Globalization, Productivity Changes, and Missing Middle in Indonesia's Manufacturing Sectors

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Abstract

This paper analyzes the productivity growth, technical efficiency, and technological changes in Indonesia's manufacturing sector. Using establishment-level industrial census, I showed the details of the productivity change, innovation, and catch-up performances of four sectors—apparel, general machinery, electric machinery, and motor vehicles. Then I identified the factors affecting the firms' performance. The results showed that globalization matters for mainly large enterprises in the electrical machinery and motor vehicle industries while medium-sized enterprises are not deeply affected by trade and investment liberalization.

JEL Classification: C14; O12; O3
Keywords: Productivity, Technical efficiency, Medium-sized enterprises

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INTRODUCTION

Although the relationship between small and medium-sized enterprises (SMEs) and economic growth is not obvious,[1] many industries in developing countries are SMEs, and the importance of SME policies has long been discussed. Among the proSME arguments are that SMEs are generally more productive than large firms, but the financial market for them is inadequate, which hampers their development. If this view is correct, enhancing competition and/or boosting entrepreneurship policies should benefit SMEs' productivity growth and efforts to innovate and catch up. SMEs, however, have been sluggish in many developing countries, and they have never been a driving force historically.

As Beck (2003) summarized, a growing body of microeconomic evidence does not support the view that SMEs are important in job creation and that they are more innovative than large enterprises. The latter view is consistent with the evidence in international trade literature that addresses the importance of openness to the world market for technology transfer. In other words, countries that are open to international trade tend to have larger firms than countries that are less open to the world market.

Economic theory advocates that market failure is the main economic reason for government intervention. Behind this rationale, there is the view that greater competitiveness leads to more efficient market structures. However, this "perfect competition" view is not observed even in developed countries. Therefore, sources of SME efficiency are particularly important for SME policy arguments.

Thus far, there is no concrete consensus on the relationship between SMEs and productivity. This paper analyzes the structure of SMEs in Indonesia's apparel, general machinery, electrical machinery, and motor vehicle industries in terms of productivity, innovativeness, and their catching-up processes. The study also shows the characteristics of firms in each sector in terms of ownership structure and degree of competition. Investigation of SMEs in four Indonesian manufacturing industries is the first purpose of the study while the second is to determine the productivity and innovation activities these SMEs undertake.

As mentioned above, SMEs, in general, have weak connections to the world market, so technical progress through technology transfer hardly happens in SMEs. This view is now becoming common among international economists. To test this hypothesis, I estimated the impact of international trade on productivity growth, technical change, and technical efficiency.

The remainder of the paper is organized as follows. I present the structure of the data and methodology used here in Section 1. Section 2 describes in greater detail the productivity growth, innovativeness, and catching-up effects in the apparel, general machinery, electric machinery, and motor vehicle industries. I also discuss the results of productivity growth in Section 2. Section 3 presents the empirical results and discusses what causes productivity growth and technical efficiency. Section 4 concludes. The detailed methodology is described in the appendix.

1. DATA AND METHODOLOGY

1.1 Data

The Indonesian economy has been sluggish since the Asian Crisis of 1997 and has not recovered to precrisis levels since then. The Asian Crisis had a severe impact on not only SMEs but also on large enterprises, including foreign companies. In Indonesia, more than 95 percent of businesses with less than five employees are microenterprises while SMEs account for 4.3 percent of the total economy.[2] This is a typical example of the "missing middle." As Harvie (2004) noted, this contrasts with the more developed economies where medium-sized enterprises contribute significantly to employment and are a major source of high growth. This is partly the reason why the promotion of SMEs is thought to be indispensable for economic growth in developing countries.

Indonesian manufacturing censuses have been compiled and provided by the Bureau of Statistics Indonesia. Although long series of Indonesian manufacturing censuses is available, the common identifier after 2001 exists only in years 2002 and 2003. In other words, panel data are available from 2002 to 2003. Since I am interested in productivity and efficiency *changes,* not the level of them, in this study, I made and used a panel data set from these two successive years.[3]

Unfortunately, however, the census does not provide information on enterprises with less than 20 employees, so this study deals with medium- (between 20 and 99 employees) and large-sized (more than or equal to 100 employees) establishments. I will use "ME" as an abbreviation for medium-sized enterprise hereafter. Table 1 shows the share of ME and the market concentration of the top four firms in each industry. Reflecting the "missing middle," the shares of ME both in terms of output and employment are small.

Apparel industry has a relatively low concentration ratio, 13.3 percent, which indicates that the market is more competitive than other industries. It can be inferred that small (less than 20 employees) enterprises are dominant in this industry. The motor vehicle industry has the highest concentration ratio of 46.8 percent among the four industries. A few large enterprises consisting mainly of car assemblers dominate the market. Reflecting the high concentration, the shares of MEs are lowest among the four industries. On the other hand, the general machinery industry has a relatively high ME share of more than 20 percent both in terms of output and employment. The top four output concentration ratio is 40.27 percent in general machinery, which is the second highest in the sample industries.

1.2 Methodology

There are roughly two ways to calculate total factor productivity (TFP).[4] These are the nonfrontier and the frontier approaches. A typical method in nonfrontier approaches is the growth accounting method, including a Solow residual. In growth accounting TFP, there are no restrictions of profit maximization, perfect competition, or other optimality conditions on estimation. However, information about input factor shares is needed. This information is very difficult to obtain especially in developing countries.

On the other hand, frontier approaches estimate the “best practice” or “benchmarking performance” among decision making units (DMUs). The two ways to measure a “best practice” are through the data envelopment approach (DEA) and the stochastic frontier approach (SFA)[5] Assuming the existence of technical inefficiency for each DMU, the frontier approach provides a better methodology for benchmarking economic performance. DEA is a nonparametric method that does not need to assume any functional forms while SFA is a parametric method requiring one functional form for estimating a best practice.[6] DEA rather than SFA is used in this study since only a two-year (strongly balanced) panel data set is available, and this is too short to estimate reliable coefficients on production functions. DEA makes it possible to decompose TFP growth into efficiency change and technical change.[7]

1.3 Characteristics of Industries

To calculate the frontier in DEA, I used each establishment's value-added as output and labor and capital as inputs. Table 2 shows the growth rates of each variable from 2002 to 2003 for four industries by size of establishments. In the samples, the apparel industry absorbs more employees than the general machinery, electrical machinery, and motor vehicle industries. There are also more medium-sized firms than large-sized firms in the apparel and machinery industries. On the other hand, in the electrical machinery and motor vehicle industries, the number of large-sized firms is greater than that of medium-sized firms.[8] In the apparel industry, the growth rates of value-added in both medium- and large-sized firms are almost same (5.5 percent and 5.6 percent, respectively) while the growth rates of labor and capital are negative for both medium- and large-sized firms. This indicates that there must have been productivity progress from 2002 to 2003. Medium-sized firms in the general machinery industry have positive growth rates for value-added and labor but negative growth rates in capital. In the electrical machinery industry, the growth rates of value-added and capital were negative no matter how large the firms are. Negative growth rates in capital suggest the severe negative impact of the 1997 Asian Crisis. In fact, the Indonesian economy did not begin to recover from the crisis until after 2005. The growth rates of value-added and capital in the motor vehicle industry are relatively high. The growth rate of value-added in large-sized firms may largely be explained by capital investment rather than productivity improvement.

Table 3 shows the firms' status, such as trade and ownership structure, by industry. It is interesting to note that almost all of the medium-sized firms are national private while more than 45 percent of large-sized general and electrical machinery firms are foreign. Central or local government firms are very rare in Indonesia.

2. PRODUCTIVITY CHANGE, INNOVATION, AND CATCHING-UP

The DEA method makes it possible to decompose TFP into efficiency change and technical change. The DEA results are reported in Table 4. TFP is measured using Malmquist production index in DEA panel data analysis. The details of DEA, Malmquist production index, and its decomposition are in the appendix. Values in TFP growth imply that medium-sized apparel firms, for example, grew 0.8 percent (1.008-1.000) from 2002 to 2003. The productivity of medium-sized firms in the apparel, general machinery, and motor vehicle industries improved from 2002 to 2003. On the other hand, the productivity of large-sized firms in the general machinery and motor vehicle industries deteriorated during the same period.

Malmquist TFP growth index can be decomposed into efficiency change and technical change. TFP is the product of efficiency change and technical change. Values in efficiency and technical changes imply that exceeding unity means improvement in efficiency and/or technical change. Table 4 shows that medium- and large-sized apparel firms improved TFP by 0.8 percent and 0.4 percent, respectively, which is due to improvements in efficiency. Technical change in the apparel industry actually shows negative growth because the values in technical change are less than unity. There is a sharp contrast between medium- and large-sized firms in the machinery industry.

Medium-sized firms have a positive TFP growth on average, which is due to a positive efficiency change while large-sized firms have a negative TFP growth on average, which is due to a negative efficiency change. Medium-sized firms in the electrical machinery industry have a negative TFP growth on average, which can be attributed to the deterioration of efficiency. A positive TFP growth of 0.6 percent per annum in medium-sized firms in the motor vehicle industry is due mainly to the improvement in technical change.

The rate of change in efficiency indicates that the firm's performance is moving toward the best practice, namely, the frontier. In this sense, this improvement can be recognized as the process of "catching-up" or "diffusion of technology." On the other hand, the technical change component of productivity growth captures shifts in the frontier of technology, providing a natural measure of "innovation." The catching-up process (positive efficiency change) can be observed in medium- and large-sized firms in the apparel industry, medium-sized firms in general machinery, and large-sized firms in electric machinery. On the other hand, innovation can be seen in large firms in general machinery, medium-sized firms in electrical machinery, and medium-sized firms in the motor vehicle industry.

Technical change can be further decomposed into two parts: pure efficiency change and scale change. The derivation of this decomposition is found in the appendix.

The result of decomposition of productivity growth of medium-sized firms by TFP level is in Table 5. As expected, industries with higher TFP also have higher efficiency change and higher technical change. However, the degree of the contribution of each factor (efficiency or technical change) varies across industries. For example, the high TFP growth in the apparel industry with higher TFP is attributed more to catching-up or efficiency change while the high TFP growth in electrical machinery is due to innovation or technical change.

Figures 1 to 4 plot the medium-sized firms' performance in TFP growth, efficiency change, and technical change by industry. The horizontal axis stands for each firm's TFP in ascending order. Figure 1 shows the case of the apparel industry. It clearly indicates that TFP growth for almost every firm came from innovation rather than catching-up. Figure 2 shows the trend in the general machinery industry. It is clear from the figure that efficiency changes, i.e., the catching-up effect, exceeds the TFP growth trend. Generally speaking, TFP growth in the general machinery industry is led by the catching-up effect rather than the innovation effect. In Figure 3 of the electrical machinery industry, TFP growth and efficiency changes exhibit a common trend, which indicates that most of the low TFP growth rate (TFP less than unity) is due to low catching-up effect. In other words, the catching-up effect influences the TFP growth of many medium-sized firms negatively in poorer performance firms. TFP growth of high performance firms in the electrical machinery industry is led by both innovation and catching-up effects. Figure 4 plots the TFP growth and two other effects in the motor vehicle industry, indicating that the innovation effect is stronger in firms with relatively lower TFP growth while the catching-up effect is stronger in firms with relatively higher TFP growth.

3. WHAT DETERMINES THE FIRM'S PERFORMANCE?

Table 6 presents the ranking of TFP by each industry, the firms' international activities and ownership structure, and their TFP growth. In the apparel industry, all firms in the top and bottom 10 are national private and do not import. It is also clear that the ranking of TFP growth follows the ranking of efficiency change, namely, the catching-up effect.

In the machinery industry, firms with higher TFP ranking tend to have high efficiency change. In other words, the catching-up effect prevails in high-rank TFP firms. On the other hand, firms with the low TFP ranking tend to have low catching-up as well as low innovation effects. There seems to be no difference between firms with high and low TFP ranking in terms of trade and ownership structures. Foreign firms are included among those with higher and lower TFP rankings, and there is no clear evidence that foreign firms are more productive than local firms.

In the electrical machinery industry, innovation (technical change) is very high in both higher- and lower-ranking firms; hence, only the catching-up effect explains the level of TFP growth in this industry.

The ranking in the motor vehicle industry is interesting because it shows that firms with higher TFP growth are likely to have a relatively high innovation effect while the catching-up effect mainly explains the level of TFP growth.

Foreign factors including international trade and foreign direct investment (FDI) affect industry growth in many ways. Importing intermediate goods gives knowledge about new technology while import competition improves domestic market distortions. On the other hand, competition may drive inefficient local firms out of the market, producing temporary unemployment. As for the effects of export, there is no clear evidence that export improves productivity. Empirical results suggest that efficient firms export, but not vice versa. FDI has many channels to improve local firms' productivity. The spillover effect of technology transfer is most important especially for developing countries. However, a growing body of empirical studies suggests that the spillover effect may not exist between a developed country's FDI and a developing country's local firms. Other important effects of FDI include an expanding demand for local firms through the creation of backward linkages and jobs. Foreign firms subcontract part of their production to local firms. However, foreign firms usually subcontract either to large local firms only or to subcontractors from the foreign firm's country. The last effect of FDI is that it drives inefficient, usually small- or medium-sized firms, out of the market. This makes the market more productive by enabling only the more efficient firms to survive. On the downside, this also causes frictional unemployment in which case the government should pay adjustment costs, such as education or training schemes for the unemployed.

The next question to be asked about the productivity of medium-sized enterprises is what factors determine the level of TFP growth. Table 7 reports the summary of regression results. Only estimated coefficients of the regression are reported. The regression equation used is as follows:

$$TFP_{it} = \beta_0 + \beta_1 Export_{it} + \beta_2 Import_{it} + \beta_4 Foreign_{it} + \varepsilon_{it},$$

where *TFP* stands for TFP growth rate; *Export* and *Import* are independent variables expressing the exporting and importing activities of a firm *i* at time *t*; and *Foreign* means a firm with more than 50 percent foreign shareholders for firm *i* and time *t*. The variable ε_{it} is the error term that satisfies ordinary conditions. Dependent variables include TFP growth, efficiency change, and technical change. The independent variable *Export* is measured 0-1, i.e., taking 1 if they export, 0 otherwise. The other independent variables, *Import* and *Foreign,* are also binary variables.

The results of the regression exercise can be summarized as follows:

1. Export and foreign ownership positively affect TFP and efficiency change only in large firms.
2. Import affects technical change in both medium- and large-sized firms in the apparel industry. However, the coefficients are very small.
3. Globalization can have a positive impact only on large-sized firms.

4. CONCLUSION AND GENERAL LESSONS

This paper examined the productivity growth of firms in Indonesia's apparel, machinery, electrical machinery, and motor vehicle industries in the period following the Asian Crisis of 1997. The main findings are that TFP growth in the apparel and machinery industries is determined mainly by catching-up effects while innovation does the same for the electrical machinery and motor vehicle industries. However, the liberalization of trade and investment has limited impact on TFP growth as well as on efficiency and technical changes. Trade and investment liberalization exerts an impact only on large-sized firms in the electrical machinery and motor vehicle industries. While importing materials affects technical change (innovation) in medium-sized apparel firms, the effect is very small.

Indonesian SMEs (and perhaps SMEs in many Asian developing countries as well) can be characterized as having a "missing middle," as "rarely exporting nor importing," and as operating under "local ownership." A growing body of empirical studies suggests that positive effects of globalization, including FDI, occur basically only for large-sized firms, not for SMEs. Based on this observation and the empirical results obtained from the study, the findings can be distilled thus: Catching-up effects dominate in the apparel and machinery industries while the innovation effect dominates in the electrical machinery and motor vehicle industries. This study recommends that the apparel and machinery industries improve efficiency by introducing quality control (QC) and providing appropriate training to workers. For the electrical machinery and motor vehicle industries, there is a need to promote research and development (R&D) and industry-university cooperation.

Because trade and investment liberalization impacts only large-sized firms, it is necessary for the government to pay the adjustment costs of globalization for dropped-out SMEs in order to restructure the economy.

Appendix

The frontier (either parametric or nonparametric) approach provides a better methodology for benchmarking economic performance because it shows both technical efficiency and technical progress. This appendix briefly explains the idea of the nonparametric frontier approach, that is, the data envelopment approach (DEA) to estimate total factor productivity (TFP). There are two methods to estimate TFP in the frontier approach. One is DEA and the other is the stochastic frontier approach (SFA). SFA is based on the parametric method while the DEA is not. Hence, SFA makes it possible to test the estimation results with statistical significance. However, while the SFA must assume some specific functional forms for estimating production (or cost) function, DEA does not need to. DEA's being completely free of specifications of functional forms is one of its attractive features.

The linear programming problem for DEA is described as follows:

$$\begin{aligned}&\min_{\theta,\lambda} \theta\\ &st\ -y_{it} + Y\lambda \geq 0,\\ &\theta x_{it} - X\lambda \geq 0,\\ &\lambda \geq 0\end{aligned}$$

Where X is K by 1 vector of inputs, Y is M by 1 vector of outputs, y_{it} is the output of i-th and t-period decision making unit (DMU). A θ is a scalar and λ is a N by 1 vector of constants. A θ must satisfy $\theta \leq 1$ and $\theta \leq 1$ indicates a point on the frontier and the DMU producing a good at a technically efficient level. A distance function $D(x, y)$

can be calculated from this linear programming.

The output distance function is defined as

$$D_t(x_t, y_t) = \inf\{\theta : (x_t, y_t/\theta) \in S_t\},$$

where S_t is the production technology set of inputs $x_t \in \Re_+^K$ and of output $y_t \in \Re_+^M$
The output-based Malmquist productivity change index is defined as

$$M(x_{t+1}, y_{t+1}, x_t, y_t) = \left[\left(\frac{D_t(x_{t+1}, y_{t+1})}{D_t(x_t, y_t)} \right) \left(\frac{D_{t+1}(x_{t+1}, y_{t+1})}{D_{t+1}(x_t, y_t)} \right) \right]^{1/2}.$$

Following Fare et al. (1994), the index can be decomposed into two parts:

$$M(x_{t+1}, y_{t+1}, x_t, y_t) = \frac{D_{t+1}(x_{t+1}, y_{t+1})}{D_t(x_t, y_t)} \left[\left(\frac{D_t(x_{t+1}, y_{t+1})}{D_{t+1}(x_{t+1}, y_{t+1})} \right) \left(\frac{D_t(x_t, y_t)}{D_{t+1}(x_t, y_t)} \right) \right]^{1/2}.$$

The first term of the product on the right-hand side indicates the "efficiency change" and the second term (squire bracket) is "technical change" between time *t* and time *t+1*. In the extreme case, for example, if there is no change in inputs and output between the periods, i.e., $x_t = x_{t+1}$ and $y_t = y_{t+1}$, Malmquist index equals 1. In other words, if the Malmquist index is different from unity, productivity must have changed between the observed periods. If the index is greater than 1, the firm's productivity is regarded as having "increased" while if it is less than 1, one can say that productivity has declined from time *t* to time *t+1*. Hence, the Malmquist TFP index is the product of efficiency change and technical change, i.e., $TFP = te \times tc$.

The first term "efficiency" can be broken into two components, i.e., "pure efficiency change" and "scale change." To derive "scale change," an additional restriction (convexity constraint) is placed on the linear programming of distance functions.

$$\begin{aligned}
&\min_{\theta,\lambda} \theta \\
&st \; -y_{it} + Y\lambda \geq 0, \\
&\theta x_{it} - X\lambda \geq 0, \\
&N'\lambda = 1 \\
&\lambda \geq 0
\end{aligned}$$

N is an N by 1 vector of ones. The scale inefficiency can be calculated from the difference between the variable returns to scale technical efficiency and the constant returns to scale technical efficiency scores. The relationship among a pure technical efficiency, scale efficiency, and technical efficiency is as follows:

$$te = pte \times se$$

Where *te* stand for technical efficiency, *pte* expresses pure technical efficiency, and *se* indicates scale efficiency, respectively. Combining this decomposition together with the decomposition of TFP defined above, we finally have the following decomposition formula:

$$TFP = te \times tc = pte \times se \times tc\ .$$

This is the decomposition formula used in this text. A *te* expresses overall inefficiency caused by the technical inefficient operation (*pte*) and at the same time by the disadvantageous scale condition (*se*). More detailed discussion about scale (in)efficiency is found in Cooper et al. (2006).

[1] Beck et al. (2003) found that SMEs are associated with growth, but the results are not robust if they control for simultaneity.

[2] See Table 3 in Harvie (2004) and for policy implications of SME in Asia, see Wattanapruttipaisant (2002/2003).

[3] Tambunnan (2008) comprehensively describes Indonesian SMEs in terms of networking and innovativeness.

[4] Total factor productivity is a measure of productivity, considering all explicit input factors while ‘partial’ productivity is a measure that considers only limited input factors such as labor, capital, and son. A simple example of the latter is labor productivity. TFP is superior to partial productivity indexes for precise evaluations of firms’ performance.

[5] Cooper et al. (2006) is an introductory textbook on DEA while Kumbhakar and Lovell (2000) is a detailed textbook for SFA.

[6] Mahadevan (2004) explains the advantages and disadvantages of DEA and SFA.

[7] I use Coelli’s (1996) DEAP version 2.1 for calculating Malmquist index and efficiency measures.

[8] Recall that the data are strongly balanced-panel so that new entry and exit firms are not counted here.

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Table 1: Share of ME and Market Concentration

	Share of ME		Concentration Ratio
2003	Output Share	Employment Share	
Apparel	4.37%	9.33%	13.30%
Genaral Machinery	27.43%	20.45%	40.27%
Electronic Machinery	3.95%	6.25%	37.53%
Motor Vehicles	3.32%	6.11%	46.80%

Note: "Concentration Ratio" is the percentage of the top four establishments' output in the total output of each industry.

Table 2: Growth Rates of Value-added, Labor, and Capital, 2002-2003

		Value Added		Labor		Capital	
	Sample	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Apparel (Medium)	520	0.05660	0.54276	-0.01016	0.21888	-0.03926	0.54648
Apparel (Large)	218	0.05550	0.70398	-0.00282	0.22390	-0.13557	1.05563
General Machinery (Medium)	87	0.07062	0.51837	0.01803	0.13988	-0.05832	0.53048
General Machinery (Large)	53	-0.13294	0.70145	-0.00305	0.10232	-0.05738	0.41724
Electrical Machinery (Medium)	34	-0.01597	0.39077	0.01839	0.09192	0.08834	0.37595
Electrical Machinery (Large)	52	-0.01807	0.55584	0.01301	0.10945	-0.14145	0.97179
Motor Vehicles (Medium)	43	0.04617	0.55436	-0.02140	0.11535	0.11036	0.56887
Motor Vehicles (Large)	56	0.03218	0.47551	0.05196	0.22997	0.20849	0.98126

Source: Author’s calculation from the industrial census of Indonesia 2002 and 2003, Badan Pusat Statistik.

Table 3: Firms' Ownership Structure by Industry in 2003

	Sample	Export	Import	Central Government	Local Government	Natioanl Private	Foreign
Apparel (Medium)	520	92	73	0	13	504	3
Share		17.7%	14.0%	0.0%	2.5%	96.9%	0.6%
Apparel (Large)	218	99	111	0	29	137	52
Share		45.4%	50.9%	0.0%	13.3%	62.8%	23.9%
General Machinery (Medium)	87	8	18	0	3	74	10
Share		9.2%	20.7%	0.0%	3.4%	85.1%	11.5%
General Machinery (Large)	53	8	36	2	7	20	24
Share		15.1%	67.9%	3.8%	13.2%	37.7%	45.3%
Electrical Machinery (Medium)	34	0	11	0	3	29	2
Share		0.0%	32.4%	0.0%	8.8%	85.3%	5.9%
Electrical Machinery (Large)	52	16	36	0	2	26	24
Share		30.8%	69.2%	0.0%	3.8%	50.0%	46.2%
Motor Vehicles (Medium)	43	1	5	0	0	40	3
Share		2.3%	11.6%	0.0%	0.0%	93.0%	7.0%
Motor Vehicles (Large)	56	5	34	0	4	36	16
Share		8.9%	60.7%	0.0%	7.1%	64.3%	28.6%

Source: Author's calculation from the industrial census of Indonesia 2002 and 2003, Badan Pusat Statistik.

Table 4: Decomposition of Productivity Changes by Size

	Sample	TFP	Efficiency Change	Technical Change	Pure Efficiency Change	Scale Change
Apparel (Medium)	520	1.008	1.009	0.999	1.024	0.986
Apparel (Large)	218	1.004	1.017	0.988	1.028	0.989
General Machinery (Medium)	87	1.003	1.030	0.974	1.007	1.023
General Machinery (Large)	53	0.994	0.993	1.001	0.981	1.012
Electrical Machinery (Medium)	34	0.995	0.983	1.012	1.010	0.974
Electrical Machinery (Large)	52	1.000	1.001	0.999	1.000	1.002
Motor Vehicles (Medium)	43	1.006	0.993	1.013	0.992	1.001
Motor Vehicles (Large)	56	0.991	0.993	0.998	0.999	0.994

Note: TFP is measured by Malmquist productivity index. See the text for detailed explanation.

Source: Author's calculation

Table 5: Decomposition of Productivity Changes in Medium-Sized Enterprises by TFP Level

		Sample	TFP	Efficiency Change	Technical Change	Value Added	Labor	Capital
Apparel (Higher)	Mean	284	1.04124	1.04117	1.00017	0.27598	-0.06572	-0.15515
	Standard Deviation		0.04469	0.04559	0.01348	0.51953	0.23258	0.49503
Apparel (Lower)	Mean	236	0.96908	0.97089	0.99824	-0.20740	0.05670	0.10019
	Standard Deviation		0.03396	0.03534	0.00967	0.44431	0.18012	0.57330
General Machinery (Higher)	Mean	54	1.02867	1.05502	0.97513	0.29613	-0.01316	-0.13701
	Standard Deviation		0.02679	0.02872	0.00743	0.42375	0.10694	0.55660
General Machinery (Lower)	Mean	33	0.96336	0.99185	0.97130	-0.29840	0.06907	0.07044
	Standard Deviation		0.02570	0.02563	0.00698	0.44553	0.17122	0.46436
Electrical Machinery (Higher)	Mean	16	1.01488	1.00169	1.01338	0.19993	0.00306	-0.00842
	Standard Deviation		0.00658	0.00815	0.00622	0.25203	0.06761	0.15460
Electrical Machinery (Lower)	Mean	18	0.97817	0.96767	1.01089	-0.20789	0.03202	0.17436
	Standard Deviation		0.02844	0.02768	0.00611	0.39687	0.10931	0.48645
Motor Vehicles (Higher)	Mean	31	1.02587	1.01300	1.01281	0.24517	-0.01786	0.08452
	Standard Deviation		0.02813	0.03228	0.01139	0.39661	0.10947	0.60398
Motor Vehicles (Lower)	Mean	12	0.95775	0.94442	1.01433	-0.46791	-0.03054	0.17712
	Standard Deviation		0.04875	0.04954	0.01106	0.58693	0.13414	0.48373

Note: Values of ‘Value Added,’ ‘Labor,’ and ‘Capital’ are expressed in growth rates.

Table 6: Ranking of Productivity

Apparel

Ranking	TFP	Eff Change	Tech Change	Pure Eff Change	Scale Eff Change	Export	Import	Central Government	Local Government	Natioanl Private	Foreign
Top 10											
1	1.283	1.293	0.993	1.227	1.054	0	0	0	0	100	0
2	1.240	1.250	0.993	1.259	0.992	0	0	0	0	100	0
3	1.216	1.110	1.095	1.000	1.110	0	0	0	0	100	0
4	1.214	1.226	0.990	1.190	1.031	0	0	0	0	100	0
5	1.205	1.170	1.030	1.159	1.009	0	0	0	0	100	0
6	1.200	1.182	1.015	1.187	0.996	1	0	0	0	100	0
7	1.180	1.192	0.990	1.164	1.024	0	0	0	0	100	0
8	1.175	1.153	1.019	1.191	0.968	0	0	0	0	100	0
9	1.170	1.162	1.007	1.154	1.007	0	0	0	0	100	0
10	1.158	1.166	0.993	1.276	0.914	0	0	0	0	100	0
Bottom 10											
520	0.845	0.851	0.993	0.857	0.993	0	0	0	0	100	0
519	0.858	0.852	1.007	0.944	0.903	1	0	0	0	100	0
518	0.859	0.846	1.015	0.817	1.035	0	0	0	0	100	0
517	0.871	0.880	0.989	0.941	0.936	0	0	0	0	100	0
516	0.875	0.881	0.993	0.910	0.968	0	0	0	0	100	0
515	0.875	0.887	0.986	0.827	1.073	0	0	0	0	100	0
514	0.876	0.889	0.986	0.940	0.946	0	0	0	0	100	0
513	0.879	0.884	0.994	0.986	0.897	0	0	0	0	100	0
512	0.879	0.882	0.997	0.853	1.034	0	0	0	0	100	0
511	0.880	0.886	0.993	0.919	0.964	0	0	0	0	100	0

Table 6: Ranking of Productivity (cont.)

General Machinery

Ranking	TFP	Eff Change	Tech Change	Pure Eff Change	Scale Eff Change	Export	Import	Central Government	Local Government	Natioanl Private	Foreign
Top 10											
1	1.119	1.145	0.977	1.142	1.003	0	99.9	0	0	100	0
2	1.097	1.127	0.974	1.059	1.064	1	2.6	0	0	25	75
3	1.092	1.121	0.974	1.096	1.023	0	0	0	0	100	0
4	1.077	1.102	0.977	1.073	1.027	0	0	0	0	51	49
5	1.071	1.090	0.982	1.034	1.055	1	100.0	0	0	40	60
6	1.065	1.090	0.977	1.082	1.008	0	0	0	0	100	0
7	1.064	1.086	0.980	1.079	1.006	0	0	0	0	100	0
8	1.063	1.092	0.974	1.054	1.036	0	0	0	0	100	0
9	1.059	1.087	0.975	1.059	1.027	0	0	0	0	100	0
10	1.054	1.089	0.968	1.000	1.089	0	0	0	0	100	0
Bottom 10											
87	0.918	0.949	0.966	0.919	1.034	0	0	0	0	100	0
86	0.919	0.959	0.958	1.000	0.959		0	0	0	100	0
85	0.926	0.950	0.976	0.970	0.979		0	0	100	0	0
84	0.928	0.960	0.967	0.930	1.032	0	33.3	0	0	100	0
83	0.929	0.953	0.975	0.921	1.035		48.0	0	0	51	49
82	0.932	0.950	0.981	0.899	1.057		0	0	0	0	100
81	0.932	0.956	0.975	0.903	1.059		97.3	0	0	45	55
80	0.936	0.973	0.962	0.975	0.998	0	0	0	0	100	0
79	0.940	0.971	0.968	0.980	0.991	0	0	0	0	100	0
78	0.947	0.970	0.976	0.960	1.011	1	37.4	0	0	100	0

Table 6: Ranking of Productivity (cont.)

Electrical Machinery

Ranking	TFP	Eff Change	Tech Change	Pure Eff Change	Scale Eff Change	Export	Import	Central Government	Local Government	Natioanl Private	Foreign
						Top 10					
1	1.026	1.009	1.017	1.000	1.009	0	0	0	0	100	0
2	1.025	1.013	1.012	1.060	0.956	0	45.7	0	0	100	0
3	1.020	1.000	1.020	1.000	1.000		100.0	0	0	0	100
4	1.020	1.010	1.010	1.010	1.000		0	0	0	100	0
5	1.019	1.002	1.017	1.069	0.937		62.2	0	0	100	0
6	1.018	0.999	1.019	1.072	0.932		62.7	0	0	100	0
7	1.018	1.011	1.007	1.060	0.954	0	0	0	0	100	0
8	1.017	1.000	1.017	1.000	1.000		0	0	100	0	0
9	1.015	0.996	1.019	1.053	0.946	0	0	0	0	100	0
10	1.012	1.016	0.997	0.991	1.025	0	0	0	0	100	0
						Bottom 10					
34	0.909	0.913	0.996	0.971	0.940	0	8.0	0	0	100	0
33	0.914	0.902	1.014	0.914	0.987	0	0	0	0	100	0
32	0.944	0.932	1.012	1.035	0.901	0	48.5	0	0	100	0
31	0.956	0.939	1.019	0.995	0.944	0	0	0	0	100	0
30	0.973	0.958	1.015	0.998	0.960	0	71.7	0	0	100	0
29	0.982	0.976	1.007	1.040	0.938	0	0	0	0	100	0
28	0.990	0.981	1.009	1.018	0.964	0	0	0	0	100	0
27	0.992	0.977	1.015	0.974	1.003		0	0	0	100	0
26	0.992	0.980	1.012	0.994	0.985	0	0	0	0	100	0
25	0.992	0.980	1.012	1.012	0.968	0	0	0	0	100	0

Table 6: Ranking of Productivity (cont.)

Motor Vehicles

Ranking	TFP	Eff Change	Tech Change	Pure Eff Change	Scale Eff Change	Export	Import	Central Government	Local Government	Natioanl Private	Foreign
						Top 10					
1	1.114	1.090	1.022	1.041	1.048	0	96.0	0	0	100	0
2	1.091	1.096	0.996	1.079	1.016	0	0	0	0	100	0
3	1.089	1.079	1.009	1.038	1.040	0	0	0	0	100	0
4	1.054	1.054	0.999	1.181	0.893	0	0	0	0	100	0
5	1.052	1.031	1.020	0.809	1.275	0	0	0	0	100	0
6	1.035	1.030	1.005	1.026	1.004	0	0	0	0	100	0
7	1.035	1.041	0.993	1.015	1.026	0	0	0	0	100	0
8	1.034	1.025	1.008	1.015	1.011	0	0	0	0	100	0
9	1.033	1.011	1.022	1.038	0.974	0	0	0	0	100	0
10	1.032	1.039	0.994	1.030	1.009	0	0	0	0	100	0
						Bottom 10					
43	0.855	0.836	1.022	0.884	0.946	0	0	0	0	100	0
42	0.885	0.869	1.018	0.867	1.003	0	0	0	0	100	0
41	0.929	0.935	0.993	0.908	1.029	0	0	0	0	100	0
40	0.930	0.923	1.008	0.926	0.997	0	0	0	30	70	0
39	0.961	0.947	1.015	0.927	1.021	0	0	0	0	100	0
38	0.966	0.945	1.023	0.948	0.997	0	0	0	0	100	0
37	0.974	0.953	1.023	0.966	0.986	0	0	0	0	100	0
36	0.996	0.974	1.023	0.987	0.987	0	0	0	0	100	0
35	0.999	0.978	1.022	1.000	0.978		0	0	0	100	0
34	0.999	0.987	1.012	0.987	1.000	0	0	0	0	100	0

Table 7: Determinants of Productivity Changes (Significant Variables)

	TFP	Eff Change	Tech Change
Export	Electrical-Large (0.025)**	Electrical-Large (0.023)**	
Import			Apparel-Medium (0.006)** Apparel-Large (0.004)*
Foreign	Vehicle-Large (0.046)*	Vehicle-Large (0.047)**	

Note: Values in parentheses are coefficients of regression. ** statistically significant at the 1%; * significant at the 5% level.

Figure 1: TFP, Efficiency, and Technological Changes in the Apparel Industry

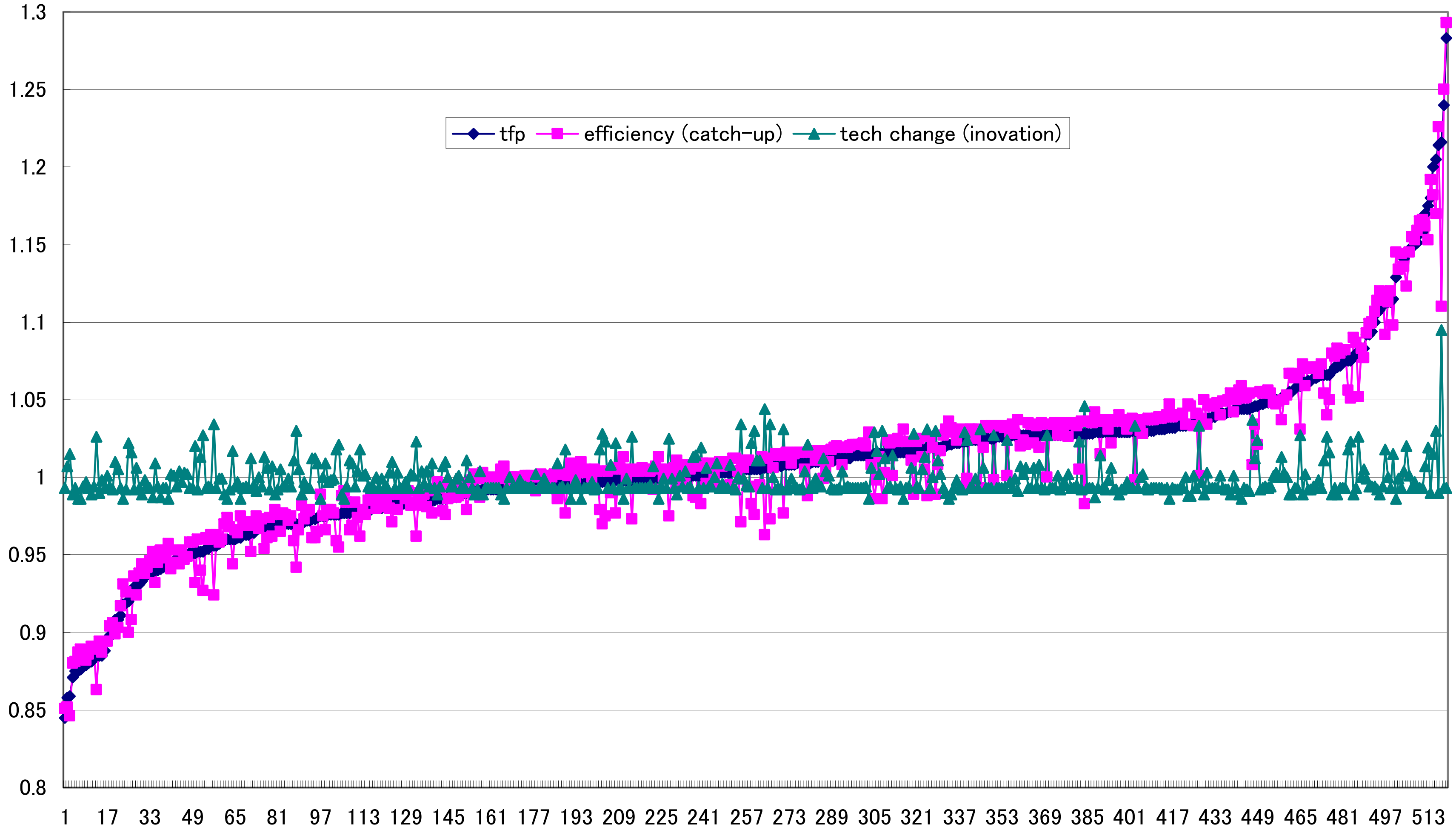

Figure 2: TFP, Efficiency, and Technological Changes in the General Machinery Industry

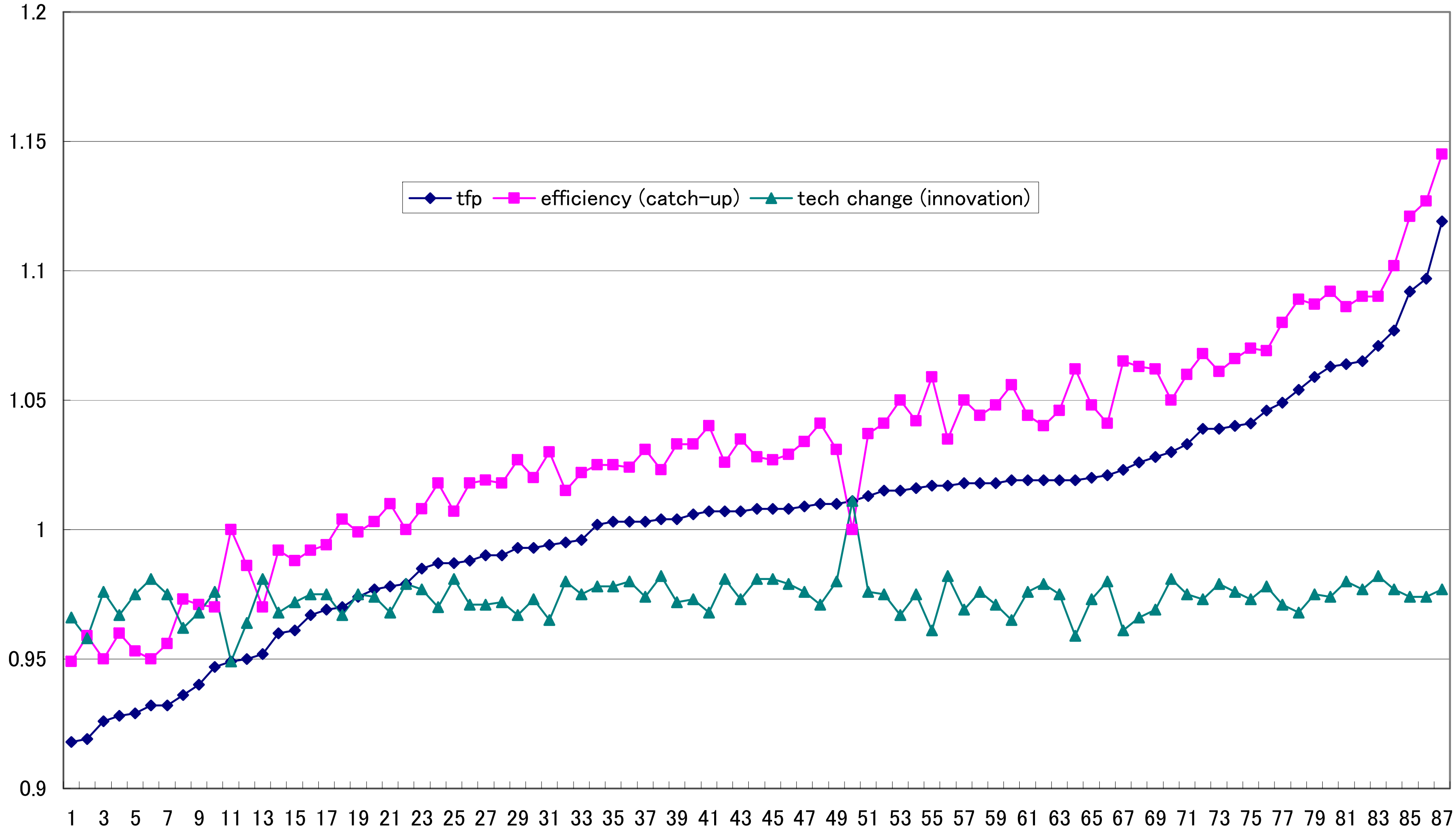

Figure 3: TFP, Efficiency, and Technological Changes in the Electrical Machinery Industry

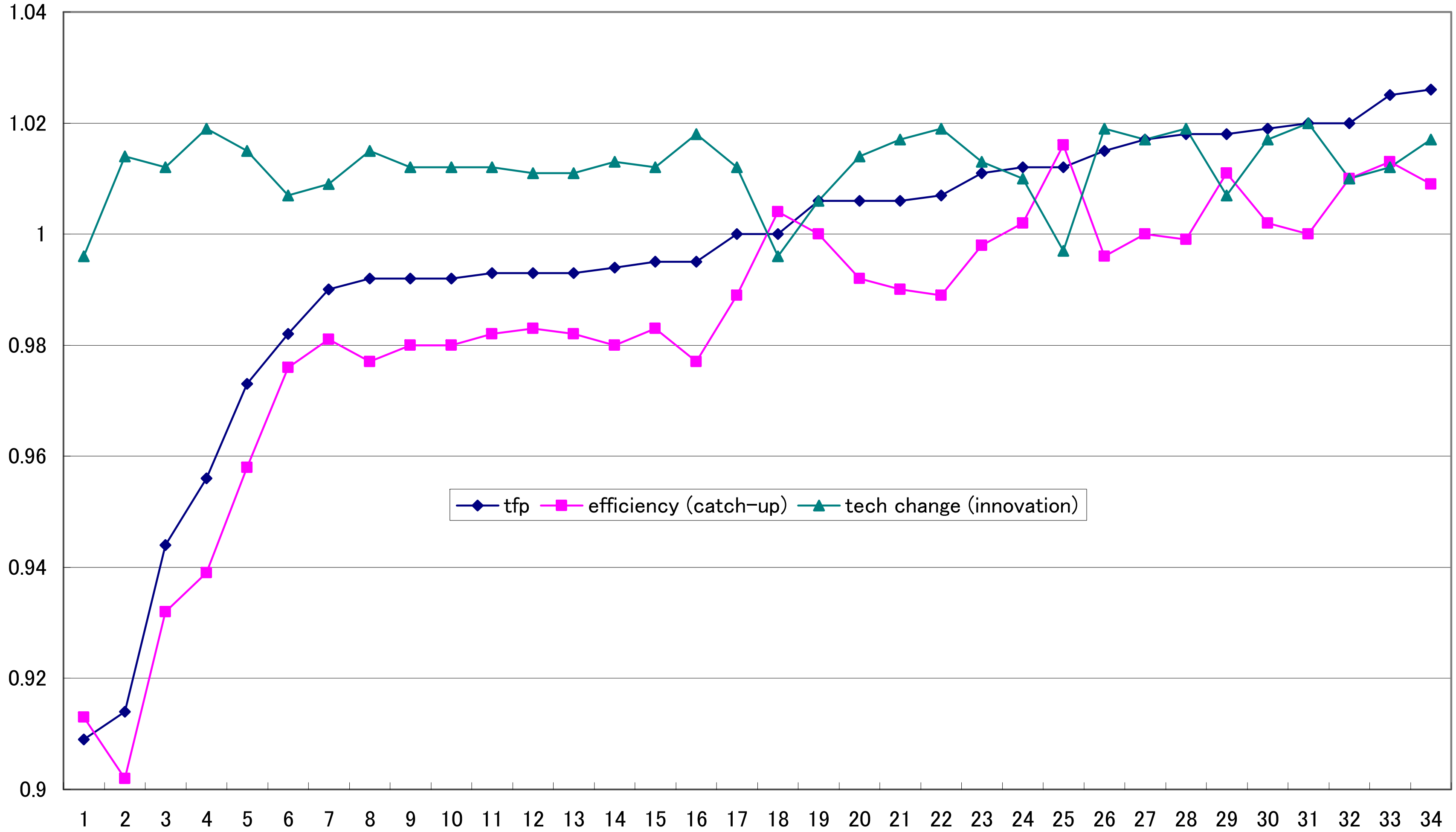

Figure 4: TFP, Efficiency, and Technological Changes in the Motor Vehicle Industry