WHICH POLICIES MATTER FOR THE COMPETITIVENESS OF VIETNAM'S TEXTILES AND GARMENTS FIRMS?

Pham Thi Anh Tuyet
Nguyen Thang[†]
John Cockburn[‡]
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[†] Centre for Analysis and Forecasting, Vietnamese Academy of Social Sciences. Email address: atpham70@yahoo.com and nguyenthang98@yahoo.com. The authors would like to thank IDRC for its financial and technical report to this research. The authors are also especially grateful to Dr. Remco Oostendorp for his valuable comments and advice on methodological and technical issues as well as revision of the paper. All remaining errors are our own responsibility.
[‡] Centre Interuniversitaire sur le Risque, les Politiques Économiques et l'Emploi (CIRPÉE), Université Laval, Canada. Email address: jcoc@ecn.ulaval.ca

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1. Introduction

In Vietnam, the textile and garment (T&G) industry has performed impressively in recent years. Its growth rate has been 10.6 percent per annum compared to annual GDP growth rate of 7.5 percent (GSO, 2003). The T&G industry plays an important role in the economy in general and in the manufacturing sector in particular. The share of T&G in manufacturing output is roughly 10.5 percent (GSO, 2003). The sector has emerged as the second biggest foreign exchange earner after crude oil for the country. Indeed, T&G exports have grown from less than US$100 million in 1989 (Hill, 1998) to US$2,752 million in 2002, representing roughly 16.5 percent of total exports (GSO, 2003). In terms of employment generation, the industry employs 25 percent of total industrial workers (Bui, 2001).

Increasing international competition has created downward pressure on both sale prices and production costs of T&G firms. This competition intensified when countries in the region devalued their currencies in response to the Asian crisis. It is likely to only become tougher with China's accession to the World Trade Organization (WTO) and the multi-fibre agreement (MFA) phase-out. These factors threaten the long-term viability of T&G firms and lower their profitability. In order to rise to these challenges to compete successfully in the market place and to further develop, T&G firms must make a careful assessment of their competitive position and identify the main factors that affect their competitiveness and performance. Such analysis may also help policy makers to ensure that the business and policy environment is favorable, or at least not harmful, for this labor-intensive export-oriented industry.

There have been a number of studies on various aspects of the competitiveness of T&G firms to date. IE (2001b) and Pham Thi Anh Tuyet and Nguyen Thang (2002) analyzed cost-based competitiveness of T&G firms using firm survey data from 1998 and 2000, respectively. However, their estimation of the production function guiding firm reactions was based on data for one year only. Furthermore, their findings may not be very robust given the turbulence in the T&G business environment in those years due to the Asian crisis. Besides, the cost competitiveness indicator they used – monetary unit costs – is subject to criticism as it does not adequately reflect the attractiveness for new investment, which will ultimately determine their capacity to compete and increase or defend their market share. A more relevant indicator of cost competitiveness is the rate of return to investment or profitability, which is used in this paper. Finally, we also makes international comparisons, more specifically with China, which were absent in existing studies.

This paper therefore intends to fill in these gaps in methodology and in policy analysis in order to come up with more credible results that can be confidently presented to policy makers and entrepreneurs. Some key findings may also provide insights for other labor-intensive export-oriented manufacturing industries such as food processing. The analysis takes into account the specific conditions of Vietnam, notably the differences in the business and policy environment of state-owned enterprise (SOEs), domestic private firms and foreign invested firms. However, the methodology we develop could be applied to any country.

Textiles and garments are treated as two separate industries in this paper, although in Vietnam they are officially classified as belonging to a single industry. There are two reasons for this. First, these two industries use very different technologies. The textile industry is relatively more capital-intensive, while the garment industry is more labor-intensive. Second,

in terms of trade policy, the textile sub-sector is predominantly import-competing, whereas the garment sub-sector is export-oriented.

The paper is structured as follows. Following this introductory section, section 2 outlines the methodology and data sources. Section 3 focuses on the current profitability of Vietnam's T&G firms. Section 4 discusses results of various policy simulations with a special focus on firm reactions to these policy changes. Section 5 presents international comparison between Vietnam's and China's T&G industries. Section 6 concludes the paper.

2. Methodological Framework

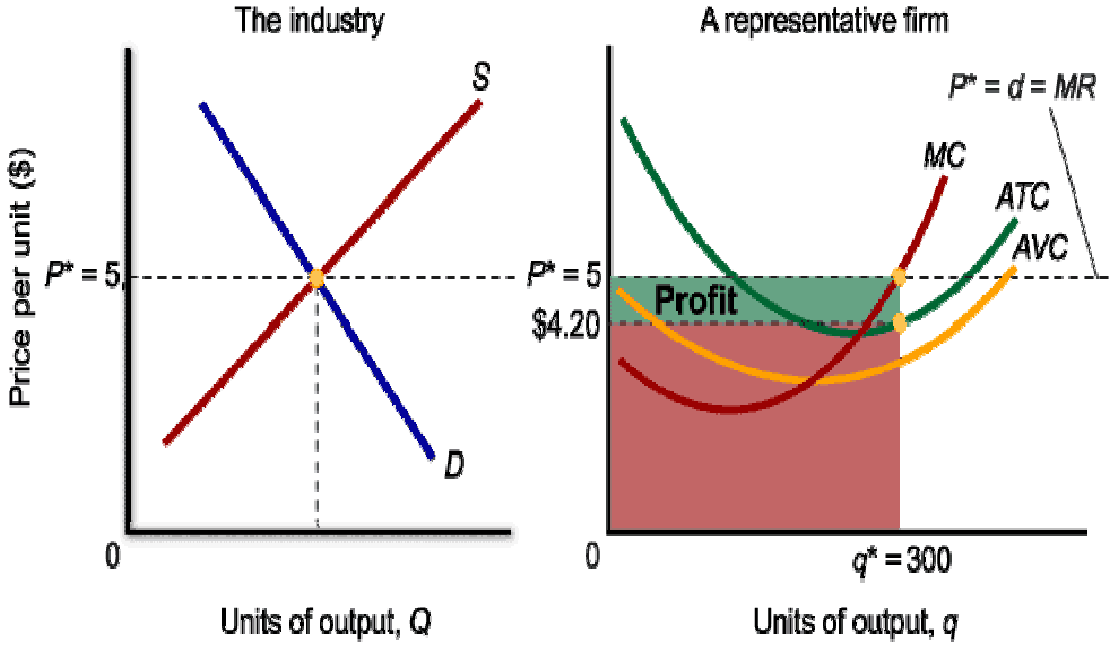
Competitiveness is defined as the capacity to sustainably sell one's product. Thus, the main competitor in any given market is the producer with the largest market share. In this context, the primary research issue and policy concern in any country is to know which sectors are likely to increase or reduce their market shares. Even more fundamentally, we would like to understand what is driving this expansion/contraction and what are the likely impacts of various policy scenarios and changes in the business environment.

Core microeconomic theory of production helps us to understand how the level of output, and thus market shares and competitiveness, are determined. In the figure below, we see that, in the short run, the output (q) of a representative firm is at the point where short-run marginal cost (MC) of production is just equal to the market price (P*). In Figure 1, price is above is above short-run average total cost (ATC) at this point. The rectangle below the price line measures the firm's "supernormal" profits, which are equal to the difference between firm revenue (P*q*) and total cost of production (ATCq*). These profits are qualified as "supernormal" as they are above and beyond the "normal" profits, measured by the average market return to capital, which is already included in the total cost of production. Had the market price been sufficiently lower, its intersection with the marginal cost curve would have been below the short-run average total cost curve and the firm would have been making losses. Had it been below the average variable cost curve, the firm would shut down in the short term. If we now consider the left-hand side of Figure 1, we see that the industry supply curve is simply the sum of the supply over all firms at each price, where firm supply is given by the marginal cost curve.

The short run is defined by the fact that no new investments can be made either by new firms or by existing firms. Thus, as output increases, more and more labor is combined with a fixed level of capital leading to diminishing marginal returns and an upward sloping marginal cost curve. In the long run, if competition is perfect (no entry barriers), the presence of above-market profit rates in a sector will attract new investment either through the entry of new firms and/or, possibly, the expansion of existing firms. This will increase industry output and lead to a rightward shift in the supply curve. This will, in turn reduce prices to the point where supernormal profits will eventually dry up[3]. In the presence of losses, the contraction or exit of existing firms will have the opposite effect leading to a reduction in industry supply and a rise in prices until these losses disappear.

[3] Note that, for a small country producing a homogeneous tradable good, demand could be practically infinite. In this situation, market prices are determined by world supply and demand, and large changes in domestic supply will only have negligible impacts on market prices (i.e. the supply curve in Figure 1 will only move marginally to the right).

Figure 1: Short-run firm and industry output



Source: Case and Fair (2002).

The extent of the long-run increase or reduction in firm and sectoral production will depend on the shape of the long-run firm and industry supply curves as well as the shape of the demand curve they face. While long-run supply curves are, by definition, only observed in the long-run, we can nonetheless assume that the greater the initial profits (losses), the more (less) attractive a sector will be to new investors and the greater the scope for expansion (contraction). Thus, in this study, firm profitability is taken as an indicator of the evolution of the competitiveness.

Profitability is measured by the rate of return on capital (ROC):

$$\text{ROC} = \frac{\pi}{\text{Capital}} \tag{1}$$

where Capital represents the book value of fixed capital, including machinery and equipment, buildings, means of transport, etc. and π represents total profits. The latter are calculated as output value less total production cost excluding capital costs (interest payments on debt and the opportunity cost of own equity). In relation to the framework above, if ROC is greater than the market interest rate, there are positive supernormal profits. The advantage of using ROC, rather than a direct measure of the rate of supernormal profits, is that it is widely used and understood.

In this context, it is straightforward to examine the impacts of changes in policy and the business environment. For example, trade liberalization will lead to a fall (leftward shift) in the industry demand curve on the domestic market as competing imports become cheaper, while at the same time leading to a rise (rightward shift) in the firm and industry supply curves by reducing the cost of tradable inputs. The direction and magnitude of the final impact on profitability will depend on the extent of tariff reduction, the share of tradable inputs and firm reactions to changing input prices. The goal of this study is to measure this

change in profitability as precisely as possible in order to predict whether specific changes in policy and the business environment will increase or reduce profitability and competitiveness. By simultaneously analyzing a large variety of likely policy/environment changes, we are able to identify which are the most important. The methodology builds on work by Cockburn et al. (1998) and Tybout et al. (1996).

2.1 Simulation techniques

A policy/environment change normally alters the price structure that a firm faces, which in turn influences its profits. At one extreme, we may assume that the firm does not alter its behavior in reaction to the changing price structure whereas, at the other extreme, the firm may be assumed to react fully to the changes in relative prices by altering its input and output levels to maximize profit. The former may be thought of as a very short-run effect of a policy change, when time is too short for the firm to adjust. Even in the medium term, firms may be constrained in their reactions through lack of access to resources including capital, labor, technology, information, etc. On the contrary, the full reaction scenario can be thought of as the long-term case with perfect markets. The reality in economies in transition like Vietnam is likely somewhere in between. Furthermore, it is unclear how long it actually takes individual firms to adjust. As these two extremes are likely to lead to different results with different policy implications, it is useful to compare them both to obtain upper and lower bounds for the actual impacts.

In the absence of firm reactions, calculation of the impact of a policy/environment change on a firm's profitability is straightforward. However, the methodology for taking account of firm reactions is more complex. As pointed out in Nicholson (1992), Tybout *et al.*(1996) and Institute of Economics (IE) (2001b), the task of modeling firm reactions to changes in prices of inputs, outputs and other production factors requires the estimation of the firm's production and/or cost function.

a) Calculation of Firm's Profit

Actual profit in the base year is calculated according to a standard accounting formula:

$$\pi_{base}^{actual} = P*Q_{base}^{actual} - w_1*K^{actual} - w_2*L^{actual} - w_3*INTER^{actual} - OtherCosts \quad (2)$$

where π–profit, Q-output, K-capital value, L-labor, INTER-intermediate inputs, OtherCosts-other costs, P-price of output, w_1-depreciation rate, w_2-wage rate, w_3-price of intermediate input. Other costs include items such as insurance payments, rent, taxes, etc.

Actual profit normally differs somewhat from maximum profit that we would obtain from an optimization framework. First, survey data provide a snapshot of the current status of firm profit, yet some firms may still be in transition towards a new short-term equilibrium after a shock which is unobservable from the survey data. Second, the production function we use in predicting profit maximization can only be an approximation of the true production function and may not capture the exact degree of substitution among factors and intermediate inputs. Third, some firms face unobserved constraints in their behavior or lack complete information. Therefore, it is useful to break down profit into a part derived from profit-maximizing behavior (line 1 below) and a residual (lines 2 and 3):

$$\pi_{base}^{actual} = P_{base} * Q_{base}^{optimal} - w_{1,base} * K_{base}^{optimal} - w_{2,base} * L_{base}^{optimal} - w_{3,base} * INTER_{base}^{optimal}$$
$$+ P_{base} * (Q_{base}^{actual} - Q_{base}^{optimal}) - w_{1,base} * (K_{base}^{actual} - K_{base}^{optimal}) - w_{2,base} * (L_{base}^{actual} - L_{base}^{optimal})$$
$$- w_{3,base} * (INTER_{base}^{actual} - INTER_{base}^{optimal}) - OtherCosts \quad (3)$$

We cannot model the residual and thus assume that changes affect prices alone, whereas changes in the profit-maximizing part is induced by both price and quantity changes

New profit without any firm response to a price shock can be calculated by plugging new prices into the initial accounting formula for profit with all quantities unchanged. To simplify, all prices are normalized to 1 in the base year, and thus the new prices are actually price indices. New profit with firm reactions to a price shock can be calculated as follows:

$$\pi_{new}^{max} = P_{new} * (Q_{base}^{actual} - Q_{base}^{optimal}) - w_{1,new} * (K_{base}^{actual} - K_{base}^{optimal}) - w_{2,new} * (L_{base}^{actual} - L_{base}^{optimal})$$
$$- w_{3,new} * (INTER_{base}^{actual} - INTER_{base}^{optimal}) - OtherCosts$$
$$+ P_{new} * Q_{new}^{optimal} - w_{1,new} * K_{new}^{optimal} - w_{2,new} * L_{new}^{optimal} - w_{3,new} * INTER_{new}^{optimal} \quad (4)$$

Optimal values before and after price shocks can be derived from the production, supply and factor demand functions.

b) Specification of the production function

We explore two alternative specifications for the production function. In the first specification, production factors are combined at two levels. At the bottom level, intermediate inputs (I) are combined using a Leontief technology to produce a composite intermediate input (INTER) while labor (L) and capital (K) are combined according to a Cobb-Douglas function in a composite factor input measured by value added (VA):

$$VA = A * K^{\alpha} L^{\beta} \quad (5)$$
$$INTER = \min(\theta_1 I_1, \theta_2 I_2 \ldots \theta_j I_j) \quad (6)$$

At the upper level, firm output (Q) is formed by combining these two composite inputs through a Leontief technology:

$$Q = \min(\theta_{va} * VA, \theta_{inter} * INTER) \quad (7)$$

The Leontief production function at the top level implies that:

$$Q = VA * \theta_{va} = \theta_{va} * A * K^{\alpha} L^{\beta} \quad (8)$$

and
$$INTER = VA * (\theta_{va}/\theta_{inter}) = A * K^{\alpha} L^{\beta} * (\theta_{va}/\theta_{inter}) \quad (9)$$

The production function with fixed capital in the short to medium term has the following form:

$$Q = VA * \theta_{va} = \theta_{va} * A * \overline{K}^{\alpha} L^{\beta} \quad (10)$$

An alternative production function is a single-level Cobb-Douglas combination of all three inputs to allow for substitution between primary factors and intermediate inputs:

$$Q=A*K^{\alpha}L^{\beta}*INTER^{\gamma} \quad (11)$$

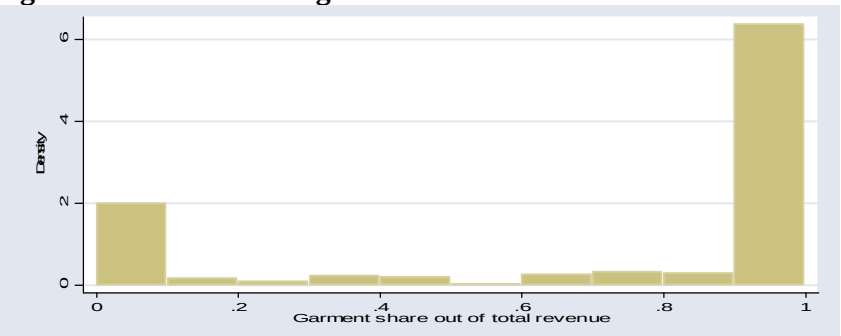
For details of the derivation of the supply and factor demand function from the production functions, see Appendix 1.

2.2 Data Sources and Definitions Used

The primary data employed in this paper are extracted from the Vietnam Textile and Clothing Competitiveness Survey conducted by the Institute of Economics in 2001. The survey gathered a rich database covering a wide range of qualitative and quantitative indicators on 150 T&G firms nationwide for two years 1999 and 2000. We use the pooled data from the two years so that the number of observations is 300 firms.

The sample accounts for 27.3 percent of the number of T&G firms, 54 percent of employment, and 46 percent of revenue in the sampling frame. The sampling frame was constructed based on the GSO-UNDP 1998 census of manufacturing firms in Vietnam. More details on the survey and dataset can be found in IE (2002). It should be noted that the sampling frame excluded small firms with less than 50 workers. Thus, conclusions derived from our analysis cannot be applied to that missing segment of firms.

Figure 2: Distribution of garment share out of total revenue



Source: Authors' calculations based on survey data

We distinguish textile and garment firms based on the bipolar distribution of garment shares in total production (Figure 2). A firm that has a garment share higher than 50 percent is considered to be a garment firm; otherwise it is a textile firm. In the same way, a firm that generates more than 50 percent of its revenue from exports is defined as outward-oriented (or export-oriented), whereas all others are classified as inward-oriented.

3. Current Profitability of Vietnam's T&G Firms

3.1 Cost Structure of Surveyed Firms

Analysis of cost structure provides some intuition as to the likely effects of various policy/environment changes on firm profitability, which is helpful for subsequent interpretation of simulation results. Shares of various cost components relative to total production value are presented in Table 1. If we look first at the textile firms, we note that for the sample as a whole, material input costs represent more than half of textile production value, followed by non-tradable inputs (electricity, water, transportation, rent, services, etc.),

wages and capital inputs (depreciation, interest payments on debt and the opportunity cost of own capital). Taxes and contributions account for only a small share of costs.

Table 1: Cost Structure of Textiles and Garments Firms (percent of production value)

		MARKET		SIZE		OWNERSHIP			
	Whole Sample	Inward oriented	Outward oriented	Medium	Large	SOE Central	SOE Local	FIEs	PEs
TEXTILES									
Number of Observations	**81**	**45**	**36**	**8**	**73**	**18**	**10**	**23**	**30**
Material inputs	53.3	52.3	54.7	32.5	55.6	53.6	73.3	58.1	43.0
Non-tradable inputs	24.2	25.5	22.6	16.1	25.1	32.5	9.4	25.0	23.5
- Electricity cost	*4.7*	*5.7*	*3.4*	*2.6*	*4.9*	*6.7*	*3.7*	*5.4*	*3.4*
Wages	18.9	15.3	23.3	46.2	15.9	12.9	15.2	10.5	30.1
Capital inputs	13.8	15.6	11.5	10.8	14.1	9.6	15.2	20.8	10.5
Taxes, contributions	1.0	1.6	0.3	0.2	1.1	1.2	1.7	0.6	1.1
Total costs	111.3	110.3	112.4	105.8	111.8	109.7	114.8	114.9	108.2
GARMENTS									
Number of Observations	**219**	**11**	**208**	**37**	**182**	**10**	**40**	**45**	**124**
Material inputs	25.2	27.9	25.1	13.4	27.6	29.2	23.1	34.5	22.3
Non-tradable inputs	35.7	26.8	36.2	26.2	37.6	50.5	33.3	36.9	34.9
- Electricity cost	*3.3*	*4.6*	*3.2*	*4.3*	*3.1*	*2.3*	*3.2*	*3.7*	*3.3*
Wages	39.4	42.1	39.3	47.7	37.7	29.8	38.8	33.9	42.3
Capital inputs	17.2	43.0	16.0	30.3	14.6	8.4	15.1	19.3	17.8
Taxes, contributions	1.7	0.4	1.8	0.3	2.0	1.1	2.3	5.7	0.2
Total costs	119.3	140.3	118.3	117.9	119.6	119.0	112.6	130.4	117.5

Source: Authors' calculations based on survey data

However, these values vary substantially according to the market orientation, size, and ownership type of textiles firms. In particular, we note that medium firms (with less than 300 workers and revenue under five billion Vietnamese Dongs) consume much less material and non-tradable inputs and much more labor than their large counterparts, although we only have eight observations of medium-sized firms (four firms over two years) on which to base this comparison[4]. Outward-oriented firms are more labor-intensive and less capital-intensive than inward-oriented firms. Important differences also exist according to firm ownership. Most striking here are the local SOEs, which use much more material inputs and much less non-tradable inputs than the others. FIEs are more capital- and material input-intensive and less labor-intensive than the others, whereas exactly the contrary is true of private enterprises.

Compared to textile firms, garment firms generate more value added, primarily through more intensive use of labor and much less reliance on material inputs. These differences are large and statistically significant at the one percent level. Among garment firms, it is noteworthy that inward-oriented firms have very high capital input shares and perform very poorly as indicated by an exceptionally high total cost/production ratio, although the number of observations is quite small. Medium firms use less than average material and tradable inputs and more primary factors. By ownership type, whereas local garment SOEs have a close-to-average cost structure, central SOEs stand out by their intensive use of non-tradable inputs and low primary factor use. Foreign-invested garment firms are characterized by total costs that far surpass their production value, high material input use and relatively high taxes and contributions. Finally, PEs are slightly more labor-intensive than the others.

[4] As noted earlier, small firms are not included in the sample.

These differences suggest that policy/environment shocks targeting one or the other of these inputs will have contrasting effects on the different types of firms. It should also be noted that total costs are well over 100 percent of production value, which implies that these firms are making losses on average.

3.2 Profitability Analysis

Table 2 presents average actual rates of return on capital and assets among our sample firms. We observe rates of returns that are below the average effective interest rate on debt (14.4 percent) for textile firms and negative for garment firms. This difference is statistically significant at the 5 (10) percent level for the returns to capital (assets). Indeed, more than half of the garment firms in our sample are loss-making, as compared to roughly 40 percent of textile firms. Generally, returns to assets are lower or more negative than returns to capital.

In both industries, inward-oriented firms are more profitable than their outward-oriented (exporting) counterparts both in terms of average rates of returns and the percentage of profitable firms. However, these differences are not statistically significant at any conventional level. Medium sized firms are more profitable than large ones. In both industries, local SOEs are the best performers while central SOEs are the worst in terms of returns to capital.

In general, care should be taken in interpreting these results as all price distortions are included in this profitability indicator, thus distorting the true performance of these firms. Only when all of these distortions are removed can we make strong conclusions with regard to the actual performance of the firm itself.

Table 2: Returns to Capital and Asset before Policy Changes (percent)

		MARKET		SIZE		OWNERSHIP			
	Whole Sample	Inward oriented	Outward oriented	Medium	Large	SOE Central	SOE Local	FIEs	PEs
TEXTILES									
Number of observations	**81**	**45**	**36**	**8**	**73**	**18**	**10**	**23**	**30**
Returns to capital before change	**5.5**	7.0	3.6	31.3	2.9	-9.8	19.7	11.1	5.7
Share of profitable firms	**59.7**	60.5	58.8	85.7	57.1	61.1	60.0	56.5	61.5
Returns to asset before change	**1.5**	7.6	-6.1	35.5	-2.2	-6.3	12.2	14.3	-7.2
Share of profitable firms	**58.0**	60.0	55.6	75.0	56.2	61.1	60.0	56.5	56.7
GARMENTS									
Number of observations	**219**	**11**	**208**	**37**	**182**	**10**	**40**	**45**	**124**
Returns to capital before change	**-10.9**	-2.5	-11.4	10.9	-15.5	-59.4	-5.2	-14.5	-7.3
Share of profitable firms	**47.3**	54.6	46.9	75.0	41.4	10.0	59.0	31.7	52.2
Returns to asset before change	**-17.1**	29.5	-19.8	24.4	-25.8	-73.2	-11.7	-22.6	-12.0
Share of profitable firms	**47.0**	54.6	46.6	74.3	41.3	10.0	57.5	32.5	51.8

Source: Authors' calculations based on survey data

The superior performance of textile firms is less striking when we consider that it sells half of its output on the highly-protected local market, while garment firms sell nearly 90 percent of their output on the unprotected export market. Furthermore, Table 3 shows that nominal rates of protection (NRP) are lower for garment firms (2.3 percent) than for textile firms (7.9 percent). These differences are accentuated when we examine effective rates of protection (ERP), which take account of slightly lower import taxes on tradable textile inputs.

As could be expected, inward-oriented firms benefit from higher overall protection than their exporting counterparts in both industries.

These results suggest that the current trade policy puts garment firms, and export-oriented firms in general, at a disadvantage. This also suggest that textile firms are likely to be more negatively affected when Vietnam reduces or eliminates tariffs in pursuance of trade liberalization and its commitments under the current AFTA and forthcoming WTO agreements. It should be noted, however, that none of these differences are statistically significant at the 10 percent level, which is unsurprising given the relatively small number of textile firms in our sample (81 out of 300).

Table 3: Protection of Textiles and Garments Firms by Firm's Characteristics

	Textiles			Garments		
	Whole Sample	**Inward oriented**	**Outward oriented**	**Whole Sample**	**Inward oriented**	**Outward oriented**
Number of Observations	**81**	45	36	**219**	11	208
Export Share	**49.5**	18.1	88.8	**89.2**	22.8	92.7
NRP	**7.9**	12.8	1.7	**2.3**	18.3	1.4
Import Tax on Tradable Inputs	**3.0**	4.0	1.7	**3.4**	11.3	3.1
ERP (Balassa)	**42.2**	77.8	-2.3	**15.8**	90.9	11.9
ERP (Corden)	**14.5**	24.2	2.3	**2.5**	24.0	1.3

Source: Authors' calculations based on survey data

4. Simulations

We first analyze the simulation results without any firm reactions to price changes. As already mentioned, these results are considered as short term or in the presence of market imperfections that prevent firms from modifying their production behavior. Further on we incorporate firm reactions and compare the two cases.

4.1 Policy Scenarios

The simulation exercise aims at quantifying the effects on firm profitability, measured by the rate of returns to capital, of changes in policies that are envisaged in Vietnam's policy reform agenda. Six sets of one or two scenarios are analyzed (Table 4). Where policy changes remove existing price distortions, this exercise also allows us to measure the current impact of these, often policy-generated, distortions.

a) Scenario 1: Elimination of all import tariffs

All tariffs imposed on imported goods are set equal to zero. This is the case of maximum tariff reform, which may be considered as the long-run objective of trade policy reforms. In the absence of data on effective tariff rates and given pervasive smuggling in Vietnam, effective tariff rates are estimated to be equal to half of official tariff rates. Effective tariff rates are then set equal to zero for this simulation. We assume that prices for output sold locally will fall correspondingly, whereas export prices remain constant. At the same time, prices for tradable material and capital inputs will also fall according to their respective initial tariff rates.

Table 4: Simulation Scenarios and Expected Price Effects

	Scenario	Expected Price Effects
1	**Eliminating all tariffs on goods**	Reduction in input and output prices.
2	**Changes in electricity tariffs**	
2.1	Unifying electricity tariffs	Increase in electricity costs of domestic firms only.
2.2	Raising uniform electricity tariffs to the level of long-term marginal costs	Increase in electricity costs of all firms.
3	**Reducing telephone fees by 50 percent**	Reduction in telecommunication costs of all firms.
4	**Exchange rate devaluation**	
4.1	Devaluation of exchange rate by 7 percent	Increase in prices of all tradable inputs, capital and outputs, as well as fuel.
4.2	Devaluation of exchange rate by 21.6 percent	As above.
5	**Combined scenarios**	
	Combination of 1, 2.2, 4 and 5.1	Changes in all input, capital and output prices.
	Combination of 1, 2.2, 4 and 5.1	As above.

Source: Scenarios are adapted from IE (2001a).

b) Scenario 2: Increase in electricity rates

A dual pricing scheme is applied to electricity, whereby FIEs pay more for electricity: currently 6.9 US cents per kilowatt as opposed to 5.6 US cents paid by Vietnamese firms (IE 2001b). Now the Government has a plan to unify prices of utilities and services for all enterprises, regardless of ownership. In scenario 2.1, prices paid by domestic firms increase by 23 percent to converge with the rate applied to FIEs. In scenario 2.2, the uniform electricity tariff increases an additional 8.7 percent to cover the long-term marginal cost, which is estimated at 7.5 cents. At roughly three to five percent of output value, changes in electricity costs are likely to have a non-negligible impact on firm profitability.

c) Scenario 3: Reduction in telecom rates

With regards to telecom fees, there is currently debate over the idea to reduce telecom costs to regional averages. A 50 percent reduction is simulated in line with expected further reductions in regional prices.

d) Scenario 4: Changes in Exchanges Rates

Exchange rate management and foreign exchange controls have resulted in an overvaluation of the Vietnamese currency. There are alternative ways to estimate the misalignment of exchange rate. Based on the PPP-method, which is possibly the simplest one, we estimate that by 2000, the dong had appreciated in real terms. The rate of overvaluation is estimated, depending on which year is taken as the base year, at 0.2 (1989), 7 (1990) or 21.6 percent (1991). Unsure of the appropriate base year, we compare results obtained with devaluations of 7 and 21.6 percent.

Devaluation of the exchange rate affects firm operations through two channels. On the output side, it raises the value of output (we assume that all T&G products are tradable) and thereby increases firm's profitability. At the same time, the costs of tradable material and capital inputs increase. The net effect of exchange rate devaluation on firm's profitability is normally positive, as long as the cost of tradable inputs and electricity prices is inferior to output value.

e) Scenario 5: Combined Scenarios

These combined scenarios integrate changes in all parameters mentioned above. The combined scenarios are constructed in such a way that reflects the maximum reform in all the specified areas, and that all changes take place simultaneously.

4.2 Without Firm Reactions

Table 5 summarizes the simulated returns to capital under various policy scenarios. We note that tariff elimination has the strongest negative effect on profitability for both textile and garment firms, whereas devaluations have the strongest positive impact. In the sections below, we examine the individual simulations in detail.

a) Elimination of Tariffs on Imported Goods

Trade liberalization alters the price of domestically-sold output and tradable inputs. The net effect of trade liberalization depends on whether the former or the latter effect dominates, which in turns depends on material input coefficients and the relative tariff rates of outputs and inputs. Our results show that the elimination of import tariffs is likely to strongly reduce profitability across all types of firms. Indeed, this is the most negative policy scenario analyzed.

Textile and garment firms see their returns to capital fall by roughly the same number of percentage points (17.5 and 16.5 percent), respectively. While textile firms sell more products locally, where output prices fall, they also benefit more from cheaper imports given their high material input shares (**Table** 1). Outward-oriented firms are affected less negatively than their inward-oriented counterparts in both the textile and garment sub-sectors.

b) Unification and Increase in Electricity Prices

Electricity costs are important, representing roughly three to five percent of output value (**Table** 1). The unification of electricity prices penalizes domestic firms, which currently pay lower electricity prices than FIEs and which face a 33 percent increase in this simulation. We observe that this uniformly reduces the returns to capital of both textile and garment firms by about two percentage points, regardless of their market orientation. A subsequent across-the-board 8.7 percent increase in electricity rates reduces the returns to capital a further 0.2 percentage points across sectors and market orientations.

c) Reduction in Telecom Rates

In this scenario, telecommunication fees are cut in half. This increases profitability by a non-negligible 0.56 to 1.54 percentage points with stronger effects for textile firms and outward-oriented firms. The greater use of telecommunications by textile firms is somewhat surprising given their lower export shares. The stronger impact on outward-oriented firms links to their need to contact with foreign distributors and customers.

d) Exchange Rate Devaluation

Table 5 shows that a seven percent devaluation increases returns to capital by 16 to 20 percentage points. This is the strongest positive impact of all policy scenarios, as input cost increases are overwhelmingly offset by the rise in output value. As expected, a stronger devaluation has a stronger effect, although the marginal effect is diminishing. No marked difference is noted by sector and by market orientation.

Table 5: Returns to Capital under Alternative Policy Scenarios (percent)

		MARKET		SIZE		OWNERSHIP			
	Whole Sample	Inward oriented	Outward oriented	Medium	Large	SOE Central	SOE Local	FIEs	PEs
TEXTILES									
Number of Observations	81	45	36	8	73	18	10	23	30
Export Share (percent)	**49.5**	18.1	88.8	49.0	49.6	24.7	66.0	64.8	47.1
Returns to capital before change	**5.5**	**7.0**	**3.6**	**31.3**	**2.9**	**-9.8**	**19.7**	**11.1**	**5.7**
1. Tariff elimination	**-12.1**	-16.4	-6.6	-27.5	-10.5	-28.6	0.5	1.0	-16.8
2.1 Unified electricity prices	**3.1**	4.6	1.2	26.8	0.8	-12.4	17.2	10.3	2.1
2.2 Electricity price increase (8.7%)	**2.9**	4.4	1.0	26.6	0.5	-12.7	17.0	10.2	1.9
3. Telecom fee reduction (50%)	**6.5**	7.5	5.1	32.6	3.9	-8.2	20.3	11.3	7.1
4.1 Devaluation (7%)	**22.0**	23.1	20.8	26.8	21.5	9.7	39.1	32.2	15.7
4.2 Devaluation (21%)	**29.2**	28.7	29.8	42.5	27.8	14.8	43.4	37.1	27.1
5.1 Combined (7% devaluation)	**-12.2**	-18.5	-4.3	14.5	-14.9	-37.6	-19.5	4.0	-6.3
5.2 Combined (21.6% devaluation)	**-4.0**	-10.1	3.8	10.1	-5.4	-30.8	-16.9	11.2	6.2
GARMENTS									
Number of Observations	219	11	208	37	182	10	40	45	124
Export Share (percent)	**89.2**	22.8	92.7	78.0	91.5	82.3	86.2	95.9	88.3
Returns to capital before change	**-10.9**	**-2.5**	**-11.4**	**10.9**	**-15.5**	**-59.4**	**-5.2**	**-14.5**	**-7.3**
1. Tariff elimination	**-26.4**	-29.7	-26.3	0.9	-31.1	-78.3	-20.2	-27.4	-23.7
2.1 Unified electricity prices	**-13.0**	-4.3	-13.5	8.9	-17.6	-61.8	-7.9	-14.6	-9.9
2.2 Electricity price increase (8.7%)	**-13.1**	-4.4	-13.6	8.8	-17.8	-62.0	-8.0	-14.7	-10.0
3. Telecom fee reduction (50%)	**-10.2**	-1.5	-10.7	11.3	-14.8	-59.1	-5.8	-13.1	-6.5
4.1 Devaluation (7%)	**9.6**	18.7	9.1	26.6	6.1	-12.1	13.0	1.0	13.1
4.2 Devaluation (21%)	**21.3**	25.3	21.1	33.8	18.7	4.5	21.5	9.0	26.9
5.1 Combined (7% devaluation)	**-7.4**	-21.9	-6.6	10.5	-11.3	-62.2	-4.5	-10.1	-2.7
5.2 Combined (21.6% devaluation)	**12.1**	-9.8	13.4	23.5	9.7	-28.5	11.8	3.2	19.0

Source: Authors' calculations based on survey data

e) Combined Scenarios

The combined scenario with a seven percent devaluation has contrasting effects on the different categories of firms. Whereas textiles firms are penalized, garment firms benefit. This result derives from the fact that textile firms are much more inward-oriented in general and inward-oriented firms are strongly penalized by this combined scenario. Returns to capital of outward-oriented garment firms increase, whereas outward-oriented textile firms experience a fall, although much less so than their inward-oriented counterparts. Results are much better for all categories of firms, especially garment firms when the other simulations are combined with a 21 percent devaluation.

In sum, the analysis reveals that trade liberalization and increases in electricity prices both reduce the profitability of firms, although trade liberalization emerges as far more important. On the contrary, exchange rate devaluation and a reduction in telecom rates both increase returns to capital, with exchange rate devaluation far more important.

4.3 With Firm Reactions

As discussed earlier, we experiment with two alternative specifications of the production function to capture firm reactions to price shocks. For each specification, we estimate or calibrate the parameters by four alternative methods. Estimations are run using OLS and IV regressions techniques. Calibration is obtained by assuming either a common or firm-specific production functions. We thus obtain eight groups of parameter estimates (Table 6), which are used to calculate changes in returns to capital.

Table 6: Estimates of Production Function

	Econometric estimation		Calibration	
	OLS	IV	Common PF[5]	Firm-specific PF
	First specification			
Textiles				
a	0.3628	0.3069	0.2619	Capital share in value added
b	0.5831	0.6808	0.4273	Labor share in value added
Garments				
a	0.3097	0.4069	0.209	Capital share in value added
b	0.5661	0.4850	0.5782	Labor share in value added
	Second specification			
Textiles				
a	0.1304	0.0656	0.1208	Capital share in (TR-OC)
b	0.3451	0.3689	0.1939	Labor share in (TR-OC)
g	0.4593	0.5078	0.6892	Intermediate input share in (TR-OC)
Garments				
a	0.1174	0.1592	0.1985	Capital share in (TR-OC)
b	0.3784	0.3268	0.5526	Labor share in (TR-OC)
g	0.4190	0.4613	0.3416	Intermediate input share in (TR-OC)

Source: Authors' calculations based on survey data

Notes: OLS: Ordinary Least Squares; IV: Instrumental Variable; PF: Production function; TR: Total revenue; OC: Other cost (not including labor, capital and material and non-tradable inputs)

Table 7 present the percentage point **variations** in returns to capital in the presence of firm reactions as compared to the corresponding returns to capital without firm reactions presented in **Table** 5. All results are in the expected direction, i.e. returns to capital with reactions are greater than or equal to those obtained without reactions.

The strongest increases in returns to capital – 8 to 52 percentage points – from firm reactions are noted in the case of exchange rate devaluations. We have already seen that the impacts of devaluation are very strong and thus firm reactions are equally strong. Impacts are stronger with the higher rate of devaluation, except in the case of the OLS regression of the second specification. These impacts are particularly strong and positive for textile firms.

In reality, firms react to changes in the relative prices of inputs and outputs by altering their input and output mix to maximize profits. However, the speed of adjustment depends on many factors such as the level of imperfections and rigidities in the goods and factors markets, the degree of substitutability between inputs. In policy terms, it is expected that the impacts of policy/environment changes will be more positive (less negative) in the long-term and that short-term assistance may be required. Also, policies that make it easier for firms to adjust (i.e. better access to credit) will accelerate this process.

[5] Coefficients do not sum to one as value added includes net direct taxes and are calculated as geometric means.

Table 7: Changes in Returns to Capital with Firm Reactions (Textile, percent)

	Econometric estimation		Calibration	
	OLS	IV	Common PF	Firm-specific PF
TEXTILES	**First Specification**			
1. Tariff elimination	2.22	5.17	2.23	1.14
2.1 Unified electricity rates	0.19	0.73	0.07	0.06
2.2 Electricity rates at cost	0.23	0.85	0.08	0.06
3. 50% telephone fee reduction	0.01	0.02	0.00	0.00
4.1 7% devaluation	8.20	27.33	14.54	6.94
4.2 21.6% devaluation	12.47	42.39	18.81	5.70
5.1 Total (7% devaluation)	3.25	7.41	3.32	1.51
5.2 Total (21.6% devaluation)	2.98	7.12	2.73	1.31
	Second Specification			
1. Tariff elimination	2.01	5.27	28.50	1.79
2.1 Unified electricity rates	0.15	0.39	3.55	0.62
2.2 Electricity rates at cost	0.17	0.44	4.14	0.82
3. 50% telephone fee reduction	0.00	0.01	0.08	0.00
4.1 7% devaluation	18.13	37.76	120.72	7.65
4.2 21.6% devaluation	14.87	52.02	187.34	11.24
5.1 Total (7% devaluation)	3.39	8.79	40.21	7.97
5.2 Total (21.6% devaluation)	3.14	8.21	51.91	9.25
GARMENTS	**First Specification**			
1. Tariff elimination	0.05	0.04	0.50	0.30
2.1 Unified electricity rates	0.94	0.33	0.02	0.03
2.2 Electricity rates at cost	1.46	0.51	0.02	0.04
3. 50% telephone fee reduction	0.04	0.02	0.01	0.00
4.1 7% devaluation	1.95	1.29	8.23	9.87
4.2 21.6% devaluation	3.17	2.08	14.67	11.98
5.1 Total (7% devaluation)	0.13	0.09	0.64	0.82
5.2 Total (21.6% devaluation)	0.82	0.56	4.75	7.77
	Second Specification			
1. Tariff elimination	0.11	0.15	28.09	3.86
2.1 Unified electricity rates	0.16	0.23	24.00	1.53
2.2 Electricity rates at cost	0.18	0.27	27.73	1.75
3. 50% telephone fee reduction	0.16	0.24	4.67	0.24
4.1 7% devaluation	7.65	10.92	228.50	11.11
4.2 21.6% devaluation	10.60	13.67	427.81	21.13
5.1 Total (7% devaluation)	1.84	2.65	41.40	2.33
5.2 Total (21.6% devaluation)	2.96	3.66	114.37	5.77

Source: Authors' calculations based on survey data

5. Comparison between Vietnamese and Chinese T&G Firms

5.1 Overview of T&G sector in China

The textile and garment industry is an important industry in China. Since China began its market-oriented reform, this industry has not only met the T&G needs of approximately 1.3 billion Chinese, but has also succeeded in exporting about one-third of its production.

In 2001, China accounts for roughly one-quarter of world production and one-seventh of world exports in this industry (Yuzhou, 2002). In the same year, all the state-owned enterprises and the non-governmental enterprises had annual sales above 5 million RMB (known as statistics-worthy enterprises or SWE in China). This sector represented 9.7 percent of China's total processing industries, 10.5 percent of its value added, 13 percent of national employment and 20 percent of the nation's commodity exports (Yuzhou, 2002). In 2002, China joined the WTO, which should only improve its growth performance in the years to come. In 2005, China's textiles export reached US$116 billion (Finfacts Business News Centre, 2006), 24 times more than Vietnam's textiles exports of US$4.8 billion (GSO, 2006).

At the same time, in the wake of Asian financial crisis, China's T&G industry has faced some challenges such as increase in raw material prices, declining demand in both domestic and international markets and weakening competitiveness. As a result, profits have fallen and, in some cases, firms have even incurred heavy losses. To help the textile industry overcome difficulties, the government of China chose this sector in 1997 as a pilot for the reform of SOEs.

With China's recent market liberalization, the private sector has been developing rapidly and more successfully than SOEs. This appears to be the result of greater flexibility in operation, lower worker benefits and more advanced technology. Between 1990 and 1997, average profit of private T&G firms increased more than fourfold. FIEs have increasingly become the major motor of growth in this industry.

5.2 Comparison between Vietnam's and China's T&G Firms

We compare the performance of Vietnamese and Chinese T&G firms using data from the World Bank's survey on competitiveness, technology and firm linkages conducted in China in 2001. Table 8 compares the cost structure of Vietnam's and China's firms. Outward-oriented firms exports more than 50 percent of their output. Whereas garment firms in Vietnam are those for which garments represent one-half or more of their output, this information is not available for China and we depend instead on the classification indicated in the survey. Note also that non-tradable and capital inputs are grouped together in the Chinese survey data.

Table 8: Cost Structure of Vietnam's and China's Firms (Percent of Production Value)

	Vietnam			China		
	Whole Sample	**Inward oriented**	**Outward oriented**	**Whole Sample**	**Inward oriented**	**Outward oriented**
TEXTILES						
Number of Observations	**81**	**45**	**36**	**37**	**15**	**22**
Material Inputs	53.3	52.3	54.7	47.9	44.1	50.4
Non-tradable Inputs	24.2	25.5	22.6	21.3	27.5	17.1
Capital Inputs	13.8	15.6	11.5			
Wages	18.9	15.3	23.3	14.5	13.4	15.3
Taxes, Contributions	1.0	1.6	0.3	1.9	1.4	2.2
Total Costs	**111.3**	**110.3**	**112.4**	**87.5**	**91.2**	**85.1**
GARMENTS						
Number of Observations	**219**	**11**	**208**	**99**	**17**	**82**
Material Inputs	25.2	27.9	25.1	46.7	45.2	47.0
Non-tradable Inputs	35.7	26.8	36.2	26.9	50.4	22.1
Capital Inputs	17.2	43.0	16.0			
Wages	39.4	42.1	39.3	23.2	33.6	21.1
Taxes, Contributions	1.7	0.4	1.8	1.1	3.1	0.7
Total Costs	**119.3**	**140.3**	**118.3**	**98.0**	**132.2**	**90.9**

Source: Authors' calculations based on survey data

We first note that Chinese firms, with the exception of inward-oriented garment firms, are generally profitable, with total costs inferior to production value, whereas the Vietnamese firms make losses on average. In both countries, textile firms tend to be more profitable and, with the exception of Vietnamese textile firms, outward-oriented T&G firms are also more profitable.

In terms of cost structure, when we consider the textile industry, we see that material inputs, non-tradable/capital inputs and labor costs are all inferior in China. In contrast, Chinese garment firms have much higher material input costs, although their lower capital and labor costs more than offset this. This may be because Vietnamese garment firms operate more on a cut-make-trim (CMT) basis than Chinese firms. FOB sales account for only 19.4 percent of total sales of surveyed Vietnamese garment firms. The data on FOB sales of Chinese firms are not available so we can not make a direct comparison.

Vietnam's inferior profitability is confirmed by our estimates of the returns to capital (Table 9). Returns to capital of Chinese firms are extremely high and much higher than returns to capital of Vietnamese firms. The percentage of profitable firms in China is also much higher than in Vietnam.

Table 9: Returns to Capital in the T&G sector in Vietnam and China (percent)

	Vietnam			China		
	All	**Inward oriented**	**Outward oriented**	**All**	**Inward oriented**	**Outward oriented**
TEXTILES						
Returns to capital	**5.5**	**7.0**	**3.6**	**37.4**	**42.2**	**34.2**
Share of profitable firms	**59.7**	60.5	58.8	**83.8**	73.3	90.9
GARMENTS						
Returns to capital	**-10.9**	**-2.5**	**-11.4**	**45.5**	**44.0**	**45.8**
Share of profitable firms	**47.3**	54.6	46.9	**75.8**	82.4	74.4

Source: Authors' calculations based on survey data

In short, data analysis shows that Chinese firms are much more competitive and profitable than Vietnamese firms. Lower wages are an important factor that makes Chinese firms more competitive than Vietnamese firms. In addition, China's accession to WTO gives Chinese firms better access to the international market. All these imply that China's textile and garment industry poses a big competitive challenge for Vietnamese firms.

6. Conclusions

We have analyzed which policies matter most for the profitability and competitiveness of Vietnam's textile and garment firms. We also compare their performance with their Chinese rivals.

A microeconomic theoretical framework is applied and a profit-based simulation methodology developed linking competitiveness to profitability. The methodology makes it possible to simulate the impacts on profitability and, hence, competitiveness of a variety of changes in policy and the business environments. Firms and sectors that are more profitable in a given market are more likely to attract investment, expand and increase their market shares, thereby increasing their competitiveness on this market.

Quick cost structure analysis of Vietnamese firms shows that there are statistically significant differences by sector, size, orientation and ownership type. In particular, garment firms have lower material input costs and higher labor-capital ratios than textile firms. Medium firms also tend to use less material inputs, although their labor-capital ratios are higher than large firms only in the textile sector. Outward-oriented firms have higher labor-capital ratios but similar material input shares with respect to their inward-oriented counterparts. These results imply that policy changes are likely to have quite different impacts on these different types of firms.

Textile firms tend to be more profitable than garment firms both in terms of the average returns to capital and to assets, which are negative in the case of garment firms, as well as the share of profitable firms, although the latter difference is not statistically significant.

A simulation exercise is used to examine the impacts of different policy changes on firm profitability. The analysis reveals that trade liberalization and increases in electricity prices both reduce the profitability of firms, although trade liberalization emerges as far more important. On the contrary, exchange rate devaluation and a reduction in telecom rates both increase returns to capital, with exchange rate devaluation far more important.

The elimination of import tariffs reduce firm's profitability across all types of firms, particularly textile firms. Increase in electricity prices reduce firm profitability, whereas a reduction in telecom rates has the opposite effect. Devaluation increases profitability, particularly among garment and outward-oriented firms, as the increase in tradable input costs is more than offset by the increase in output prices. When we combine these scenarios, returns to capital fall among textile firms and increase among garment firms. However, within these sectors, profitability falls among inward-oriented firms, whereas it increases quite substantially among outward-oriented firms.

When we integrate firm reactions to policy shocks, returns to capital uniformly increase. Returns to capital of both textile and garment firms improve significantly under the scenarios of tariff elimination, exchange rate devaluations and in both combined scenarios. Firms react to changes in the relative prices of outputs, inputs and production factors by altering their product mix and factor proportions in order to maximize profits. However, the speed and extent of adjustment of firms depend on many factors such as market imperfections and rigidities in the goods and factors markets, the degree of substitutability between various inputs and between production factors, etc.

Comparison with Chinese textile and garment firms show that Chinese firms are much more competitive and profitable than Vietnamese firms. Lower labor costs are an important factor that makes Chinese firms more competitive. China's textile and garment industry thus poses a big competitive challenge for Vietnamese firms.

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Appendix 1: Derivation of supply and factor demand functions

1. First Specification of the Production Function

We begin by replacing the first specification of the production function (10) into the standard profit formula (2) to set up the maximization problem:

$$\max \pi = P*\theta_{VA}*A*\overline{K}^{\alpha}*L^{\beta} - w_1*\overline{K} - w_2*L - w_3*(\theta_{VA}/\theta_{INTER})*A*\overline{K}^{\alpha}*L^{\beta} - OtherCosts$$

or:

$$\max \pi = (P-w_3/\theta_{INTER})*\theta_{VA}*A*\overline{K}^{\alpha}*L^{\beta} - w_1*\overline{K} - w_2*L - OtherCosts$$

Assuming that the market price is above variable costs, the first-order condition of profit maximization is[6]:

$$\beta*(P-w_3/\theta_{INTER})*\theta_{VA}*A*\overline{K}^{\alpha}*L^{\beta-1} = w_2$$

from which we can derive the following labor demand function:

$$L^{optimal} = [\beta*(P-w_3/\theta_{INTER})*\theta_{VA}*A*\overline{K}^{\alpha}/w_2]^{\frac{1}{1-\beta}}$$

Substituting this function into the original production function, we obtain optimal output:

$$Q^{optimal} = \theta_{VA}*A*\overline{K}^{\alpha}*[\beta*(P-w_3/\theta_{INTER})*\theta_{VA}*A*\overline{K}^{\alpha}/w_2]^{\frac{\beta}{1-\beta}}$$

or

$$Q^{optimal} = \theta_{VA}^{\frac{1}{1-\beta}}*A^{\frac{1}{1-\beta}}*\overline{K}^{\frac{\alpha}{1-\beta}}*[\beta*(P-w_3/\theta_{INTER})/w_2]^{\frac{\beta}{1-\beta}}$$

In the same way, the labor demand function can be replaced into intermediate input demand function (9):

$$INTER^{optimal} = (\theta_{VA}/\theta_{INTER})*A*\overline{K}^{\alpha}*[\beta*(P-w_3/\theta_{INTER})*\theta_{VA}*A*\overline{K}^{\alpha}/w_2]^{\frac{\beta}{1-\beta}}$$

$$INTER^{optimal} = (\theta_{VA}^{\frac{1}{1-\beta}}/\theta_{INTER})*A^{\frac{1}{1-\beta}}*\overline{K}^{\frac{\alpha}{1-\beta}}*[\beta*(P-w_3/\theta_{INTER})/w_2]^{\frac{\beta}{1-\beta}}$$

2. Second Specification of Production Function

In the second specification, production is a Cobb-Douglas function of capital, labor and intermediate inputs:

$$Q=A*K^{\alpha}L^{\beta}*INTER^{\gamma} \qquad (11)$$

The short to medium term profit maximization problem is as follows:

$$\max \pi = P*A*\overline{K}^{\alpha}*L^{\beta}*INTER^{\gamma} - w_1*\overline{K} - w_2*L - w_3*INTER - OtherCosts$$

[6] It can be easily shown that if $\beta<1$, the second-order condition of profit maximisation is also satisfied.

The first order conditions are[7]:

$$\beta*P*A*\overline{K}^{\alpha}*L^{\beta-1}*INTER^{\gamma}=w_2$$

$$\beta*P*A*\overline{K}^{\alpha}*L^{\beta-1}*(\frac{w_2}{w_3})^{\gamma}*(\frac{\gamma}{\beta})^{\gamma}*L^{\gamma}=w_2$$

or

$$INTER=\left(\frac{w_2}{w_3}\right)*\left(\frac{\gamma}{\beta}\right)*L$$

Substituting this into the first of the first order conditions and assuming that $(\beta+\gamma)\neq 1$, we obtain the following labor and intermediate input demand functions:

$$L^{optimal}=[\beta*P*A*\overline{K}^{\alpha}*w_2^{\gamma-1}*(\frac{1}{w_3})^{\gamma}*(\frac{\gamma}{\beta})^{\gamma}]^{1/(1-\beta-\gamma)}$$

$$INTER^{optimal}=(\frac{w_2}{w_3})*(\frac{\gamma}{\beta})*[\beta*P*A*\overline{K}^{\alpha}*w_2^{\gamma-1}*(\frac{1}{w_3})^{\gamma}*(\frac{\gamma}{\beta})^{\gamma}]^{1/(1-\beta-\gamma)}$$

Finally, the supply function is:

$$Q^{optimal}=A*\overline{K^{\alpha}}*(\frac{w_2}{w_3})^{\gamma}*(\frac{\gamma}{\beta})^{\gamma}*[\beta*P*A*\overline{K}^{\alpha}*w_2^{\gamma-1}*(\frac{1}{w_3})^{\gamma}*(\frac{\gamma}{\beta})^{\gamma}]^{(\beta+\gamma)/(1-\beta-\gamma)}$$

3. Estimation of Parameters of Production Function

Parameters of the production functions can be estimated econometrically by (i) OLS or (ii) Instrumental Variables. Instrumental variables address the possible endogeneity of capital and labor, as they also depend on output and are therefore correlated with the error term. We need at least one instrument for each variable. An ideal instrument is not correlated with the error term, but highly correlated with these variables. Lagged values are strong candidates for these instruments, as they are not contemporaneously correlated with the error term (therefore exogenous in this sense), yet highly correlated with their current values (because of sluggishness of the production system). Thus, in the paper, lags of capital, labor, and intermediate input are used as instruments for their corresponding variables.

Due to the potential problem of identification under conditions of perfect competition with all firms maximizing profit under the same set of inputs and output prices, these parameters can alternatively be calibrated by using labor share in value added (under the first specification of production function) or shares of labor and intermediate inputs in total revenue minus other costs (under the second specification of production function).

$$b=\sqrt[n]{\prod_1^n \frac{w_{2,i}*L_i}{(Q_i/q_{VA,i})}}$$

For each specification of the production function, these shares may be firm-specific, if the production function varies across firms, or, if a common production function is assumed, they may be calibrated as a geometric mean of the respective shares for all firms.

[7] It can be easily shown that if β and $\gamma<1$, the second-order condition of profit maximisation is also satisfied.