# Controlling Flexibility of Product Cost in Market Uncertainty

Review of Integrative Business & Economics Research

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**ABSTRACT**

The purpose of this study is to examine in what ways large Japanese manufacturers have been coping with product market uncertainties since the 1990s in the face of the increasing global competition and ICT innovation. The research objective is to examine the extent to which large Japanese manufacturers control the costs-of-goods-sold flexibility in response to product market fluctuations and how they secure such flexibility. Case analyses are conducted on a sample of machinery, electric, and automobile manufacturers in Japan. This study demonstrates that large manufacturers have been flexibly controlling the costs of goods sold with respect to sales fluctuations. This study also explains the robustness of the elasticity of costs in analyzing cost patterns. Moreover, this study demonstrates four patterns of controlling the costs of goods sold with or without an outsourcing strategy.

Keywords: Uncertainty; Product market; Flexibility; Costs of goods sold; Outsourcing.

Received 14 May 2019 | Revised 28 July 2019 | Accepted 17 August 2019.

## 1. INTRODUCTION

The Japanese manufacturing industry was rather successful during the three decades from the 1960s to the 1980s thanks to the expanding domestic market and the increasing exports to the U.S. market. From the 1990s onwards, however, Japanese manufacturers have been suffering from problems related to market fluctuations. In the 1990s, such problems began to make their product markets uncertain due to the collapse of the asset-inflated economy, the contracting labor force, the appreciation of Yen, and the entry of new rivals from Taiwan, Korea, and China. These market fluctuations forced the Japanese manufacturers to control the production costs flexibility in order to secure a certain level of profits. While a flexible manufacturing system, such as the just-in-time system,

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implemented in their factories is one of their competitive strategies, outsourcing the production of finished products can also be a powerful way to secure the flexibility of product costs.

The purpose of this study is to explore in what ways large Japanese manufacturers control the costs-of-goods-sold flexibility along with the changes in the sales of finished goods. In section 2, we provide analytical viewpoints for controlling the costs-of-goods-sold flexibility. In section 3, we examine the cases of 26 manufacturers in the machinery, electric, and auto industries in Japan and measure their flexibilities of costs of goods sold in response to their fluctuating sales revenues. It is then followed by discussions and conclusions in section 4.

## 2. ANALYTICAL METHOD

The research question in this study is in what ways large Japanese manufacturers control the costs-of-goods-sold flexibility along with changes in the sales of finished goods. We divide this research question into two parts: the first question is to demonstrate the extent to which large Japanese manufacturers control the costs of goods sold in response to changes in sales revenues over time; and the second question is how the manufacturers control the costs-of-goods-sold flexibility in response to changes in sales revenues over time.

### Elasticity of costs of goods sold with respect to sales revenues

The relationship between sales revenues and COGS (costs of goods sold) is traditionally examined by breaking down COGS into variable costs and fixed costs based on the sales revenues. This relationship can be described by a liner function: COGS = fixed costs + variable costs per unit of sales × sales revenues. Instead of using the traditional method, we calculate the elasticity of COGS with respect to sales revenues in order to observe the extent to which large Japanese manufacturers control the costs of goods sold in response to changes in sales revenues over time. The reason for measuring the elasticity of COGS is that the elasticity of costs is more useful than variable costs in explaining the flexibility of costs in response to changes in sales revenues, where variable costs is defined as the marginal costs per unit of product sold. Since manufacturers usually produce multiple products, variable costs can be calculated as the marginal costs per dollar that has no direct relationship with fixed costs. In other words, variable costs can explain only a part of changes in COGS in response to changes in sales revenues, while the elasticity of COGS with respect to sales revenues in percentage terms can explain the total change in COGS in response to sales revenues.

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Elasticity measures how responsive an economic variable is to a change in another variable. For instance, variable X's elasticity with respect to variable Y is defined as the derivative coefficient in the following equation:

$$Y=\beta X^{\alpha} \quad (1)$$

Equation (1) is called a power function where α and β are constants. With β being greater than 0, the power curve's slope changes with the value of α as follows: when α is greater than 1, Y increases with X and the slope of the curve increases with X; when α is between 0 and 1, Y increases with X and the slope of the curve decreases with X; when α is equal to 1, the slope of the power curve is constant; when α is smaller than 0, Y decreases with X and the slope of the curve gradually flattens as X increases. With this model, the effect of a change in the independent variable X is defined as follows:

$$\Delta Y/\Delta X = \alpha\beta X\alpha\text{-}1 = (\alpha/X)Y \quad (2)$$

Solving Equation (2) for α yields: $\alpha = (\Delta Y/Y)/(\Delta X/X)$. The power function model can be estimated using standard OLS by taking the logarithm on both the left- and right-hand sides of the equation:

$$\text{Log } Y_t = \log\beta + \alpha \log X_t \quad (3)$$

We first calculate the logarithm of the independent and dependent valuables and then input these log-transformed values into the OLS regression model.

**Strategy for controlling the flexibility of costs of goods sold**

Costs of goods sold is calculated by the following equation: COGS = costs of products manufactured + (opening inventory value – closing inventory value) + costs of products outsourced. Since manufacturers continuously produce and sell products to markets, they usually maintain a constant amount of inventory at the end of each business year. As the beginning inventory value tends to be very close to the closing inventory value, the difference between them is usually very small. If we assume that there is no difference between the beginning inventory and the closing inventory, the costs of goods sold consists of the costs of products manufactured and the costs of products outsourced as follows: COGS = COPM + COPO. Therefore, manufacturers have two alternatives to control the flexibility of COGS in response to changes in sales revenues: orchestrating the production level in response to the predicted change in sales revenues; and purchasing finished products from external suppliers in conjunction with the predicted change in sales revenues. The decision on choosing which one of these two alternatives is called the "Make-or-Buy" problem in the field of management accounting. However, the effectiveness of these two alternatives in controlling the flexibility of COGS in response to the changing sale revenues depends on the accuracy of forecasting the sales revenues because a certain amount lead time is needed for both in-house production and

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outsourcing.

### Trend Analysis

Trend analysis is useful for detecting the general pattern of the relationship between sales revenues, costs of goods sold, costs of products manufactured, and costs of products outsourced. It is a method of time series data analysis involving a comparison of the same variable across time. To apply this analytical method, time series data are collected for some variables in sequence over time and are shown longitudinally in a line chart. If some variables are related to each other, the line plots of those variables in the chart will go in the same or opposite direction. Therefore, a time series line chart in which sales revenues and costs of goods sold move in the same direction demonstrates a positive correlation between the two variables. The same idea applies to the relationship between sales revenues and costs of products manufactured as well as to the relationship between sales revenues and costs of products outsourced.

## 3. CASE ANALYSIS

### Cases and Data

The manufacturers sampled for the case analysis include 26 large manufacturing firms in Japan: 6 of them are machinery manufacturers; 10 of them are electric manufacturers; and the remaining 10 are auto manufacturers. All the sample firms are listed on the Tokyo Stock Exchange and thus are required to disclose their financial statements. We retrieved data on their sales revenues, costs of goods sold (COGS), costs of products manufactured (COPM) from each of their financial statements over the 35-year period from 1980 to 2015. All the data were downloaded from the Nikkei NEEDS Financial Database. The costs of products outsourced (COPO) was calculated as the difference between COGS and COPM.

### Results of Analysis

The results of data analysis are summarized in the Table 1, Table 2-1, Table 2-2, Table 3-1, and Table 3-2. Table 1 shows the results of analysis on the 6 machinery manufacturers, Tables 2-1 and 2-2 show the results concerning the 10 electric manufacturers, and Tables 3-1 and 3-2 show the results concerning the 10 auto manufacturers (see Appendix).

In the table of each type of manufacturers, the term “Elasticity” refers the elasticity of costs of goods sold (COGS), costs of products manufactured (COPM), and costs of products outsourced (COPO) with respect to sales revenues, respectively; the term “Correl. Coeffi.” refers to the correlation coefficient of COGS, COPM, and COPO with

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respect to sales revenues, respectively; and the term "Ratio of COGS to sales" is the average ratio of costs of goods sold to sales revenues and its respective standard deviation. The elasticity and correlation coefficient between COGS and sales revenues are calculated using the data from 1980 to 2015, while those indicators concerning COPM, COPO, and sales revenues are measured using the data from 1980 to 2013 due to lack of observations in 2014 and 2015. Bellow each table, there is a combined chart indicating the longitudinal movements of the variables. A blue line indicates the changes in sales revenues and a red one indicates the changes in costs of goods sold from 1980 to 2015. A green line indicates the changes in costs of products manufactured and a purple one indicates the changes in costs of products outsourced from 1980 to 2013. The monetary amounts of these four variables are shown in million Yen on the left axis. The area chart indicates the changes in the ratio of COGS to sales revenues with a scale in percentage terms along the right axis.

**Machinery Industry**

Table 1 presents the longitudinal changes concerning the 6 manufacturers in the industrial machinery sector. The sales revenues of these manufacturers have been fluctuating since the 1980s. Most of the firms in this industry have been producing what we call "mother machines" that are used to produce other products. Therefore, the sales revenues of these manufacturers can be amplified by the business cycles of the entire manufacturing industry in Japan. OSG is one exceptional firm that seems to have been experiencing an increase in its sales revenues gradually for over three decades.

We can confirm that, in the face of such large fluctuations in sales revenues, the five manufacturers except for OSG have been controlling their COGS in conjunction with the changes in their sales revenues. The blue lines (sales revenues) and the red lines (COGS) move in a similar pattern as shown in the diagrams of each firms. Moreover, both the elasticity indicators and the correlation coefficients of COGS with respect to sales revenues are strong as indicated in these five manufacturers' summary tables.

Furthermore, the fact that the ratios of COGS to sales revenues of the five manufacturers level off at around 80 percent in terms of relative standard deviations, indicating that these manufacturers have been putting great efforts in stabilizing the ratio of COGS to sales revenues in order to secure their gross operating incomes.

We can also confirm that these five manufacturers were controlling the flexibility of COGS at in-house production stages because they have never utilized an outsourcing strategy. The red lines (COGS) and green lines (COPM) change in a similar pattern in the diagrams of each firms. Both the elasticity indicators and correlation coefficients of COGS with respect to sales revenues are strong while those indicators of COPO are weak

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due to the absence of outsourcing operations. OSG has a different pattern in terms of the change in sales revenues compared with those of other manufacturers in the same industry. This manufacturer gradually increased its sales revenues from 1980 to 2007 with a two- to three-year cycle of ups and downs. We can confirm that OSG have been controlling their COGS in conjunction with the changes of sales revenues based on the fact that the blue and the red lines shift in the same direction as shown in the diagrams. Moreover, both the elasticity indicators and correlation coefficients of COGS with respect to sales revenues are strong as shown in the firm's summary table.

Specifically, in the period from 1980 to 1992, the company doubled its sale revenues with a steady COGS-to-sales ratio at the average of 72 percent and enjoyed economy of scales. After that period, the company continued its sales revenues growth with flexible COGS. Although the company seems to have started outsourcing products in 1993, the quantity of the products outsourced have been leveled off at five billion Yen. On the other hand, the red and the green lines in the diagram of OSG move in the same direction, which means that the company's COGS flexibly changes in conjunction with the sales revenues based on a strong elasticity of COPG as well as a high correlation to sales revenues.

**Electric Industry**

Table 2-1 and 2-2 show the longitudinal changes regarding the 10 manufacturers in the electric instrument industry. First, we can find that these electric manufacturers have been controlling the flexibility of COGS with respect to sales revenues for more than three decades based on the fact that: the blue lines (sales revenues) and the red lines (COGS) shift in similar patterns as shown in the diagram of each firm; both the elasticity indicators and the correlation coefficients of COGS with respect to sales revenues are strong in the firms' summary tables; and the manufacturers in this industry have a stable COGS-to-sales ratio (all the manufacturers have a relatively small standard deviation in the average COGS-to-sales ratio),

Second, we examine how these electric manufacturers have been controlling COGS with respect to sales revenues. Hitachi (1980-1987), Mitsubishi Electric (1980-2001), Sony (1980-2007), and Fujitsu (1980-1985) seem to have the same pattern of costs behavior as OSG (1980-1992) in terms of COGS. These manufacturers produced products in their factories without outsourcing. They increased sale revenues with a steady COGS-to-sales ratio and enjoyed economy of scales during their respective periods.

However, companies such as Hitachi (1998-2013), Mitsubishi Electric (2002-2013), Sony (2008-2013), and Shibaura Mechatronics have the same pattern as the five machine manufacturers in terms of the way in which they control the flexibility of COGS at in-house production stages. The red lines (COGS) and the green lines (COPM) change in a

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similar pattern in the diagrams of each firm. Moreover, both the elasticity indicators and correlation coefficients of COGS with respect to sales are strong while the indicators of COPO are weak due to the absence of outsourcing operations.

Although the five manufacturers in this industry have been outsourcing products, they are different in terms of their effectiveness of an outsourcing strategy in controlling the flexibility of COGS. Toshiba TEC (1980-1994,95-2013), NEC, and Fujitsu (1998-2013) have the same pattern as OSG (1999-2013) in terms of their costs behaviors of COGS, COPM and COPO. These three manufactures have been constantly buying products from outside of the firms, but they weakly link the quantity of outsourced products to the change of sales in their respective periods.

We can confirm that these three manufacturers have been controlling their COGS in conjunction with the changes in sales revenues and a strong flexibility of COPM based on the fact that the blue, the red, and the green lines move in a similar way in the diagrams. Moreover, both the elasticity indicators and the correlation coefficients of COGS with respect to sales revenues are strong in their respective periods as shown in the firms' summary tables [although Toshiba TEC (1995-2013) seems to have linked the quantity of outsourced products to changes in sales revenues in the same period, we judge that the company continues to control COPM more flexibly than COPO based on the fact that the correlation coefficient (0.47) between sales revenues and COPM in the period of 1995-2013 is a little larger than that (0.37) between sales revenues and COPO in the same period].

In comparison to the above costs control strategies, Omron (1980-2013), Makita, Panasonic (1988-2013), and Fujitsu (1986-1997) have been buying a large quantity of products from outside of the company and linking COPO more closely to changes in sales revenues than COPM. In other words, these manufacturers operate production activities at a certain level and buy products from outside of the company in conjunction with changes in sales revenues. We can confirm this linkage based on the fact that the blue lines, the red lines and the purple lines move in a similar pattern in the diagrams of the respective firms.

**Auto Industry**

Table 3-1 and 3-2 show the longitudinal changes of the ten manufacturers in the auto industry. First, we can find that these automobile manufacturers have been controlling the flexibility of COGS with respect to sales revenues for more than three decades based on the fact that the blue lines (sales revenues) and the red lines (COGS) shift in similar patterns in the diagram of each firm; both the elasticity indicators and correlation coefficients of COGS with respect to sales revenues are strong as shown in these five

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firms' summary tables; and the manufacturers in this industry have a stable average COGS-to-sales ratio (all the manufacturers have a relatively small standard deviation in the average COGS-to-sales ratio)

Second, we examine how these automobile manufacturers have been controlling COGS with respect to sales revenues. Toyota Motor, Suzuki Motor, Fuji Heavy Industry, Mitsubishi Motors, Hino Motors, Nissan Motor (1980-1992), Mazda Motor (1980-1992), and Isuzu Motors (1980-1992) seem to have the same pattern of costs behavior (1980-1992) in terms of COGS. These manufacturers produced products in their factories without outsourcing. They increased sale revenues with a steady COGS-to-sales ratio and enjoyed economy of scales in their respective periods. Although some of these auto makers like Nissan Motor (1993-2013), Mazda Motor (1993-2004), and Isuzu Motors (1996-2013) began to severely suffer from the fluctuations of sales revenues, they were able to hold stable the COGS-to-sales ratio by a strong flexibility in manufacturing costs.

On the other hand, Daihatsu Motor (1980-2013), Mazda Motor (2005-2013), and Honda Motor have been constantly outsourcing products. While the purple lines in these firms' diagrams are rather flat, the blue lines, the red lines and the green lines move closely together as shown in the diagrams. We can confirm that these auto makers with an outsourcing strategy have been controlling COGS flexibility by flexible factory operations. Therefore, the costs behavior pattern of COGS, COPM and COPO of these manufacturers are the same as those of Toshiba TEC, NEC and Fujitsu (1998-2013).

## 4. DISCUSSIONS AND CONCLUSIONS

Based on the results of the analyses, we can confirm that all the 26 manufacturers have been controlling the flexibility of costs of goods sold during the last three decades. We classify the manufacturers' methods to control the flexibility of COGS into four patterns. Table 4 shows the four patterns together with their distinctive features.

We first separate the ways of controlling COGS used by manufacturers who produce goods in-house from those used by manufacturers who undertake both in-house production and outsourcing. We further classify the former into two groups based on the differences in their trend of sales revenues and the effectiveness of COGS flexibility.

Pattern-11 is a costs behavior pattern of COGS in which COGS (COMP) flexibly changes when the firm's sales revenues fluctuate. Those manufacturers characterized with the Pattern-11 costs behavior can achieve economy of scales when they expand their sales revenues because they are able to maintain a strong elasticity of COGS as well as a high correlation coefficient with respect to sales revenues. The manufactures who seem to have the Pattern-11 costs behavior in the case analysis are OSG (1980-1992), Toyota Motor,

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Suzuki Motor, Fuji Heavy Industry, Mitsubishi Motors, Hino Motors, Nissan Motor (1980-1992), Mazda Motor (1980-1992), Isuzu Motors (1980-1992), Hitachi (1980-1997), Mitsubishi Electric (1980-2001), Sony (1980-2007), and Fujitsu (1980-1985). The Pattern-11 costs behavior of COGS(COPM) can be described by Figure 1-1.

Table 4: Patterns of Conrolling Cost of Goods Sold

| | | Pattern-11 | Pattern-12 | Pattern-21 | Pattern-22 |
|---|---|---|---|---|---|
| Behavior of cost of goods sold | | COGS changes flexibly by the strong elasticity of COPM when sales proceeds increase | COGS changes flexibly by the stronger elasticity of COPM when sales proceeds fluctuate | COGS changes flexibly by the strong elasticity of COPM when sales proceeds fluctuate | COGS changes flexibly by the strong elasticity of COPO when sales proceeds fluctuate |
| Pattern of Change of Sales Proceeds (Market Environment) | | Increasing with a cycle of ups and downs | Fluctuating (Decreasing) | Fluctuating (Decreasing) | Fluctuating (Decreasing) |
| Cost of Products manufactured | Elasticity | Strong | Stronger | Stronger | Weak |
| | Correlation to sales proceeds | High | High | High | Lower |
| Cost of Products Outsourced | Elasticity | n/a | n/a | Weak | Stronger |
| | Correlation to sales proceeds | n/a | n/a | Lower | High |
| Change of Sales Proceeds | | Increasing | Fluctuating (Decreasing) | Fluctuating (Decreasing) | Fluctuating (Decreasing) |
| Effectiveness | | Economies of scales | Stabilization of ratio of COGS to sales proceeds | Reduction and/or Stabilization of COPM | Reduction and/or Stabilization of COPM |
| Sample companies | | OSG (1980-1992) | | OSG (1993-2013) | |
| | | Toyota Motor<br>Suzuki Motor<br>Fuji Heavy Industry<br>Mitsubishi Motors<br>Hino Motors | Tsugami<br>Okuma<br>Toshiba Machine<br>Takisawa Machine<br>Makino Milling Machine | | |
| | | Nissan Motor (1980-1992)<br>Mazda Motor (1980-1992)<br>Isuzu Motors (1980-1992) | Nissan Motor (1993-2013)<br>Mazda Motor (1993-2004)<br>Isuzu Motors (1996-2013) | Daihatsu Motor (1980-2013)<br>Mazda Motor (2005-2013)<br>Honda Motor | |
| | | Hitachi (1980-1997)<br>Mitsubishi Electric (1980-2001)<br>Sony (1980-2007) | Hitachi (1998-2013)<br>Mitsubishi Electric (2002-2013)<br>Shibaura Mechatronics<br>Sony (2008-2013) | Toshiba Tec (1980-1994, 95-2013)<br>NEC | Makita<br>Omoron (1980-2013)<br>Panasonic (1988-2013) |
| | | Fujitsu (1980-1985) | | Fujitsu (1998-2013) | Fujitsu (1986-1997) |

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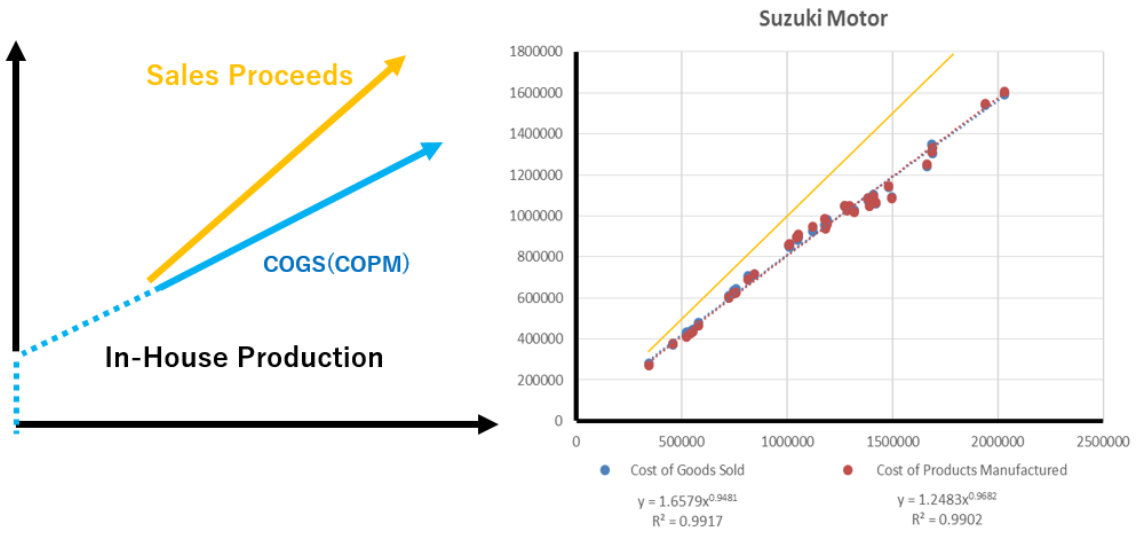
Figure 1-1. Pattern-11 of Controlling GOGS Flexibility




Pattern-12 is a costs behavior pattern of COGS in which COGS (COMP) flexibly changes when the firm's sales revenues fluctuate. Those manufacturers characterized with the pattern-12 costs behavior can hedge the risks of losing money when they experience a reduction in sales revenues. They can stabilize the ratio of COGS with respect to sales revenues because of a strong elasticity and a high correlation coefficient of COGS with respect to sales revenues. As a result, they can secure high gross margins. The manufacturers who seem to have the pattern-12 costs behavior in the case analysis are Tsugami, Okuma, Toshiba Machine, Mikino Milling Machine, Nissan Motor (1993-2013), Mazda Motor (1993-2004), Isuzu Motors (1996-2013), Hitachi (1998-2013), Mitsubishi Electric (2002-2013), and Sony (2008-2013). The pattern-12 costs behavior of COGS(COPM) is shown in Figure 1-2.

We further classify the ways of controlling COGS used by manufacturers who conduct both in-house production and outsourcing into two patterns, namely Pattern-21 and Pattern-22, based on the extent to which the outsourcing strategy absorbs the risks of market uncertainty.

Pattern-21 is a costs behavior pattern of COGS in which COMP changes more flexibly than COPO when the firm's sales revenues fluctuate. Those manufacturers with the pattern-22 costs behavior constantly outsource a certain quantity of products and flexibly produce the products when they face fluctuations in sales revenues. They can hedge the risks of losing money when they experience a reduction in the sales volume by controlling the production level in-house. They can also stabilize the COGS-to-sales ratio because of a strong elasticity and a high correlation coefficient of COGS with respect to

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sales revenues. As a result, they can secure high gross margins. The manufacturers who seem to have the pattern-12 costs behavior are OSG (1993-2013), Daihatsu Motor (1980-2005), Mazda Motor (2005-2013), Honda Motor, Toshiba Tec (1980-1994), Omron (1980-2013), and NEC. The pattern-21 costs behavior of COGS(COPM+COPO) is shown in Figure 1-3.

Figure 1-2. Pattern-12 of Controlling Flexibility of GOGS

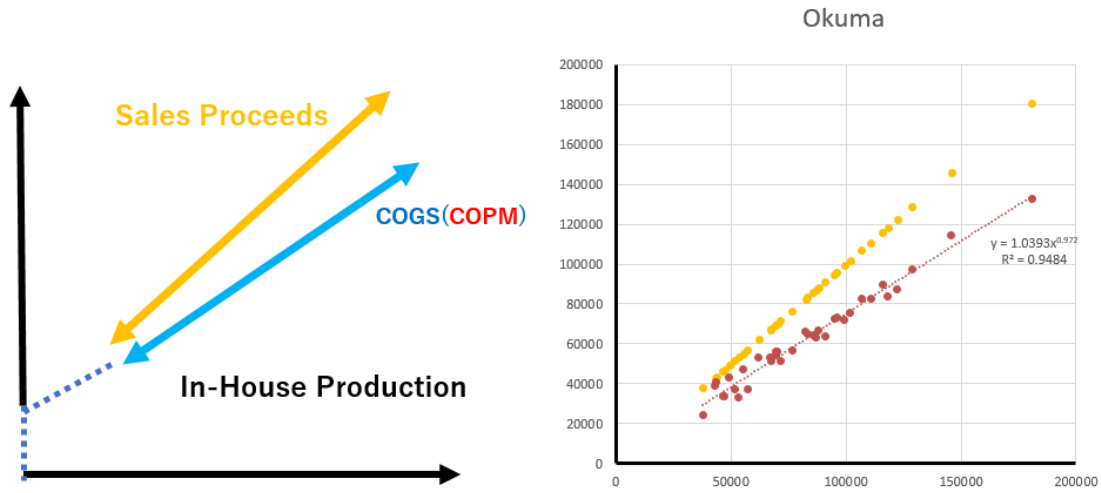
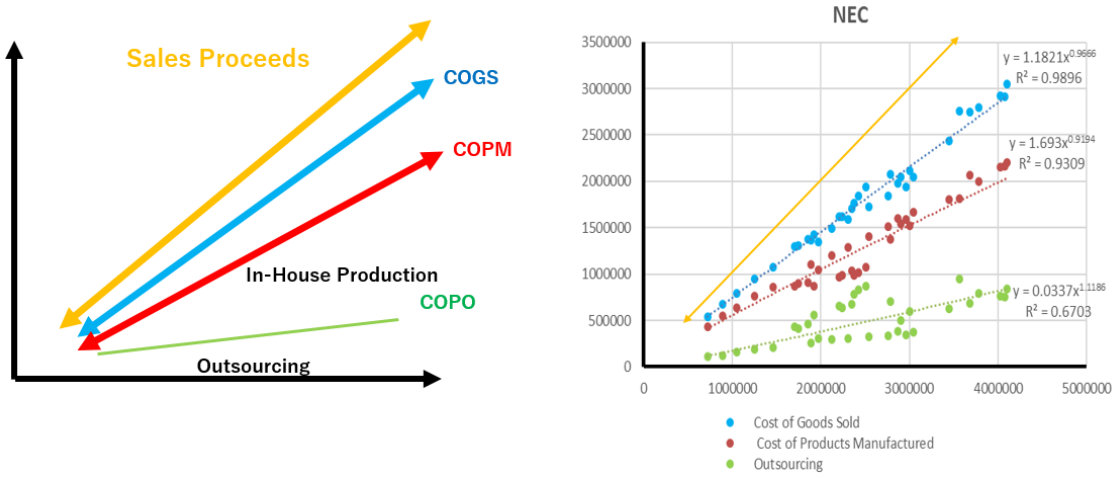



Figure 1-３. Pattern-21 of Controlling Flexibility of GOGS




Pattern-22 is a costs behavior pattern of COGS in which COPO changes more flexibly than COPM when the firm's sales revenues fluctuate. Those manufacturers with the pattern-22 costs behavior constantly produce a certain quantity of goods and flexibly outsource certain products when they face fluctuations in their sales revenues. They can hedge the risks of losing money when they experience a reduction in sales volume by controlling the production level in-house. They can also stabilize the COGS-to-sales ratio

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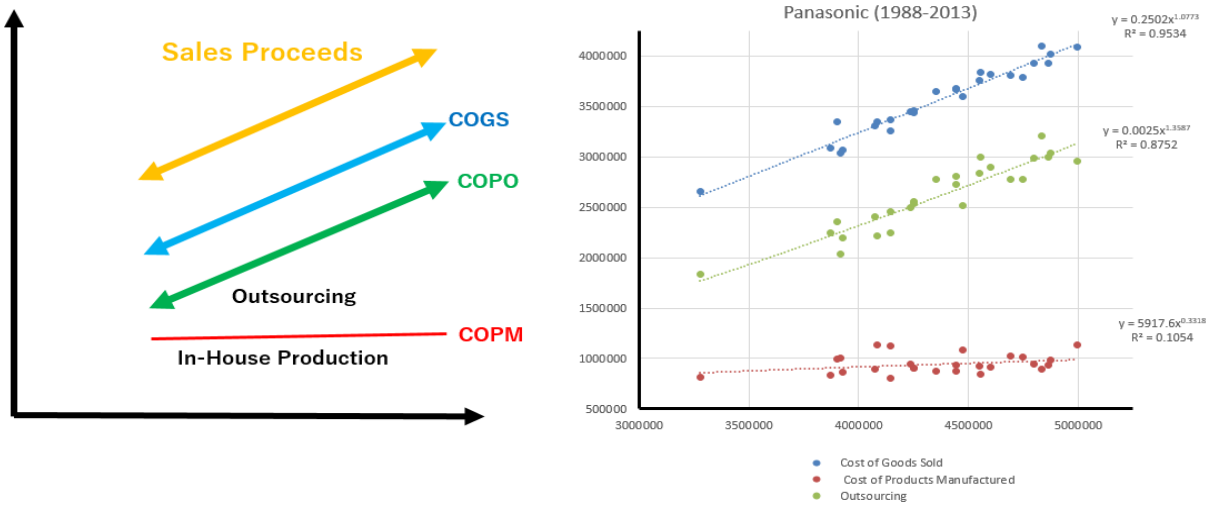
because of a strong elasticity and a high correlation coefficient of COGS with respect to sales revenues. As a result, they can secure high gross margins. The manufacturers who seem to have the pattern-12 costs behavior are Daihatsu Motor (2006-2013), Toshiba Tec (1995-2013), Omron (1980-2013), Makita, Panasonic and Fujitsu (1986-2013). The pattern-22 costs behavior of COGS(COPM+COPO) is shown in Figure 1-4.

Figure 1-4. Pattern-22 of Controlling Flexibility of GOGS




The results of the case analysis in this research revealed some special features about large Japanese manufacturers' COGS behaviors. First, this study demonstrates that many large manufacturers in Japan have been flexibly controlling the costs of goods sold in conjunction with the fluctuations of sales revenues for more than three decades since 1980. Second, this study explained the robustness of the elasticity of costs in analyzing cost patterns. Third, this article demonstrated that there are four patterns of controlling the costs-of-goods-sold flexibility with or without an outsourcing strategy.

This study has several limitations. First, the number of sample manufacturers in the case analysis is small. Therefore, it is difficult to develop generally accepted propositions from the findings. Second, the financial data used in the research are on unconsolidated basis. The accounting rules in Japan traditionally demand firms in this country to disclose unconsolidated financial statements. Japanese firms began to report their business performance and financial conditions at the end of 1990s. However, manufacturers are allowed to disclose production costs only on the unconsolidated basis. These limitations could be addressed by future research.

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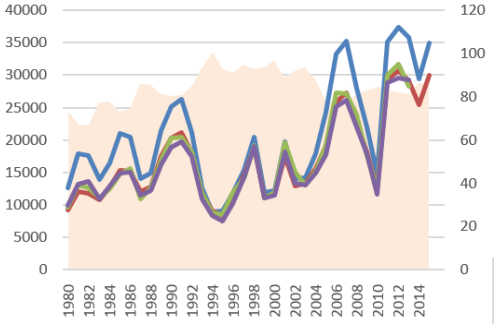
# Appendix

**TABLE 1**
**MACHINERY MANUFACTURERS**

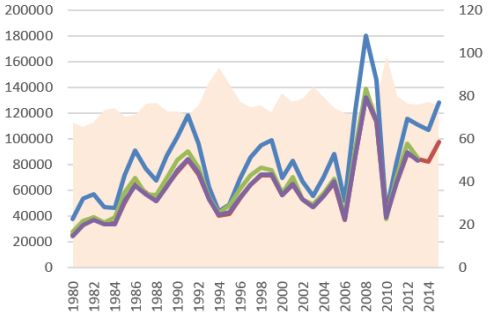
TSUGAMI

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.899 | 0.878 | 0.884 |
| Correl. coeffi. | 1980-2013,15 | 0.970 | 0.962 | 0.978 |
| Elasticity | 1980-1991 | 1.005 | 0.983 | 0.863 |
| Elasticity | 1992-2013,15 | 0.867 | 0.852 | 0.880 |



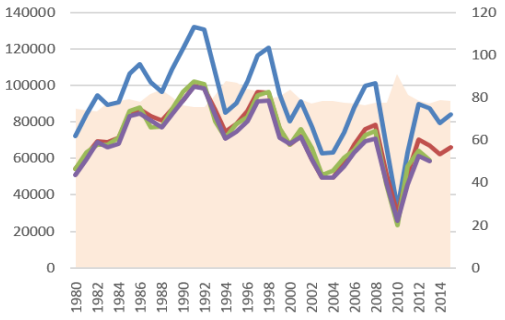

OKUMA

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.941 | 0.952 | 0.968 |
| Correl. coeffi. | 1980-2013,15 | 0.976 | 0.976 | 0.972 |
| Elasticity | 1980-1991 | 1.038 | 1.064 | 1.091 |
| Elasticity | 1992-2013,15 | 0.851 | 0.865 | 0.862 |



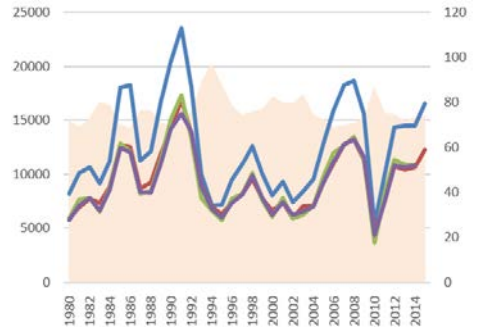

TOSHIBA MACHINE

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.938 | 1.009 | 0.992 |
| Correl. coeffi. | 1980-2013,15 | 0.984 | 0.973 | 0.978 |
| Elasticity | 1980-1991 | 1.050 | 1.108 | 1.139 |
| Elasticity | 1992-2013,15 | 0.935 | 1.006 | 0.971 |



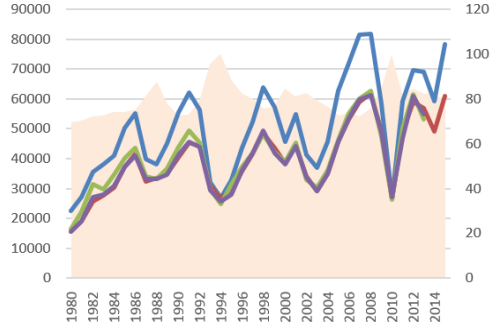

TAKISAWA MACHINE

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.828 | 0.923 | 0.840 |
| Correl. coeffi. | 1980-2013,15 | 0.983 | 0.983 | 0.981 |
| Elasticity | 1980-1991 | 0.919 | 0.963 | 0.905 |
| Elasticity | 1992-2013,15 | 0.801 | 0.934 | 0.848 |




MAKINO MILLINGMACHINE

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.920 | 0.881 | 0.915 |
| Correl. coeffi. | 1980-2013,15 | 0.964 | 0.977 | 0.966 |
| Elasticity | 1980-1991 | 1.052 | 1.019 | 1.041 |
| Elasticity | 1992-2013,15 | 0.792 | 0.798 | 0.800 |




OSG

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.977 | 0.823 | 0.856 |
| Correl. coeffi. | 1980-2013,15 | 0.990 | 0.967 | 0.970 |
| Elasticity | 1980-1997 | 0.972 | 0.784 | 0.776 |
| Elasticity | 1998-2013,15 | 0.749 | 0.894 | 0.871 |

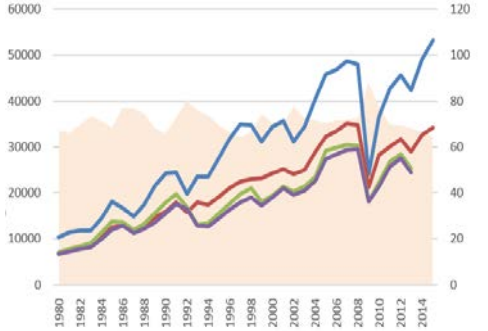



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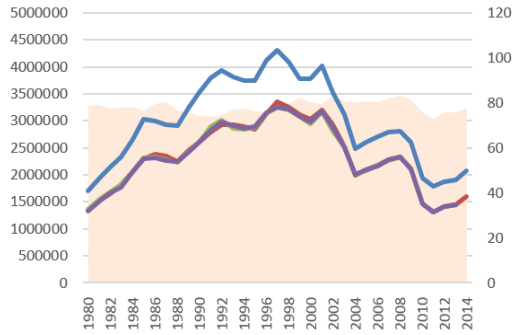
**TABLE 2–1**
**ELECTRIC MANUFACTURERS**

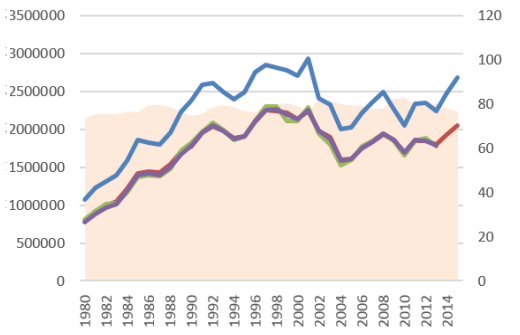
**HITACHI**

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.014 | 0.996 | 1.011 |
| Correl. coeffi. | 1980-2013,15 | 0.993 | 0.994 | 0.993 |
| Elasticity | 1980-1997 | 0.952 | 0.938 | 0.965 |
| Elasticity | 1998-2013,15 | 1.098 | 1.076 | 1.086 |



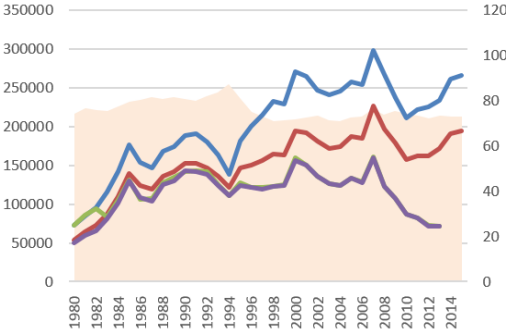

**MITSUBISHI ELECTRIC**

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.047 | 1.062 | 1.091 |
| Correl. coeffi. | 1980-2013,15 | 0.995 | 0.996 | 0.995 |
| Elasticity | 1980-1992 | 1.034 | 1.038 | 1.070 |
| Elasticity | 1993-2013,15 | 0.899 | 0.983 | 0.915 |



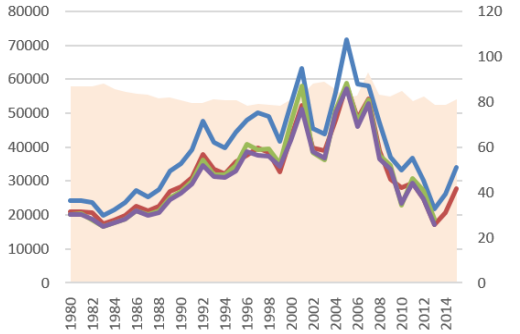

**TOSHIBA TEC**

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.928 | 0.340 | 0.577 |
| Correl. coeffi. | 1980-2013,15 | 0.988 | 0.509 | 0.683 |
| Elasticity | 1980-1994 | 1.095 | 0.668 | 1.098 |
| Elasticity | 1995-2013,15 | 0.904 | 0.933 | 0.956 |



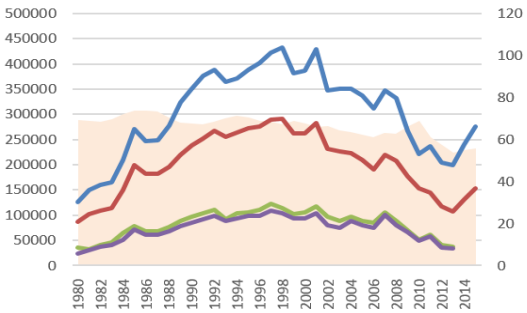

**SHIBURA MECHATRONICS**

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.982 | 1.042 | 1.006 |
| Correl. coeffi. | 1980-2013,15 | 0.993 | 0.984 | 0.986 |
| Elasticity | 1980-1992 | 0.874 | 0.884 | 0.831 |
| Elasticity | 1993-2013,15 | 1.049 | 1.042 | 1.042 |




**OMRON**

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.018 | 1.107 | 1.174 |
| Correl. coeffi. | 1980-2013,15 | 0.972 | 0.966 | 0.975 |
| Elasticity | 1980-1992 | 0.989 | 1.056 | 1.162 |
| Elasticity | 1993-2013,15 | 1.240 | 1.378 | 1.343 |




**NEC**

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.965 | 1.005 | 0.919 |
| Correl. coeffi. | 1980-2013,15 | 0.995 | 0.959 | 0.965 |
| Elasticity | 1980-1997 | 0.931 | 0.960 | 0.899 |
| Elasticity | 1998-2013,15 | 0.992 | 1.338 | 1.167 |

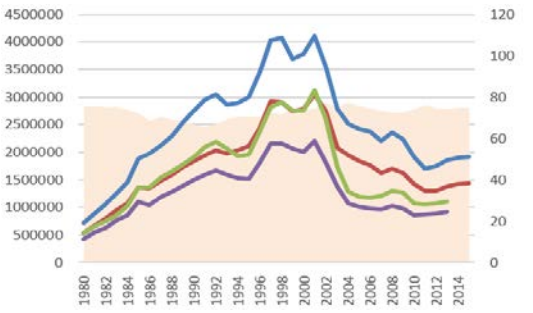



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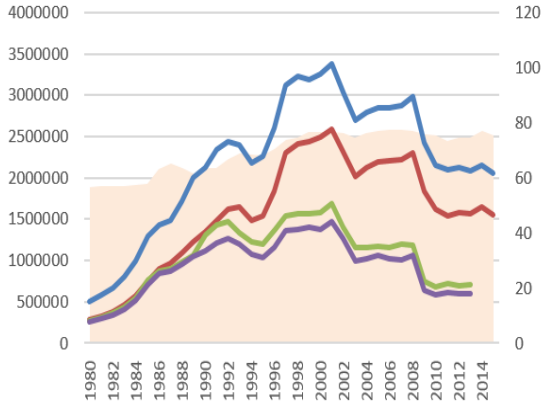
**TABLE 2-2**
**ELECTRIC MANUFACTURERS**

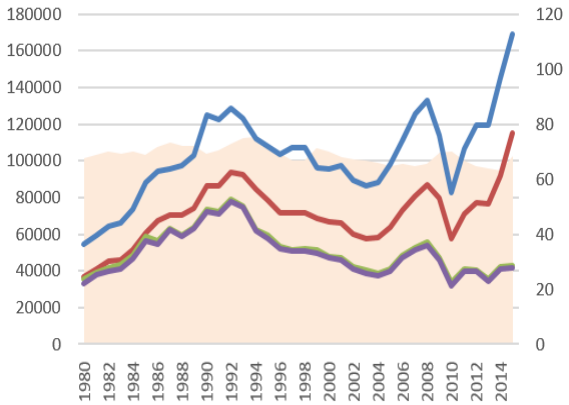
FUJITSU

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.192 | 0.859 | 0.807 |
| Correl. coeffi. | 1980-2013,15 | 0.995 | 0.914 | 0.891 |
| Elasticity | 1980-1997 | 1.134 | 1.007 | 0.956 |
| Elasticity | 1998-2013,15 | 1.045 | 1.904 | 1.984 |



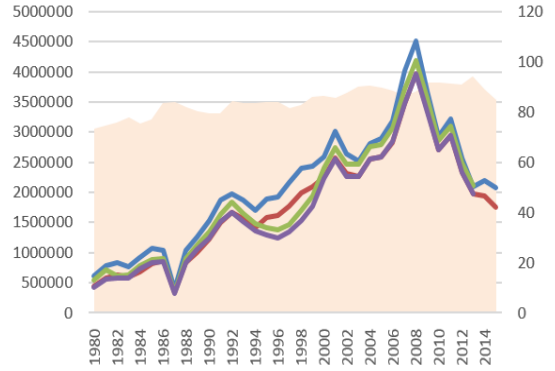

MAKITA

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.976 | 0.573 | 0.615 |
| Correl. coeffi. | 1980-2013,15 | 0.983 | 0.561 | 0.578 |
| Elasticity | 1980-1992 | 1.050 | 0.881 | 0.931 |
| Elasticity | 1993-2013,15 | 0.953 | 0.777 | 0.817 |




SONY

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.086 | 1.055 | 1.086 |
| Correl. coeffi. | 1980-2013,15 | 0.998 | 0.988 | 0.987 |
| Elasticity | 1980-2008 | 1.074 | 1.035 | 1.064 |
| Elasticity | 2009-2013,15 | 1.059 | 0.942 | 0.948 |




PANASONIC

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.017 | 0.773 | 0.814 |
| Correl. coeffi. | 1980-2013,15 | 0.997 | 0.938 | 0.944 |
| Elasticity | 1980-1992 | 1.005 | 0.857 | 0.881 |
| Elasticity | 1993-2013,15 | 1.180 | 0.004 | (0.007) |

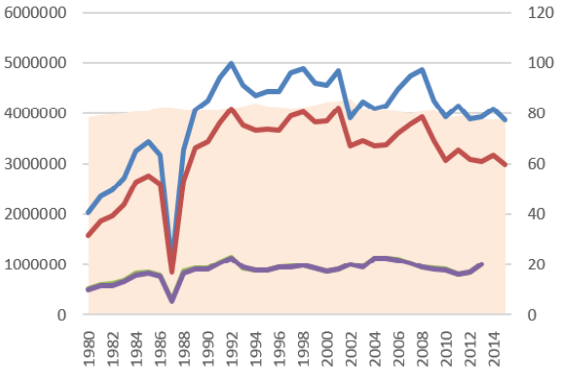



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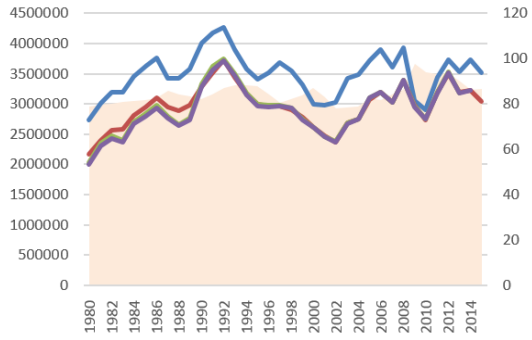
**TABLE 3–1**
**AUTO MANUFACTURERS**

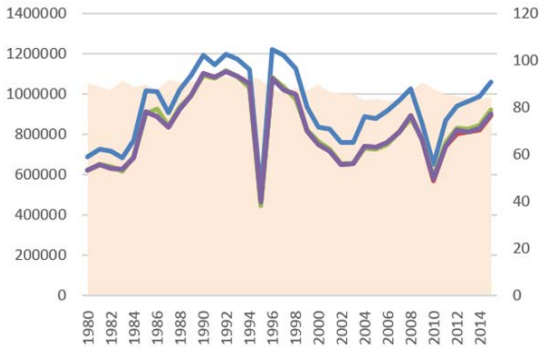
NISSAN MOTOR

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.034 | 1.122 | 1.120 |
| Correl. coeffi. | 1980-2013,15 | 0.891 | 0.867 | 0.857 |
| Elasticity | 1980-1992 | 1.172 | 1.349 | 1.360 |
| Elasticity | 1993-2013,15 | 0.905 | 0.926 | 0.915 |



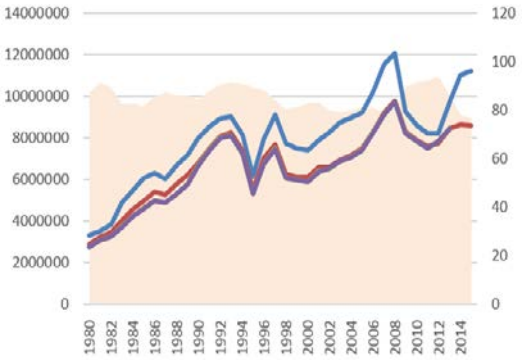

ISUZU MOTORS

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2015 | 1.015 | 1.024 | 1.020 |
| Correl. coeffi. | 1980-2015 | 0.984 | 0.986 | 0.986 |
| Elasticity | 1980-1992 | 1.054 | 1.051 | 1.054 |
| Elasticity | 1993-2015 | 0.991 | 1.003 | 0.995 |



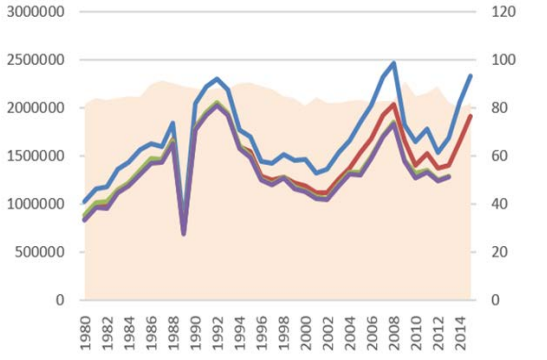

TOYOTA MOTOR

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.940 | 1.018 | 1.022 |
| Correl. coeffi. | 1980-2013,15 | 0.985 | 0.983 | 0.982 |
| Elasticity | 1980-1993 | 1.001 | 1.033 | 1.035 |
| Elasticity | 1994-2013,15 | 0.829 | 0.934 | 0.937 |



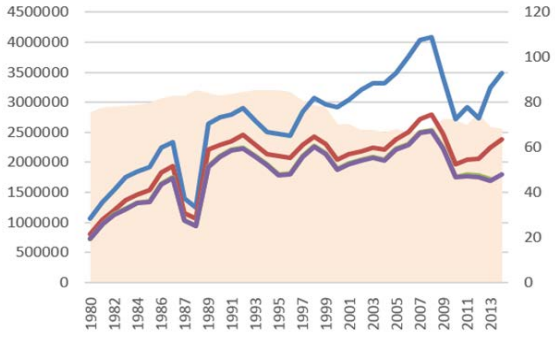

MAZDA MOTOR

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 1.001 | 0.937 | 0.943 |
| Correl. coeffi. | 1980-2013,15 | 0.988 | 0.944 | 0.948 |
| Elasticity | 1980-1992 | 1.046 | 0.993 | 0.999 |
| Elasticity | 1993-2013,15 | 0.964 | 0.885 | 0.890 |




HONDA MOTOR

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.860 | 0.885 | 0.885 |
| Correl. coeffi. | 1980-2013,15 | 0.968 | 0.971 | 0.971 |
| Elasticity | 1980-1992 | 1.064 | 1.066 | 1.062 |
| Elasticity | 1993-2013,15 | 0.500 | 0.597 | 0.597 |




SUZUKI MOTOR

| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
|---|---|---|---|---|
| Elasticity | 1980-2013,15 | 0.948 | 1.012 | 0.978 |
| Correl. coeffi. | 1980-2013,15 | 0.996 | 0.998 | 0.996 |
| Elasticity | 1980-2008 | 0.966 | 1.012 | 0.990 |
| Elasticity | 2009-2013,15 | 0.904 | 0.929 | 0.932 |

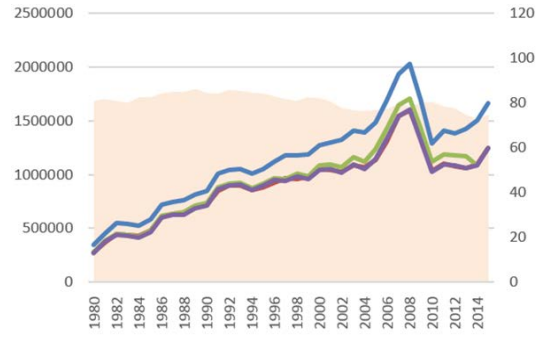



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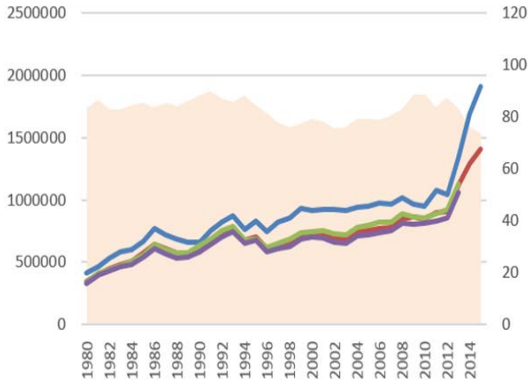
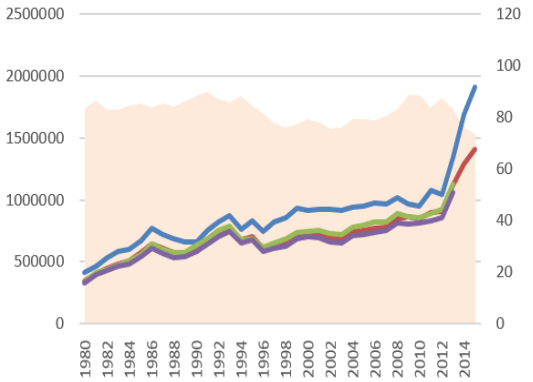
**TABLE 3-2**
**AUTO MANUFACTURERS**

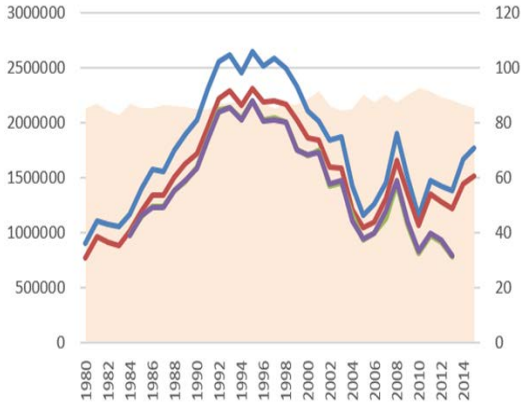
| FUJI HEAVY INDUSTRY | | | | |
|---|---|---|---|---|
| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
| Elasticity | 1980-2013,15 | 0.918 | 0.984 | 0.933 |
| Correl. coeffi. | 1980-2013,15 | 0.985 | 0.981 | 0.975 |
| Elasticity | 1980-1993 | 1.042 | 1.083 | 1.040 |
| Elasticity | 1994-2013,15 | 0.927 | 1.075 | 1.013 |



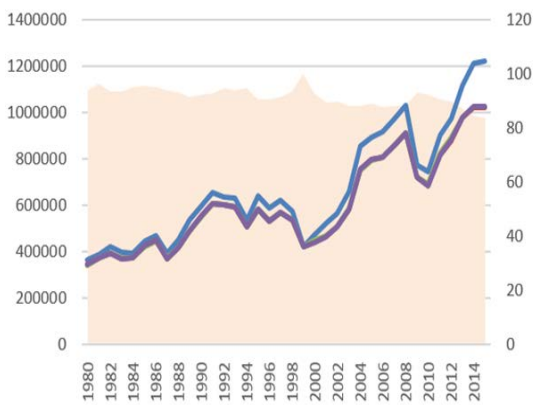

| DAIHATSU MOTOR | | | | |
|---|---|---|---|---|
| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
| Elasticity | 1980-2013,15 | 0.965 | 0.831 | 0.846 |
| Correl. coeffi. | 1980-2013,15 | 0.999 | 0.945 | 0.947 |
| Elasticity | 1980-1992 | 0.958 | 0.932 | 0.950 |
| Elasticity | 1993-2013,15 | 0.993 | 0.587 | 0.583 |




| MITSUBISHI MOTORS | | | | |
|---|---|---|---|---|
| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
| Elasticity | 1984-2013,15 | 0.966 | 1.126 | 1.108 |
| Correl. coeffi. | 1984-2013,15 | 0.996 | 0.967 | 0.969 |
| Elasticity | 1984-1992 | 0.991 | 0.974 | 0.971 |
| Elasticity | 1993-2013,15 | 0.957 | 1.177 | 1.153 |




| HINO MOTORS | | | | |
|---|---|---|---|---|
| | Period | Cost of Sales | Current Manufacturing Costs Incurred | Cost of Products Manufactured |
| Elasticity | 1980-2013,15 | 0.915 | 0.927 | 0.927 |
| Correl. coeffi. | 1980-2013,15 | 0.998 | 0.998 | 0.998 |
| Elasticity | 1980-1992 | 0.963 | 0.957 | 0.963 |
| Elasticity | 1993-2013,15 | 0.903 | 0.912 | 0.920 |

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