Foreign Ownership and Productivity in the Indonesian Automobile Industry: Evidence from Establishment Data for 1990-1999

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Abstract

This paper investigates the productivity differentials between foreign and local establishments and the determinants of productivity in the Indonesian automobile industry, using the establishment-level data for 1990-1999 collected by the Central Bureau of Statistics (BPS) of Indonesia. According to the traditional theory of multinational corporations (MNCs), foreign-affiliated establishments are expected to have higher productivity than local establishments because MNCs have several ownership-specific advantages, including superior production technology and managerial resources. The results suggest that the labor productivity of foreign-affiliated establishments is higher than that of local ones, as expected. However, a comparison of total factor productivity (TFP) levels in foreign and local establishments reveals no significant evidence that foreign plants have higher TFP that can be attributed to their ownership-specific advantages. Moreover, the source of TFP growth and the cost elasticities for foreign and local establishments are analyzed using the cost function framework. It is found that both foreign and local establishments exhibit increasing returns to scale and that capital utilization is extremely inefficient in foreign establishments. The greatest part of TFP growth is explained by the scale effect and the capital utilization effect, while the technological change effect is negligible both for foreign and local establishments. The paper thus concludes that the small size of the Indonesian automobile market prevents both the foreign and the local plants from exploiting scale economies.

1. Introduction

Many a developing country government has attempted to utilize foreign direct investment (FDI) in its industrialization and technology development efforts. In the traditional theory of multinational corporations (MNCs), FDI by MNCs is regarded as the movement of managerial resources (in other words, the intangible assets related to technological knowledge in production and marketing as well as managerial know-how). A large body of literature on MNCs suggests that MNCs are more productive than local companies because of the advantages embodied in their managerial resources (e.g., Dunning 1988; Caves 1996; Markusen 1991). Moreover, the entry of MNCs may also affect overall productivity levels by bringing new ideas or increasing the level of competition in the market. This suggests that a larger presence of MNCs may play an important role in increasing productivity levels in the host country as higher-productivity foreign-owned production replaces lower-productivity domestic production.

Taking these hypothesized roles of MNCs as their point of departure, many researchers have investigated productivity gaps between MNCs and local firms, and technology transfer from MNCs to local firms, by conducting descriptive analyses based on interviews and questionnaires or calculating various productivity measures. Using establishment-level data, many studies report that foreign-owned establishments are more efficient than local ones, suggesting that foreign ownership seems to be an important determinant of productivity in manufacturing in some countries.[1] On the other hand, there are some studies which found the difference between foreign and local plants not to be pervasive, for example in Canada and Thailand.[2] Therefore, in light of

[1]For example, in their study on the British manufacturing sector, Griffith and Simpson (2001) suggest that foreign-owned establishments have significantly higher labor productivity than those under domestic ownership. Doms and Jensen (1998), using U.S. plant-level data, found that U.S. multinational plants had the highest labor productivity, foreign-owned establishments had the second highest labor productivity, and US-owned non-multinational plants had the lowest. Using Indonesian establishment-level data, Blomström and Sjöholm (1998), Sjöholm (1999), Takii and Ramstetter (2000) and Takii (2002) all found foreign establishments showed a higher productivity than local ones. In addition, Aitken and Harrison (1999) also found that in Venezuela plant productivity is positively correlated with foreign participation.

[2] In Globerman, Ries, and Vertinsky's (1994) study using Canadian plant-level data, although foreign-owned plants were found to have a higher labor productivity, the differences disappear after controlling for size, capital intensity, and the share of non-production workers. Ramstetter (2001b) compares average labor productivity between groups of foreign MNCs and local plants in Thai manufacturing, using establishment-level data for 1996 and 1998. He found that the vast majority of comparisons revealed that differences between local and foreign plants were statistically insignificant. His other studies also found no strong evidence suggesting that

the findings of previous studies, the so-called "ownership advantage" in the theory of MNCs has not always been corroborated, and MNCs do not always exploit firm-specific advantages in terms of productivity.

There are thus two empirical questions that I seek to shed light on in this paper. First, are foreign plants more productive than local plants as MNC theory predicts? Second, if so, what are the determinants of the productivity of plants? Even though many previous studies have tried to answer these questions, comprehensive empirical evidence offering conclusive answers – particularly regarding the second question – is very limited.

This paper examines these issues in as much detail as possible, using the establishment-level data provided by Indonesia's Biro Pusat Statistik (BPS or Central Bureau of Statistics), taking the Indonesian automobile industry as a case. Most automobile firms in Indonesia were established by major Indonesian conglomerates as a joint venture or under a licensing agreement with foreign (principally Japanese) automakers. Despite government efforts to foster the industry for more than thirty years through high degrees of protection and intense policy intervention, the Indonesian automobile sector still remains in its infancy. (Okamoto and Sjöholm 2000; Aswicahyono, Basri, and Hill 2000). While it is difficult to directly test the effect of policy or institutional factors on plant productivity due to data constraints, this paper aims at evaluating the quantitative plant performance as well as investigating the industry characteristics using the establishment-level data.

Given the dominant position of foreign – principally Japanese-affiliated – automakers in the Indonesian market, it might be expected that foreign-affiliated automobile manufacturers and auto parts suppliers should have been at the forefront of the development of the automobile industry in Indonesia. However, Okamoto and Sjöholm (2000), examining productivity performance and its dynamics in the Indonesian automobile industry between 1990 to 1995, concluded that productivity of the overall industry did not improve during that period, though foreign establishments tended to show a better performance than local ones. Rather, all the productivity measures, i.e., gross output per employee, value added per employee, and TFP, decreased from 1990 to 1995. Although their analysis is limited to a simple comparison of descriptive statistics between 1990 and 1995 or between local and foreign establishments, their results imply that the spillover effect of foreign MNCs does not seem to have been strong.

The productivity differentials between local and foreign plants in the automobile

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foreign establishments enjoy systematically higher productivity levels than local ones in Thailand (Ramstetter 1999; 2001a).

industry have been investigated in other countries as well. Okamoto (1999) analyzed the impact of Japanese FDI on the productivity of the U.S. auto parts industry using establishment-level data. She calculated the relative TFP index for each establishment and found that Japanese-affiliated plants were less productive than their U.S. counterparts in 1992. Griffith (1999) estimated the production function of the U.K. automobile industry, using data on individual establishments located in the U.K. over the period from 1980 to 1992. Her results suggest that foreign-owned establishments in this industry have significantly higher levels of output per worker (more than twice as high as domestic-owned establishments). However, these differences can be almost entirely explained by differences in input levels. That is, foreign plants invest more in physical capital, use a higher level of intermediate inputs, and pay their workers higher wages. Ito (2002) investigated the efficiency gap between foreign and local establishments and the determinants of productivity in the Thai automobile industry, using establishment-level data in 1996 and 1998. Mainly relying on the 1996 data, I calculated various partial productivity measures such as output per employee, value added per employee, capital per employee, output per capital, inventory ratios, price-cost margins, and so on, as well as the relative TFP index. In the simple comparison of those productivity measures between foreign and local establishments, foreign establishments were found to exhibit significantly higher labor productivity, capital-labor ratios, and higher wages. However, the capital productivity was significantly lower for foreign establishments than for local ones in the motor vehicle bodies and the motor vehicle parts industries. The results of the regression analyses are analogous to Griffith's (1999) results, and provided no evidence that foreign establishments enjoy higher productivity after controlling for factor intensities. Moreover, there was no evidence that foreign plants achieved higher TFP because of their advantages in managerial resources. Therefore, the results of Griffith (1999) and Ito (2002) raised the question why domestically-owned establishments were not investing in capital and/or paying their workers the same wages as foreign-owned establishments.

The aforementioned study by Okamoto and Sjöholm (2000) suggested that in the Indonesian automobile industry foreign-owned establishments tended to display higher productivity than local ones. Taking Okamoto and Sjöholm's (2000) findings and methodology as its point of departure, this paper pursues this line of enquiry further by using data for a much longer period and examines in detail the determinants of productivity and its growth by conducting regression analyses and a cost function estimation as well as a simple comparison of descriptive statistics as employed by

Okamoto and Sjöholm. To this end, given the deficiencies in the BPS' establishment-level data,[3] various productivity measures will be calculated and analyzed in order to obtain robust results. First, various characteristics of automobile establishments are examined by calculating some partial productivity measures such as average variable cost and labor productivity, and other descriptive statistics. Second, by conducting ordinary least squares (OLS) regressions, determinants of the partial productivity and TFP are investigated. Third, the cost structure is examined by using the cost function framework. Finally, the growth of TFP is calculated based on the estimated cost function and the contribution of different sources to TFP growth rate are investigated.

The remainder of the paper is organized as follows. Section 2 provides an overview of the development of the Indonesian automobile industry and discusses industrial organization aspects of the industry. In section 3, using establishment-level data, various partial productivity measures are calculated and compared in time-series and between local and foreign establishments. A statistical examination of the difference between the two groups is also conducted. Section 4 describes the econometric model of the cost function estimation, and states the methodology for the decomposition of TFP growth. Then, a summary of the primary results obtained from the model estimation is presented. The final section offers some concluding remarks.

2. Overview of the Indonesian Automobile Industry

Development of the Indonesian Automobile Industry

In Indonesia, as in many other developing countries, the automobile industry is viewed as the leading edge of industrialization and skilled job creation, as well as a fundamental source of positive spillovers. The Indonesian government has been nurturing the industry within the country since the late 1960s.[4] As in other Asian or

[3] The BPS micro-data have a number of deficiencies related to non-reporting and apparently incorrect entries. For example, there were a number of apparent mistakes in the information on foreign ownership shares (e.g., foreign ownership shares of 100 percent for all but one or two random years and shares of 0 in the other years), which I corrected. Probably most problematic is the data on capital stock for each establishment. We should be cautious in using capital stock data, because their reliability is doubtful.

[4] The automobile industry is considered strategic for the following reasons: first, it supplies equipment used to meet the transportation requirement of the public; second, it creates employment opportunities in that sector and facilitates the introduction of high technology into its own and other markets; and third, it generates income for the government from import duties

Latin American countries, foreign automakers have been playing an important role in the development of the local automobile industry. Since the "New Order" government assumed power in 1968, the automobile industry has received special treatment through local content rules, entry barriers and foreign ownership restrictions (Hill 1996; Aswicahyono, Anas, and Rizal 2000). An import ban on completely built-up (CBU) cars was introduced in 1971 and remained in force until 1993, when it was replaced by tariffs ranging from 175 to 275 percent. In 1977, the government introduced a deletion program that required assemblers to use locally produced components. However, the program, which was intended to provide an opportunity for supporting industry to develop, turned out to be unsuccessful, probably due to a lack of technological capabilities of local producers; high profits required by distributors; the small production scale owing to market fragmentation; and the presence of foreign principals that kept their local agents as distributors rather than full manufacturers (Aswicahyono, Anas, and Rizal 2000). Moreover, the government used a licensing system that limited production of certain functional components such as transmissions and brake systems to one or two companies in order to ensure a minimum production scale. The system, however, not only hindered competition within the parts industry, but also led to cost increases due to small-lot production over a wide variety of products, since the one or two licensed companies were compelled to produce multiple parts under multiple brands (Takayasu, Ishizaki, and Mori 1996). As a result, although Indonesia is the second largest automobile market in the ASEAN-4 countries (as of 1995), the number of auto parts manufacturers lags far behind that in Thailand (Panel B of Table 1). However, quite a few foreign auto parts suppliers (most of them Japanese) have established an affiliate in Indonesia due to the local content requirements, and have been supplying major parts to automobile assemblers. The liberalization of the licensing system in 1993 and the expansion of automobile production in response to market growth in the early 1990s have brought an accelerating influx of both local and foreign parts manufacturers.[5] As in the other ASEAN-4 countries, most of the automobiles sold in

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and taxes (Aswicahyono, Anas, and Rizal 2000).

[5] The government implemented a number of deregulation packages in the 1990s. In 1993, the deletion program was replaced by an incentive program. The latter, designed to promote local parts, provided incentives to parts suppliers in the form of lower import duties on imported components, sub-components, semi-finished parts and raw materials based on the extent of local content achieved. In 1995, the remaining components of commercial vehicles that had reached a local valued-added ratio of 40 percent and of passenger cars that had reached a local value-added ratio of 60 percent were exempted from import duties. The 1995 deregulation package also removed restrictions on investments in the automobile industry for the production of new cars. Although deregulation packages suggested a shift in the government's policy

Indonesia are made by Japanese automakers (Panel A of Table 1).

Figure 1 shows the development of automobile production since the 1960s. Despite the protection by the government, automobile production stagnated until the late 1980s. However, the industry displayed impressive growth from the early 1990s just until the financial crisis. The crisis heavily affected the industry: automobile production dropped by about eighty-five percent from 389,000 units to 57,000. Although automobile production rapidly recovered from 1999 to 2000, the number of cars produced in 2000 remained below pre-crisis levels.

In terms of value added, the contribution of the automobile industry to the manufacturing sector increased more than threefold, from 1.6 percent in 1975 to 5.3 percent in 1990, though this subsequently declined to 4.6 percent in 1996. The share of the automobile industry in total manufacturing employment, however, remained at only 1.4-1.5 percent throughout this period. Despite the rigorous protection and state intervention, the size and significance of the Indonesian automobile industry is still quite small compared with Thailand, where the contribution of the automobile industry to the manufacturing sector reached about 15 percent in terms of value added and 4.7 percent in terms of employment in 1996 (Aswicahyono, Anas, and Rizal 2000; Ramstetter 2001a; Ito 2002).

[INSERT TABLE1 & FIGURE 1]

Ownership and Market Structure

In the Indonesian automobile industry, foreign (particularly Japanese) firms have always been dominant players in the assembly and component sectors, except for the small-scale replacement parts segment – a pattern not untypical in developing countries. Table 2 provides a detailed picture of the major automobile assemblers in Indonesia. Most major automobile manufacturing companies are joint ventures between local conglomerates and Japanese, European, or U.S. automakers established with the aim of gaining access to world-class technology. In 1995, there were fourteen major automobile assemblers (Panel A of Table 2). As shown in Table 2, all the assemblers rely on foreign partners, though the modalities of MNC entry have varied, depending on

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paradigm from protectionism towards a market-oriented approach, the Soeharto Administration later launched the National Car Project which contradicted the earlier market-oriented posture. However, following the IMF reform program in 1998 after the crisis, the government agreed that it would discontinue the granting of special tax, customs and credit privileges to the National Car Project (Aswicahyono, Anas, and Rizal 2000).

the regulatory environment and foreign partners' preferences.[6,7] Until recently, however, foreign partners were rarely able to acquire majority ownership. Another key feature of ownership patterns is a small number of local joint venture participants. The Astra group owns three manufacturers, Indomobil (Salim) group owns four, Krama Yudha group owns two, and so on. This characteristic derives in part from the highly regulated environment, in which the government virtually selected the major domestic business groups that were to participate in the industry (Aswicahyono, Basri, and Hill 2000). As a result, the Astra group holds a market share of over 50 percent , and the sum of the market shares of the three major groups (Astra, Indomobil, and Krama Yudha) reaches about 90 percent. Moreover, some of assemblers produce more than one foreign brand name. Aswicahyono, Basri, and Hill (2000) point out that this feature prevents some foreign partners from having durable and close relationships with the local partner and making a major commitment to upgrading the technological capabilities of the local firm.

The Astra group, which laid its business foundations in the manufacturing of automobiles and machinery, holds a number of firms producing automobile components. According to a directory of automobile parts manufacturers (FOURIN 2000), there were 158 automobile such companies in Indonesia in the late 1990s. Out of the 158, 76 were Japanese-affiliated firms and 23 were under the control of the Astra group. Out of the 76 Japanese-affiliated firms, 15 were joint ventures with Astra group firms. Sato (1996) provides comprehensive and very detailed information on the Astra group and shows the high degree of the Astra group's vertical integration from body and general components to core components. According to her research, the Astra group is the only automaker that procures all six functional components such as engines, chassis frames, brakes, and transmissions, within the group.[8]

After the 1997 Asian economic crisis, local partners' financial difficulties as well as sweeping liberalization allowed foreign investors to increase their ownership or newly acquire shares in Indonesian automobile firms, as can be seen in Panel B of Table 2. However, the Astra group still keeps the leading position in the Indonesian automobile industry.

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[6] See Aswicahyono, Basri, and Hill (2000) for details.

[7] Entry to the components sector has generally been less restrictive, and in technologically less demanding segments there are some domestically-owned firms that do not have formal tie-ups with foreign firms (Aswicahyono, Basri, and Hill 2000).

[8] With regards to these functional components, the government used a licensing system, as mentioned above in this section. In this situation, the Astra group secured licenses for all items because Astra was in a favorable position to secure the limited licenses (Sato 1996).

[INSERT TABLE2]

3. Micro Data and Productivity Measurement

The Data

The data used in this study are establishment-level unbalanced panel data for the period from 1990 to 1999 provided by Indonesia's BPS for the motor vehicle industry (BPS various years).[9] The data set provides information for each establishment on detailed industry classification, geographical location, type of ownership, starting year of commercial production, output, value added, materials and energy used, number of workers, wages, inventory, book value of fixed assets, and so on. Although each establishment is labeled by the same identification code for every year, the name of the establishment is not provided by the BPS. Moreover, for reasons of confidentiality, it is not allowed to expose the raw data or indices for an establishment and to match the establishment data with other corporate data sources.[10] This study performs a thorough analysis of plant productivity at the 5-digit ISIC (Indonesian Standard Industrial Classification) industry level, i.e. motor vehicles (automobile assemblers, ISIC 38431/34100), motor vehicle bodies (automobile body suppliers, 38432/34200), and motor vehicle components and apparatuses (automobile parts suppliers, 38433/34300).[11] Table 3 shows the number of establishments, employment, output, and value-added in each 5-digit industry in 1990, 1995, and 1999. Because many observations in the raw data provided by the BPS do not contain sufficient information or because there are not contiguous time series observations for many establishments, such deficient

[9] The establishment-level data were collected for the Industrial Survey conducted annually by the BPS. Covered in the survey are large and medium establishments, i.e. all establishments employing 20 workers or more. The response rate of the annual survey is around 75-85 percent, for example, 85 percent, 84.47 percent, and 75.35 percent for the years 1991, 1995, and 1999, respectively.

[10] Indeed, it is extremely difficult to identify the name of the establishment by matching it with the *Manufacturing Industry Directory* provided by the BPS for the following reasons: 1) The directory only includes categories such as detailed industry, geographical location, and number of workers, but does not include other information such as starting year of operation and fixed assets. 2) Many establishments agglomerate in some particular regions or sub-regions, which makes it difficult to use the location information as a key criterion. 3) Information on the number of workers, which often varies in a short period, is not a good criterion particularly for medium or small establishments.

[11] The ISIC was changed beginning with the 1998 survey. For the motor vehicles industry, for example, the ISIC code had been 38431 before 1998 but was changed to 34100 in 1998.

observations were excluded from the sample used for the productivity analysis in this paper. The number of establishments included in the final compilation by the BPS, *Statistik Industri* (BPS various years) is 10, for example, in the motor vehicles industry (38431/34100) for the year 1990, which is shown in the row labeled BPS in Table 3. However, after eliminating the unreliable observations, the sample used in this study contains 7 establishments for motor vehicles in 1990 shown in the next row in Table 3 labeled "This sample". While "foreign-owned establishments" in this study are defined as those where the foreign ownership share is more than zero, in the present sample the foreign ownership share in fact exceeded 25 percent in all cases. In terms of gross output and value added, the share of foreign-owned establishments is extremely high at more than 80 percent in the motor vehicles industry and 50-70 percent in the motor vehicle component industry. However, in terms of the number of establishments and employment, the foreign share is relatively small. As for the nationality of foreign establishments, it was found that the majority of foreign-owned establishments were Japanese-affiliated ones. The table also shows that quite a few establishments newly entered the Indonesian automobile industry during the sample period, particularly in the motor vehicle component industry after 1995. As mentioned in the previous section, this trend is attributable to the economic boom in Indonesia and neighboring ASEAN countries in the early 1990s, the introduction of the incentive program, and the liberalization of the licensing system in 1993.[12]

[INSERT TABLE 3]

Table 4 shows a set of descriptive statistics on the sampled establishments by detailed industry in 1990, 1995, and 1999.[13] The table shows that the different indicators move

[12] Appendix Table 1 summarizes the entry and exit flows in the dataset compiled for the analysis in this paper.

[13] The statistics for the overall motor vehicle industry (at the 4-digit ISIC level or the 2-digit level in the new ISIC) are presented in Appendix Table 2. The upper panel of Appendix Table 2 gives the simple mean of each variable for all the sampled establishments, while the bottom panel of Appendix Table 2 gives the simple mean only for the large establishments in the sample. Appendix Table 2 shows that employment, output, and value-added per establishment increased in the period from 1990 to 1995, but then decreased from 1995 to 1999 in real terms. Capital stock and wages, however, increased in the period from 1990 to 1999 in real terms. Moreover, regarding productivity measures, average variable cost and value added per employee deteriorated during the period from 1990 to 1995 but recovered during 1995 to 1999. Output per employee improved from 1990 to 1999. These productivity measures indicate that the average productivity increased from 1995 to 1999 in real terms despite the 1997 financial crisis and the succeeding economic disorder.

quite differently over time in each of the three sectors, which might in part be due to heterogeneity among the establishments and to the small sample size, particularly in the motor vehicles industry. For example: In the motor vehicles industry, labor productivity measured by output per employee in real terms increased from 1990 to 1995 but decreased from 1995 to 1999, while it decreased throughout the entire period in the motor vehicle bodies and the motor vehicle component industries. Production worker wages, on the other hand, first increased but then decreased in the motor vehicles and the motor vehicle bodies industries, but rose in both periods in the motor vehicle component industry. In contrast, uniform movements for all three industries could be observed for output, which grew from 1990 to 1995 but then shrank, and for capital stock per establishment, which increased throughout the period. TFP, finally, deteriorated throughout the period from 1990 to 1999.[14]

Comparing the various statistics across industries, the table presents many interesting observations: The Herfindahl index measured by output share of each establishment is extremely high in the motor vehicles industry, implying a high concentration in this industry. The average price-cost margin is also high, particularly in the motor vehicles industry, which again suggests a lack of competition in the industry. It should be noted, however, that the price-cost margin diminishes in 1999 in the motor vehicles and the motor vehicle component industries. This trend might reflect the demand contraction after the crisis, though the price-cost margins nevertheless remain at quite a high level.[15] The share of non-production workers as well as wages are both higher in the motor vehicles industry than in other industries, which might be a reflection of the fact that motor vehicle assembler establishments are owned by a large company. Total inventory ratios are high at around 20-30 percent in every industry, and import ratios are also high in the motor vehicles and the motor vehicle component industries. Another notable observation is that the export share in output goes up remarkably in the motor vehicles and the motor vehicle component industries during this period.

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[14] Following Baily, Hulten, and Campbell (1992) and Okamoto and Sjoholm (2000), TFP of the *i*th establishment in each industry for year *t* is defined as follows: $\ln TFP_{it} = \ln Y_{it} - \alpha_L \ln L_{it} - \alpha_K \ln K_{it} - \alpha_M \ln M_{it}$, where Y_{it} is real gross output, and L_{it}, $K_{it,}$ and M_{it} are labor, capital, and intermediate inputs for the *i*th establishment in year *t*. α_L, α_K, α_M are factor income shares of labor, capital, and intermediate inputs, averaged over industries and years of the period from 1990 to 1999.

[15] Average price-cost margins are in the range from 26 percent to 59 percent in Table 4. These figures seem to be high compared with those in Thailand and Japan. The price-cost margins are around 25 percent in the Thai automobile industry and around 20 percent in the Japanese automobile industry (Ito 2001; 2002).

[INSERT TABLE 4]

Productivity Differences between Foreign and Local Establishments

Table 5 compares a set of descriptive statistics of foreign and local establishments by detailed industry.[16] The first two columns give the mean values for domestic and foreign-owned establishments for years before the financial crisis, i.e. from 1990 to 1996. In addition, the local-foreign comparisons are conducted for the years 1990, 1995, and 1999. T-tests are also performed to examine the statistical difference between the domestic and the foreign-owned establishments. The four columns from the right show the ratio of foreign- to domestic-owned establishments.

Table 5 indicates that foreign establishments tend to be larger than local ones in terms of employment, output, value added, and capital stock. Wages and labor productivity, measured by output per employee, value added per employee and TFP are significantly higher for foreign establishments in the motor vehicle component industry. However, these differences are not statistically significant in the motor vehicles industry, which again might be in part due to heterogeneity among the establishments and to the small sample size. One interesting observation is that inventory ratios tend to be higher for foreign establishments, but are lower in 1999 in the motor vehicles and the motor vehicle component industries (statistically significant in the latter). The import ratio tends to be much higher for foreign establishments in the motor vehicles and the motor vehicle component industries and they are statistically significant in some cases. In addition, the capital-labor ratio and the share of non-production workers are higher for foreign establishments in many cases, but the difference is not statistically significant.

[INSERT TABLE 5]

Comparing Productivity Trajectories

The last thing to be done in this section is to compare the productivity trajectories of foreign and local establishments, controlling for industry-wide time effects as well as

[16] Appendix Table 3 presents a comparison between large foreign and large local establishments in the overall motor vehicle industry. Given that most local establishments are much smaller in size than foreign ones, it appears more meaningful to compare productivity measures between establishments of similar size. The table shows that the size of establishments measured by output, value added, and capital stock is generally larger for foreign establishments, and that wages, labor productivity, the capital-labor ratio, and the import ratio tend to be higher for foreign establishments.

observable plant-specific productivity determinants like age and size. Four productivity proxies are used here: average variable cost (*AVC*), output per employee in real terms (*LAB*), value added per employee in real terms (*VALAB*), and total factor productivity (*TFP*). Average variable cost is defined as the sum of labor and intermediate input costs divided by output in real terms. To purge these productivity measures of industry-wide time effects and observable plant-specific characteristics, each is expressed in logarithms and regressed on time dummies (D_{jt}, specific to year t and the j^{th} 5-digit ISIC industry), age of the establishment (*AGE*), age of the establishment squared, size of the establishment (*SIZE*), and size of the establishment squared. Both age and size are measured in logarithms. Establishment size is measured by employment and normalized on mean industry employment.[17] In addition, interaction terms of age variables and the dummy variable for foreign establishments (*FOR*) are included in order to see the marginal difference of the age effects between local and foreign establishments. The following equations are estimated:

$$\ln(PRODUCTIVITY) = \sum_{j=1}^{J}\sum_{t=1}^{T}\gamma_{jt}D_{jt} + \beta_1 \ln(AGE_{it}) + \beta_2 (\ln(AGE_{it}))^2 + \beta_3 \ln(SIZE_{it}) + \beta_4 (\ln(SIZE_{it}))^2 + \varepsilon_{it} \quad \ldots (1)$$

$$\ln(PRODUCTIVITY) = \sum_{j=1}^{J}\sum_{t=1}^{T}\gamma'_{jt}D_{jt} + \beta'_1 \ln(AGE_{it}) + \beta'_2 (\ln(AGE_{it}))^2 + \beta'_3 FOR_{it} \cdot \ln(AGE_{it}) + \beta'_4 FOR_{it} \cdot (\ln(AGE_{it}))^2 + \beta'_5 ln(SIZE_{it}) + \beta'_6 (ln(SIZE_{it}))^2 + \beta'_7 FOR_{it} + \varepsilon'_{it} \quad \ldots (2)$$

PRODUCTIVITY: *AVC*, *LAB*, *VALAB*, and *TFP*

The residuals from the regressions using equation (1) are then used as the indices of deviation from time- and industry-specific productivity norms. In order to see whether the productivity difference between foreign and local establishments is significant or not, the dummy variable for foreign establishments (*FOR*) is added in equation (2).

Table 6 presents the regression results of the above equations. The scale effects are strongly significant in all equations. Labor productivity measures (output per employee

[17] It might be preferable to use capital stock data instead as the size variable. However, given the poor reliability of capital stock data, we used employment data as a proxy for the size variable.

and value added per employee) and TFP improve with age, but the marginal difference of the age effects between local and foreign establishments is not statistically significant. In labor productivity equations (4) and (6), the coefficients on the dummy variable for foreign establishments (*FOR*) are positive and significant, suggesting that foreign establishments enjoy higher labor productivity than local ones. However, in TFP equation (8), the coefficient on the dummy variable for foreign establishments (*FOR*) is negative and not significant.[18]

Using the residuals of equations (1), (3), (5), and (7) in Table 6, unweighted average trajectories for average variable cost, output per employee, value added per employee, and TFP are calculated and presented by plant ownership type in Figure 2. In panel (a) through panel (d), foreign-owned establishments are shown to be substantially and consistently more efficient than local ones. Although the gap in labor productivity (output per employee and value added per employee) between local and foreign establishments seems to be smaller around 1992 to 1995, it becomes larger from 1996 onward. However, there is no clear evidence that the productivity of both foreign and local establishments grew markedly during the period from 1990 to 1999.

[INSERT TABLE 6 & FIGURE 2]

4. Total Factor Productivity Growth and Its Decomposition

The Model Specification

So far, the various productivity measures show that foreign-owned establishments tend to be larger in size and show higher productivity than local ones. In terms of labor productivity, the difference between local and foreign establishments is statistically significant. Although the average TFP level tended to be higher for foreign-owned establishment, the gap in TFP levels between local and foreign establishments became insignificant after controlling for industry-wide time effects and observable plant-specific characteristics such as age and size. Moreover, there was no evidence that productivity had grown during the period from 1990 to 1999 at either foreign or local

[18] An extremely large assembler establishment in terms of both employment and output is included in the dataset. When conducting regression analyses without this outlier establishment, the results were almost identical. However, the coefficient on the dummy variable, *FOR*, became insignificant for the equation of value added per employee, although the coefficient on *FOR* for the equation of output per employee remained positive at the 10 percent significance level.

establishments. In this section, in order to investigate the determinants of productivity growth, the cost function framework is employed to analyze the source of TFP growth as well as the cost elasticities for foreign and local establishments. Moreover, the cost function framework is advantageous because it can endogenize the impact of capital utilization.[19]

Following Fuss and Waverman (1992), Nadiri and Nandi (1999), Kawai (2000), etc., the variable cost function in the translog form is specified for the purpose of estimation. Since physical capital stock is considered as a quasi-fixed input in the short-run, the variable cost function is given by:[20]

$$\begin{aligned}
\log VC_t = {} & (a_0 + df_0 * FOR_t + Dcrisis * CR_t + a_T * T) + a_L * log(P_{Lt}/P_{Mt}) + a_Y * \log Y_t \\
& + a_K * \log K_t + (a_L + df_L * FOR_t) * log(P_{Lt}/P_{Mt}) \\
& + (a_Y + df_Y * FOR_t) * \log Y_t + (a_K + df_K * FOR_t) * \log K_t \\
& + a_{LT} * \log(P_{Lt}/P_{Mt}) * T + a_{YT} * \log Y_t * T + a_{KT} * \log K_t * T \\
& + \frac{1}{2} a_{LL} * (\log(P_{Lt}/P_{Mt}))^2 + a_{YL} * Y_t * \log(P_{Lt}/P_{Mt}) + a_{KL} * K_t * \log(P_{Lt}/P_{Mt}) \\
& + \frac{1}{2} a_{YY} * (\log Y_t)^2 + a_{YK} * \log Y_t * \log K_t + \frac{1}{2} a_{KK} * (\log K_t)^2 + \frac{1}{2} a_{TT} * T^2
\end{aligned} \qquad \ldots (3)$$

In above equation, the following regularity conditions are imposed:

$$\begin{aligned}
& a_L + a_M = 1 \\
& a_{LL} + a_{LM} = a_{ML} + a_{MM} = 0 \\
& a_{KL} + a_{KM} = a_{YL} + a_{YM} = 0
\end{aligned} \qquad \ldots (4)$$

The definitions of the variables in equation (3) are as follows. The two variable factors are labor and materials. The average wage rate is normalized by the material's price (P_{Lt}/P_{Mt}), and the variable cost (VC_t) is in real terms. Output and physical capital stock are denoted by Y_t and K_t, respectively. Intercept and slope dummy variables are used to capture the difference in production technology between foreign and local establishments. A dummy variable, FOR_t, takes zero for local establishments and one for foreign ones. Another dummy variable, *CR*, takes value one for the period after the financial crisis, 1997-1999, and zero otherwise. An index of time (T) represents

[19] There is no information on the number of hours worked in the database. Although the survey asks the percentage of actual production to production capacity during the year, the quality of the capacity utilization data is too poor to be used for the analysis.

[20] A subscript i is omitted in the following equations for simplicity.

disembodied technical change. Subscript *t* is used to represent time.

Taking derivatives with respect to the natural logarithm of labor and material prices (P_{Lt}, P_{Mt}), and using Shepard's lemma, one obtains the labor share function as:

$$S_{Lt} = a_L + df_L * FOR + a_{LT} * T + a_{LL} * \log(P_{Lt}/P_{Mt}) + a_{LY} * \log Y_t + a_{KL} * \log K_t \quad \dots (5)$$

The variable cost function (3) and the labor share function (5) are jointly estimated by using the time-series and cross-section establishment-level data from 1990-1999. A maximum likelihood method is employed. Several elasticities are derived as follows:

$$\begin{aligned}
\varepsilon_{Yt} &= a_Y + a_{YT} * T + a_{LY} * \log(P_{Lt}/P_{Mt}) + a_{YK} * \log K_t + a_{YY} * \log Y_t + df_Y * FOR \\
\varepsilon_{Kt} &= a_K + a_{KT} * T + a_{KL} * \log(P_{Lt}/P_{Mt}) + a_{KK} * \log K_t + a_{YK} * \log Y_t + df_K * FOR \\
\varepsilon_{Tt} &= a_T + a_{LT} * \log(P_{Lt}/P_{Mt}) + a_{KT} * \log K_t + a_{YT} * \log Y_t + a_{TT} * T
\end{aligned} \quad \dots (6)$$

Moreover, the calculated TFP growth rate can be decomposed into several factors by applying formula (7).[21]

$$\begin{aligned}
ln\frac{TFP_t}{TFP_{t-1}} = {} & \frac{1}{2}\left[\left(1-\frac{VC_t}{TC_t}\varepsilon_{Yt}\right)+\left(1-\frac{VC_{t-1}}{TC_{t-1}}\varepsilon_{Yt-1}\right)\right] ln\frac{Y_t}{Y_{t-1}} \\
& -\frac{1}{2}\left[\left(1+\frac{VC_t}{TC_t}(\varepsilon_{Kt}-1)\right)+\left(1+\frac{VC_{t-1}}{TC_{t-1}}(\varepsilon_{Kt-1}-1)\right)\right] ln\frac{K_t}{K_{t-1}} \\
& -\frac{1}{2}\left[\frac{VC_t}{TC_t}\varepsilon_{Tt}+\frac{VC_t}{TC_{t-1}}\varepsilon_{Tt-1}\right]\frac{\dot{T}}{T}
\end{aligned} \quad \dots (7)$$

where TC_t represents total cost. The first term on the right-hand side of equation (7) indicates the contribution from the change in output. The second term represents the contribution from capacity expansion, reflecting the difference in the marginal conditions between the short-run and the long-run equilibrium. That is, in the short-run equilibrium, the shadow price of capital ($-\partial VC_t/\partial K_t$) is likely to differ from the long-run rental price of capital (P_{Kt}) due to the adjustment cost. If the quasi-fixed input, physical capital, was at the optimal level, then $\partial VC_t/\partial K_t = -P_{Kt}$ and $\varepsilon_{Kt} = -P_{Kt}K_t/VC_t$. Using these relationships and the definition of total cost and variable cost, $TC_t = VC_t + P_{Kt}K_t$, the second term on the right hand side of equation (7) is cancelled out when physical capital is at the optimal level. Therefore, the effect represented by the

[21] For details on the decomposition formula, see appendix B.

second term can be interpreted as a capital utilization effect. The third term indicates the contribution from technological progress.

By using this decomposition, the TFP growth can be interpreted from both supply-side and demand-side aspects. On the supply-side, economies of scale arise if average cost falls as output rises, and may be a characteristic of the technology. However, at the same time, sufficient demand size is a necessary condition for an increase in output. Therefore, the scale effect (the first term on the right-hand side of equation (7)) captures both supply-side and demand-side factors. On the other hand, the capacity utilization effect (the second term) captures the effect from a change in demand in the short-run.

The Data and Estimation Results

Data on output and physical capital stock are expressed in real terms, deflated by the wholesale price index (1993=100).[22] The price of labor for each establishment was calculated by dividing the total payroll by the number of workers. The price of materials was calculated for each establishment as a weighted average of the wholesale price index for imported manufacturing raw materials and the wholesale price index for manufacturing raw materials. The expenditures on imported materials and domestically produced raw materials are used as a weight. Estimates of the coefficients of the variable cost function (3) are presented in Table 7 and the derived elasticities based on the average value of each variable are presented in Table 8. The majority of the parameter estimates in Table 7 are statistically significant. The important characteristics of the cost side of the industry are summarized below.

The variable cost elasticities of output (E_{Yt}) are shown in column 2, and the scale effect, which is defined as the inverse of E_{Yt}, is shown in the last column of Table 8. The results show a relatively high cost elasticity of output for local establishments. On average, a 1% increase in output causes an increase of 0.81% in the variable cost for foreign establishments and an increase of 0.89% in the variable cost for local establishments. The scale effect presented in the last column indicates that both foreign and local establishments experienced increasing returns to scale during the sample period. The scale effect is relatively higher for foreign establishments, and increased over time for both foreign and local establishments.

The elasticity of variable cost with respect to increases in physical capital stock (E_{Kt}) is shown in column 3 of Table 8. The negative values for E_{Kt} indicate that variable costs

[22] For details, see Appendix A.

decline with increases in the levels of the quasi-fixed input. The capital elasticity for all establishments is negative over the period from 1990 to 1998, but the absolute value decreases over time. This implies that the utilization of physical capital became less efficient during this period. It should be noted that the capital elasticity is positive for foreign establishments, suggesting that capital utilization is extremely inefficient in foreign establishments.

[INSERT TABLES 7 & 8]

TFP growth and its decomposition are shown in Table 9 and in Figure 3. The TFP growth rate for each year is estimated using equation (7). The average annual TFP growth rate remained very low and negative for the sample period. Even before the financial crisis, average TFP growth over the period 1990-1996 was negative for both local and foreign establishments. Moreover, there was a substantial drop in the TFP growth rate from 1997 to 1998 due to the large decline in the contribution of production scale, most likely caused by the rapid fall in demand after the economic crisis. Local establishments experienced larger negative scale and capital effects on TFP growth. However, the TFP growth rate from 1998 to 1999 is positive, implying a recovery from the crisis to some extent. A substantial negative capital effect is observed for the 1994-95 and 1995-96 periods, particularly for foreign establishments. This might be a reflection of the fact that many establishments invested in machinery and equipment or other fixed capital around 1994 to 1996 based on the expectation of continuing growth in the Indonesian automobile market. In addition, quite a few foreign and local establishments were newly established in the mid 1990s, which also may have contributed to the negative capital effect on TFP growth. On average, compared with local establishments, foreign establishments had a lower TFP growth rate over the 1990-1996 period but a higher one during 1996-1999. As a result, the average TFP growth rate over the sample period is -5.8 percent for foreign establishments and -5.6 percent for local establishments, suggesting that both foreign and local establishments experienced substantial negative TFP growth on average and the difference between them is not very large.

It should be noted that the greatest part of the TFP growth rate is explained by the scale and the capital effects, and that the technological change effect is negligible over the sample period for both foreign and local establishments.

[INSERT TABLE 9 & FIGURE 3]

5. Concluding Remarks

According to economic theory, manufacturing plants owned by multinational corporations are considered to be more productive than local ones because of their advantages in managerial resources. This paper empirically studies the difference in productivity between foreign-owned and local establishments and tries to uncover the sources of productivity growth for both foreign and local establishments. Given drawbacks in establishment-level data of developing countries like Indonesia, this paper calculates various productivity measures in order to make the analyses as thorough as possible and obtain robust and comprehensive results.

Consistent with previous empirical studies, the results of this paper suggest that foreign establishments tend to be larger in size, enjoy higher labor productivity, and pay higher wages than local ones. Moreover, foreign establishments tend to show a higher import ratio than local ones. As for the export share in output, this was negligibly small before the financial crisis, but more recently foreign establishments increased the export share rapidly. The results of the regression analysis of the determinants of productivity measures show that foreign establishments achieved significantly higher labor productivity than local ones (Table 6). However, a comparison of TFP levels for foreign and local establishments reveals no significant evidence that foreign plants do in fact enjoy higher TFP that could be attributed to their ownership-specific advantages, as economic theory would suggest. Furthermore, the results instead indicate that the scale effect is an important determinant of productivity levels. The cost function analysis in this paper enables us to calculate the variable cost elasticities and find out the difference in cost structures between foreign and local establishments. Moreover, using the estimated variable cost function, the different sources of TFP growth are investigated. It is found that both foreign and local establishments experienced increasing returns to scale during the sample period, and that the scale effect is relatively higher for foreign establishments. The results also show the existence of excess capacity throughout the sample period. In particular, capital utilization is extremely inefficient in foreign establishments. The results of the decomposition of TFP growth suggest that the average annual TFP growth rate remained very low or negative for the sample period. Even before the financial crisis, average TFP growth was negative for both local and foreign establishments. In addition, the greatest part of the TFP growth rate is explained by the scale effect and the capital utilization effect, while the technological change effect is

negligible for both foreign and local establishments. This suggests that demand side factors are rather important for productivity growth in Indonesia. According to Rhys (1998), the minimum efficient scale is about 250,000 units per year for automobile assembly and about one million units per year for the casting of engine blocks and pressing of panel parts. In Indonesia, however, even the largest assembler plant only assembles at most about 75,000 automobiles per year, which is much lower than the production scale of a major Japanese assembly plant (approximately 600,000 units per year) or a major Thai assembly plant (approximately 150,000 units per year).[23]

On the other hand, according to economic theory, the inefficiency of capital utilization may be the result of the fragmented small market and non-competitive reasons that affect market power (Tirole 1988). As argued in section 2, although there are more than ten automobile assemblers in Indonesia, a small number of conglomerates own more than one assembly firm and produce more than one brand name. Moreover, one conglomerate, the Astra group, commands a market share of more than 50 percent and controls a large number of affiliated auto parts suppliers. The high average price-cost margins also imply that there is little competition in the Indonesian automobile market. Therefore, an important reason for the poor overall performance of both foreign and local establishments seems to have been the highly concentrated structure of the industry and the lack of competition.

The results of this paper strongly confirm that production scale and capital utilization are extremely important determinants of productivity and that technological change is negligible for both foreign and local establishments. They therefore clearly demonstrate the importance of sufficient market scale and competition if efficiency is to be improved.

As Okamoto and Sjöholm (2000) argue, the highly protective policies for the automobile industry should be reconsidered. The government interventions have created an environment in which weak competition allows inefficient establishments to stay in the industry. Sufficiently large demand and sufficient technological capabilities are essential to the development of the automobile industry; otherwise, the industry will remain in its infancy stage. However, even after thirty years of protection and government support, the Indonesian economy is not yet at the motorization stage and it seems it will take at least several more years for full-scale motorization to occur (a boom cannot take off; but motorization could). Thus, given the insufficient size of the domestic market as well as the inefficiency/low efficiency displayed by Indonesian

[23] The information on units of cars assembled in a year was taken from various yearbooks of the automobile market and interviews by the author.

automobile industry, a major rethink of government policy seems in order. Although the Indonesian government has introduced some deregulation packages since the early 1990s, the liberalization policy seemed to lack a rigorous discipline or strategy: The government also launched the national car project in 1996 to which it granted special privileges. However, following the IMF instructions after the 1997 crisis, then scrapped the privileges to the national car project and began to implement various liberalization policies. In 1999, the government abandoned the incentive system, which it had introduced in 1993 to foster the auto parts industry, and liberalized the imports of CBU (completely built-up) cars and lowered import tariffs. Moreover, the government sold its shares in PT. Astra International to a Singaporean company in 2000. It is difficult to evaluate the effects of the liberalization policy on plant productivity in the automobile industry, as the analysis in this paper is limited to the short period from 1990 to 1999 and plant productivity was heavily affected by the large demand shock after the crisis. Nevertheless, some indices seem to provide a positive sign for the future prospects of productivity growth. For example, in the motor vehicle component industry, average variable cost and value added per employee improved from 1995 to 1999 and the export share in output rapidly increased during the period. At the same time, the Herfindahl index decreased substantially, suggesting an intensification of competition in the motor vehicle component industry (Table 4). In order to judge whether the liberalization packages are successful and whether the intensified competition in both the domestic and the overseas markets contributes to productivity improvements, further studies are required, in which case the introduction of a cross-country comparative perspective should be helpful.

Appendix A: Data Description

The value of plant output is measured as the sum of the total value of production and revenues from manufacturing services. The value of output is deflated by the wholesale price index of manufactured commodities defined at the 3-digit ISIC industry level.

In my analysis, each producer uses three inputs in production: labor, capital, and intermediate materials. Labor input is measured as the number of production and other workers. Total payments to labor are measured as total salaries to both groups and are deflated by the general consumer price index.

Capital input is estimated as the book value of fixed assets, including buildings, machinery and equipment, vehicles, and other fixed capital. To control for price level changes in new capital goods, using the 1993 book values as the basis, I deflate the changes in each plant's book values between the years by the wholesale price indices for capital goods. By adjusting these deflated changes to the 1993 book values, the book values of capital goods at each year are scaled to the 1993 basis. The change in the book value of buildings is deflated by the wholesale price index of residential and non-residential buildings. The changes in the book values of machinery and equipment, vehicles, and other fixed capital are deflated by the wholesale price index of capital goods. In addition, it should be noted that some missing values of fixed assets are linearly interpolated or extrapolated by the author using the number of employees for the establishment as an explanatory variable.

Material input includes raw materials and fuel used by the plant. Expenditures on domestically produced raw materials are deflated by the wholesale price index for manufacturing raw materials, and expenditures on imported raw materials are deflated by the wholesale price index for imported manufacturing raw materials. Fuel expenditures are deflated by the consumer price index for fuel, electricity, and water (unfortunately, the wholesale price index for fuel is not available).

The wholesale price indices are taken from the BPS, *Monthly Statistical Bulletin: Economic Indicators* (BPS various years). The consumer price indices are taken from the BPS, *Statistical Yearbook of Indonesia* (BPS various years).

In order to obtain the total cost for each establishment, the rental rate of physical capital is calculated as $w_{kt} = p_{Kt} * (r_t + \delta_K)$, where r_t is the real rate of return in year t, δ_K is the depreciation rate of capital, and p_{Kt} is the price deflator for capital investment in year t. I used the interest rates for investment at commercial banks, obtained from the

Bank Indonesia, *Indonesian Financial Statistics* (Bank Indonesia various years). The depreciation rate was assumed at an arbitrary 10%.

Appendix B: TFP Decomposition Formula

The TFP decomposition formula is derived as follows. When physical capital stock (K_t) is considered as a quasi-fixed input in the short-run, the variable cost (VC_t) function is given by:

$$VC_t = h\left(P_{Lt}, P_{Mt}, K_t, Y_t, t\right) \tag{B1}$$

where P_{Lt} and P_{Kt} are the factor prices of labor and of intermediate inputs, and Y_t denotes output.

Taking the total derivative with respect to time t, we get

$$\frac{dVC_t}{dt} = \sum_{f=L,M} \frac{\partial h}{\partial P_{ft}} \frac{dP_{ft}}{dt} + \frac{\partial h}{\partial K_t} \frac{dK_t}{dt} + \frac{\partial h}{\partial Y_t} \frac{dY_t}{dt} + \frac{1}{VC_t} \frac{\partial h}{\partial t}$$

(B2)

Using $\varepsilon_{Kt} = \partial \ln VC_t / \partial \ln K_t$, $\varepsilon_{Yt} = \partial \ln VC_t / \partial \ln Y_t$ and applying Shepard's lemma, equation (B2) becomes

$$\frac{d \ln VC_t}{dt} = \frac{TC_t}{VC_t} \sum_{f=L,M} s_{ft} \frac{d \ln P_{ft}}{dt} + \varepsilon_{Kt} \frac{d \ln K_t}{dt} + \varepsilon_{Yt} \frac{d \ln Y_t}{dt} + \frac{1}{VC_t} \frac{\partial h}{\partial t} \tag{B3}$$

where $s_{ft} = P_{ft} X_{ft} / TC_t$.

On the other hand, since the variable cost is defined as $VC_t = \sum_{f=L,M} P_{ft} X_{ft}$, taking the total derivative of this definition equation yields

$$\frac{d \ln VC_t}{dt} = \frac{TC_t}{VC_t} \sum_{f=L,M} s_{ft} \frac{d \ln X_{ft}}{dt} + \frac{TC_t}{VC_t} \sum_{f=L,M} s_{ft} \frac{d \ln P_{ft}}{dt}$$

(B4)

Subtracting the common terms from equations (B3) and (B4), and applying the Törnqvist index type approximation, we obtain

$$\frac{1}{2}\left(\frac{VC_t}{TC_t}\varepsilon_{Kt}+\frac{VC_{t-1}}{TC_{t-1}}\varepsilon_{Kt-1}\right)ln\frac{K_t}{K_{t-1}}+\frac{1}{2}\left(\frac{VC_t}{TC_t}\varepsilon_{Yt}+\frac{VC_{t-1}}{TC_{t-1}}\varepsilon_{Yt-1}\right)ln\frac{Y_t}{Y_{t-1}}$$
$$+\frac{1}{2}\left[\frac{1}{TC_t}\frac{\partial VC_t}{\partial t}+\frac{1}{TC_{t-1}}\frac{\partial VC_{t-1}}{\partial t}\right]=\frac{1}{2}\sum_{i=L,M}\left(s_{it}+s_{it-1}\right)ln\frac{X_{it}}{X_{it-1}} \quad \text{(B5)}$$

On the other hand, the definition of TFP growth rate is given by

$$ln\frac{TFP_t}{TFP_{t-1}}=ln\frac{Y_t}{Y_{t-1}}-\frac{1}{2}\sum_{f=L,K,M}\left(s_{ft}+s_{ft-1}\right)ln\frac{X_{ft}}{X_{ft-1}} \quad \text{(B6)}$$

From the definition of the TFP growth rate (B6) and equation (B5), the TFP growth decomposition formula is derived as equation (7) in section 4.

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Table 1. Automobile Industry in ASEAN Countries

<Panel A> Automobile markets

	Indonesia		Thailand		Malaysia		Philippines		ASEAN-4	
ASEAN market sales: units (import shares in parentheses)										
1995	384,449	(27.7%)	571,580	(36.9%)	285,792	(4.1%)	128,162	n.a.	1,369,983	n.a.
1996	337,399	(27.4%)	589,126	(31.1%)	364,789	(43.1%)	162,095	n.a.	1,453,409	n.a.
1997	392,185	(30.6%)	363,156	(22.8%)	404,837	(41.6%)	144,434	n.a.	1,304,612	n.a.
1998	167,234	n.a.	201,055	n.a.	198,797	(115.7%)	86,751	n.a.	653,837	n.a.
1999	93,814	n.a.	218,330	n.a.	288,547	n.a.	74,415	n.a.	675,106	n.a.
Sales by Japanese manufacturers: units (market shares in parentheses)										
1995	365,520	(95.1%)	514,704	(90.0%)	83,393	(29.2%)	111,808	(87.2%)	1,075,425	(78.5%)
Sales by U.S. and European manufacturers: units (market shares in parentheses)										
1995	17,137	(4.5%)	46,322	(8.1%)	21,706	(7.6%)	1,127	(0.9%)	86,292	(6.3%)

Source: Takayasu *et al* . (1996) Tables 3, 8, 13, 17; Nikkan Jidosha Shinbun-sha (2000), *Jidosha Sangyo Handbook 2001* (Handbook of Automobile Industry 2001).

<Panel B> Structure of the automobile parts industry (as of January 1998)

	Indonesia		Thailand		Malaysia		Philippines		ASEAN-4	
Total number of parts manufacturers										
1998	150-200		750-800		200-250		150-200		1300－1500	
Japanese affiliates or subsidiaries (shares in parentheses)										
1998	82	(46.9%)	209	(27.0%)	61	(27.1%)	54	(30.9%)	406	(30.0%)
U.S. and European affiliates or subsidiaries (shares in parentheses)										
1998	7	(4.0%)	21	(2.7%)	19	(8.4%)	5	(2.9%)	406	(4.0%)

Source: Poapongsakorn and Wangdee (2000) Table 2.

<Panel C> Automotive tariffs and non-tariff barriers, 1998

	Indonesia		Thailand		Malaysia		Philippines		ASEAN-4	
Average applied tariff rates										
	Parts	Vehicles	Parts	Vehicles	Parts	Vehicles	Parts	Vehicles	Parts	Vehicles
	21.8	86.4	42.7	43.3	16.3	53.1	11.5	23.3	26.6	47.2
Share of imports subject to non-tariff barriers										
	Parts	Vehicles	Parts	Vehicles	Parts	Vehicles	Parts	Vehicles	Parts	Vehicles
	0.0	70.2	2.8	64.7	9.4	81.5	2.5	40.6	2.8	64.7

Source: Farrel and Findlay (2001) Table 2.8.

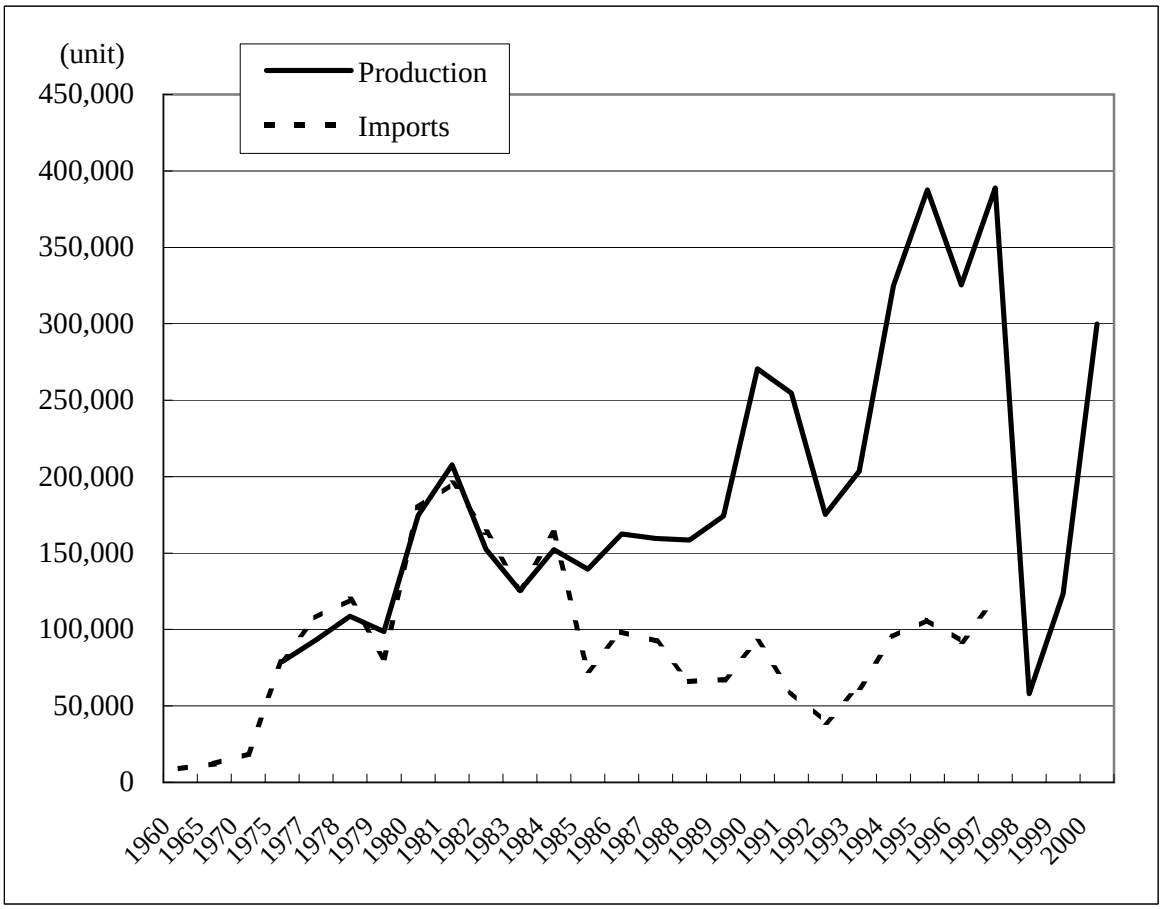

Figure 1. Motor Vehicle Production and Imports in Indonesia

Source: Nikkan Jidosha Shinbun-sha (various years).

Table 2. Major Auto Manufacturers in Indonesia

Panel A. Year 1995

Group	Market share	Ethnic Group of Local Shareholders[a]	Local Firm	Started Operation (Date of Establishment)	Foreign Partner	
					Joint Venture	Contract
(1) Astra	54.5%	Government + Chinese	(a) Toyota Astra Motor	1972 (Apr. 1971)	Toyota (49%)	
			(b) Gaya Motor	(1955)		Daihatsu, Isuzu, Nissan, BMW, Ford, Peugeot
			(c) Pantja Motor	1974		Isuzu, Nissan
(2) Indomobil (Salim)	20.9%	Chinese	(a) Indomobil Suzuki International	1991 (Mar. 1990)	Suzuki (49%)	
			(b) Ismac	1973 (Oct. 1971)		Nissan Chrysler
			(c) National Assemblers	1974 (Oct. 1971)		Mazda, Volvo, Hino
			(d) GM Buana Indonesia		GM (60%)	
(3) Krama Yudha	19.5%	Pribumi	(a) Krama Yudha Kesuma Motor	1981 (1970)		Mitsubishi
			(b) Krama Yudha Ratu Motor	1973 (Jun. 1973)		Mitsubishi
(4) Imora	1.3%	Chinese	Prospect Motor	1975 (Jun. 1973)		Honda
(5) Bimantara	2.3%	Pribumi (Soeharto's son)	(a) German Motor	(1970)	Mecedes Benz (35%)	
			(b) Tricitra Karya	1995		Hyundai
(6) Starsauto	n.a.		Starsauto Dinamika	1995		Daewoo
(7) Humpus	0.0%	Pribumi (Soeharto's son)	Kia-Timor Motors		Kia (35%)	

Note: [a] Pribumi is an Indonesian language term referring to indigeous groups.
Sources: Aswicahyono, Basri, and Hill (2000) Table 3, pp.220-221; Nomura (1996) Table I-5, pp.96-99.

Panel B. Year 1998

Group	Market share	Ethnic Group of Local Shareholders[a]	Local Firm	Started Operation (Date of Establishment)	Foreign Partner	
					Joint Venture	Contract
(1) Astra	50.6%	Government + Chinese	(a) Toyota Astra Motor	1972 (Apr. 1971)	Toyota (49%)	
			(b) Gaya Motor	(1955)		Isuzu, BMW, Ford, Peugeot
			(c) Pantja Motor	1974	Isuzu (12.5%)	
			(d) Astra Daihatsu Motor	(1992)	Daihatsu (40%)	
			(e) Astra Nissan Diesel Indonesia	1996	Nissan Diesel (12.5%)	
(2) Indomobil (Salim)	21.0%	Chinese	(a) Indomobil Suzuki International	1991 (Mar. 1990)	Suzuki (49%)	
			(b) Ismac Nissan Manufacturing	1996 (1973)	Nissan (35%)	Audi, Volvo, Ssangyong
			(c) Ismac	1973 (Oct. 1971)		Mazda, Volvo, VW, Audi, Nissan, Chrysler
			(e) Hino Automobil Indonesia	Suspended	Hino (39%)	
(3) Krama Yudha	18.1%	Pribumi	(a) Krama Yudha Kesuma Motor	1981 (1970)	MKM(Mitsubishi Krama Yudha Motors & Mfg.)	
			(b) Krama Yudha Ratu Motor	1975 (Jun. 1973)		Mitsubishi
(4) Imora	1.8%	Chinese	Honda Prospect Motor	(1992)	Honda Group (49%)	
(5) Bimantara	1.0%	Pribumi (Soeharto's son)	(a) Tricitra Karya	1995		Hyundai Ford
			(b) Bimantara Hyndai Indonesia	1999 (planned)	Hyundai (50%)	
(6) Starsauto	0.2%		Starsauto Dinamika	1995		Daewoo
(7) Humpus	5.0%	Pribumi (Soeharto's son)	Kia-Timor Nasional	1998 (planned)	Hyundai (30%)	
(8) Mercedes-Benz Group Indonesia	1.3%	Europe	Mercedes-Benz Group Indonesia	(1970)	DaimlerChrysler (95%)	
(9) GM	1.1%	U.S.A.	GM Buana Indonesia	1994	GM (100%) * wholly owned by GM in 1997	

Note: [a] Pribumi is an Indonesian language term referring to indigeous groups.
Sources: Aswicahyono, Basri, and Hill (2000) Table 3, pp.220-221; Nomura (1996) Table I-5, pp.96-99; FOURIN (2000)

Table 3. Industry Definitions by 5-Digit ISIC (Indonesia Standard Industrial Classification), and Employment, Output, and Value Added by Industry

	Motor vehicles (38431/34100)[a]					
	1990		*1995*		*1999*	
No. of establishments (in which foreign-owned establishment						
BPS [b]	***10***	***(2)***	***14***	***(5)***	***13***	***(8)***
This sample [c]	***7***	***(2)***	***7***	***(3)***	***5***	***(3)***
No. of person engaged (share of which accounted for by foreign-owned establishments)						
BPS [b]	*7,642*		*14,181*		*10,533*	
This sample [c]	*5,675*	*(64.2%)*	*7,626*	*(75.7%)*	*5,437*	*(85.0%)*
Value of gross output (unit: Mil.Rp) (share of which accounted for by foreign-owned establishments)						
BPS [b]	*1,812,352*		*4,573,780*		*3,434,349*	
This sample [c]	*1,190,773*	*(92.0%)*	*2,911,686*	*(81.7%)*	*3,101,157*	*(98.1%)*
Value added at market prices (unit: Mil. Rp) (share of which accounted for by foreign-owned establishments)						
BPS [b]	*854,399*		*2,160,723*		*1,741,803*	
This sample [c]	*663,256*	*(94.3%)*	*1,527,761*	*(92.2%)*	*1,537,402*	*(96.9%)*
Main country of the investors of foreign-owned establishments (This sampl						
Japan	1		1		2	
U.S.A.	0		1		0	
Germany	0		0		0	
Korea	0		0		0	
Others	1		1		1	
Unknown	0		0		0	
Foreign ownership share of foreign-owned establishments (This sampl						
Distribution						
0%< & <30%	0		0		0	
30%=< & <50%	1		2		2	
50%=< & <70%	1		1		0	
70%=< & <90%	0		0		1	
90%=< & <100%	0		0		0	
100%	0		0		0	
Range						
Min. share	49%		49%		49%	
Max. share	57%		60%		70%	

(continued)

Table 3. (continued)

	Motor vehicle bodies (38432/34200)[a]					
	1990		*1995*		*1999*	
No. of establishments (in which foreign-owned establishment						
BPS [b]	***118***	***(7)***	***124***	***(2)***	***81***	***(1)***
This sample [c]	***54***	***(0)***	***60***	***(0)***	***39***	***(1)***
No. of person engaged (share of which accounted for by foreign-owned establishments)						
BPS [b]	*18,824*		*17,831*		*7,381*	
This sample [c]	*8,792*	*n.a.*	*9,723*	*n.a.*	*4,483*	*(32.2%)*
Value of gross output (unit: Mil.Rp) (share of which accounted for by foreign-owned establishments)						
BPS [b]	*340,133*		*429,871*		*293,416*	
This sample [c]	*104,444*	*n.a.*	*179,785*	*n.a.*	*144,216*	*(61.0%)*
Value added at market prices (unit: Mil. Rp) (share of which accounted for by foreign-owned establishments)						
BPS [b]	*151,402*		*160,594*		*188,572*	
This sample [c]	*41,846*	*n.a.*	*57,991*	*n.a.*	*105,865*	*(71.6%)*
Main country of the investors of foreign-owned establishments (This sampl						
Japan	0		0		0	
U.S.A.	0		0		0	
Germany	0		0		0	
Korea	0		0		0	
Others	0		0		0	
Unknown	0		0		1	
Foreign ownership share of foreign-owned establishments (This sampl						
Distribution						
0%< & <30%	0		0		0	
30%=< & <50%	0		0		1	
50%=< & <70%	0		0		0	
70%=< & <90%	0		0		0	
90%=< & <100%	0		0		0	
100%	0		0		0	
Range						
Min. share	n.a.		n.a.		60%	
Max. share	n.a.		n.a.		60%	

(continued)

Table 3. (continued)

	Motor vehicle component & apparatus (38433/34300[a])					
	1990		*1995*		*1999*	
No. of establishments (in which foreign-owned establishment						
BPS [b]	***68***	***(8)***	***121***	***(16)***	***150***	***(41)***
This sample [c]	***34***	***(6)***	***44***	***(8)***	***75***	***(17)***
No. of person engaged (share of which accounted for by foreign-owned establishments)						
BPS [b]	*11,622*		*29,185*		*23,755*	
This sample [c]	*8,247*	*(27.4%)*	*16,318*	*(26.4%)*	*15,950*	*(38.2%)*
Value of gross output (unit: Mil.Rp) (share of which accounted for by foreign-owned establishments)						
BPS [b]	*988,156*		*3,531,507*		*5,049,558*	
This sample [c]	*687,163*	*(62.9%)*	*2,543,486*	*(51.0%)*	*3,583,401*	*(65.4%)*
Value added at market prices (unit: Mil. Rp) (share of which accounted for by foreign-owned establishments)						
BPS [b]	*329,198*		*1,014,521*		*2,478,389*	
This sample [c]	*274,140*	*(63.1%)*	*765,440*	*(68.6%)*	*1,695,000*	*(67.1%)*
Main country of the investors of foreign-owned establishments (This sampl						
Japan	4		6		7	
U.S.A.	0		0		0	
Germany	0		0		1	
Korea	0		0		1	
Others	0		0		0	
Unknown	2		2		8	
Foreign ownership share of foreign-owned establishments (This sampl						
Distribution						
0%< & <30%	1		1		0	
30%=< & <50%	1		1		1	
50%=< & <70%	4		5		4	
70%=< & <90%	0		1		5	
90%=< & <100%	0		0		3	
100%	0		0		4	
Range						
Min. share	25%		25%		40%	
Max. share	65%		70%		100%	

Note: [a] Industrial classification code for BPS, *Statistik Industri* (BPS various years). The industry code was changed in 1998

[b] "BPS" figures are calculated from the raw dataset provided by the BPS.

[c] "This sample" figures are calculated from the dataset compiled for my analyses in this paper.

n.a. - not available.

Sources: Author's calculations based on BPS establishment-level data (BPS various years)

Table 4. Descriptive Statistics of the Sample of Establishments
--- By detailed industry *(simple average)* ---

	Motor vehicles (38431/34100)		
	1990	*1995*	*1999*
No. of observations	*7*	*7*	*5*
Herfindahl index	*0.828*	*0.659*	*0.949*
No. of employees	811	1,089	1,087
Output per establishment[a]	217,000	357,000	275,000
Value added per establishment[a]	146,000	220,000	184,000
Capital stock per establishment[a]	11,100	52,400	68,500
Years in operation	18.4	23.4	18.6
Productivity measures			
Average variable cost[b]	0.40	0.50	0.58
Output /employee[a]	108.9	225.1	83.7
Value added / employee[a]	70.6	85.4	57.6
TFP (in logarithm)	3.5	3.0	2.6
Inventory ratios			
Total inventory (%)	n.a.	23.1	21.4
Final goods inventory (%)	n.a.	10.6	11.6
Work-in-process inventory (%)	n.a.	1.3	3.6
Raw materials inventory (%)	n.a.	11.9	9.5
Other indicators			
Capital-labor ratio[a]	17.8	52.5	66.9
Share of non-production workers (%)	24.3	27.5	33.5
Production worker wages[c]	4,479	6,749	4,699
Non-production worker wages[c]	8,893	11,235	6,868
Price-cost margin (%)[d]	58.6	50.5	34.9
Export share in output (%)	0.0	0.0	20.0
Import ratio (%)	44.6	27.7	39.6

(continued)

Table 4. (continued)

	Motor vehicle bodies (38432/34200)		
	1990	*1995*	*1999*
No. of observations	*54*	*60*	*39*
Herfindahl index	*0.088*	*0.089*	*0.381*
No. of employees	163	162	115
Output per establishment[a]	2,441	2,540	1,580
Value added per establishment[a]	1,127	970	1,215
Capital stock per establishment[a]	1,455	2,355	3,226
Years in operation	9.8	14.7	15.6
Productivity measures			
Average variable cost[b]	0.73	0.72	0.64
Output /employee[a]	14.6	14.1	7.9
Value added / employee[a]	5.9	5.6	4.9
TFP (in logarithm)	2.7	2.5	2.3
Inventory ratios			
Total inventory (%)	n.a.	20.5	33.3
Final goods inventory (%)	n.a.	2.2	5.1
Work-in-process inventory (%)	n.a.	8.1	12.4
Raw materials inventory (%)	n.a.	14.0	20.6
Other indicators			
Capital-labor ratio[a]	26.7	27.9	34.3
Share of non-production workers (%)	14.1	19.1	24.0
Production worker wages[c]	1,763	1,883	1,454
Non-production worker wages[c]	3,749	2,839	3,210
Price-cost margin (%)[d]	26.5	27.7	30.2
Export share in output (%)	1.1	0.8	0.0
Import ratio (%)	5.8	3.5	5.7

(continued)

Table 4. (continued)

	Motor vehicle component & apparatus (38433/34300)		
	1990	*1995*	*1999*
No. of observations	*34*	*44*	*75*
Herfindahl index	*0.175*	*0.174*	*0.087*
No. of employees	243	371	213
Output per establishment[a]	25,600	49,600	21,300
Value added per establishment[a]	14,000	16,100	13,200
Capital stock per establishment[a]	6,507	10,500	17,600
Years in operation	9.4	13.2	10.7
Productivity measures			
Average variable cost[b]	0.54	0.64	0.61
Output /employee[a]	87.2	85.1	82.0
Value added / employee[a]	43.6	25.2	54.1
TFP (in logarithm)	2.6	2.4	2.2
Inventory ratios			
Total inventory (%)	n.a.	27.4	33.2
Final goods inventory (%)	n.a.	8.2	7.2
Work-in-process inventory (%)	n.a.	4.0	4.5
Raw materials inventory (%)	n.a.	16.3	24.9
Other indicators			
Capital-labor ratio[a]	24.8	24.7	88.4
Share of non-production workers (%)	21.3	18.9	19.9
Production worker wages[c]	2,707	2,966	3,286
Non-production worker wages[c]	7,200	8,655	18,083
Price-cost margin (%)[d]	44.4	39.5	32.9
Export share in output (%)	0.0	4.0	9.6
Import ratio (%)	42.9	47.7	40.0

[a]In 1993 Mil. Rp. For price deflators, see Appendix A.

[b]Average cost is defined as the sum of labor and intermediate input costs divided by output.

[c]In 1993 1,000 Rp. For price deflators, see Appendix A.

[d]Price-cost margin is defined as (value added - wages paid) / output.

Note: 1) Some of the observations were not included because of missing values or recording mistakes.

2) The t-tests are performed based on the assumption of unequal variances.

3) * significant at 10% level, ** significant at 5% level, *** significant at 1% level (two-tailed test).

4) n.a. - not available.

Source: Author's calculations based on BPS establishment-level data (BPS various years).

Table 5. Descriptive Statistics of the Sample of Establishments by Ownership in the Motor Vehicle Industries --- By detailed industry (Simple Average) ---

	Motor vehicles (38431/34100)														
	1990-96 pooled			*1990*			*1995*			*1999*					
	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Ratio of foreign to domestic 1990-96	1990	1995	1999
No. of observations	*31*	*19*		*5*	*2*		*4*	*3*		*2*	*3*					
No. of employees	426	1,843	***	407	1,821		464	1,923		409	1,540		4.3	4.5	4.1	3.8
Output per establishment[a]	80,457	504,258	**	24,144	699,903		114,633	679,119		13,381	449,704		6.3	29.0	5.9	33.6
Value added per establishment[a]	27,502	345,394	**	14,230	477,003		29,185	475,109		11,139	299,881		12.6	33.6	16.3	27.0
Capital stock per establishment[a]	10,083	70,312	***	7,228	20,753		16,941	99,631		11,668	106,417		7.0	2.9	5.9	9.1
Years in operation	21.6	18.2		19.2	16.5		26.0	20.0		16.0	20.3		0.8	0.9	0.8	1.3
Average variable cost[b]	0.61	0.52		0.42	0.35		0.52	0.47		0.56	0.59		0.9	0.8	0.9	1.1
Output /employee[a]	177.4	149.7		57.5	237.3		265.3	171.5		20.5	125.9		0.8	4.1	0.6	6.1
Value added / employee[a]	59.4	90.0		33.6	162.9		63.3	115.0		16.9	84.8		1.5	4.8	1.8	5.0
TFP (in logarithm)	3.3	3.3		3.4	3.9		2.8	3.2		2.5	2.6		1.0	1.1	1.2	1.1
Total inventory (%)[c]	26.1	39.3		n.a.	n.a.		13.8	35.5		46.6	4.5		1.5	n.a.	1.4	0.1
Final goods inventory (%)[c]	3.7	6.1		n.a.	n.a.		0.6	23.9		28.8	0.1		1.6	n.a.	2.6	0.0
Work-in-process inventory (%)[c]	13.5	3.1		n.a.	n.a.		0.9	1.9		8.3	0.5		0.2	n.a.	40.8	0.1
Raw materials inventory (%)[c]	54.7	20.3		n.a.	n.a.		0.1	10.7		17.9	3.9		0.4	n.a.	2.2	0.2
Capital-labor ratio[a]	25.5	43.2		20.1	12.3		39.0	70.4		28.6	92.5		1.7	0.6	1.8	3.2
Share of non-production workers (%)	26.6	27.1		27.1	17.3		23.6	32.8		31.1	35.0		1.0	0.6	1.4	1.1
Production worker wages[d]	4,852	6,417		4,082	5,469		6,223	7,449		4,198	5,033		1.3	1.3	1.2	1.2
Non-production worker wages[d]	9,692	11,125		7,399	12,627		9,545	13,489		3,889	8,854		1.1	1.7	1.4	2.3
Price-cost margin (%)[e]	45.8	48.5		56.8	63.2		48.4	53.1		43.7	29.0		1.1	1.1	1.1	0.7
Export share in output (%)	0.0	3.8		0.0	0.0		0.0	0.0		0.0	33.3		n.a.	n.a.	n.a.	n.a.
Import ratio (%)	31.7	52.3	*	42.9	48.8		18.3	40.1		0.0	66.1		1.6	1.1	2.2	n.a.

(continued)

Table 5. (continued)

	Motor vehicle bodies (38432/34200)														
	1990-96 pooled			*1990*			*1995*			*1999*			Ratio of foreign to domestic			
	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	1990-96	1990	1995	1999
No. of observations	*416*	*0*		*54*	*0*		*60*	*0*		*38*	*1*					
No. of employees	164	n.a.		163	n.a.		162	n.a.		80	1,445	n.a.	n.a.	n.a.	n.a.	18.1
Output per establishment[a]	2,588	n.a.		2,441	n.a.		2,540	n.a.		650	36,916	n.a.	n.a.	n.a.	n.a.	56.8
Value added per establishment[a]	1,159	n.a.		1,127	n.a.		970	n.a.		398	32,266	n.a.	n.a.	n.a.	n.a.	81.2
Capital stock per establishment[a]	1,827	n.a.		1,455	n.a.		2,355	n.a.		2,628	25,946	n.a.	n.a.	n.a.	n.a.	9.9
Years in operation	12.5	n.a.		9.8	n.a.		14.7	n.a.		15.4	23.0	n.a.	n.a.	n.a.	n.a.	1.5
Average variable cost[b]	0.72	n.a.		0.73	n.a.		0.72	n.a.		0.66	0.15	n.a.	n.a.	n.a.	n.a.	0.2
Output /employee[a]	14.7	n.a.		14.6	n.a.		14.1	n.a.		7.4	25.5	n.a.	n.a.	n.a.	n.a.	3.5
Value added / employee[a]	6.7	n.a.		5.9	n.a.		5.6	n.a.		4.4	22.3	n.a.	n.a.	n.a.	n.a.	5.1
TFP (in logarithm)	2.6	n.a.		2.7	n.a.		2.5	n.a.		2.3	3.3	n.a.	n.a.	n.a.	n.a.	1.5
Total inventory (%)[c]	19.8	n.a.		n.a.	n.a.		20.5	n.a.		32.7	55.6	n.a.	n.a.	n.a.	n.a.	1.7
Final goods inventory (%)[c]	1.5	n.a.		n.a.	n.a.		2.2	n.a.		5.0	10.0	n.a.	n.a.	n.a.	n.a.	2.0
Work-in-process inventory (%)[c]	3.7	n.a.		n.a.	n.a.		8.1	n.a.		11.9	30.9	n.a.	n.a.	n.a.	n.a.	2.6
Raw materials inventory (%)[c]	13.5	n.a.		n.a.	n.a.		14.0	n.a.		20.7	17.2	n.a.	n.a.	n.a.	n.a.	0.8
Capital-labor ratio[a]	27.2	n.a.		26.7	n.a.		27.9	n.a.		34.7	18.0	n.a.	n.a.	n.a.	n.a.	0.5
Share of non-production workers (%)	18.3	n.a.		14.1	n.a.		19.1	n.a.		23.9	27.2	n.a.	n.a.	n.a.	n.a.	1.1
Production worker wages[d]	1,954	n.a.		1,763	n.a.		1,883	n.a.		1,480	473	n.a.	n.a.	n.a.	n.a.	0.3
Non-production worker wages[d]	3,413	n.a.		3,749	n.a.		2,839	n.a.		3,278	750	n.a.	n.a.	n.a.	n.a.	0.2
Price-cost margin (%)[e]	29.4	n.a.		26.5	n.a.		27.7	n.a.		28.7	85.2	n.a.	n.a.	n.a.	n.a.	3.0
Export share in output (%)	0.6	n.a.		1.1	n.a.		0.8	n.a.		0.0	0.0	n.a.	n.a.	n.a.	n.a.	n.a.
Import ratio (%)	4.1	n.a.		5.8	n.a.		3.5	n.a.		5.8	0.0	n.a.	n.a.	n.a.	n.a.	0.0

(continued)

Table 5. (continued)

Motor vehicle component & apparatus (38433/34300)

	1990-96 pooled			*1990*			*1995*			*1999*			Ratio of foreign to domestic			
	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	1990-96	1990	1995	1999
No. of observations	*255*	*55*		*28*	*6*		*36*	*8*		*58*	*17*					
No. of employees	255	452	***	214	377		334	539		170	358	*	1.8	1.8	1.6	2.1
Output per establishment[a]	18,456	99,905	***	11,407	92,067		29,636	139,366		9,497	61,520	**	5.4	8.1	4.7	6.5
Value added per establishment[a]	6,820	48,892	***	6,797	47,806		6,371	59,967		6,091	37,433	**	7.2	7.0	9.4	6.1
Capital stock per establishment[a]	8,724	22,625	***	5,450	11,439		9,013	17,345		12,786	34,077	**	2.6	2.1	1.9	2.7
Years in operation	11.1	10.8		9.5	9.2		13.3	12.9		11.4	8.2		1.0	1.0	1.0	0.7
Average variable cost[b]	0.63	0.51	**	0.55	0.46		0.66	0.55		0.57	0.74		0.8	0.8	0.8	1.3
Output /employee[a]	61.0	152.2	***	69.1	172.1		66.6	168.5		42.8	215.7	*	2.5	2.5	2.5	5.0
Value added / employee[a]	24.6	71.8	***	33.1	92.7		16.3	65.4		27.4	145.4	*	2.9	2.8	4.0	5.3
TFP (in logarithm)	2.3	3.0	***	2.5	3.2	**	2.3	3.1	*	2.1	2.4		1.3	1.3	1.3	1.1
Total inventory (%)[c]	20.4	24.0		n.a.	n.a.		27.9	24.9		41.1	10.2	**	1.2	n.a.	0.9	0.2
Final goods inventory (%)[c]	4.6	4.4		n.a.	n.a.		9.0	4.7		8.9	2.3	***	1.0	n.a.	0.5	0.3
Work-in-process inventory (%)[c]	2.6	1.0	***	n.a.	n.a.		3.7	5.4		5.6	1.1	**	0.4	n.a.	1.5	0.2
Raw materials inventory (%)[c]	11.7	13.8		n.a.	n.a.		15.5	19.8		31.1	6.8		1.2	n.a.	1.3	0.2
Capital-labor ratio[a]	35.2	52.9		25.0	24.3		24.2	26.9		63.1	174.7	*	1.5	1.0	1.1	2.8
Share of non-production workers (%)	20.3	24.1	*	20.6	24.5		18.2	21.6		18.8	23.7		1.2	1.2	1.2	1.3
Production worker wages[d]	2,499	4,680	***	2,245	4,864	**	2,448	5,299	**	1,930	7,912	**	1.9	2.2	2.2	4.1
Non-production worker wages[d]	6,789	10,497	***	5,825	13,617	*	8,632	8,757		8,104	49,782		1.5	2.3	1.0	6.1
Price-cost margin (%)[e]	38.6	48.3	**	43.2	49.9		37.9	46.9		38.6	47.7		1.3	1.2	1.2	1.2
Export share in output (%)	3.7	3.0		0.0	0.2		4.9	0.0	**	5.0	25.3	*	n.a.	n.a.	n.a.	5.1
Import ratio (%)	40.6	65.9	***	38.1	65.4		43.8	65.4		32.2	64.6	***	1.6	1.7	1.5	2.0

[a]In 1993 Mil. Rp. For price deflators, see Appendix A.

[b]Average cost is defined as the sum of labor and intermediate input costs divided by output.

[c]Inventory data are not available for 1990 and 1991.

[d]In 1993 1,000 Rp. For price deflators, see Appendix A.

[e]Price-cost margin is defined as (value added - wages paid) / output.

Note: 1) Some of the observations were not included because of missing values or recording mistakes.

2) The t-tests are performed based on the assumption of unequal variances.

3) * significant at 10% level, ** significant at 5% level, *** significant at 1% level (two-tailed test).

4) n.a. - not available.

Source: Author's calculations based on BPS, establishment-level data (BPS various years).

Table 6. Determinants of Productivity (OLS regressions)

	Dependent variable			
	ln (average variable cost)		*ln (real output per employee)*	
	(1)	(2)	(3)	(4)
ln(AGE)	0.006	0.042	0.498 *	0.761 ***
	(0.05)	(0.32)	(1.87)	(2.76)
(ln(AGE))^2	0.007	-0.003	-0.158 **	-0.211 ***
	(0.23)	(-0.11)	(-2.60)	(-3.43)
*FOR*ln(AGE)*		-0.877		-0.763
		(-1.56)		(-0.89)
FOR(ln(AGE))^2*		0.221		0.212
		(1.61)		(0.94)
ln(SIZE)	-0.080 ***	-0.065 ***	0.390 ***	0.296 ***
	(-4.32)	(-4.21)	(10.06)	(8.76)
(ln(SIZE))^2	-0.003	-0.004	-0.082 ***	-0.090 ***
	(-0.32)	(-0.47)	(-3.90)	(-5.06)
FOR		0.470		1.593 **
		(0.88)		(2.24)
No. of obs.	1134	1134	1134	1134
F	4.88 ***	4.82 ***	18.76 ***	20.21 ***
Adj. R-squared	0.118	0.145	0.327	0.378

	Dependent variable			
	ln (real value added per employee)		*ln (Total Factor Productivity)*	
	(5)	(6)	(7)	(8)
ln(AGE)	0.274	0.529 *	0.275 *	0.228
	(1.05)	(1.95)	(1.91)	(1.51)
(ln(AGE))^2	-0.117 **	-0.165 ***	-0.082 ***	-0.074 **
	(-1.99)	(-2.76)	(-2.60)	(-2.27)
*FOR*ln(AGE)*		-0.458		0.561
		(-0.55)		(1.05)
FOR(ln(AGE))^2*		0.109		-0.096
		(0.50)		(-0.71)
ln(SIZE)	0.385 ***	0.302 ***	0.166 ***	0.135 ***
	(10.13)	(9.20)	(8.26)	(7.90)
(ln(SIZE))^2	-0.078 ***	-0.082 ***	-0.015	-0.019 *
	(-3.78)	(-4.64)	(-1.35)	(-1.94)
FOR		1.427 **		-0.363
		(2.06)		(-0.76)
No. of obs.	1124	1124	1125	1125
F	23.74 ***	24.38 ***	11.56 ***	11.23 ***
Adj. R-squared	0.382	0.430	0.246	0.275

Notes: The numbers in parentheses are t-statistics based on White's robust standard errors (White 1980).
* significant at 10% level, ** significant at 5% level, ***significant at 1% level (two-tailed test).
All equations include interaction of year dummies with industry dummies.
Source: Author's calculations.

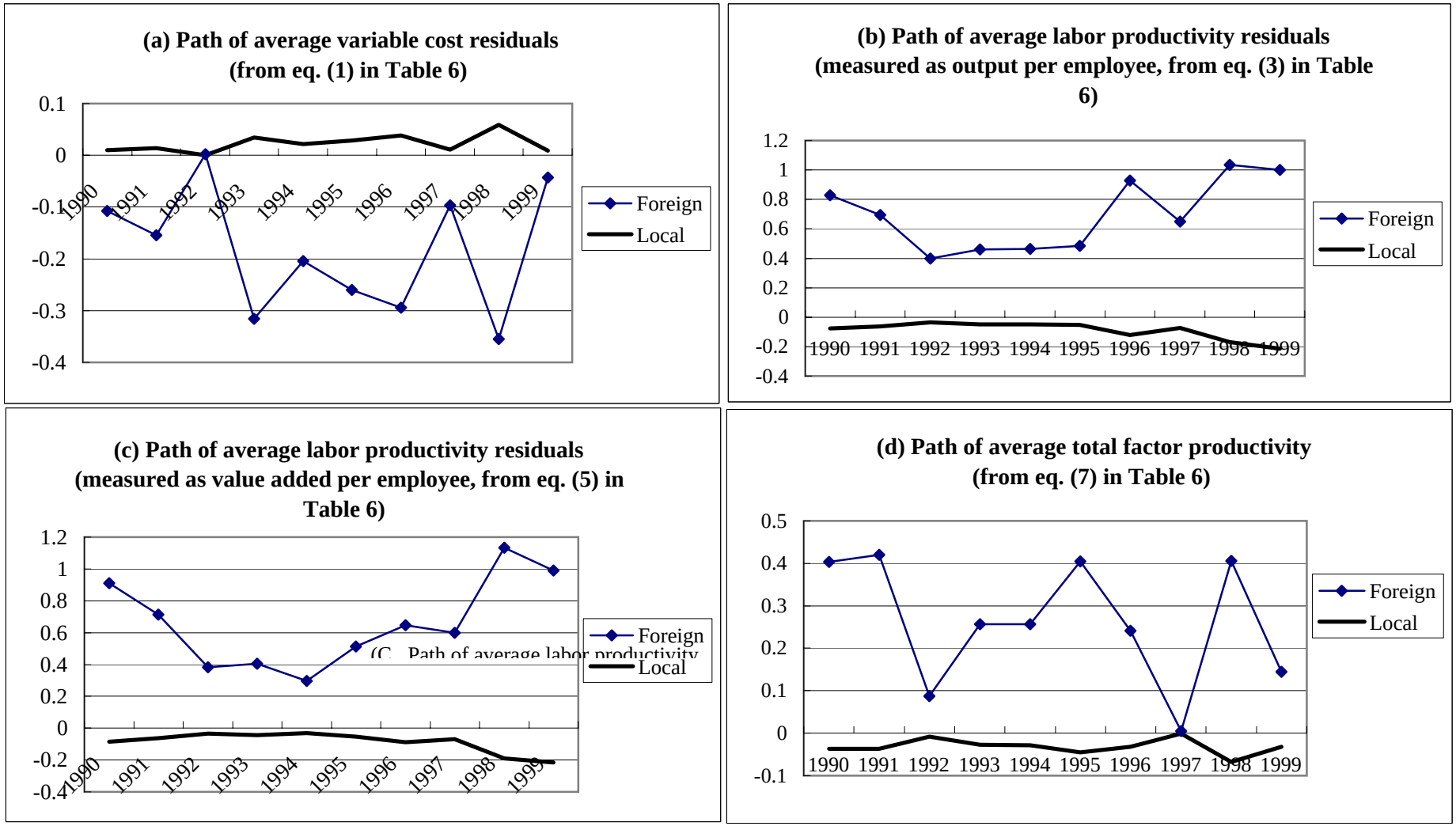

Figure 2. Path of Productivity Residual

Source: Author's calculations based on equations (1), (3), (5), and (7) in Table 6.

Table 7. Estimation Results

Variable Cost Fuctions				
Parameter	Estimate	Std. Error	z	
A0	27.211	21.634	1.26	
AT	-0.612	0.459	-1.33	
AL	0.387	0.196	1.98	**
AY	1.538	0.369	4.17	***
AK	-0.563	0.342	-1.65	*
ALT	0.005	0.002	2.56	**
AYT	-0.013	0.004	-3.59	***
AKT	0.009	0.004	2.41	**
ALL	0.078	0.008	10.34	***
AYL	-0.097	0.004	-22.8	***
AKL	0.042	0.004	10.61	***
AYY	0.088	0.011	8.24	***
AYK	-0.029	0.008	-3.77	***
AKK	0.001	0.008	0.09	
ATT	0.007	0.005	1.49	
DF (intercept dummy)	-0.076	0.534	-0.14	
DFL (Slope dummy with labor)	0.106	0.018	5.94	***
DFY (Slope dummy with output)	-0.175	0.034	-5.19	***
DFK (Slope dummy with capital stock)	0.143	0.035	4.02	***
Dcrisis (intercept dummy)	-0.077	0.058	-1.33	
No. of obs.	1085			
R-squared	0.9451			
R-squared for labor share function	0.3318			

* significant at 10% level, ** significant at 5% level, ***significant at 1% level (two-tailed test).

Source: Author's calculations.

Table 8. Variable Cost Elasticities

(a) All establishments

Year	Output (E_{Yt})	Capital (E_{Kt})	Time (E_{Tt})	Scale Effect ($1/E_{Yt}$)
1990	0.9359	-0.0485	-0.0140	1.0684
1991	0.9232	-0.0435	-0.0045	1.0831
1992	0.8900	-0.0286	0.0060	1.1236
1993	0.8831	-0.0218	0.0126	1.1323
1994	0.8862	-0.0200	0.0187	1.1284
1995	0.8767	-0.0151	0.0271	1.1406
1996	0.8479	-0.0014	0.0368	1.1794
1997	0.8558	-0.0013	0.0417	1.1685
1998	0.8560	-0.0047	0.0553	1.1682
1999	0.8414	0.0078	0.0614	1.1886
Average	0.8796	-0.0177	0.0241	1.1368

(b) Foreign establishments

Year	Output (E_{Yt})	Capital (E_{Kt})	Time (E_{Tt})	Scale Effect ($1/E_{Yt}$)
1990	0.8748	0.0371	-0.0263	1.1431
1991	0.8692	0.0404	-0.0179	1.1505
1992	0.8063	0.0644	-0.0025	1.2403
1993	0.8199	0.0627	0.0022	1.2197
1994	0.8269	0.0646	0.0068	1.2094
1995	0.8029	0.0752	0.0162	1.2455
1996	0.7891	0.0766	0.0278	1.2673
1997	0.7743	0.0850	0.0359	1.2914
1998	0.7965	0.0741	0.0452	1.2555
1999	0.7570	0.0949	0.0539	1.3211
Average	0.8117	0.0675	0.0141	1.2320

(c) Local establishments

Year	Output (E_{Yt})	Capital (E_{Kt})	Time (E_{Tt})	Scale Effect ($1/E_{Yt}$)
1990	0.9418	-0.0566	-0.0128	1.0618
1991	0.9282	-0.0512	-0.0033	1.0773
1992	0.8981	-0.0376	0.0068	1.1134
1993	0.8901	-0.0312	0.0138	1.1234
1994	0.8929	-0.0295	0.0200	1.1200
1995	0.8854	-0.0257	0.0284	1.1295
1996	0.8560	-0.0122	0.0381	1.1682
1997	0.8656	-0.0116	0.0424	1.1553
1998	0.8662	-0.0183	0.0571	1.1544
1999	0.8611	-0.0125	0.0631	1.1614
Average	0.8885	-0.0286	0.0254	1.1254

Source: Author's calculations based on estimation results in Table 7.

Table 9. Decomposition of TFP Growth: 1990 - 1999

(a) All establishments

Year	No. of obs.	Scale effect	Capital effect	Technological change	TFP
1990-91	91	-0.965	-0.840	0.009	-1.796
1991-92	93	-3.579	-1.065	0.000	-4.644
1992-93	102	1.784	-0.738	-0.009	1.037
1993-94	108	2.390	-0.774	-0.015	1.601
1994-95	105	1.265	-2.275	-0.022	-1.032
1995-96	96	0.269	-3.121	-0.029	-2.881
1996-97	118	5.308	-0.097	-0.033	5.178
1997-98	98	-38.007	-10.892	-0.025	-48.924
1998-99	104	17.005	-10.225	-0.022	6.758
Average annual growth rate					
1990-96		0.194	-1.469	-0.011	-1.286
1996-99		-5.232	-7.071	-0.027	-12.329
1990-99		-1.615	-3.336	-0.016	-4.967

(b) Foreign establishments

Year	No. of obs.	Scale effect	Capital effect	Technological change	TFP
1990-91	8	-1.735	-0.744	0.024	-2.456
1991-92	8	-15.053	-0.713	0.011	-15.755
1992-93	9	5.428	-0.772	0.000	4.656
1993-94	11	4.757	0.446	-0.004	5.199
1994-95	11	1.293	-4.505	-0.011	-3.222
1995-96	10	4.295	-14.207	-0.020	-9.932
1996-97	13	-1.795	-1.188	-0.026	-3.009
1997-98	12	-28.416	0.145	-0.021	-28.291
1998-99	15	-11.847	12.660	-0.022	0.791
Average annual growth rate					
1990-96		-0.169	-3.416	0.000	-3.585
1996-99		-14.019	3.873	-0.023	-10.170
1990-99		-4.786	-0.986	-0.008	-5.780

(c) Local establishments

Year	No. of obs.	Scale effect	Capital effect	Technological change	TFP
1990-91	83	-1.103	-2.634	0.007	-3.730
1991-92	85	-3.373	-1.315	-0.001	-4.689
1992-93	92	0.535	-0.294	-0.009	0.232
1993-94	97	2.099	-0.789	-0.016	1.293
1994-95	94	0.993	-1.980	-0.023	-1.010
1995-96	85	-1.730	-1.684	-0.030	-3.444
1996-97	105	7.482	-0.913	-0.034	6.535
1997-98	85	-46.995	-5.768	-0.025	-52.788
1998-99	87	13.058	-6.285	-0.016	6.757
Average annual growth rate					
1990-96		-0.430	-1.449	-0.012	-1.891
1996-99		-8.818	-4.322	-0.025	-13.166
1990-99		-3.226	-2.407	-0.016	-5.649

Source: Author's calculations based on estimation results in Table 7.

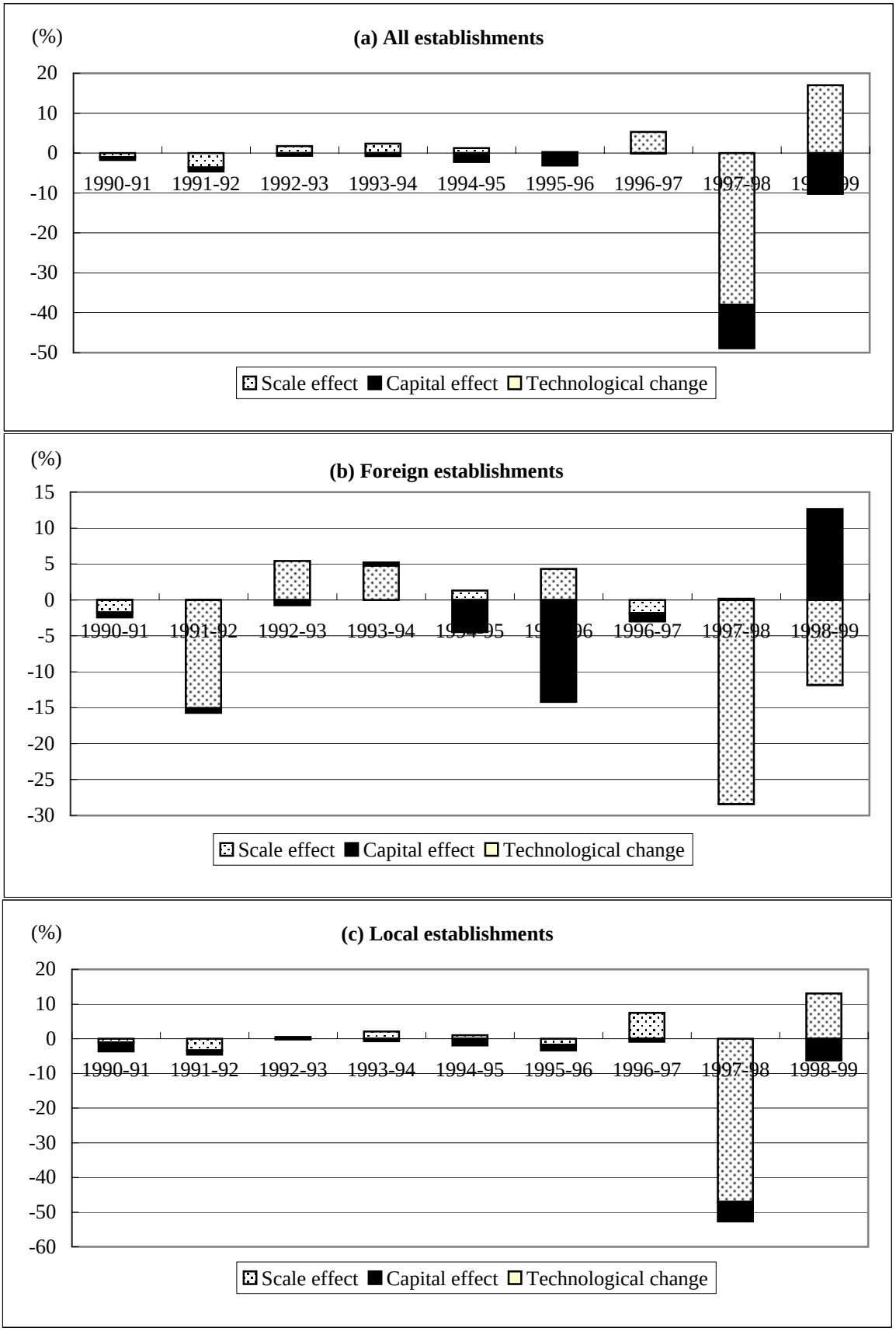

Figure 3. Decomposition of TFP Growth

Source: Author's calculations based on estimation results in Table 7.

Appendix Table 1. Entry and Exit Flows in the Dataset

	1990-1995			1995-1997			1997-1999		
No. of establishments (in which foreign-owned establishments)									
Motor vehicles (38431/34100)[a]									
Continuing	7	(3)		4	(2)		5	(3)	
Newly entered[e]	0	(0)		2	(1)		0	(0)	
in which Newly established	*0*	*(0)*		*1*	*(0)*		*0*	*(0)*	
Exit[f]	0	(0)		3	(1)		1	(0)	
Motor vehicle bodies (38432/34200)[a]									
Continuing	50	(0)		47	(0)		38	(1)	
Newly entered[e]	9	(0)		9	(0)		1	(0)	
in which Newly established	*5*	*(0)*		*7*	*(0)*		*0*	*(0)*	
Exit[f]	4	(0)		12	(0)		18	(0)	
Motor vehicle component & apparatus (38433/34300)[a]									
Continuing	33	(6)		37	(7)		62	(10)	
Newly entered[e]	10	(2)		29	(4)		13	(7)	
in which Newly established	*6*	*(1)*		*22*	*(4)*		*13*	*(7)*	
Exit[f]	1	(0)		6	(2)		4	(1)	

Note: [a] Industrial classification code for BPS, *Statistik Industri* (BPS various years).
The industry code was changed in 1998.
Ownership information for exiting establishments is based on the foreign ownership share in the initial year in the period, while for operating and newly-entered establishments it is based on the foreign ownership share in the last year of the period.

Source: Author's calculations based on BPS, establishment-level data (BPS various years).

Appendix Table 2. Descriptive Statistics of the Sample of Establishments

--- Motor vehicles total (simple average) ---

	Motor vehicles total (3843/34), full sample		
	1990	*1995*	*1999*
Number. of establishments	*95*	*111*	*119*
Number of employees per establishment	239	303	217
Output per establishment[a]	26,600	43,500	25,500
Value added per establishment[a]	16,500	20,800	16,500
Capital stock per establishment[a]	3,973	8,749	15,000
Years in operation	10.3	14.7	12.6
Productivity measures			
Average variable cost[b]	0.64	0.67	0.62
Output per employee[a]	47.5	55.5	57.8
Value added per employee[a]	24.2	18.4	38.1
Capital-labor ratio[a]	25.4	28.1	69.8
Share of non-production workers (%)	17.4	19.6	21.8
Inventory Ratios			
Total inventory (%)	n.a.	23.4	32.6
Final goods inventory (%)	n.a.	5.1	6.7
Work-in-process inventory (%)	n.a.	6.0	7.2
Raw materials inventory (%)	n.a.	14.8	22.6
Other indicators			
Production worker wages[c]	2,301	2,619	2,745
Non-production worker wages[c]	5,416	5,726	12,717
Price-cost margin (%)	35.2	33.8	32.1
Export share in output (%)	0.7	2.0	6.9
Import ratio (%)	22.0	22.5	28.5

(continued)

Appendix Table 2. (continued)

	Motor vehicles total (3843/34), large establishments		
	1990	*1995*	*1999*
Number. of establishments	*48*	*56*	*60*
Number of employees per establishment	407	539	369
Output per establishment[a]	52,000	85,800	50,200
Value added per establishment[a]	32,300	41,000	32,400
Capital stock per establishment[a]	6,349	15,900	27,800
Years in operation	10.5	14.1	12.7
Productivity measures			
Average variable cost[b]	0.55	0.62	0.54
Output per employee[a]	84.2	101.9	107.7
Value added per employee[a]	43.9	32.8	71.6
Capital-labor ratio[a]	18.6	27.1	111.4
Share of non-production workers (%)	20.4	21.6	22.7
Inventory Ratios			
Total inventory (%)	n.a.	24.5	28.5
Final goods inventory (%)	n.a.	8.0	4.3
Work-in-process inventory (%)	n.a.	3.8	3.4
Raw materials inventory (%)	n.a.	13.6	24.4
Other indicators			
Production worker wages[c]	3,118	3,769	3,996
Non-production worker wages[c]	7,863	8,816	21,732
Price-cost margin (%)	43.0	38.5	37.3
Export share in output (%)	0.0	4.0	13.7
Import ratio (%)	36.7	37.7	46.3

[a]In 1993 Mil. Rp. For price deflators, see Appendix A.

[b]Average cost is defined as the sum of labor and intermediate input costs divided by output.

[c]In 1993 1,000 Rp. For price deflators, see Appendix A.

Note: 1) Some of the observations were not included because of missing values or recording mistakes.
2) The t-tests are performed based on the assumption of unequal variances.
3) * significant at 10% level, ** significant at 5% level, *** significant at 1% level (two-tailed test).
4) n.a. - not available.
5) "Large establishments" are defined as the largest 50% of establishments sorted by output each year.

Source: Author's calculations based on BPS, establishment-level data (BPS various years).

Appendix Table 3. Descriptive Statistics of the Sample of Establishments by Ownership in the Motor Vehicle Industries (Simple Average) --- Large Establishments ---

	Motor vehicles total (3843/34), large establishments														
	1990-96 pooled			*1990*			*1995*			*1999*					
	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Domestic -owned	Foreign- owned	T-test	Ratio of foreign to domestic 1990-96	1990	1995	1999
No. of observations	*317*	*74*		*40*	*8*		*45*	*11*		*39*	*21*					
No. of employees	385	809	***	341	738		447	916		256	579	*	2.1	1.8	1.6	2.1
Output per establishment[a]	25,507	203,725	***	13,637	244,026		36,706	286,572		14,836	115,803		8.0	8.1	4.7	6.5
Value added per establishment[a]	9,412	125,021	***	7,779	155,106		8,736	173,188		9,660	74,679		13.3	7.0	9.4	6.1
Capital stock per establishment[a]	8,005	34,869	***	4,865	13,768		10,085	39,787		19,073	44,024	*	4.4	2.1	1.9	2.7
Years in operation	11.7	12.7		10.4	11.0		14.0	14.8		13.7	10.7		1.1	1.0	1.0	0.7
Average variable cost[b]	0.62	0.51	***	0.57	0.43		0.65	0.53		0.46	0.69		0.8	0.7	0.8	1.5
Output /employee[a]	75.0	151.5	***	63.4	188.4	*	85.4	169.3		61.3	193.8	*	2.0	2.5	2.5	5.0
Value added / employee[a]	29.3	76.5	***	30.6	110.3	*	21.6	78.9		39.7	130.9	*	2.6	2.8	4.0	5.3
Capital-labor ratio[a]	23.2	50.4	**	18.1	21.3		24.3	38.8		87.7	155.5		2.2	1.0	1.1	2.8
Share of non-production workers (%)	22.2	24.8		20.0	22.7		20.9	24.7		21.2	25.5		1.1	1.2	1.2	1.3
Total inventory (%)[c]	22.1	27.8		n.a.	n.a.		18.5	16.7		14.8	11.6		1.3	n.a.	0.9	0.8
Final goods inventory (%)[c]	3.7	4.8		n.a.	n.a.		4.0	3.8		2.6	2.4		1.3	n.a.	1.0	0.9
Work-in-process inventory (%)[c]	4.0	4.1		n.a.	n.a.		2.4	0.8	**	2.7	1.0	**	1.0	n.a.	0.3	0.4
Raw materials inventory (%)[c]	15.2	18.7		n.a.	n.a.		10.1	7.8		17.0	6.9		1.2	n.a.	0.8	0.4
Production worker wages[d]	3,212	5,126	***	2,739	5,015	**	3,252	5,885	*	2,300	7,146	**	1.6	2.2	2.2	4.1
Non-production worker wages[d]	7,669	10,658	***	6,761	13,369	**	8,515	10,047		11,033	41,600		1.4	2.3	1.0	6.1
Export share in output (%)	3.3	3.2		0.0	0.1		5.0	0.0	**	7.4	25.2	*	n.a.	n.a.	n.a.	5.1
Import ratio (%)	32.1	62.4	***	31.7	61.3	*	32.6	58.5	*	37.7	61.7	**	1.9	1.7	1.5	2.0

[a]In 1993 Mil. Rp. For price deflators, see Appendix A.

[b]Average cost is defined as the sum of labor and intermediate input costs divided by output.

[c]Inventory data are not available for 1990 and 1991.

[d]In 1993 1,000 Rp. For price deflators, see Appendix A.

Note: 1) Some of the observations were not included because of missing values or recording mistakes.

2) The t-tests are performed based on the assumption of unequal variances.

3) * significant at 10% level, ** significant at 5% level, *** significant at 1% level (two-tailed test).

4) n.a. - not available.

5) "Large establishments" are defined as the largest 50% of establishments sorted by output each year.

Source: Author's calculations based on BPS, establishment-level data (BPS various years).