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Contribution of productivity and firm size to value-added: Evidence from Vietnam

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ABSTRACT

A new indexing method is developed to decompose the contributions of productivity, prices and firm size to a firm's value-added. The method introduces an error term into the decomposition equation to capture measurement biases which are caused by using the deflator instead of the observed price and all other sorts of measurement error. An application of the method is given using private small and medium manufacturing firm level data in Vietnam from 1996 and 2001. The error index decomposition method provides a comparison of performance of all firms to the hypothetical representative firm. The analysis allows firms and policy makers to realize the key factors contributing to the success or failure of a firm and suggest strategies to improve firm economic performance.

1. Introduction

An understanding of the factors contributing to a firm's profit and value-added, and also at the industry level, is important to both firm owners and policy makers. In this paper an index-number profit decomposition method is extended to account for the nature of manufacturing industrial data, i.e., firms produce different outputs and use different inputs, to evaluate firm and industry performance. This different dimensionality results in difficult problems of aggregating and decomposing separate price effects with the profit decomposition method.

To overcome the problem of decomposing profit and value-added given the data characteristics, a new indexing decomposition method called the error index decomposition method (EIDM) is developed using the value-added total factor productivity (TFP) measurement. The EIDM allows for differences in a firm's value-added to be decomposed into separate effects due to variations in productivity and firm size in both labor and capital. It also helps resolve the dimensionality problem by using the industry deflator instead of the observed price. This approximation introduces biases into TFP measurement (Coelli et al., 2003; Diewert, 2005) and, thus, an error term is added into the decomposition equation to capture measurement biases and white noise. The method is applied to domestic private small and medium manufacturing enterprises in Vietnam over the period 1996–2001 and shows that productivity is a core contributor to the success of a firm.

The remainder of the paper is organized as follows. Section 2 describes the profit decomposition and the EIDM. Details of data and variable measurement are presented in Section 3 while Section 4 discusses the value-added TFP index for private small and medium manufacturing enterprises (SMEs) in Vietnam. The decomposition of factors contributing to a firm's value-added is analyzed in Section 5. Section 6 concludes with suggestions as to how to promote firm and industry performance in Vietnam.

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2. Methodology

Lawrence, Diewert and Fox (LDF) (2001) and Fox, Grafton, Kirkley and Squires (FGKS) (2003) have developed an index-number profit decomposition (INPD) method that explains changes in a firm's variable profits from productivity, output prices, variable input prices and firm size. LDF apply this method to assess the contribution of these factors on profitability of Telstra, Australia's major telecommunications carrier. FGKS extend this approach to multiple cross-sectional data and compare firm performance in the British Columbia halibut fishery. In this paper, we adapt and extend the methodology to the manufacturing firm level data in one developing country: Vietnam.

The INPD method defines the variable non-zero profits of an arbitrary firm b, π^b relative to the variable profits of another firm a, π^a as

$$\Gamma^{a,b} = \pi^b/\pi^a \tag{1}$$

Using Fisher's weak reversal test, the variable profit index defined in Eq. (1) is a product of price and quantity indexes, i.e.,

$$\Gamma^{a,b} = P^{a,b}Q^{a,b} \tag{2}$$

where $P^{a,b}$ and $Q^{a,b}$ are the price and quantity indexes of the 'netputs', respectively. In the 'netputs' vector, output quantities are treated as positive, while variable input quantities are treated as negative. The result from Eq. (2) is, hence, the relative variable profit or the gross return to capital index between two firms.

Using the translog identity exploited by Diewert and Morrison (1986), FGKS prove that if a firm's profit function π is in translog form, and under profit maximizing behavior, the capital TFP[1] index between two firms a and b is exactly equal to a Tornqvist implicit netput quantity index, divided by the capital index. That is

$$R^{a,b} = \frac{Q^{a,b}}{K^{a,b}} \tag{3}$$

where $R^{a,b}$ is the capital TFP index, $Q^{a,b}$ is the implicit netput quantity index derived from (2) and $K^{a,b}$ is the capital quantity index.

Deriving $Q^{a,b}$ from (2), substituting into (3), and rearranging, we obtain

$$\Gamma^{a,b} = R^{a,b}P^{a,b}K^{a,b} \tag{4}$$

$P^{a,b}$ and $K^{a,b}$ are also in the Tornqvist form and calculated as

$$P^{a,b} \equiv \exp\left[\sum_{m=1}^{M}\frac{1}{2}(s_m^b + s_m^a)\ln(p_m^b/p_m^a)\right] \tag{5}$$

$$K^{a,b} = \exp\left[\sum_{n=1}^{N}\frac{1}{2}(s_n^b + s_n^a)\ln(k_n^b/k_n^a)\right] \tag{6}$$

where p_m is the price of mth commodity and k_n is the quantity of nth capital component, $s_m = p_m y_m/\sum p_m y_m$ is the profit share of netput m and $s_n = r_n k_n/\sum p_m y_m$ is the profit share of fixed input n. Using the multiplicative nature of the Tornqvist index, $P^{a,b}$ and $K^{a,b}$ can be further decomposed into individual or group component effects of output and variable input prices and capital as

$$P^{a,b} = \prod_{m=1}^{M} p^{a,b} \tag{7}$$

where $p^{a,b}$ is the price index of individual or group of outputs and variable inputs, and

$$K^{a,b} = \prod_{n=1}^{N} k^{a,b} \tag{8}$$

where $k^{a,b}$ is the capital quantity index of individual or group of capital.

When applying the method of FGKS to firm level data in Vietnam, we face the problem of different dimensionality. It is very often the case that two different firms produce different numbers of outputs and use different numbers of intermediate inputs in the same industry. Hence, the traditional bilateral index number breaks down as it requires the same dimensionality (Bresnahan and Gordon, 1996; Gordon and Griliches, 1997; Diewert, 2003). Consequently, we cannot decompose the price index $P^{a,b}$ into the output and intermediate input price indexes to calculate each individual index. This difficulty can be resolved by using a value-added TFP measurement as follows.

First, we define the value-added total factor productivity (VATFP) index of firm b relatively to firm a as follows:

$$\theta^{a,b} = \frac{Q_{VA}^{a,b}}{Q_{KL}^{a,b}} \tag{9}$$

where $\theta^{a,b}$ is the VATFP index, $Q_{VA}^{a,b}$ is the value-added quantity index and $Q_{KL}^{a,b}$ is the primary inputs (capital, labor) quantity index. The non-zero value-added is defined as revenue minus the intermediate cost, that is,

$$VA = R - C_M = py - wx \tag{10}$$

where R is revenue, C_M is intermediate cost, y is output quantity, x is intermediate input quantity, p and w are the price of those factors, respectively. In this TFP measurement approach, the intermediate inputs are treated as negative outputs. Any production unit is considered as a mechanism that turns capital and labor into 'value-added' production. Thus the 'productivity' measure in (9) is the difference in the value-added quantity that cannot be explained by differences in capital and labor.

If $Q_{VA}^{a,b}$ cannot be calculated directly, for example, if the data on outputs and intermediate inputs are only available in terms of value, or if the variation in price ratios is less than in the quantity ratios (Allen and Diewert, 1981), it is preferable to use the implicit VA quantity index based on Fisher's weak reversal test, i.e.,

$$Q_{VA}^{a,b} \equiv \frac{\Omega^{a,b}}{P_{VA}^{a,b}} \tag{11}$$

[1] We call this productivity the capital TFP as the denominator is only the capital index rather than the index of primary inputs as in value-added TFP, or the aggregate index of all inputs including capital, labor and intermediate inputs in a gross-output TFP.

where $\Omega^{a,b}$ is the value-added index and $P_{VA}^{a,b}$ is the price index of output and intermediate inputs.

Substituting $Q_{VA}^{a,b}$ into (9) and rearranging, we obtain

$$\Omega^{a,b} \equiv \theta^{a,b} P_{VA}^{a,b} Q_{KL}^{a,b} \tag{12}$$

In practice, when we face the problem of different dimensionality, as in the case in the Vietnamese data we use, it may not be possible to aggregate $P_{VA}^{a,b}$ based on the observed price information from the data set. In such cases, it is possible to use the aggregate price index or deflator for the industry published by the national statistics office. The VATFP index can be calculated as follows:

$$\theta'^{a,b} = \frac{\Omega^{a,b}/P'^{a,b}_{VA}}{Q_{KL}^{a,b}} \tag{13}$$

where $P'^{a,b}_{VA}$ is the deflator for each industry. The use of the deflator as a proxy for the observed price is an approximation and, thus, may introduce biases into the TFP measurement due to the deviation of individual price from the deflator or the average price.[2] Eq. (12) now can be written as

$$\Omega^{a,b} = \theta'^{a,b} P'^{a,b}_{VA} Q_{KL}^{a,b} \tag{14}$$

In expression (14), capital and labor are exogenous, the deflator is given, $\theta'^{a,b}$ is an estimate of the 'true' $\theta^{a,b}$ in Eq. (12). If we compute $\Omega^{a,b}$ based on the observed value and treat VATFP as a residual, not only measurement bias in using industry specific deflators but also other sorts of errors such as biases in input and output quantity measurements will be captured in the derived VATFP. To reduce as much as possible the measurement bias in TFP measure, we propose a method of decomposing $\theta'^{a,b}$ in (14) into two components as follows:

$$\theta'^{a,b} = \theta^{a,b}\alpha^{a,b} \tag{15}$$

where $\theta^{a,b}$ is calculated independently, which captures unexplained differences between outputs and inputs due to factors relating to TFP; $\alpha^{a,b}$ captures unexplained differences caused by measurement biases and white noise. The way to calculate $\theta^{a,b}$ is developed in Section 4.

Eq. (14) thus can be redefined as

$$\Omega^{a,b} \equiv \theta^{a,b}\alpha^{a,b} P'^{a,b}_{VA} Q_{KL}^{a,b} \tag{16}$$

In this equation, all components but $\alpha^{a,b}$ are computed independently. The term α is treated as a residual which captures measurement errors. This approach is analogous to the stochastic frontier approach where the error term is decomposed into technical efficiency and white noise (see Aigner et al., 1977; Meeusen and van den Broeck, 1977).

If we employ the Tornqvist index, we can decompose labor and the capital quantity indexes as follows:

$$\Omega^{a,b} \equiv \theta^{a,b}\alpha^{a,b} P'^{a,b}_{VA} Q_{K}^{a,b} Q_{L}^{a,b} \tag{17}$$

where $Q_{L}^{a,b}$ and $Q_{K}^{a,b}$ are the quantity index of labor and capital, respectively. This indexing method allows differences in a firm's *VA* to be broken down into separate effects due to productivity difference, the composite impacts of differences in the price of output and intermediate inputs, and firm size in terms of both labor and capital.

2.1. Benchmark firm

For cross-sectional comparative purposes, a benchmarking firm must be chosen in the index decomposition. In the FGKS method, they use the most profitable firm as the reference. This benchmarking firm is also used in Fox et al. (2006) and Grafton et al. (2006). Their purpose is to compare every firm with the best performing one to help identify what factors may be constraining profits in the rest of the industry. However, in the context of the transitional economy, the most profitable firm may be the 'star'. In other words, there could be very large differences between the most profitable firm that can make a 'star' and the majority of firms, making such comparison difficult. For instance, firms may lag far behind the 'star' due to big differences in technology used, management skills, marketing skills, and/or sensitive reasons such as lobbies from the local government or tax evasion. To facilitate comparison, especially where large differences exist among firms in the presence of unobserved determinants, we use a 'sample mean' firm as a reference and compare every firm with this hypothetical representative firm. The advantage of using the sample mean firm is that it makes indexes satisfy the transitivity condition to allow multilateral comparison. We use the method pioneered by Christensen et al. (1981) and Caves et al. (1982) for multilateral cross-country comparisons. In their works, output, productivity and input levels of an arbitrary firm/country are compared with the hypothetical representative firm/country defined as the geometric mean with output vector $\overline{\ln Y_i}$ and input vector $\overline{\ln X_i}$ where Y_i and X_i are output and input levels of each individual firm/country. A number of papers (Baily et al., 1992; Hill, 1997; Motohashi, 2005) follow this approach in making cross-sectional comparisons.

In our approach, we create the hypothetical representative firm for the total manufacturing industry, and make comparisons to this level. The representative firm is defined as the weighted geometric mean with weights taken as the share of value-added in the total industry VA. This asymmetric average firm reflects more accurately mean industry performance as larger firms get more weight than tiny firms. Given that output and intermediate inputs are measured in terms of the value of deflated revenue and cost, the quantity indexes are calculated implicitly. Capital quantity is measured by the sale price of fixed assets including buildings and machineries while labor is measured by the number of workers. This is comparable across firms.

3. Data and variable measurement

3.1. Data

The EIDM is applied to the pooled sample of domestic private manufacturing SMEs in Vietnam. The data were

[2] To see how these biases could occur in practice, readers can refer to Coelli et al. (2003).

Table 1
Firms' characteristics by ownership.

Ownership type	Percentage	Average size (no. of workers)	Average machinery capital (thous. VND[a])	% Of micro firm[b]
1996 (307 obs[c])				
Household	45.93	6.48	33,318.76	82.27
Private	37.13	14.28	86,460.03	42.11
Cooperative	13.36	19.49	100,928.70	17.07
L&S[d]	3.58	19.00	186,152.50	18.18
2001 (603 obs)				
Household	71.10	6.89	31,451.33	81.23
Private	19.23	10.47	83,576.40	60.65
Cooperative	6.37	19.41	88,796.34	5.88
L&S	3.30	18.53	199,061.90	21.05

[a] VND is the Vietnamese currency.
[b] Proportion of micro firms for each ownership type.
[c] Observations.
[d] L&S are limited and share holding companies, which are considered as modern enterprises with more advanced technology and management skills.

collected by the Institute of Labor Science and Social Affairs (ILSSA) of the Ministry of Labor, Invalids and Social Affairs (MOLISA) of Vietnam in collaboration with the Stockholm School of Economics (SSE) of Sweden in 1996 and 2001. The sample covers different private ownership characteristics including household firms, private enterprises, cooperatives, partnership enterprises and limited companies.

In 1996, the survey collected data from nearly 800 firms. The 2001 survey collected data of around 1400 firms of which approximately 600 were surveyed in 1996. After dropping missing and irrelevant values,[3] 307 and 603 observations remain in the 1996 and 2001 samples, respectively, making the total number of the pooled sample 910. Among these firms, only 90 enterprises were surveyed in both years. In our paper, we divide the sample into two groups: micro firms with <10 workers and small and medium (SM) firms that employ between 10 and 300 workers.[4] Table 1 documents the characteristics of firms by ownership type.

3.2. Variable measurement

Labor: Labor quantity is measured as the number of workers. The implicit labor price for each firm is calculated by taking total wage divided by the number of paid workers. For enterprises which use only family labor, their labor price is replaced by the minimum implicit labor price. This is because calculations from the data set show that mean profit of these enterprises is just below half of that of enterprises using paid labor. The profits are the return to family labor. Total wage of every firm is then adjusted by taking the implicit labor price multiplied by total number of workers.

[3] A number of firms do not meet the requirement of having positive value-added as required by the indexing method.

[4] Although medium firms are defined as having up to 300 workers, in reality, almost all small and medium enterprises in Vietnam have fewer than 50 workers.

Capital: The surveys collected data of total owned assets including buildings, machinery and inventories at their current sale price for each firm. It should be noted that the survey lumped land value into the value of buildings, and so we use the term 'building' to indicate the total value of building and land. According to Morrison (1999), inventories should not be included as a capital measure as they do not provide productive services.[5] In our case, inventories account for a small proportion of capital; we follow Morrison's (1999) suggestion of excluding inventories from the measure of 'building' and machinery.

Price of capital: To calculate the primary input quantity index, we need a capital cost to compute the relevant cost share. In the standard case, the rental price or user cost of capital is the sum of depreciation cost, interest rate cost and risk premium. Unfortunately, in transitional and developing countries, a risk premium is not available and hard to calculate. As a result, the premium is not included as a capital cost.

Because the surveys did not collect any information about the age of assets, capital costs can be computed using the approach suggested by Diewert (2006). However, when we apply this approach, it turns out that almost all rental prices are negative. The results confirm the suggestion of Morrison (1999) that land is virtually meaningless in terms of its productive input because if land values are improving, its rental price could be negative. This is also true in the case of Vietnam where land prices increased substantially during the period studied. As there is no way, given the data available, to exclude land value from the value of 'building', we calculate the rental price of capital as the interest rate cost only.

To provide accurate measures of the contribution to value-added changes, we convert all values into 1994 constant prices. Outputs and intermediate inputs are deflated by output and intermediate input price indices

[5] This opinion is, however, objected to by Diewert (2005).

Table 2
Summary statistics of data.

	Obs	Mean	Std. dev.	Minimum	Maximum
All year					
Revenue	910	249,707.90	360,876.50	4025.52	3,242,805.00
Intermediate cost	910	175,971.10	282,120.80	1279.03	2,892,409.00
Capital quantity	910	313,500.60	330,221.20	19,061.88	1,825,781.00
Capital cost	910	33,464.83	35,888.04	2273.97	220,944.20
Number of workers	910	9.18	8.20	1.00	50.00
Wages	910	47,075.26	54,379.47	228.31	441,704.70
1996					
Revenue	307	345,656.30	500,245.70	9721.50	3,242,805.00
Intermediate cost	307	246,996.70	403,405.80	2300.31	2,892,409.00
Capital quantity	307	237,051.00	226,059.70	19,061.88	1,091,287.00
Capital cost	307	47,844.28	45,621.66	3824.04	220,944.20
Number of workers	307	11.56	9.97	2.00	50.00
Wages	307	51,673.86	54,242.44	360.52	341,630.90
2001					
Revenue	603	200,858.60	249,718.70	4025.52	1,802,157.00
Intermediate cost	603	139,810.50	183,246.90	1279.03	1,100,859.00
Capital quantity	603	352,422.70	366,308.60	31,301.03	1,825,781.00
Capital cost	603	26,143.95	26,975.54	2273.97	136,767.10
Number of workers	603	7.97	6.83	1.00	50.00
Wages	603	44,734.01	54,344.55	228.31	441,704.70

for the two-digit sub-industry in which the firm belongs, respectively. Wages are deflated by the consumer price index (CPI). To compute the deflator for capital quantity, we use the value of an increase in fixed assets under investment. This is the most suitable candidate to deflate capital as it reflects the increase of a mix of buildings and machineries valued at current and constant prices.[6] Because our rental price of capital is calculated as the interest rate cost only, we use the general inflation rate to deflate capital costs to get the real price of capital. Summary statistics of the data are provided in Table 2.

4. Value-added TFP index for private manufacturing SMEs in Vietnam

The VATFP index $\theta^{a,b}$ in Eq. (17) is calculated for the pooled sample based on the value-added TFP approach suggested by Balk (2003). Formulas to calculate the VATFP index are developed in Appendix A. The reference firm is chosen as the weighted geometric mean firm having the output vector $\overline{\ln Y_i}$ and input vector $\overline{\ln X_i}$ with weights taken as the share in the total industry value-added. Output and intermediate input quantity indexes are computed by relating the deviation of firm deflated revenues and intermediate costs from the asymmetric industry mean. The appropriate deflators for these indexes are the output and intermediate input prices constructed for particular industries (Morrison, 1999; Coelli et al., 2003). The list of sub-industries, number of observations and the price deflators are provided in Appendix B. The primary input quantity index are calculated using the Tornqvist formula. The plotted VATFP indexes are presented for the whole manufacturing industry in Figs. 1a and b.

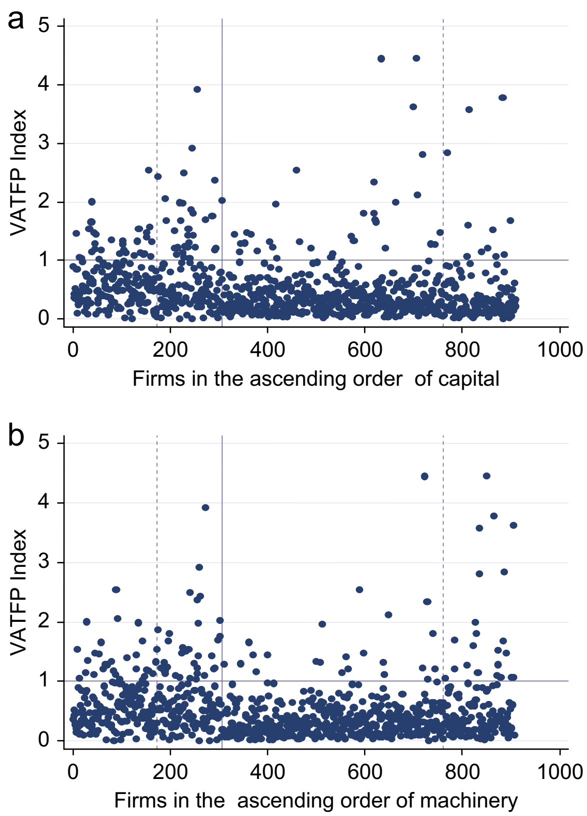

Fig. 1. (a) Value-added TFP index on capital and (b) value-added TFP index on machinery.

[6] We acknowledge that the deflator for capital quantity may be problematic as the value of 'building' in the data set embodies land value. However, given the Vietnamese statistical publications, this is the most appropriate choice.

In Figs. 1a and b, observations of each year are separated by the solid vertical line while the dashed line separates firms in each year (1996 and 2001) into micro and SM groups. The horizontal line divides TFP indexes below and above 1. The above 1 group includes firms with a TFP level greater than that of the average firm, and the below 1 group contains firms with a TFP level less than the level of the average firm.

Fig. 1a represents TFP indexes by observation, where firms are ranked in the ascending order of capital. As shown in this figure, there is an increasing trend of TFP indexes along with capital in 1996, but the pattern is less pronounced in 2001. This may be because a large proportion of 'building' is land and its values raised considerably due to land speculation in 2000 (Ministry of Finance, 2005). Thus, more capital does not necessarily imply more machinery or more advanced technology, at least for the latter period. In order to analyze the relationship between TFP and technology, we graph TFP indexes on the ascending order of machinery (Fig. 1b). The increasing trend of TFP indexes is clearer for both 1996 and 2001. Firms with higher machinery capital have higher TFP level.

A striking feature of the figures is that the majority of firms in the sample have TFP level less than that of the sample mean firm. This suggests that the productivity performance of SMEs in Vietnam during the period studies is very low. Overall, firms in 1996 have higher VATFP indexes than those in 2001. An explanation for this finding is that the 2001 sample included more household enterprises, which are considered to have a large proportion of land, but use much less machinery, as shown in Table 1.

5. Value-added decomposition

5.1. Factors contributing to value-added

Our focus is to analyze the contribution of factors including productivity, the composite effects of output and intermediate input prices, labor and capital to value-added of an arbitrary firm relative to the pooled sample mean firm in the period 1996–2001. It should be noted that the availability of Vietnamese official statistics does not allow us to infer the implicit VA deflator for 1996, we simply use the output deflator as a proxy for VA price indexes. Given the relationship related by Eq. (17) and the way we calculate components in this equation, only residual term α is affected by the choice of this deflator.

When comparing the index values in the indexing decomposition method, if a value-added index is greater (less) than 1, value-added of a compared firm is higher (lower) than that of the hypothetical representative firm. For decomposition, a component index of more (less) than 1 implies that the contribution of that factor to value-added is higher (lower) than it is for the reference firm. The contribution to value-added of each factor of an arbitrary enterprise relative to the average firm can be investigated through Figs. 2a–f, where pooled indexes are plotted in the ascending order of labor and capital.

As can be seen in Fig. 2a, *VA* indexes increase as firm size gets larger. Particularly, for the SM group, the majority of indexes are above 1 in both 1996 and 2001. One of the important contributions to this increasing trend is TFP. The larger the firms are, the higher is the contribution of productivity to *VA* (Fig. 2b). Nevertheless, the contribution

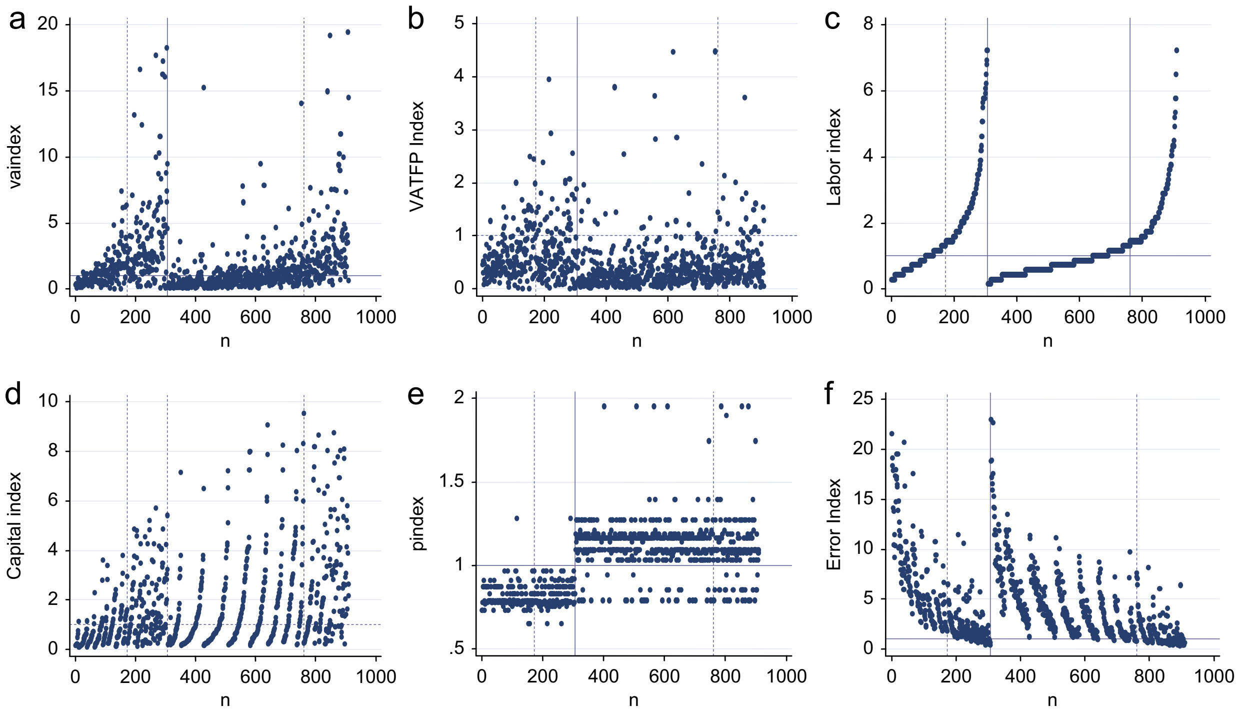

Fig. 2. (a–f) Plotted indexes for the whole manufacturing industry: (a) value-added indexes; (b) VATFP indexes; (c) labor indexes; (d) capital indexes; (e) composite price indexes; and (f) error indexes.

of TFP to VA of firms in the sample is, in general, much lower compared to the representative firm. Labor is another important contributing factor (Fig. 2c) while the contribution of capital to *VA* is not consistent. At each level of firm size, capital indexes vary in a range with a somewhat similar lower value. However, the upper value gets larger as firm size increases (Fig. 2d). This is because more capital sometimes implies a higher proportion of land rather than advanced technology. Finally, a rise in the price in the manufacturing industry during the period 1996–2001 leads to a higher contribution of price to *VA* in 2001 compared to 1996 (Fig. 2e). Error indexes reported in Fig. 2f reveal that the bigger the firm is, the lesser is the unexplained difference between outputs and inputs due to measurement biases and noise.

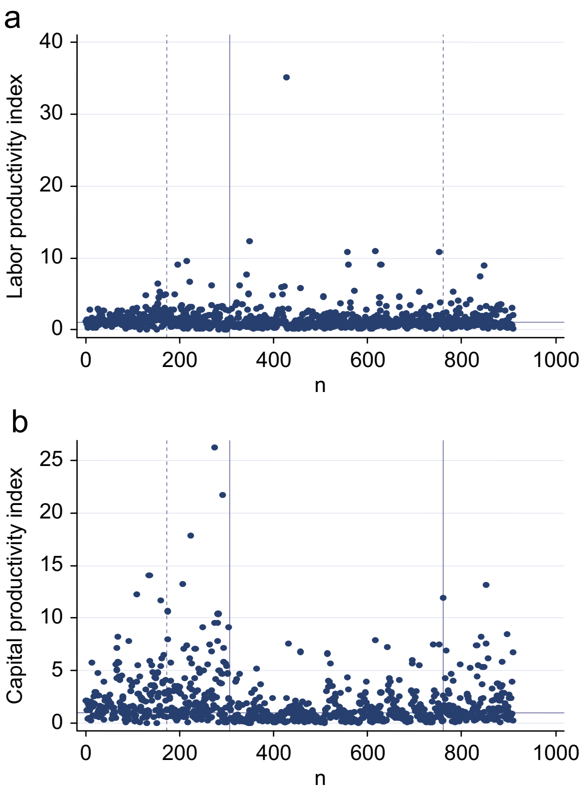

Fig. 3. (a) Labor productivity and (b) capital productivity.

To provide an insight into the contribution of each factor of production, we provide the plotted partial productivity indexes of labor and capital in Figs. 3a and b. Partial productivity or average product of labor and capital is defined as the value-added per employee and per unit of capital, respectively.

As can be seen in Fig. 3b, capital productivity increases with firm size in each year, reflecting the efficient use of capital of larger firms. On the other hand, labor productivity (Fig. 3a) is similar across firm sizes, except for a slightly increasing trend for the 'micro' group in 1996. Similar labor productivity indicates no advantage in the unit labor cost of larger firms. The increasing contribution of labor to *VA* is, therefore, solely attributed to a higher absolute value of *VA* as a result of higher proportion of wages when firms hire more labor rather than the increase in the value of a product. This indicates that in order to increase their competitiveness and profits, SMEs should increase capital or/and reduce the wage proportion in *VA* by increasing labor productivity. Given the fact that most SMEs in Vietnam face a capital shortage (Ramamurthy, 1998; Ronnas et al., 1998; MPI-UNIDO/Project, 1999; World Bank, 1999; Sakai and Takada, 2000; Edmund, 2004), increasing labor productivity that leads to lower unit labor cost should be a priority. This, in turn, requires better management methods and skilled workers. In case of increasing capital, labor intensive technique would be preferred because it is suitable to small scale production with the abundance of not very high skilled labor as in the case of domestic private sector in Vietnam.

Geometric means of indexes in Table 3 support the findings from Figs. 2a–f, i.e., the average contribution of all factors in the SM group is higher than in the micro group while measurement biases decrease with firm size. During the period studied, 1996 marks higher contributions of productivity to value-added. Nevertheless, smaller productivity indexes in 2001 do not imply the decreasing trend of productivity. Rather, it reflects that the 2001 sample includes many more inefficient performers.

The above results depict an accurate picture of the economy of Vietnam during the period 1996–2001. Entry constraints, including complicated registration procedures, long processing of application forms and corruption, pushed entry costs up to a very high level (GTZ-CIEM-UNDP, 2004)

Table 3
Decomposition of VA, means.

	VA index	VATFP	Labor index	Capital index	Price of VA index	Error index
All years	1.000	0.329	0.999	1.000	1.567	3.034
Micro	0.686	0.291	0.681	0.819		4.126
SM[a]	2.294	0.433	2.335	1.549		1.541
1996	1.388	0.476	1.249	0.802	1.278	3.563
Micro	0.882	0.461	0.735	0.551		5.829
SM	2.496	0.497	2.477	1.303		1.887
2001	0.846	0.273	0.893	1.118	1.738	2.796
Micro	0.623	0.244	0.661	0.954		3.616
SM	2.137	0.383	2.214	1.808		1.286

[a] Small and medium group.

early in the 1990s. This limited domestic private firms to the best performers only. In addition, favorable economic conditions in the mid-1990s with rapid economic growth and expanding effective demand (World Bank, 1999, 2003; Ramstetter, 2004) have probably made firms more productive.

The success of the private sector and the awareness of constraints facing private SMEs led to a program promoting the private sector in 2000 with the issuance of the law on private enterprise. This has simplified registration procedures and lowered entry cost, resulting in a boom of registered private firms. However, the majority of new entry firms are household and micro firms with obsolete technology and low management skills. In addition, the contracted demand following the financial crisis in Asia in 1998 may have lowered average performances in 2001.

To investigate which of several possible factors contribute to the success or failure of a firm, we categorize the pooled sample into 20_quantiles and extract the highest, lowest and middle 5% performing groups. The value-added decomposition for each group is provided in Tables 4–6.

A cross-comparison of these tables shows that productivity is the most important factor contributing to the success of the top 5% (Table 4). The contribution of TFP to VA in this group is much higher than in the middle 5% and the bottom 5% groups (Tables 5 and 6). Thus, it is suggested that to grow sustainably, firms must shift to productivity as a core contributor.

Table 4
Value-added decomposition of the top 5%.

Firm number	$\Omega^{a,b}$	$\theta^{a,b}$	$Q_L^{a,b}$	$Q_K^{a,b}$
590	6.3638	1.6634	3.4693	0.2430
1307	6.4584	1.6880	2.0238	1.1469
1250	6.5123	0.8002	2.3129	5.2189
2946	6.5680	2.8260	0.7228	2.0365
1055	6.5810	0.6052	6.7941	2.8377
1197	6.6064	1.1075	3.9030	1.3212
1477	6.8745	1.3255	3.6139	0.8802
1234	7.1223	1.8084	1.4456	2.0360
2464	7.3038	2.0050	1.7347	1.3986
1097	7.3440	0.8443	4.3367	3.0845
1429	7.4108	0.6906	7.2278	3.0474
512	7.4258	2.5008	1.1564	1.5411
2240	7.4736	1.0738	2.8911	3.4072
355	7.5110	1.8105	2.3129	0.9946
1278	7.5462	0.9257	2.6020	5.6374
343	7.6536	2.1287	1.4456	1.8949
2052	7.7910	3.6470	0.7228	1.7776
692	7.8670	2.8510	0.8673	2.6983
513	8.3522	1.2280	3.9030	2.1635
1467	8.7295	1.4391	3.4693	2.0634
1236	8.8070	0.9673	6.2159	1.8641
2948	8.9733	1.1577	3.1802	4.1229
2949	9.3818	1.4916	3.0357	2.4761
1151	9.4867	0.6747	7.2278	5.4203
512	9.5022	4.4722	0.8673	1.2004
1387	9.9831	1.9983	2.8911	1.4625
2792	9.9879	1.0784	3.7585	5.3530
2752	10.2390	1.1106	3.0357	6.9254
1279	10.3070	1.2154	3.4693	4.1867
1323	11.5298	2.0658	3.6139	1.1084
2205	11.7370	1.6070	3.3248	3.4303
1271	12.4144	2.9326	1.8792	2.0126
32	13.1660	2.3895	1.4456	3.7563
1307	14.0900	4.4815	1.3010	1.8869
1187	14.5204	1.2885	7.2278	2.1621
1291	14.9683	1.6962	2.0238	8.0238
2928	15.2593	3.8070	0.4337	6.4961
1379	16.0868	1.6984	5.7822	2.8229
1204	16.2791	1.7724	5.0595	3.4823
1342	16.6577	3.9538	1.7347	2.2575
1368	17.2940	2.5554	5.6377	0.7972
1167	17.7240	2.0400	2.8911	5.7049
507	18.2559	1.8811	6.9387	1.9930
1215	19.2284	3.6113	2.1683	3.6263
2235	19.4506	1.5403	6.5050	4.9407

Table 5
Value-added decomposition of the bottom 5%.

Firm number	$\Omega^{a,b}$	$\theta^{a,b}$	$Q_L^{a,b}$	$Q_K^{a,b}$
533	0.0082	0.0009	1.0119	2.0212
1202	0.0220	0.0031	1.1564	1.4670
416	0.0401	0.0269	0.5782	0.2073
1040	0.0430	0.0060	3.7585	0.6096
2947	0.0439	0.0154	0.5782	0.6516
2817	0.0480	0.0031	0.5782	6.5453
1162	0.0521	0.0150	1.0119	0.5305
367	0.0539	0.0289	0.5782	0.3394
768	0.0551	0.0398	0.1446	0.4099
2705	0.0552	0.0239	0.5782	0.4147
1509	0.0690	0.0491	0.2891	0.3807
345	0.0737	0.0423	0.4337	0.3899
2314	0.0760	0.0164	0.8673	0.9599
1359	0.0817	0.0710	0.4337	0.2080
2699	0.0820	0.0368	0.5782	0.4455
1067	0.0851	0.0277	0.4337	0.9080
1509	0.0865	0.0848	0.2891	0.2266
388	0.0877	0.0596	0.4337	0.3167
2560	0.0893	0.0598	0.5782	0.2725
1105	0.0928	0.0079	5.9268	1.0173
2844	0.0977	0.0156	0.2891	2.8758
1358	0.0988	0.0970	0.4337	0.1378
2114	0.0997	0.0347	0.1446	1.2832
1399	0.1027	0.1358	0.1446	0.2082
2520	0.1067	0.0796	0.4337	0.2041
208	0.1099	0.0324	0.7228	0.9291
1376	0.1106	0.0293	0.4337	1.2880
1401	0.1111	0.1167	0.4337	0.1636
2914	0.1113	0.0340	0.2891	1.2321
2332	0.1116	0.0378	0.5782	0.8198
2513	0.1153	0.1474	0.1446	0.2247
2536	0.1168	0.1338	0.2891	0.1912
2338	0.1169	0.0564	0.4337	0.6343
2779	0.1176	0.0088	0.7228	7.9712
2366	0.1191	0.0856	0.4337	0.2470
1049	0.1198	0.0917	0.4337	0.2876
1390	0.1200	0.1200	0.2891	0.2373
2398	0.1210	0.0549	0.8673	0.3021
2152	0.1213	0.1022	0.1446	0.4050
1071	0.1213	0.1255	0.4337	0.1907
1502	0.1227	0.0415	0.8673	0.6756
2494	0.1235	0.1188	0.2891	0.2535
3007	0.1252	0.0195	1.0119	3.0292
1113	0.1288	0.0176	0.2891	3.7908
2282	0.1306	0.0389	0.4337	1.0215
2266	0.1320	0.0369	0.5782	1.4097

Table 6
Value-added decomposition of the middle 5%.

Firm number	$\Omega^{a,b}$	$\theta^{a,b}$	$Q_L^{a,b}$	$Q_K^{a,b}$
1119	0.9927	0.4445	1.0119	0.6409
2368	0.9956	0.5007	1.0119	0.3386
2531	0.9980	0.3991	1.7347	0.3539
2184	1.0013	0.2901	0.4337	2.5435
2339	1.0021	0.2045	1.7347	1.8348
540	1.0022	0.3525	1.1564	0.7824
2853	1.0035	0.4680	0.8673	0.6051
1466	1.0040	0.5983	1.0119	0.2519
2992	1.0060	0.7469	0.2891	0.5933
2415	1.0093	0.4148	1.1564	0.4981
2647	1.0195	0.4365	0.7228	0.9881
2382	1.0268	0.6896	0.7228	0.2567
2515	1.0326	0.5486	0.8673	0.4617
1108	1.0366	0.3404	0.8673	1.2832
1508	1.0383	0.2560	0.7228	2.8524
2716	1.0388	0.4320	0.7228	1.1416
2337	1.0444	0.1948	0.7228	3.9401
2636	1.0473	0.2902	1.4456	1.0895
2518	1.0525	0.3332	1.4456	0.6602
2941	1.0528	0.4764	1.0119	0.4617
2022	1.0536	0.2714	1.0119	2.1466
2227	1.0575	0.3228	0.5782	2.0640
2203	1.0620	0.3108	1.0119	1.7496
1129	1.0680	0.4886	0.5782	1.0424
1505	1.0688	0.4939	0.7228	0.9234
2848	1.0706	0.5435	0.8673	0.4571
2802	1.0711	0.2357	0.5782	4.0180
1506	1.0714	0.4736	0.7228	0.9535
1183	1.0749	0.4804	1.1564	0.5090
2997	1.0764	0.7102	0.7228	0.2734
2525	1.0783	0.3192	1.4456	1.0315
2120	1.0823	0.4382	0.8673	0.9558
2202	1.0825	0.1727	1.1564	4.3417
1503	1.0838	0.5246	0.8673	0.5540
2955	1.0842	1.4672	0.2891	0.2559
2640	1.0887	0.6356	0.7228	0.4455
1447	1.0905	0.5083	0.5782	1.2190
1120	1.0974	0.5270	0.7228	0.7913
831	1.1009	0.6147	0.5782	0.7374
131	1.1017	0.2022	1.5901	2.3085
1020	1.1033	0.3443	1.1564	1.1956
1066	1.1089	0.1385	0.8673	4.6105
527	1.1094	0.3235	1.4456	0.9965
1131	1.1201	0.7080	0.7228	0.4345
2086	1.1220	0.1378	0.7228	7.2421

5.2. *Government assistance and firm characteristics*

To analyze the impact of government support on a firm's performance, we categorize government assistance in terms of both financial and non-financial supports including consultations for managerial and technical problems, training workers and providing market opportunities in Table 7.

Panel B of Table 7 shows differences among groups. The middle 5% receives the least in government support. Most government support is allocated to the lowest and the top 5% groups. In Vietnam, government support is provided in response to requests from firms. It would seem there are two kinds of firms that look for support; weak performers that need support to survive, and strong firms that face constraints restricting their potential growth. In addition, there has been an increase and a shift in government assistance during the period studied.

Table 7
Government financial and non-financial assistance.

	Panel A: no. of obs			Panel B: Percentage		
	Top 5%	Bottom 5%	Middle 5%	Top 5%	Bottom 5%	Middle 5%
Credit assistance						
All year	44	46	45			
Yes	9	22	5	20.45	47.83	11.11
No	35	24	40	79.55	52.17	88.89
1996	27	7	10			
Yes	6	1	0	22.22	14.29	–
No	21	6	10	77.78	85.71	100.00
2001	17	39	35			
Yes	3	21	5	17.65	53.85	14.29
No	14	18	30	82.35	46.15	85.71
Non-financial assistance						
All year	44	43	40			
Yes	15	26	9	34.09	60.47	22.50
No	29	17	31	65.91	39.53	77.50
1996	27	7	10			
Yes	12	3	1	44.44	42.86	10.00
No	15	4	9	55.56	57.14	90.00
2001	17	36	30			
Yes	3	23	8	17.65	63.89	26.67
No	14	13	22	82.35	36.11	73.33

Note: Figures in panel B are in vertical percentage.

While the top 5% group received more support than the bottom 5% in 1996, the opposite was true in 2001, and the differential in receiving support between the two groups became larger. A lower proportion of better performing firms receiving government credit assistance may be attributed to complicated procedures and high costs of accessing credit application, which deflect efficient firms from borrowing and lead to adverse selection. The other possibility may be due to the weakness of the banking sector in appraising commercial credits (Carlier and Tran, 2004). A high proportion of poorly performing firms with lower management skills that resort to government non-financial support reflects the ineffectiveness of this program. Surveys on business services for private SMEs in Vietnam (Service-Growth Consultants Inc. and Thien Ngan Co. Ltd., 1998; GTZ-VCCI-Swisscontact, 2002) show that lack of information about non-financial support and its role in the growth of firms, and its quality, are hindrances. Consequently, better performers have to rely on their internal services leading to an increase in recruitment, and hence, operating costs. This may explain why larger firms have no advantage in unit labor cost.

Characteristics of the 5% groups are provided in Table 8. Gross returns to capital[7] of the top 5% of firms are much higher than those of the middle 5%, while the bottom 5% experience losses. This raises concerns about the survival rate of poorer performers. Among ownership kinds, household enterprises account for a small proportion in the top 5% in comparison with the above 90% of that kind of ownership in the bottom and the middle 5% groups. On the other hand, the percentage of more

[7] For self-employed enterprises, variable profits are the return to both family labor and capital.

Table 8
Characteristics of the 5% groups.

	Top 5%	Bottom 5%	Middle 5%
Variable profits (thous. VND[a])	234,390.60	−8798.98	6136.91
Ownership (percentage)			
Household firms	26.67	91.30	91.11
Private enterprises	42.22	2.17	8.89
Cooperative	17.78	4.35	
L&S[b] companies	13.33	2.17	
Labor (average number of workers)	21.91	5.02	6.60
Age (average year of operation)	10.58	12.04	8.49
Location (percentage)			
Urban	71.11	21.74	46.67
Rural	28.89	78.26	53.33

[a] VND is the Vietnamese currency.
[b] L&S are limited and share holding companies, which are considered as modern enterprises with more advanced technology and management skills.

evolved ownership types, such as private enterprises and limited and shareholding companies, are higher in the top 5%. Although gaining some tax advantages,[8] this suggests that by being reluctant to become formalized, household enterprises may suffer from loss of accessing to larger markets. Table 8 indicates that firms in the top 5% group are much larger than those in the other groups, on average. Moreover, most of the firms in this group are located in urban areas while the majority in the bottom and the middle 5% groups are located in rural areas. A higher percentage of urban firms in the top 5% group most likely reflects advantages of having higher technical and managerial training, as well as educational level of workers and managers in urban areas in Vietnam (Edmund, 2004).

6. Concluding remarks

An indexing method is developed to decompose the contribution of productivity, prices and firm size to a firm's value-added. To avoid the problem of different dimensionality of outputs and inputs within the same industry, an industry deflator is used instead of the observed price. The use of the deflator gives an approximation and may introduce biases into total factor productivity measurement. Thus, an error term is added into the decomposition equation to capture measurement biases and white noise. The method is then applied to domestic private small and medium manufacturing firm level data in Vietnam between 1996 and 2001.

The results reveal an increasing trend of total factor productivity with the use of machinery capital, and value-added with firm size. The decompositions indicate that the contribution of total factor productivity to value-added of firms in the sample is much lower compared to the representative mean firm. However, this is the most important factor contributing to the success of a firm. Moreover, larger firms use capital more efficiently than smaller firms, while labor productivity is somewhat similar among different firm sizes. Thus, the increasing contribution of labor to value-added is attributed only to the higher absolute value of value-added as a result of higher wage proportion, not necessarily to a higher value of a product. This finding raises concerns about weak management skills, unskilled workers and weak competitiveness of domestic private small and medium manufacturing enterprises in Vietnam.

In order to compete in the world market, it would seem Vietnamese private small and medium enterprises should increase their productivity, especially labor productivity by investing more in labor intensive advanced technology and/or training managers and workers, as well as using out-sourcing services from the government to release burdens from over-recruitment. This, in turn, requires an effective government support program.

Although the Vietnamese government has created a better policy environment and increased assistance services to firms, the analysis shows that the majority of recipients are poor performers. Given that productivity is a core component factor to the success of firms, which can benefit from skilled workers and managers, and outside specialized services, the Vietnamese government should improve its non-financial support program. A particular focus should be on providing information and improving quality of assistance services as well as on smart selection of which kinds of firms to support to enhance their economic performance.

Appendix A. Formulas to calculate value-added total factor productivity index

As shown by Balk (2003), the relationship between the gross-output and the value-added TFP indexes can be expressed as

$$\ln VATFP = \frac{L(r^1, r^0)}{L(VA^1, VA^0)} \ln GOTFP \tag{A.1}$$

where *IGOTFP* is the gross-output TFP index, r^1 and r^0 are revenue at periods 1 and 0, respectively and VA^1 and VA^0 are value-added at periods 1 and 0, respectively. $L(r^1, r^0)$ and $L(VA^1, VA^0)$ are developed using the tool of logarithmic mean as follows:

$$L(a,b) = \frac{a-b}{\ln(a/b)}$$

where a and b are two real numbers.

Following this approach, the value-added TFP index for cross-sectional data can be developed as follows:

$$\ln IVATFP^{a,b} = \frac{L(r^b, r^a)}{L(VA^b, VA^a)} \times \left\{ \ln Q_0(p^b, y^b, p^a, y^a) - \frac{L(c_M^b, c_M^a)}{L(r^b, r^a)} \ln Q_i''(\omega_M^b, x_M^b, \omega_M^a, x_M^a) - \frac{L(VA^b, VA^a)}{L(r^b, r^a)} \ln Q_i'(\omega_{KL}^b, x_{KL}^b, \omega_{KL}^a, x_{KL}^a) \right\} \tag{A.2}$$

[8] In Vietnam, household enterprises are not required to retain accounting records for calculation of value-added and profit taxes, but pay lump-sum tax to local authorities (MPI-UNIDO/Project, 1999).

Table B1
List of industries and deflators.

Industries	No. of observations	Output deflator	Intermediate input deflator
1996	307		
15: Food product and beverages	58	1.2335	1.2343
17: Manufacture of textiles	20	1.2244	1.2289
19: Manufacture of leather products	8	1.4375	1.3601
20: Manufacture of wood and wood products	16	1.4228	1.2572
21: Paper and paper products	20	1.2037	1.2279
22: Publishing and printing	2	2.0097	1.3903
24: Chemicals and chemical products	4	1.1991	1.2239
25: Rubber and plastic product	43	1.2998	1.2852
26: Manufacture of other non-metallic mineral products	12	1.1477	1.2294
28: Fabricated metal products	39	1.2178	1.2595
29: Machinery and equipment n.e.c.	6	1.2165	1.2026
30: Office, accounting and computing machineries	4	1.0228	1.1497
31: Electrical machinery and apparatus n.e.c.	11	1.1841	1.2289
33: Medical and optical instruments, watches and clocks	3	1.2420	1.2115
35: Manufacture of other transport	13	1.5111	1.3030
36: Manufacture of furniture, manufacturing n.e.c.	48	1.3654	1.3039
2001	603		
15: Food product and beverages	156	1.8236	1.8629
17: Manufacture of textiles	36	1.7082	1.6904
18: Manufacture of wearing apparel	9	1.7885	1.7247
19: Manufacture of leather products	4	1.6563	1.6945
20: Manufacture of wood and wood products	57	1.7125	1.9374
21: Paper and paper products	19	1.7155	1.8093
22: Publishing and printing	9	1.8942	1.8868
24: Chemicals and chemical products	6	1.4736	1.5835
25: Rubber and plastic product	38	1.6866	1.7232
26: Manufacture of other non-metallic mineral products	39	1.2373	1.6582
27: Manufacture of basic metals	10	1.6825	1.7242
28: Fabricated metal products	57	1.8587	1.8108
29: Machinery and equipment n.e.c.	64	1.6147	1.8191
30: Office, accounting and computing machineries	7	3.0603	2.2871
31: Electrical machinery and apparatus n.e.c.	9	2.1825	1.8020
33: Medical and optical instruments, watches and clocks	3	2.7356	1.9724
36: Manufacture of furniture, manufacturing n.e.c.	59	1.9941	1.8867
37: Recycling	21	1.3393	N/A

where $Q_0(\cdot)$ is the output quantity index, $Q_i''(\cdot)$ is the intermediate input quantity index, and $Q_i'(\cdot)$ is the primary input quantity index. c_M is the intermediate input cost.

The primary input quantity index is computed using the Tornqvist form as

$$\ln Q_i' = \sum_{i=1}^{2} \frac{\omega_i^b + \omega_i^a}{2} (\ln q_i^b - \ln q_i^a) \quad (A.3)$$

where $\omega_i = p_i q_i / \sum_{i=1}^{2} p_i q_i$ is the cost share of each primary input. If firm a is the average benchmark, its weight is calculated as

$$w_i^a = \frac{1}{n} \sum w_i \quad (A.4)$$

Appendix B

See Table B1.

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