unique contributions to the literature. For example, it draws upon a unique dataset to provide first evidence of the role of import competition on productivity in Vietnam. In addition, there are some methodological challenges when considering the role of import penetration on firms' productivity. For example, the results can be biased by unobserved characteristics and imports may be endogenous. These issues have been overcome by using a combination of time-differenced and Instrumental Variable estimations.

The remainder of the paper is in three parts. Section 2 presents background of import activities in Vietnam. Section 3 explains data sources and methodology. Section 4 discusses the empirical results. The final section summarises the main findings and provides some policy implications

2. Background of Vietnamese Import Activities

Vietnam is an open economy with fast growing of imports especially since 2000. The total import value of Vietnam (in current US$), as displayed in the Figure 1, shows the country experienced a significant growth from nearly US$ 15.7 billion in 2000 to nearly US$ 85 billion in 2010. In addition, as shown in Figure 1, there are three important cornerstones affecting import growth of Vietnam through this period. The first was a trade agreement with the USA in 2001. This has been a significant factor in boosting the trade relationship between Vietnam and the US since 2000. In addition, imports in Vietnam continued to boom in the period following admittance to the WTO in 2007. Although the value of import growth witnessed a drop in 2009 due to global crises, there are clear signs of quick recovering in following years.

Figure 1: Imports and Trade-GDP Ratio 2000-2010



Source: Statistical Yearbook (various issues) from Vietnam General Statistical Offices.

In terms of measuring the openness of the economy, the ratio of trade over GDP is a popular index measuring the integration of the economy. As displayed in Figure 1, this ratio increased nearly twice (from near 97 percent in 2000 to approximately 155 percent in 2010). This suggests that on one hand the degree of integration of Vietnamese economy is becoming greater, and the economic growth depends on the value of exports and imports. On the other hand, the economy can be easily vulnerable to external shocks.

3. Data and Econometric Models

3.1 Data

Estimating the effects of import competition on productivity and employment requires data on firm production (value added, capital and labour inputs), together with indicators of import penetration – both at the firm level and by industry. The primary dataset used in this paper is drawn from the Vietnam Enterprise Survey (VES). The survey has been conducted annually since 2000 by the Vietnam General Statistical Office (GSO). The VES offers a panel dataset spanning from 2000 to 2009. All registered firms have to fill the questionnaire provided by the district statistical offices as legal liability described in the Vietnam Statistical Law 2003. The VES provides comprehensive information about firms and their activities in the first decade of the twenty first century. The census offers information on firm demographics, ownership, business activities, employment, wages, assets, capital, business performance, revenue, and profit. Industries have been defined in this paper by the Vietnam Standard Industrial Classification 1993 (VSIC1993) 4-digit industry level codes.

Chinese export and Vietnamese import data have been sourced from the United Nations (UN) Comtrade by the Standard International Trade Classification (SITC) Revision 3, we then concord the trade data with the VSIC1993. Import data were used in the paper to capture key shocks to Vietnam import such as China's accession to WTO in 2001, Vietnam's accession to WTO in 2006 and FTAs between Vietnam and its key trade partners in the decade of 2000s. Import penetration is defined as ratio of total import over sales by sector (four-digit industry level) and for each year.

Our sample consists of the manufacturing sector only as we do not have services import data. The analysis is restricted by data limitations. We removed firms without a tax code for some reasons such as missing data or infant firms without tax codes, since we use the tax code as firm identifiers to merge data. Further, our data transformation, for example taking logarithms in the production function estimation removes negative or zero value data. Table 1 provides a summary of key variables of the dataset used in this paper.

Table 1: Manufacturing Industry Sample

Year	Observations	Mean Value Added (VA)	Mean Cost of Capital (K)	Mean Employment (L)
2000	9,852	5,187	2,649	148
2001	12,882	4,658	2,337	133
2002	14,573	5,057	2,162	138
2003	16,670	5,525	2,202	142
2004	20,216	5,540	2,201	134
2005	23,126	5,448	2,249	125
2006	26,318	6,003	2,420	119
2007	30,480	6,857	2,520	115
2008	37,546	7,111	3,143	100
2009	44,139	7,816	2,764	88
Overall	235,802	6,335	2,550	116

Notes:
VA and K are at current prices, measured in VND million. Employment is labour count. Cost of capital is equal to depreciation plus interest rate multiplied by fixed assets.

The sample shows that the number of firms has increased significantly between 2000 and 2009, especially after introduction of the Unified Enterprise Law and Competition Law in 2005. This is in line with the massive rise in number of all sector firms, from more than 42,000 in 2000 to more than 240,000 firms in 2009 (Doan and Stevens 2012). It also shows that more smaller-firms enter the market as we observe that mean employment tends to decline over the study period, from 148 to 88 employees.

3.2 Econometric Models and Estimation Issues

3.2.1 Empirical Model for Impact of Import Penetration on Firm Productivity

To estimate the effects of import penetration on firm productivity, we estimate an augmented Cobb-Douglas production function, which is a common empirical specification in this literature (for example, Bloom, Draca and Van Reenen 2011, Bugamelli, Fabiani and Sette 2010). Specifically, we estimate a value added production function with inputs of capital and labour, augmented with measures of import penetration, which takes the following form:

$$lnVA_{ijt} = \alpha + \beta_1 imp\_pen_{jt} + \beta_2 lnK_{ijt} + \beta_3 lnL_{ijt} + \beta_4\, ownership_{ijt} + \lambda_t + \lambda_j + \lambda_i + e_{ijt} \qquad (1)$$

where $lnVA_{ijt}$ is log value added of firm i in industry j at time t; K_{ijt} is cost of capital services; and L_{ijt} is a count of employment. At the industry level, we include annual measures of import penetration, and also firm ownership (foreign, private and state) to capture the productivity differences. Equation (1) also contains dummy variables for year (λ_t), industry (λ_j), and firm (λ_i) fixed effects.

However, estimates from equation (1) may be biased. The bias arises from two sources: omitted variables and endogeneity of the import penetration variable. The estimation is done with a time-differenced model specification because the differencing can remove the bias from omitted variables at least for variables that are time invariant within firm or industry (equation 2). That is, we can control for unobserved heterogeneity between firms (fixed effect). However, one potential problem of differencing is that it may magnify measurement error, so longer differences should be used to reduce the impact of the measurement error.[1]

In empirical analysis we start with a baseline estimation of equation (1) with the Ordinary Least Squares (OLS) and Fixed Effect (FE) model for level data (equation 1), and then with a certain time-differenced specifications (equation 2).

$$\Delta lnVA_{ijt} = \alpha + \beta_1 \Delta imp\_pen_{jt} + \beta_2 \Delta lnK_{ijt} + \beta_3 \Delta lnL_{ijt} + \beta_4\, ownership_{ijt} + \lambda_t + \Delta e_{ijt} \qquad (2)$$

[1] But longer time differencing for example, three-year or four-year differencing also comes at cost of losing more observations of short-lived firms, so two-year differenced specification is the main model specification for our time-differencing approach.

This is a common parsimonious alternative (for example, Bloom *et al.* 2011, Edwards and Jenkins 2013, Bugamelli *et al.* 2010) to estimating separate capital and labour coefficients for each of 128 separate industry groups at four digit level over the study period, or using a two-step approach of regressing residuals from industry-specific production functions on import penetration measures. Due to the inclusion of industry fixed effects, the coefficients on the import penetration measures are identified by within-industry (four-digit level) variation over time for time-difference models. In this construction, there is no within-industry variation in import penetration in any given year.

Direct estimation of equation 2 may give biased estimates of the key parameters of interest (β_1) due to omitted variables that are correlated with both import penetration and value added, or due to the endogeneity of factor inputs or import penetration, where these covariates may respond to value added. Such biases may lead to estimates of positive (or negative) effects, or even no effects taking place.

The endogenous choice of factor inputs is a potential source of endogeneity bias. Firms may choose variable factor inputs in response to new information on their (possibly time varying) firm-specific productivity (λ_i). This introduces an upward bias in the coefficients on variable inputs such as labour, and a consequent downward bias on the capital coefficient (Griliches and Mairesse 1998). The degree of bias that this form of endogeneity causes to estimates of import penetration effects is an empirical question.

There are several solutions to the endogeneity of inputs. The first is the instrumental variable approach. This method needs valid instruments that are correlated with endogenous variables (input level choice, for example, labour) but not correlated with firm outcome or its residual (error terms). It is typically hard to find good instruments that satisfy the conditions. Input prices (interest rate and/or wage rate) can be potential instruments, but input prices are often unavailable in datasets or do not vary or do not vary enough across firms. Even if there is a variation in input price, it may account for market power in input markets or heterogeneity in quality of inputs, for example, worker quality, that may invalidate the use of input price as an instrument (Ackerberg, Caves and Frazer 2006).

Recently, some suggest using Levinsohn and Petrin (2003), an extension of Olley and Pakes (1996). This approach uses firm's intermediate consumption to control for the endogeneity. However, there are some disadvantages in these approaches such as identification and estimation issues (see more detailed discussion in Ackerberg *et al.* 2006, and Wooldridge 2009). Due to the lack of valid instruments to address the endogeneity and lack of outperformed methods, we therefore apply the conventional approach, the OLS and the FE to Cobb-Douglas production function in this paper to estimate TFP.

We rely on estimates that do not explicitly control for the endogeneity of factor inputs, focusing instead on controlling for the potential endogeneity of import penetration. Whereas firms are expected to endogenously adjust factor inputs in response to annual changes in firm-specific productivity (λ_{it}), import penetration is likely to respond to changes in overall productivity performance within industries. The inclusion of industry fixed effects and industry-specific time control for the influence of import firms targeting particular industries on the basis of average industry productivity or relative productivity growth of industries over the sample period. Imports maybe gravitate towards more profitable or higher mark-up sectors. Imports may also be attracted to less competitive sectors to take their greater competitive advantages. Therefore there is potential reverse causality.

The import penetration (or import penetration growth as we use time-difference) variable is potentially endogenous and may be influenced by international trade shocks in the last few decades such as China's accession to WTO that resulted in Chinese export boom, and FTAs that Vietnam signed with her key trade partners. Therefore estimates from (1) and (2) may suffer the bias resulting from endogeneity of import penetration. We will discuss some potential approaches to deal with the bias below.

Our identification strategy to deal with the endogeneity is to exploit the exogenous shocks to Vietnam imports. In the last decade Vietnam signed many FTAs with its key trade partners particularly with China in year 2004 when Vietnam is a member of ASEAN.[2] The event of China's accession to WTO in 2001 may be a big shock to Vietnam import somehow. These make use of China export (to the world) as a potential good instrument candidate for our identification strategy because China export may meet two conditions for a good instrument, namely,

Relevance: corr(Vietnam *import*, China *export*) ≠ 0

and

Exclusion (validity): corr(Firm productivity, China *export*) = 0

China's *export* penetration may not be directly correlated with firm's productivity. Hence we may model Vietnam import penetration as a function of China's *export*, either level or changes as seen in equations (3) and (4).

$$import_{j,t-m} = f(CNexport_{j,t-m}\ ,\ X_{j,t-m}) \quad (3)$$

$$\Delta import_{j,t-m} = f(\Delta CNexport_{j,t-m},\ \Delta X_{j,t-m}) \quad (4)$$

[2] The signing of the Agreement on Trade in Goods of the China-ASEAN FTA which entered into force in July 2005, and in January 2007, the Agreement on Trade in Services came into effect in July of the same year. In August 2009, the two parties signed the Agreement on Investment.

We also use lag length (*m*) to allow for reverse causality and firm dynamic response to import competition in the production function estimation.

We shall exploit Chinese export growth as a source for instruments because they capture the impact of China's accession to WTO (in December 2001) on China's export boom.[3] In particularly quotas on Multi-Fibre Agreement (MFA) were eliminated in two waves in 2002 and 2005, according to Brambilla *et al.* (2010) the removal of the quotas have led to a huge increase (270 percent) in Chinese textile and apparel exports, and according to Bloom *et al.* (2011, p.52), 'China's [export] increase was substantially larger than other countries not just because it joined the WTO but also because the existing quotas seemed to bite more heavily on China as indicated by the higher 'fill rates – the proportion of actual imports divided by the quota' of Chinese quotas and Chinese quotas were increased more slowly over time than those in other countries.'

The increasing import share to Vietnam from China seems to be exogenous (to Vietnamese firm productivity) and determined by the fast growing export of China to the world in 2000s (see Appendices 1 and 2). To capture the shocks to Vietnam import by China accession to WTO and impact of the quota removal for China in 2002 and 2005, China – ASEAN FTA signed in 2004 we can use the change in China's exports to instrument change in Vietnam's import penetration.

As a further means of limiting the potential bias from endogeneity of import penetration, we use lagged rather than current values of import penetration and instrumental variable methods. Longer period lags of the import penetration variables may be appropriate as import penetration would take time to have an effect on local firm productivity. However, using long changes restricts the sample as a result of dropping initial periods, and also excluding firms that cease operation. The latter may lead to survivor bias by estimating impact on only surviving firms, we will miss possible negative impacts of import penetration on short-lived firms.

We estimate equation 5 in time-differenced form – regressing changes in firm value added against changes in factor inputs and (lagged) import penetration. The differencing has the effect of removing industry and firm-level variation in the level of productivity, and the bias associated with their correlation with import penetration. We present estimates using changes over two or three years. Estimates based on longer changes better capture the impact of more persistent changes, and are less affected by noise that biases the coefficients towards zero (Griliches and Hausman 1986).[4] The estimating equation is shown as equation 5, with all variables included as *k*-period changes, and import penetration variables lagged by *m* periods.

[3] Bloom *et al.* (2011, p.28) indicate that China is a good experiment of low wage country trade shock in the recent decades.

[4] For this reason we do not estimate for one-year difference specification.

Lagged changes are used to ensure that import penetration changes are predetermined relative to current plan productivity changes, and to allow for the possibility that the effect on productivity may take time to have an effect. We then combine level and time-differences with instrument variable method to further consolidate our findings.

$$\Delta_k lnVA_{ijt} = \alpha + \beta_1 \Delta_k\, imp\_pen_{j,t-m} + \beta_2 \Delta_k\, lnK_{ijt} + \beta_3 \Delta_k\, lnL_{ijt} + \beta_4\, ownership_{ijt} + \lambda_t + \Delta e_{ijt} \qquad (5)$$

Equation 5 is estimated with standard errors clustered by industry and year to allow for the fact that measured import penetration does not vary within industry and year (Moulton, 1990).[5]

We also want to test the hypothesis that import competition may affect various groups of firms differently, for example, high-tech firms, but may adversely affects the outcomes of low-tech industries (firms), low-tech firms shrink, or even exit, reduce employment because the low-tech firms are directly faced with competition exposure from Chinese imports. Firm size could be a proxy for firm competitiveness so that we will run separate regressions for different firm size group. We expect that larger firms are more likely to compete with import penetration while smaller firms may be defeated by cheaper and better quality products from imports. We therefore estimate the effects of import penetration for different firm sizes and for various technology level industries.

4. Empirical Results

4.1 Baseline Effect Estimates

The first and second columns of Table 2 present the results of Ordinary Least Squares (OLS) and Fixed Effect (FE) estimation of equation 1, which models value added as a function of contemporaneous factor inputs and import penetration. Columns 3, 4, and 5 of Table 2 show estimates of equation 2, modelling changes in value added on contemporaneous (k=0) changes in inputs and penetration, for changes over two and three years.

The coefficients for both labour input and the cost of capital services are highly significant across the models, and provide credible production function estimates. The OLS estimates are likely to be upward biased due to the correlation of factor inputs with firm fixed effects. The implied returns to scale coefficient (the sum of labour and capital coefficients) is 1.08. This reduces to 1.02 when fixed effects are controlled for in column 2, and lies between 0.86 and 1.02 in the differenced specification. The lowest estimate of 0.86 is for the second differenced specification, in which coefficients, especially the coefficient on labour, will be

[5] Clustering may be still problematic if the number of clusters (industry-years) is small relative to the units per cluster. Cameron, Gelbach and Miller (2008) suggest cluster bootstrapping techniques for inference. We tried both clustered and clustered bootstrapping for our main estimates and found very similar estimated standard errors. We report clustered standard errors in the paper.

lower due to transitory fluctuations. All the models are controlled for industry, year and ownership (foreign, state and private) dummies.

The inclusion of *concurrent* import penetration variables in Table 2 may result in endogeneity bias. However, they provide baseline estimates and also some evidence of self-selection of import penetration. Industries with lower productivity tend to import more. All regressions include industry and year effects, so the estimated impact of import penetration reflects the association between productivity and penetration over time within industries. The fixed effects estimate of import penetration in the second column of Table 2 is smaller (in absolute term) than that of the OLS estimation. The estimates across differenced specifications are also lower than the OLS estimate. The differences across these specifications reflect a combination of different samples, and the potential impact of endogeneity associated with using concurrent changes of import penetration. Sample sizes are smaller when using longer time-differences or changes because data are missing for short-lived firms.[6]

To remove endogeneity bias and reduce the influence of volatile short-term fluctuations, our preferred specification for time differences relies on lagged values of import penetration changes, as in equation 5, with changes measured over two years (column 4 of Table 2). We choose lag lengths to ensure that lagged changes are measured prior to output changes. Estimates of our preferred specification are shown in equation 6, column 4 of Table 2. As we use two-year differences, the shortest predetermined lag of import penetration variables that we can use is a 3-period lag. One of the costs of ensuring that import penetration variables are predetermined is that the estimation sample is greatly reduced due to the absence of lagged values for early years. The estimation sample is reduced to 32,214, which is less than one third of the sample available for the two-year differenced specification in column 3 of Table 2.

The first column of Table 2 presents our baseline estimates. Changes in import penetration are estimated to have a significantly negative impact on domestic firm productivity. The coefficient of negative 0.061 implies that across all industries increased import penetration lowers productivity by 0.061 percent. The estimated impact of penetration remains negative and significant when we move to fixed effect and time-differenced specifications. Although the time differenced specifications and distributed lag of import penetration remove a bulk of short-lived firms, the effect is still negative and statistically significant but the magnitude (in absolute term) declines. This may imply that the effect of import penetration on short-lived firms is either stronger or overestimated by the OLS.

[6] Some observations are also lost even for continuing firms as a result of missing data in some years.

Table 2: Effects of Import Penetration on Firm Productivity 2000-2009

Variables	OLS (k=0)(1)	Fixed effect (k=0) (2)	Two-year difference (k=2) (3)	Two-year difference (k=2) (4)	Three-year difference (k=3) (5)	Controlled for tech level (6)	High tech only (7)
$\Delta_k \ln L_t$	0.698	0.680	0.653	0.555	0.680	0.555	0.649
	(0.006)**	(0.023)**	(0.011)**	(0.015)**	(0.012)**	(0.015)**	(0.038)**
$\Delta_k \ln K_t$	0.378	0.336	0.333	0.305	0.336	0.310	0.285
	(0.005)**	(0.012)**	(0.006)**	(0.008)**	(0.007)**	(0.008)**	(0.018)**
Δ_kImp_pen$_t$	-0.061	-0.020	-0.035		-0.016		
	(0.005)**	(0.002)**	(0.002)**		(0.002)**		
Δ_kImp_pen$_{t-3}$				-0.016		-0.0161	-0.0147
				(0.002)**		(0.002)**	(0.002)**
Constant	1.816	1.972	0.108	0.135	0.148	0.135	0.0487
	(0.047)**	(0.074)**	(0.022)**	(0.029)**	(0.027)**	(0.029)**	(0.1159)
Observations	191,907	191,907	88,797	32,214	64,956	32,214	3,227
R-squared	0.87	(w)0.57	0.39	0.29	0.45	0.29	0.32
Year effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind2 controlled	Yes	No	Yes	Yes	Yes	Yes	Yes

Notes:

The dependent variable is the natural log of value added. Clustered (by year and ind4) standard errors are in parentheses. + significant at 10%; * significant at 5%; ** significant at 1%. k represents time length-differences; 'k=0' indicates levels. All models control for year, two-digit industry dummies, and ownership (private, SOEs and FDI). Δ_k is k-year differences. Switching industry was corrected to allow for fixed effect within industry (ind4) and also correctly clustering. Tech levels are low, medium, and high technology.

The final two columns of Table 2 offer estimates from a model that controlled for technology level dummies (column 6) and a model for high tech industries only (column 7, see Appendix 3 for tech level industry definition). The results in columns 6 and 7 are comparable with those in column 4. The results from a model controlled for technological level are almost unchanged compared with those in column 4. The results in column 7 for high tech industries only show a slight change with the impact of import penetration reduced (in absolute term) marginally, from -0.016 to -0.015. The contribution from labour increases while that of capital is declined in comparison with results in columns 4 and 6. This can be explained by the fact that the high tech industries employ higher skilled workers and then labour plays a more important role in the firms' output. However, the difference between estimates of import penetration variable from high tech industries is very small (that is, -0.016- (-0.015) = -0.001)) suggesting that the technology level by definition in this paper does not matter.

As tech level by definition does not correctly represent firm tech level, the distance to the frontier may be a better measure. The similar or even lower level of Vietnam's tech advance in relation to importing countries may lead to fiercer competition among firms in Vietnam. Therefore, firms in high tech industries in Vietnam do not gain an advantage by importing products to escape competition and to improve productivity.

4.2 Instrumental Variable Approach

The other approach to correct for endogeneity of import penetration is to use an instrumental variable (IV) method. As discussed earlier, China's exports (or export growth) are a potential instrument for the prediction of the level of Vietnam's imports, but may not directly affect firms' productivity in Vietnam. We thus use China's export penetration, proportion of China's export over total sales of industry, as an instrument for import penetration. We applied the IV model to both level variable specifications (the left panel of Table 3) and time-difference specifications (the right panel of Table 4). We report some statistics for the relevance, validity and weak IV tests on the bottom rows of Table 3.

All the test results in Table 3 show that the instrument is valid and strong, implying that the instrument is a good one. This result is consistent with existing evidence in the literature that found that China's exports were a good instrument to predict imports (Bloom et al, 2011; Bugamelli et al, 2010; Edwards and Jenkins, 2013) and in line with the theory of trade shock from China's export boom.

The left panel of Table 3 presents the estimated effects of import penetration on firm productivity using level data. Three model specifications were investigated: contemporaneous, first lag and second lag of import penetration. We used lags to allow for some lags of the effect. The endogenous variable, import penetration were instrumented by the corresponding China export penetration. The Anderson and Robin (AR) test for weak instrument rejects the hypothesis of the weak instrument in all model specifications at the one percent level. The results in columns

2 and 3 are more significant, in other words, the estimated results of the model specifications in columns 2 and 3 are more precisely estimated (see the last row of Table 3 for the test statistics). The results show that import penetration has a significantly negative effect on firm productivity.

The right panel of Table 3 combines three approaches, IV, time-difference, and lagged level of the difference. This combination can simultaneously address omitted variable and endogeneity bias. The AR test statistics show even more precise estimates especially in columns 4 and 6. The estimates are also smaller (in absolute term) than that from the left panel. However, it must be noted that the sample size in the right panel is smaller than the ones in the left panel. Consequently, one could say that the decline in the estimated effect is due to the removal of short-lived firms from the sample.

Overall, the estimated results show that import penetration has a significantly negative effect on firm productivity. The summation of capital and labour variables remaining around one gives us confidence about the accuracy of estimates and quality of the dataset.

Columns 7 and 8 of Table 3 offer estimates from a model that controlled for technological level dummies (column 7) and a model for high tech industries only (column 8). The results on columns 7 and 8 are comparable with those in column 6. The results in both columns 7 and 8 are again almost unchanged compared with that in column 6. In addition, the results are similar to those of time-difference specification models. This suggests that the technology level by the GSO definition does not matter in affecting the impact of import penetration on productivity.

4.3 Effects by Firm Size

Firms may have different competitive capacity to compete with imports. The literature on import competition suggests that firms with less advanced technologies or small firms may find it hard to compete (for example, Bugamelli *et al.* 2010, Bloom *et al.* 2011). In this section, we hypothesise that larger domestic firms may benefit more from the presence of increasing imports, due to their generally more sophisticated technologies and business processes, while smaller firms suffer a negative crowding out effect from import competition. The estimates are presented in the first two columns of Table 4. We used three cut-offs: 20 employees, 100, and 200 employees to classify firms.

Consistent with our hypothesis, a significantly negative impact is evident for the smaller firm-size categories. The coefficients are more negative for smaller group (20 or fewer). In the meantime, the effect is positive for firms with 100 or more employees. However, the effects for larger firm group are not estimated precisely.

Table 3: Effects of Import Penetration on Firm Productivity 2000-2009 (IV Estimation – GMM Method)

Variables	K=0 (level)			K=2 (two-year difference)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_k \ln L_t$	0.698	0.684	0.677	0.653	0.578	0.555	0.555	0.649
	(0.006)**	(0.006)**	(0.007)**	(0.011)**	(0.012)**	(0.015)**	(0.015)**	(0.038)**
$\Delta_k \ln K_t$	0.378	0.390	0.401	0.333	0.301	0.305	0.305	0.285
	(0.005)**	(0.006)**	(0.006)**	(0.006)**	(0.007)**	(0.008)**	(0.0081)**	(0.018)**
$\Delta_k$imp_pen	-0.091			-0.035				
	(0.041)*			(0.003)**				
$\Delta_k$imp_pen_L1		-0.067			-0.014			
		(0.018)**			(0.004)**			
$\Delta_k$imp_pen_L2			-0.025					
			(0.007)**					
$\Delta_k$imp_pen_L3						-0.016	-0.016	-0.015
						(0.003)**	(0.003)**	(0.0025)**
constant	1.816	1.885	1.952	0.071	0.115	0.135	0.272	0.060
	(0.047)**	(0.038)**	(0.036)**	(0.024)**	(0.019)**	(0.029)**	(0.024)**	(0.012)**
Observations	191,907	129,274	95,382	88,797	62,689	32,214	32,214	3,227
Centered R^2	0.87	0.89	0.89	0.39	0.30	0.29	0.29	0.32
Instrumented variable	imp_pen	imp_pen_L1	imp_pen_L2	$\Delta_2$imp_pen	$\Delta_2$imp_pen_L1	$\Delta_2$imp_pen_L3	$\Delta_2$imp_pen_L3	$\Delta_2$imp_pen_L3
Excluded instrument	expCN_pen	expCN_pen_L1	expCN_pen_L2	$\Delta_2$expCN_pen	$\Delta_2$expCN_pen_L1	$\Delta_2$expCN_pen_L3	$\Delta_2$expCN_pen_L3	$\Delta_2$expCN_pen_L3
1st stage Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Partial R^2	0.93	0.98	0.98	0.99	0.99	0.99	0.99	0.98
Test for instrument equal zero in the 1st stage, F-val (P-val)	2.6e+06 (0.0000)	6.7e+06 (0.0000)	9.2e+06 (0.0000)	1.2e+07 (0.0000)	7.5e+06 (0.0000)	1.2e+07 (0.0000)	1.2e+07 (0.0000)	3.4e+07 (0.0000)
AR test for weak IV, Chi2(1) (P-value in brackets)	7.96** (0.0048)	15.56** (0.0001)	11.99** (0.0005)	139.43** (0.0000)	8.86** (0.0029)	39.9** (0.0000)	39.8** (0.0000)	36.5** (0.0000)

Notes:
The dependent variable is the natural log of value added. Clustered (by year and industry) standard errors are in parentheses. + Significant at 10%; * at 5%; and ** at 1%. k represents time length-differences; 'k=0' indicates k-year-difference. L is lag level. All models controlled for year, 2-digit industry fixed effect, and ownership (private, SOEs and FDI). Column 7 controlled for tech level dummies. Column 8 is for high tech industries only.

Table 4: Decomposing Effects by Firm Size (Employees) 2000-2009

Variable	Firm Size Fewer than			Firm Size Greater than or Equal	
	20	100	200	100	200
	(1)	(2)	(3)	(4)	(5)
$\Delta_2 \ln L_t$	0.588	0.552	0.553	0.556	0.560
	(0.027)**	(0.017)**	(0.015)**	(0.023)**	(0.030)**
$\Delta_2 \ln K_t$	0.325	0.311	0.310	0.294	0.285
	(0.014)**	(0.009)**	(0.009)**	(0.013)**	(0.016)**
$\Delta_2 Imp\_pen_{t-3}$	-0.018	-0.013	-0.013	36.544	46.691
	(0.004)**	(0.002)**	(0.002)**	(20.355)+	(25.086)+
Constant	0.371	0.081	0.084	0.158	0.183
	(0.279)	(0.041)*	(0.034)*	(0.044)**	(0.056)**
Observations	8032	19693	23947	12521	8267
R-squared	0.30	0.30	0.30	0.27	0.26

Notes:
The dependent variable is the two-year difference in the log of value added. Standard errors are in parentheses; + significant at 10%; * significant at 5%; ** significant at 1%. Dependant variable $\Delta_2$lnva, Δ_2 is the two-year difference. All models controlled for year, 2-digit industry fixed effect, and ownership (private, SOEs and FDI).

5. Conclusions

This paper examined how firm productivity is affected by import penetration in the Vietnam manufacturing sector. The analysis is carried out using a panel dataset of more than two hundred thousand firms during the period 2000-2009, thus making the sample comprehensive and representative of the Vietnam manufacturing business population. The source of the data was the VES from the General Statistics Office, Vietnam. The study uses different approaches to deal with biases caused by omitted variables and endogeneity of import penetration. The study also examined the impact of import penetration on productivity according to firm size.

Overall, as we set out in the beginning of the paper Vietnamese manufacturing firms are typically less technologically advanced and have low competitiveness. There is evidence of a negative effect from many robust and highly significant estimates .This finding is explained by recent arguments in the literature. Edwards and Jenkins (2013) show that imports replace or crowd out domestic production. This may make local firms lose market share by importing goods, thus reducing their scale of production which impacts negatively on productivity via negative effects on scale efficiency.

We identify the impact of import penetration by examining within-industry variation in import penetration over the period 2000-2009, and use regression analysis to identify the contribution of these changes to firm-level productivity growth. On average, firms' exposure to increasing import competition leads to lower productivity. The negative impact is mainly from smaller firm groups (SMEs) who have 200 or fewer employees. We also find some evidence of positive effects for larger firm groups, but the estimates are less precise. However, we do not find any significant evidence on variation in the impact of import penetration across different technological level industries. However, tech level definition by GSO may not represent firms' tech level properly.

In future research, we will refine our study by separating out imports if they come from developing and developed countries. We also separate various impacts of imported inputs by classifying imported intermediate inputs and imports of final competing goods to see how they affect firm productivity and employment in developing economies. Furthermore, as suggested by Yahmed and Dougherty (2012), one may look at the position of firm's productivity in relation to the industry productivity frontier to provide a better measure of technological advance.

References

Acharya, R. C. and Keller, W. (2008). *Estimating the productivity selection and technology spillover effects of imports*. National Bureau of Economic Research. Retrieved from: http://www.nber.org/papers/w14079.pdf

Acharya, R. C. and Keller, W. (2009). Technology transfer through imports. *Canadian Journal of Economics/Revue canadienne d'économique, 42*(4), 1411-1448.

Ackerberg, D., Caves, K. and Frazer, G. (2006). Structural identification of production functions. Available at http://www.econ.ucla.edu/ackerber/ACF20withtables.html

Bloom, N., Draca, M., and Van Reenen, J. (2011). *Trade induced technical change? The impact of Chinese imports on innovation, IT and productivity*. National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w16717

Brambilla, I., Khandelwal, A. K. and Schott, P. K. (2010). China's experience under the multi-fiber arrangement (MFA) and the agreement on textiles and clothing (ATC) *China's Growing Role in World Trade* (pp. 345-387): University of Chicago Press.

Bugamelli, M., Fabiani, S., and Sette, E. (2010). *The pro-competitive effect of imports from China: an analysis of firm-level price data*. Retrieved from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1601933

Bugamelli, M., Fabiani, S. and Sette, E. (2010). *The pro-competitive effect of imports from China: an analysis of firm-level price data*. Retrieved from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1601933

Cameron, A., Gelbach, B. and Miller, L. (2008). Bootstrap-based improvements for inference with clustered errors. *Review of Economics and Statistics, 90*, 414-427.

Coe, D. T. and Helpman, E. (1995). International RandD spillovers. *European Economic Review, 39*(5), 859-887.

Doan, T. and Stevens, P. (2012). Evolution of competition in Vietnam industries over the recent economic transition. *Economics - The Open-Access, Open-Assessment E-Journal, 6*(19), 1-24.

Edwards, L. and Jenkins, R. (2013). *The impact of chinese import penetration on the south african manufacturing sector*. Retrieved from: https://www.uea.ac.uk/documents/439774/0/Edwards+Jenjkins+SALDRU.pdf/82f05bfc-bf8b-4af1-b843-bb522695c6d6

Fernandes, A. M. (2007). Trade policy, trade volumes and plant-level productivity in Colombian manufacturing industries. *Journal of International Economics, 71*(1), 52-71.

Freeman, R. B., and Kleiner, M. M. (2005). The last American shoe manufacturers: Decreasing productivity and increasing profits in the shift from piece rates to continuous flow production. *Industrial Relations: A Journal of Economy and Society, 44*(2), 307-330

Griliches, Z, and Mairesse, J. (1998). Production functions: the search for identification. In *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, edited by Steinar Strøm, 169–203. Cambridge: Cambridge University Press.

Griliches, Z. and Hausman, J. (1986). Errors in variables in panel data. *Journal of Econometrics* 31 (1) (February): 93–118.

Grossman, G. M. and Helpman, E. (1995). Technology and trade. *Handbook of international economics, 3*, 1279-1337.

Halpern, L. and Körösi, G. (2001). Efficiency and market share in the Hungarian corporate sector. *Economics of Transition, 9*(3), 559-592.

Halpern, L. Koren, M. and Szeidl, A. (2005). *Imports and productivity*. Retrieved from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=785127

Kasahara, H. and Rodrigue, J. (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. *Journal of Development Economics*, *87*(1), 106-118.

Keller, W. (2004). International technology diffusion. *Journal of Economic Literature, 42*(3), 752-782.

Levinsohn, J. and Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, *70*(2), 317-41.

Moulton, B.R. (1990). An illustration of a pitfall in estimating the effects of aggregate variables on micro units. *Review of Economics and Statistics*, *72*(2), 334–38.

Olley G.S. and Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica, 64(6), 1263-97.*

Van Biesebroeck, J. (2003). *Revisiting some productivity debates*. National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w10065.pdf

Vogel, A. and Wagner, J. (2010). Higher productivity in importing German manufacturing firms: self-selection, learning from importing, or both? *Review of World Economics, 145*(4), 641-665.

Wooldridge, J. (2009). On estimating firm-level production functions using proxy variables to control for unobservables. *Economics Letters, 104*(2009), p.112-114.

Yahmed, S. and Dougherty, S. (2012). *Import competition, domestic regulation and firm-level productivity growth in the OECD.* OECD, Economics Department Working Paper No. 980.

Appendices

Appendix 1: China Exports 1998-2011

Year	Total World Exports ($US billion)	CN Export ($US billion)	Growth	
1998	5,158	184	1%	
1999	5,220	195	6%	
2000	6,010	249	28%	
2001	5,830	266	7%	(WTO accession)
2002	6,190	326	23%	
2003	7,240	438	34%	
2004	8,780	593	35%	
2005	9,940	762	28%	
2006	11,600	969	27%	
2007	13,200	1,220	26%	
2008	15,300	1,430	17%	GFC
2009	11,900	1,200	-16%	GFC
2010	14,400	1,580	32%	
2011	15,000	1,900	20%	
Average	10,047	808	19%	

Source: UN Comtrade database.

Appendix 2: Vietnam Imports from World and China 1998-2011

Year (1)	VN Total Imports ($US billion) (2)	VN Import Growth (3)	VN Imports from China ($US billion) (4)	%VN Imports in World Trade (5)	VN Imports from China (Percent of Total Imports) (6)
1998	11.5	-0.9%	0.51	0.22%	4%
1999	11.7	1.7%	0.67	0.22%	6%
2000	15.6	33.3%	1.40	0.26%	9%
2001	16.2	3.8%	1.61	0.28%	10%
2002	19.7	21.6%	2.16	0.32%	11%
2003	25.3	28.4%	3.14	0.35%	12%
2004	32.0	26.5%	4.60	0.36%	14%
2005	36.8	15.0%	5.90	0.37%	16%
2006	44.9	22.0%	7.39	0.39%	16%
2007	62.8	39.9%	12.71	0.48%	20%
2008	80.7	28.5%	15.97	0.53%	20%
2009	69.9	-13.4%	15.41	0.59%	22%
2010	84.8	21.3%	20.20	0.59%	24%
2011	107.0	26.2%	24.59	0.71%	23%
Average	44.2	18%	8.3	0.41%	15%

Source: UN Comtrade and GSO website. Column 3 is calculated from column 2 so it is nominal growth rates.

Appendix 3: Tech Level Industry Groups

Group 1
Low technology
D15: Food and beverages
D16: Cigarettes and tobacco
D17: Textile products
D18: Wearing apparel, dressing and dying of fur
D19: Leather and products of leather; leather substitutes; footwear.
D20: Wood and wood products, excluding furniture
D21: Paper and paper products
D22: Printing, publishing, and reproduction of recorded media
D23: Coke and refined petroleum products and nuclear fuel
D36: Furniture and other products not classified elsewhere
D37: Recycles products

Group 2
Medium technology
D24: Chemicals and chemical products
D25: Rubber and plastic products
D26: Other non-metallic mineral products
D27: Iron, steel and non-ferrous metal basic industries
D28: Fabricated metal products, except machinery and equipment

Group 3
High technology
D29: Machinery and equipment
D30: Computer and office equipment
D31: Electrical machinery apparatus, appliances, and supplies
D32: Radios, television and telecommunication devices
D33: Medical equipment, optical instruments
D34: Motor vehicles and trailers
D35: Other transport equipment