Data Construction and Productivity Analysis on the Medical Device Manufacturing Industry in Japan

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出版者	The Institute of Comparative Economic Studies, Hosei University
journal or publication title	Journal of International Economic Studies
volume	37
page range	5-21
year	2023-03
URL	http://doi.org/10.15002/00026476

Journal of International Economic Studies (2023), No.37, 5–21

Data Construction and Productivity Analysis on the Medical Device Manufacturing Industry in Japan*

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Abstract

Medical devices play an essential role in healthcare. However, statistics on the Japanese medical device industry are insufficient. This study provides statistics for Japan's medical device manufacturing industry from 1994 to 2016 using the Census of Manufacture (Ministry of Economy, Trade, and Industry). In addition, this study presents a fundamental analysis of industry, productivity analysis, and inter-industry comparison. As evaluated by labour productivity and total factor productivity, the medical device manufacturing industry (1) is research and development (R&D) intensive, (2) does not have sufficient investment in R&D, and (3) has low productivity. This study concludes that it is essential to improve the accuracy of data in the future and to publish data regularly.

Keywords: capital formation, medical device, productivity, R&D efficiency, statistics.

JEL classification: **D2, E2, I15.**

1. Introduction

Japan has faced problems in recent years with healthcare, including demographic changes, shortages of hospitals, financial stringencies, and COVID-19. In particular, the COVID-19 pandemic has been a significant challenge for modern medical technology and healthcare services in Japan.

The health services industry comprises three parts: hospitals, pharmaceuticals, and medical devices. Several studies have been conducted on hospitals and pharmaceuticals. However, there have been few economic analyses of the medical device industry. This seems to be due to the lack of adequate statistics on medical devices.

This study develops statistics for the medical device manufacturing industry. It also analyses the current state of the medical device industry based on these data.

The Census of Manufacture (Ministry of Economy, Trade, and Industry) was used to compile the statistical data. It covers the period 1994-2016 and is comparable to that of other industries.

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* As this paper is a revised version of MDSI Research Paper No.32, I thank Professor Sugahara of Hosei University, Dr. Horie (GEM in Gakushuin University), Mr. Kakino (GEM in Gakushuin University), and Mr. Watanabe (Doctoral Student in Gakushuin University) for their helpful comments and advice on the early version of this paper. Additionally, I thank the Faculty of Economics in Rissho University for excellent suggestions and advice. This study is supported by Medical Device Strategy Institute.

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Comparing the medical device industry with other industries enables improved understanding of the development of the medical device industry and its successes relative to other industries.

Even before the COVID-19 pandemic, the Japanese economy was limited by prolonged stagnation. Japan also faces a declining birth rate and an aging and shrinking population. The contribution of past economic development has sustained the current social security system in Japan. This implies that it may be impossible to maintain the system if economic stagnation continues. Under these circumstances, evidence-based policymaking is vital for promoting the medical device industry, which is an essential part of the healthcare sector. It is therefore necessary to develop more accurate statistics and develop the analysis conducted in this study.

The main findings of this study are as follows. First, although the medical device manufacturing industry (MED-MI) is research and development (R&D) intensive, its R&D investment has stagnated. Second, labour productivity and total factor productivity (TFP) growth are stagnant. Third, R&D profitability and efficiency are stagnant.

This paper consists of five sections. Following this introduction, the second section explains the estimation method for an outline of the data. The third section shows the productivity analysis of MED-MI. The fourth section presents the relationship between TFP growth and R&D efficiency. The final section summarises our results and discusses future work. The statistical data are provided in the Appendix.

2. Data construction and statistical analysis

This section defines the medical device manufacturing industry (MED-MI) analysed in this study. The wholesale and retail sectors of the medical device industry in MED-MI[1] are excluded, since the focus here is on the manufacturing sector to measure performance compared with other industries and to estimate how many medical devices they provide. However, no definition is completely consistent with the concept of MED-MI. It is necessary to classify industries in order to measure them. MED-MI is thus defined as the industries indicated in the Census of Manufacture (Ministry of Economy, Trade, and Industry). Table 1 shows the sectors MED-MI[2] is constructed from.

Table 1. Definition Set of MED-MI

Industry classification in the Census of Manufacture			
1	Textile sanitary materials	7	X-ray equipment
2	Sanitary clothing	8	Medical instruments electronic equipment
3	Paper sanitary materials	9	Medical measuring instruments
4	Medical and sanitary rubber products	10	Medical instruments and apparatus
5	Scientific glass instruments	11	Microscopes and telescopes
6	Sanitary pottery	12	Ophthalmic goods, including frames

To measure real variables about sales and value added, we construct price indexes used by the

1 The definition of MED-MI differs from that used by Ministry of Health, Labour and Welfare (MOH). The definition used in this paper excludes the sector for sales of on medical devices, while MOH statistics includes the sales sector.

2 Of course, these industries also manufacturing some goods for medical services, but it is not possible to separate out and exclude these medical goods.

System of National Accounts (SNA, Cabinet Office). Suppose a nominal x_i for the ith industry and an SNA deflator for the ith industry is p_i, then, the real value R is:

$$R = \sum \frac{x_i}{p_i} \tag{1}$$

If the aggregate of the current value x_i is X, then there exists a price index for X equal to X/R. Figure 1 shows the price indices for output yield and value added of MED-MI. Figure 1 shows that the trend of these price indices is declining. In 1997 it was 1.143 in terms of value added, but in 2016, it had dropped to 0.955. This means that deflation occurred at an annual rate of 0.94%. This price decline means cheaper healthcare for patients. However, for MED-MI, revenue is declining because the prices of traditional products are falling.

Figure 2 shows the output, and Figure 3 shows the value added of MED-MI.

Figure 1. Price Indexes for Output and Value Added (2011=1)

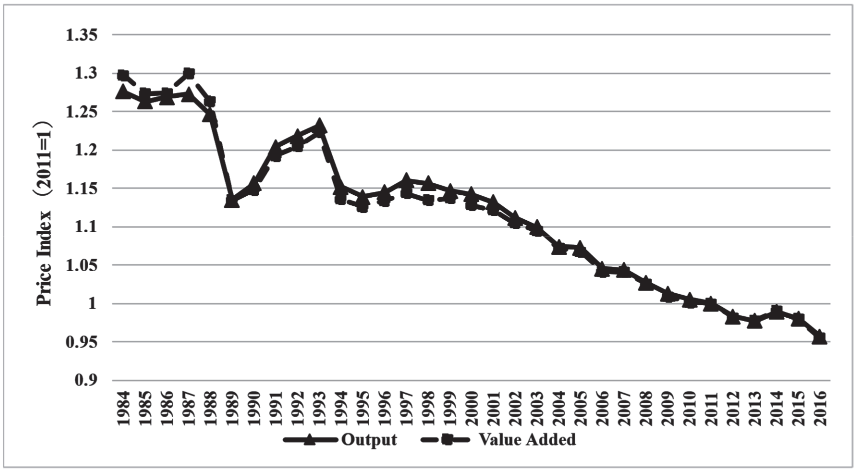


Figure 2. Output Value in MED-MI (Billion JPY)

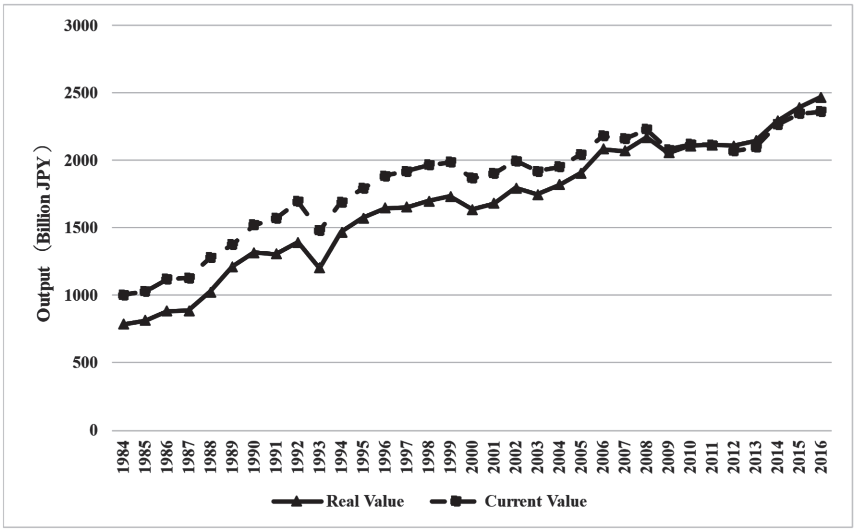
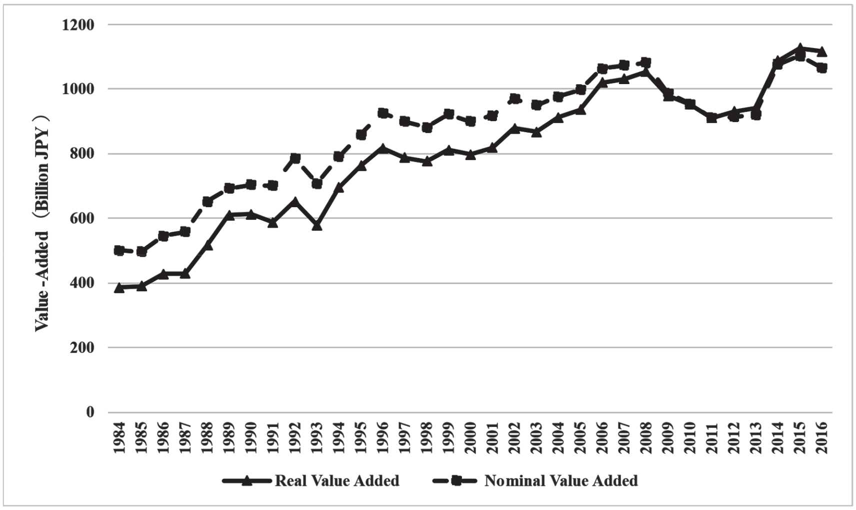


Figure 3. Value Added in MED-MI (Billion JPY)



Companies and stakeholders are often evaluated nominally. In the face of deflation, real value added increased by 38% between 1995 and 2008, while nominal value added increased by only 25%. In the MED-MI, therefore some people appear to think that revenues have not risen sufficiently despite the increase in production.

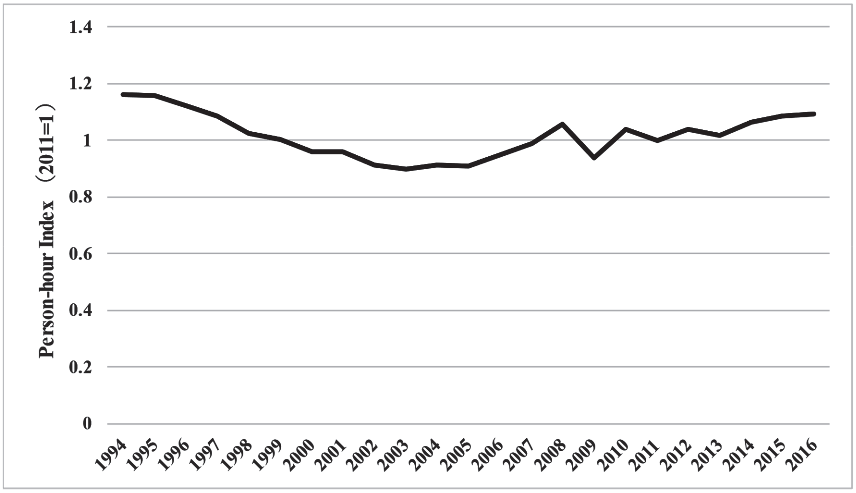
On the other hand, deflation also means that healthcare services with medical devices are provided at a low cost and the contribution to the public's health is immeasurable. Thus, it is necessary to simultaneously discuss the appropriate price of medical equipment and the spread of inexpensive medical services.

Certainly, MED-MI is growing, but the growth rate is declining. The growth rate of value added has also declined in recent years. In real terms, the annual growth rate was 5.7% before 2000 but has dropped significantly to 2.2% since 2000. After the global financial crisis occurred in 2008, value added declined drastically between 2008 and 2013, but it is unlikely that the financial crisis significantly impacted the frequency of MED-MI use. One interpretation is that Japan faced severe appreciation of the yen during this period. The strong yen may therefore have affected medical equipment exports.

Thus far, output data for MED-MI has been constructed. The factors MED-MI requires for output as input factors will now be estimated below.

First, labour input in MED-MI was measured. Labour input is evaluated in person-hours, the number of workers multiplied by the numbers of hours worked. The number of workers is taken from the Census of Manufacture. The labour hours are taken from SNA. Figure 4 shows the person-hour index.

Figure 4. Person-hour Index (2011=1)



The person-hour index declined until the early 2000s but has since increased; labour input increased by approximately 10% in 2016 compared to 2011.

Next, another factor required for production, capital, was estimated. Capital input is the balance of goods necessary for production held by a company and refers to goods that can be used repeatedly. Examples include tangible assets such as machinery, buildings, and vehicles. It also has intangible assets such as ideas and software, which are difficult to ascertain. Therefore, only R&D is included in capital stock. Capital accumulation is defined as follows:

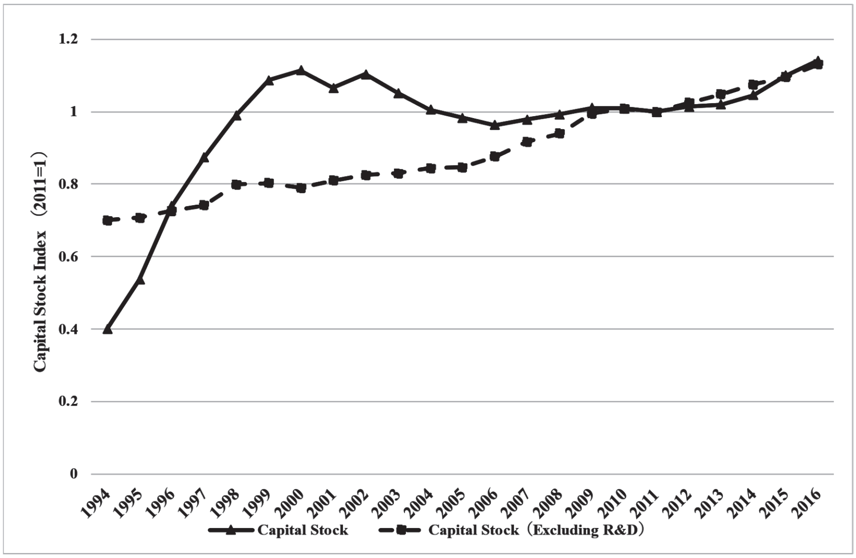
$$K_t^j = I_t^j + (1 - \delta^j) K_{t-1}^j \quad (2),$$

where I^j, K^j, and δ^j are investment (capital formation), capital stock, and depreciation for the jth asset. While SNA defines many assets the Census of Manufacture does not include all assets. Thus, only three tangible assets were measured: structures, constructions, machinery, and other assets. Other assets include transport equipment and tools. It was assumed that the other assets were mostly transport equipment. Here, it is also assumed that the expenditure for these assets are tangible capital investments. These expenditures are current values, but a real value for capital accumulation is needed. The capital goods deflators are taken from SNA. In addition, the depreciation rates are 3.76% (structure and construction), 17.01% (machinery), and 25.81% (other assets). These rates were estimated using the SNA average.

Recently, researchers have focused on both tangible and intangible assets. One of the representative intangible assets is R&D. In SNA, R&D, software, mineral exploration and evaluation, and entertainment originals are considered intangible assets. However, since we cannot measure R&D and software from the Census of Manufacture, R&D expenditure in MED-MI can only be estimated. Moreover, the medical instruments and apparatus category given in the Basic Survey of Japanese Business Structure and Activities (Ministry of Economy, Trade, and Industry) incur R&D expenditures. The rate of R&D expenditure to value added to medical instruments and apparatus was then calculated. This rate in other industries that constitute MED-MI was multiplied by the value added. The deflator of R&D expenditure is from SNA, and the depreciation rate is 15.76%[3].

Capital was accumulated from 1984, but data from 1984 to 1993 was not used to estimate the robustness of capital stock. Figure 5 shows the estimated index of capital stock in MED-MI.

Figure 5. Capital Stock Index



Excluding R&D (tangible assets only), capital stock is growing. In Japan, little capital stock growth occurred during the long period of stagnation known as the 'lost two decades.' However, capital stock growth in MED-MI is surprisingly high.On the other hand, the picture is different for more general capital stock, which includes R&D. Capital stock (including R&D) increased rapidly until 2000, after which it stagnated. It has also increased again since 2014. However, capital stock in 2016 was only at the same level as in 2002.

The significant difference between the capital stock of MED-MI and the stock of tangible assets is due to R&D. MED-MI is an R&D-intensive industry, and R&D stock accounts for more than 60% of the total capital stock. Therefore, when R&D investment declines, capital stock declines rapidly. owing to the high rate of R&D depreciation.

As R&D investment is expenditure on innovative technologies and products, MED-MI may aggressively invest in R&D. In the early 2000s, the Non-Performing Loan problem was severe. In addition, bursting of the IT bubble and other factors may have made it difficult to raise funds. Moreover, declining revenues and other factors are related to declines in R&D investment. Since 2013, however, monetary easing has improved access to finance and increased capital stock.

As argued by Ogawa and Suzuki (1998), and Suzuki (2001), companies in Japan have traditionally raised funds by using land as collateral. Here, landholdings, which are not directly used for production but are thought to be an asset, are considered. While purchased assets secure tangible asset investments, a typical feature of R&D is that it cannot be secured by intangible assets. Therefore, repayability is necessary for investments in intangible assets[4]. As MED-MI is an R&D-intensive industry, this financial constraint is considered more severe. Therefore, the market value

3 The depreciation rate of R&D is estimated from the SNA average.

4 See Brown and Petersen (2011).

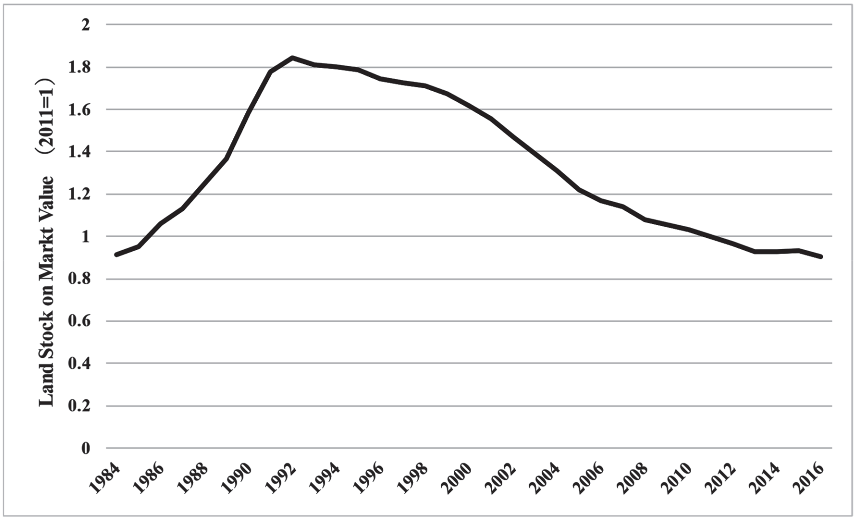
stock of land held by the MED-MI was measured.

Measuring land stock held by MED-MI at market-value[5] follows Ogawa and Suzuki (1998):

$$L_t = L_{t-1} \times \frac{P_t}{P_{t-1}} + (BL_t - RL_t) \quad (3).$$

where *BL*, *L*, *RL*, and *P* mean book-value land stock, market-value land stock, retirement land stock, and price level of the land. Figure 6 shows the effect of land stock on market value holdings by MED-MI.

Figure 6. Land Stock at Market Value (2011=1)



From 1984 to 1992, the market value stock of the land increased. The Japanese economy was in a bubble during this period because the land price was extremely high. In addition, MED-MI also increased land purchases due to the impact of prices. Indeed, between 1984 and 1992, land prices rose by 55%, whereas the market value of stocks held by MED-MI increased by 107%.

However, since 1992, the market value of the land stock has declined. This was due to the collapse of the bubble economy, which caused land prices to fall. However, from 1992 to 2013, land prices fell by 56%, whereas the land stock at market value decreased by 50%. Hence, MED-MI did not sell land to raise funds but continued to buy land.

Such a sudden depreciation of the land stock at market value leads to damage to the value of the collateral. Therefore, it is highly likely that MED-MI struggled to raise funds during this period. In addition, the land stock at market value in 2016 was always low. This means fundraising in 2016 may have been more challenging than in 1984. This is the context in which MED-MI has invested in tangible assets and R&D.

3. Productivity

This section presents the growth account theory used to measure economic growth. Economic growth occurs not only through labour input and capital but also through productivity growth.

5 By valuing land at market value, the price at which the land is actually sold is considered.

Productivity, which does not depend on these inputs was estimated. Here, the Cobb-Douglas production function is assumed as:

$$Y_t = A_t \, K_t^{\alpha} \, L_t^{1-\alpha} \qquad (4),$$

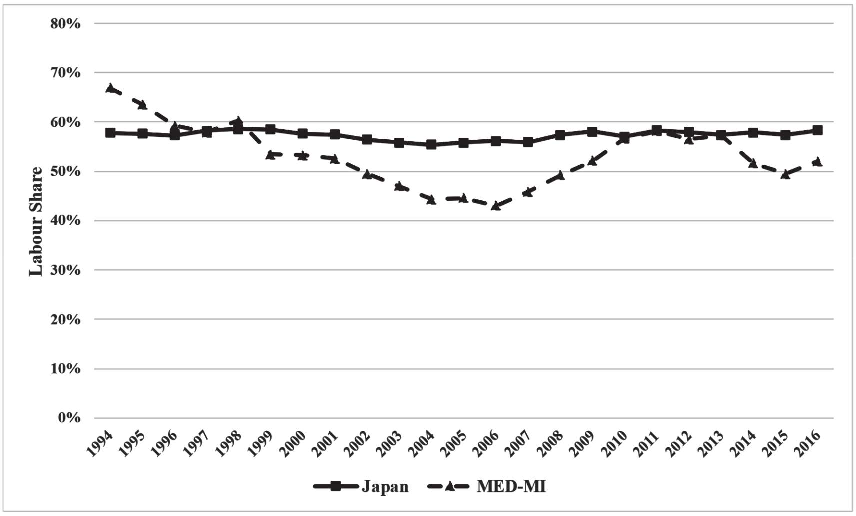
where Y_t is the real output, K_t and L_t are capital and labour inputs, A_t denotes the level of Total Factor Productivity (TFP), and α ($0 < \alpha < 1$) is the capital share.

From equation (4), following Solow (1956, 1957), Swan (1956), and Jorgenson and Griliches (1967), the growth rate of output using the capital and labour growth rates are obtained:

$$g_Y = g_A + \alpha \, g_K + (1 - \alpha) \, g_L \qquad (5),$$

where $g_{\cdot} = d \ln_{\cdot} / dt$ ($X = Y, A, K, or\ L$). From equation (5), TFP equals the growth rate of output excluding the growth rate of contribution of capital input ($\alpha \, gK$) and growth rate of contribution of labour input ($(1-\alpha) \, g_L$). To measure the contribution of labour and capital growth, labour share was used, which is the employer compensation divided by nominal value added. However, the Census of Manufacture does not include employee benefits. Employee benefit was then estimated as the total wage rate of an adjusted multiplier. This multiplier is (total wages + employee benefit) / value added. Figure (7) shows the labour share in MED-MI.

Figure 7. Movements of Labour Share

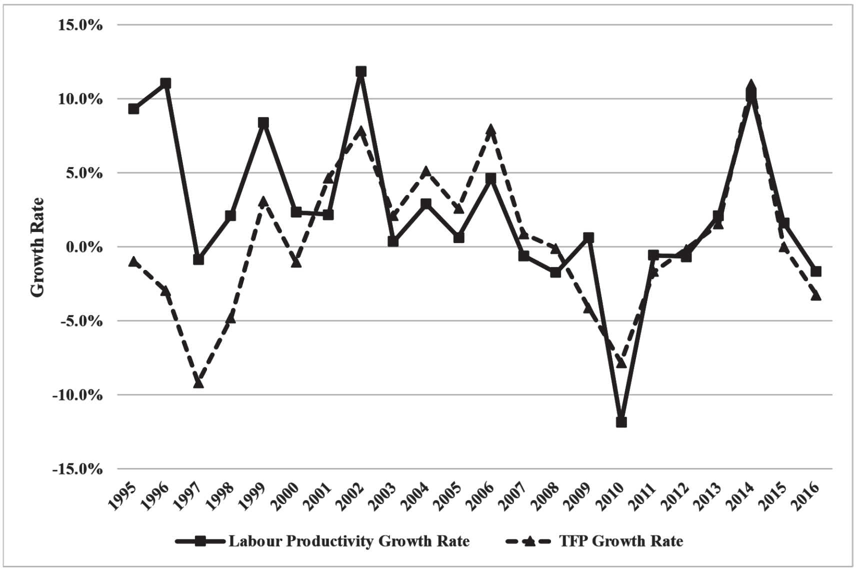


Note: From SNA and author estimation.

The labour share in Japan[6] is stable at approximately 58%. By contrast, labour productivity in MED-MI has been relatively dynamic. In 1994, the labour share was the highest, but in 2007, this trend declined. After 2007, the labour share approached Japan's average. Other countries have observed a declining trend in labour share. Karabarbounis and Neiman (2014) point out that the labour share decline is caused by high-performance and cheaper computers, improved information technology (IT) thus replacing labour work. Figure 8 shows the growth rates of labour productivity and TFP.

6 Labour share in Japan is (employer compensation + Taxes on Production and Imports)/ GDP by SNA.

Figure 8. TFP and Labour Productivity Growth Rates



Before the global financial crisis, the TFP growth rate was higher than labour productivity. The labour productivity growth rate was high before the global financial crisis but decreased after this crisis. On the other hand, the TFP growth rate was lower than the labour productivity rate before the early 2000s.

Beginning in 2013, an economic policy known as Abenomics was implemented. This led to a temporary pickup in productivity, which slumped again in 2015[7]. The differing movements in total factor productivity and labour productivity are due to differences in the input factors considered. The TFP growth rate is the growth in value added minus labour and capital contributions. Table 2 presents the growth rate of the value added of these contributing factors.

Table 2. Factor Decomposition of the Growth Rate of Value Added

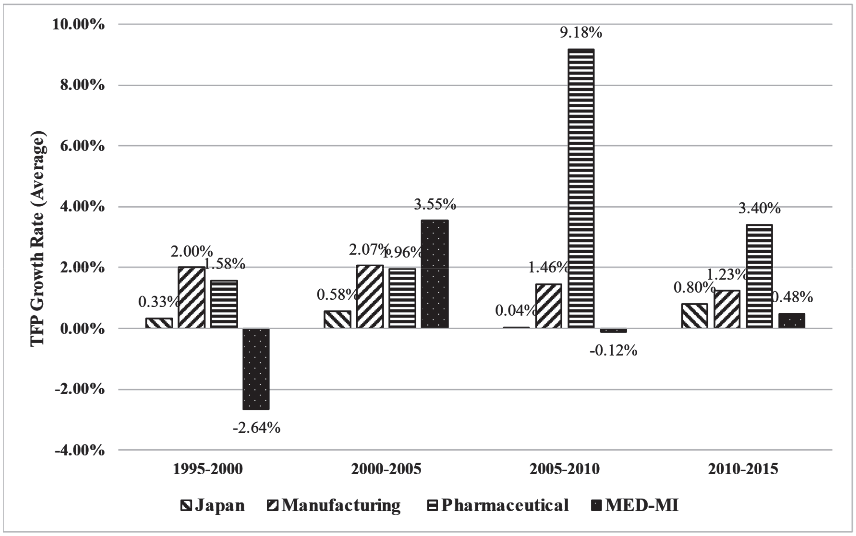
	1995-2000	2000-2005	2005-2010	2010-2015	1995-2005	2005-2015
Growth Rate of Value Added	2.09%	1.85%	1.01%	2.32%	2.36%	2.10%
Capital Contribution	6.64%	-0.90%	-0.02%	0.68%	3.02%	0.37%
Labour Contribution	-1.91%	-0.79%	1.15%	1.16%	-1.25%	0.82%
TFP Contribution	-2.64%	3.55%	-0.12%	0.48%	0.59%	0.91%

The growth of value added stagnated from 2005 to 2010 but averaged around 2%, indicating that MED-MI had very high growth. In contrast, Japan's GDP growth rate averaged 0.8% from 1995 to 2016. Capital contribution grew at a very high rate from 1995 to 2000 but declined and has barely grown since 2000. In particular, the growth rate of capital contribution was negative in the 2000s, and this capital slump led to a recession in the growth rate of value added. However, the labour contribution was negative until 2005, but its growth rate later exceeded 1%.

7 Why do economic phenomena such as the financial crisis and Abenomics affect the healthcare sector? One possible reason is due to trade. However, analysing what is actually occurring is a subject for future work.

From 1995 to 2005, capital and TFP were the growth drivers. However, from 2005 to 2015, there was a turnaround, with TFP accounting for approximately half of the growth. Thus, it can be said that MED-MI growth was dependent on an increase in TFP. In addition, the capital contribution was approximately 20%, and the stagnation of capital accumulation restrained the growth of value added. Figure 9 shows the TFP growth rates of MED-MI and other industries.

Figure 9. Industry Comparison of TFP Growth Rate



Note: JIP Database 2021[8] and author estimation.

Thus MED-MI experienced high growth during the 2005-2010 period. However, the rest of the period saw shallow growth, not only in the manufacturing sector but also in Japan. From 2005 to 2010, the pharmaceutical industry, in the same medical sector, grew by 9%. Even for the entire period, the growth rate differed from that of MED-MI by approximately 2%. Therefore, it is not the medical field that is stagnant; the stagnation is a problem specific to MED-MI.

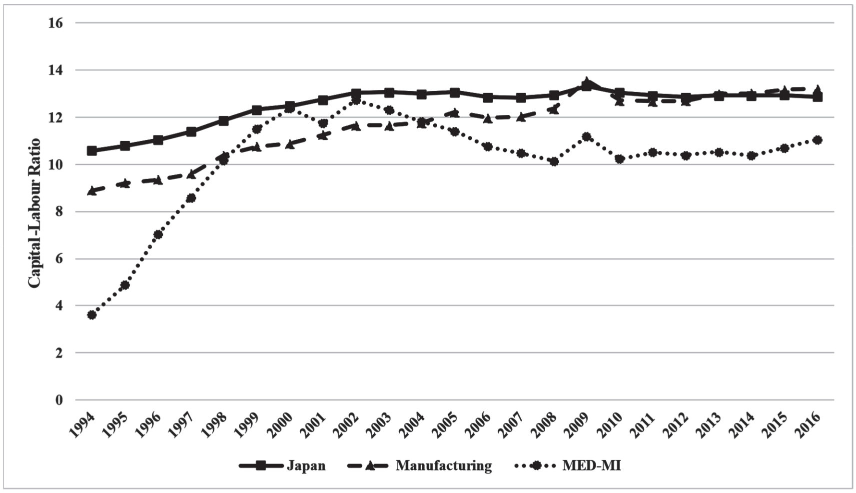
How should the relationship between TFP and labour productivity be considered? The focus is placed on the relationship between TFP and labour productivity to answer this question. This relationship is expressed as follows:

$$g_{LP} = g_{TFP} + \alpha g_{K/L} \quad (6),$$

where g_{LP}, g_{TFP}, and $g_{K/L}$ represent the growth rate of labour productivity, the growth rate of TFP, and the growth rate of the capital-labour ratio. The capital-labour ratio implies that capital is divided by the person-hour labour force. This equation means that movement the capital-labour ratio affects labour productivity growth through the TFP growth rate. Figure 10 shows the movement in the capital-labour ratio.

8 https://www.rieti.go.jp/jp/database/JIP2021/

Figure 10. Movements in the Capital-Labour Ratio



Note: SNA and author estimation.

In Japan, the capital-labour ratio has stagnated since 2000, and the manufacturing sector has stagnated since the global financial crisis (2009). In contrast, MED-MI underwent a more significant change as: the capital-labour ratio rose rapidly until 2000. In the 2000s, however, the capital-labour ratio declined. This decline in the capital-labour ratio may have caused a decline in labour productivity.

Slow capital accumulation has caused a decline in the capital-labour ratio. This implies sluggish capital investment. Investment in intangibles, as typified by R&D, is also weak. Since MED-MI is an R&D-intensive industry, its capital stock has not grown due to sluggish R&D investment.

Sluggish investment can create problems not only for the capital-labour ratio but also for production. Weak investment means that old equipment is not replaced by new equipment. This new equipment embodies new technology which old equipment does not have. Hence, production efficiency may be declining.

TFP often indicates technological progress, but it is unrealistic to achieve progress using old production technologies; sufficient investment is essential to promote MED-MI and produce world-class medical devices.

4. R&D efficiency

This section focuses on total factor productivity (TFP): an increase in TFP increases the economy's growth rate as a whole, that is, the growth rate of value added. The previous section confirms that an increase in TFP also increases labour productivity. Therefore, the challenge is to increase TFP.

The idea that TFP captures a certain percentage of technological progress is common. Working more efficiently with new technologies or successfully using production equipment through ideas is included in TFP. The source of these ideas and new technologies in R&D investment is expenditure on equipment, materials, and others used in R&D. Here, the focus is shifted to the relationship between TFP growth and R&D. The endogenous growth theory, one of the theories of economic growth, formulates the relationship between R&D and TFP. Griliches (1998) expresses it as follows;

$$g_{TFP} = R_{R\&D} \times S_{R\&D} \quad (7),$$

where $R_{R\&D}$ and $S_{R\&D}$ are the rate of return on R&D, and R&D intensity. From equation (7), the rate of return on R&D is evaluated by dividing the growth rate of TFP by R&D intensity. R&D intensity refers to the share of R&D expenditure in value added. Figure 11 and Table 3 show the rates of return on R&D.

Figure 11. Rate of Return on R&D

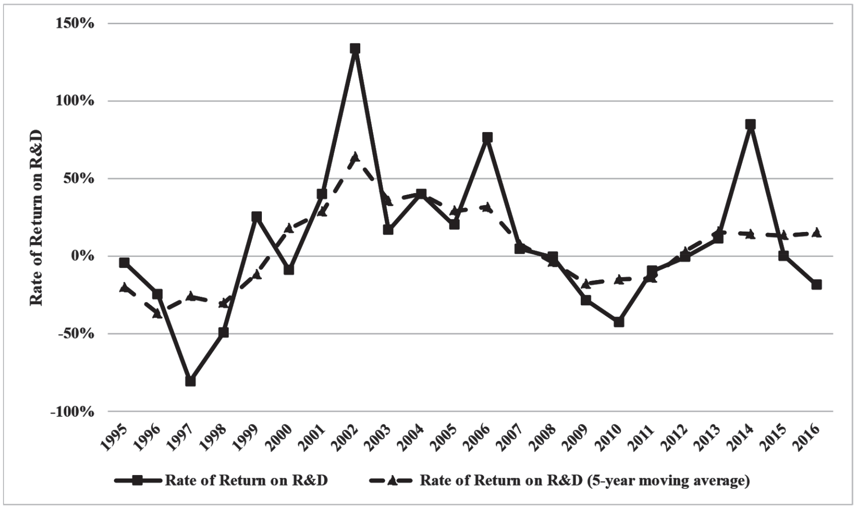


Table 3. Rate of Return on R&D

	All terms	1995-2005	2005-2016	2000-2008	2012-2016
Rate of Return on R&D	8.23%	9.64%	6.82%	35.56%	15.23%
Rate of Return on R&D (5-year moving average)	6.16%	7.98%	4.34%	27.59%	12.09%

TFP often takes a negative value, resulting in a lower R&D rate of return. However, comparing 1995-2005 and 2005-2016, the latter was 30-50% lower than the former. Between 2000 and the global financial crisis (2009), and 2012-16, after the Great East Japan Earthquake, the latter was less than half of the former. This significant reduction in the rate of return is problematic.

The relationship between TFP and R&D is sometimes considered to concern R&D efficiency rather than R&D profitability. It is a structure in which R&D activities increase TFP through R&D efficiency, as follows:

$$g_{TFP} = E_{R\&D} \times L_{R\&D} \quad (8),$$

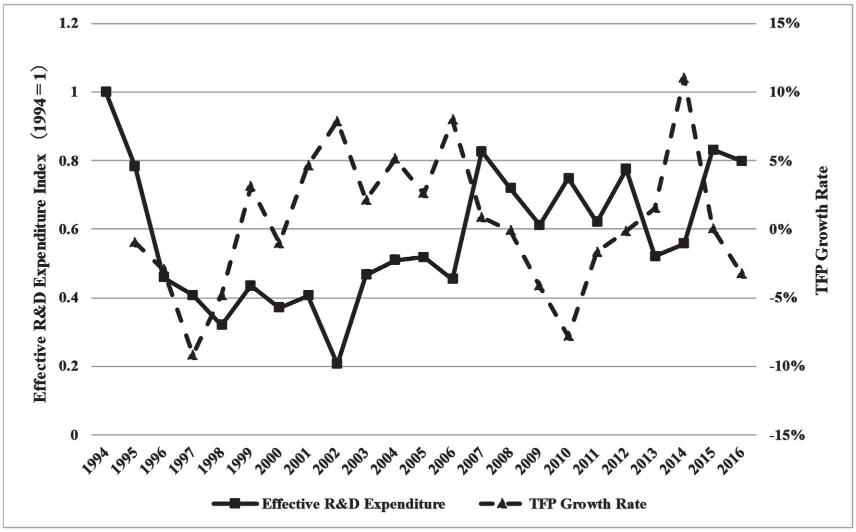
where $E_{R\&D}$ and $L_{R\&D}$ represent the efficiency of R&D and the number of R&D workers.

R&D workers often signifies that a large number of researchers are employed. However, despite an increase in the number of researchers, the TFP growth rate declined. Bloom et al. (2020) pointed out that R&D efficiency is declining. They explain the decline in R&D efficiency within the framework of economic theory. The authors conducted their analysis using effective R&D

expenditure, where R&D expenditure is evaluated in terms of researchers' wages rather than the number of researchers. As a result, they confirm that R&D efficiency has declined significantly in the US healthcare as well as in agriculture and the high-tech industries. Miyagawa and Ishikawa (2019) used these ideas in their analysis. Their results confirm that R&D efficiency is declining in Japanese manufacturing, albeit more slowly than in the USA.

Figure 12 shows the relationship between effective R&D expenditure and the TFP growth rate in MED-MI.

Figure 12 Relationship Between Effective R&D and TFP Growth



There is, no significant difference between the wages of researchers and general workers in Japan. The average MED-MI wage was used as the researcher's wage. Since 1998, TFP has remained stable, except for around 2009. However, effective R&D expenditure is at a lower level than that in 1994. Since 1997, effective R&D expenditure has risen, but its value in 2016 was lower than in 1994. Table 4 shows that R&D efficiency in MED-MI is evaluated through effective R&D.

Table 4. R&D Efficiency (1995-2000 = 1)

	2000-2005	2005-2010	2010-2016	2000s	2010s
R&D Efficiency	1.23	0.86	0.76	1.09	0.76

R&D efficiency in1995-2000 was standardised as 1. In 2000-2005, R&D efficiency was higher than in 1995-2000. However, since 2005, R&D efficiency has declined. In 2010-2016, efficiency fell by 24% compared to 1995-2000. This means that R&D was more successful in the 2000s than the 2010s. R&D profitability was also twice as high in the 2000s, when MED-MI enjoyed the benefit of innovation, as in the 2010s. Since 2010, the problem has been the stagnation of R&D profitability and efficiency, indicating stagnant TFP growth rates. Therefore, it is necessary to increase R&D efficiency and profitability to develop MED-MI.

5. Conclusion

The statistical data on MED-MI in this study were initially generated and then analysed for productivity. Four main results were obtained. First, MED-MI always faces a price decline (deflation). Therefore, real value added exceeds nominal value added. Second, MED-MI is an R&D-intensive industry. However, R&D investment has stagnated, and the capital stock has not increased. This may be due to insufficient financing for R&D investment, and funding needs to be discussed in MED-MI. Third, labour productivity growth remained high until the early 2000s. Since then, however, labour productivity growth has stagnated. This stagnation in the labour productivity growth rate can be attributed to the stagnation of the capital-labour ratio. Finally, the sluggish TFP growth rate is explained by the decline in R&D efficiency and profitability. Aggressive R&D investment is needed, but market structures and institutions may have contributed to these declines, which will need to be discussed in the future.

The stagnation of the capital-labour ratio is not a problem unique to Japan. According to Miyagawa and Ishikawa (2021), developed countries have experienced a slump in the capital-labour ratio since the global financial crisis. A shift to investment in intangible assets can explain the capital-labour ratio slump. Intangible assets depreciate rapidly and are challenging to grasp. Kim, Gong, and Fukao (2019) argue that Japan's long-term stagnation is due to slow capital accumulation. MED-MI has a high growth rate of value added but a sluggish TFP growth rate and investment. MED-MI urgently requires investment promotion and deregulation to improve its growth.

There can be no evidence-based policymaking without data. The indicators in this study are inadequate; regular and continuous data publications are necessary to develop MED-MI. For this reason, our future works will include improving the data and creating data that take into account software and other intangible assets that could not be measured in this paper. Moreover, as a further future task, we would also like to develop an input-output table.

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Appendix: Statistics

Statistics on Medical Device Manufacturing Industry in Japan

Name	Output		Value Added		Total Wage	Employee benefit	Labour	Person-hour	Nominal Investment				
	Current Value	Real Value	Current Value	Real Value						Structures and Constructions	Machinery and Equipment	Others	R&D
Unit	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY	Number	1000 hours	million JPY	million JPY	million JPY	million JPY	million JPY
1994	1691639.00	15002.90	790516.00	701097.00	354574.00	174102.80	92748.00	186236.21	260940.34	15861.00	28419.00	13229.00	203431.34
1995	1790921.00	16030.39	858453.00	768394.29	370778.00	174736.64	92120.00	185985.53	222320.47	14557.00	26387.00	13799.00	167577.47
1996	1885552.00	16743.86	926915.00	823108.09	363746.00	185901.01	88467.00	178418.56	162390.12	19484.00	28988.00	13487.00	100431.12
1997	1919385.00	16822.08	900221.00	788981.40	364567.00	156852.51	86623.00	172519.50	152051.79	17251.00	28427.00	15313.00	91060.79
1998	1964800.00	17177.92	881617.00	770783.09	372097.00	159704.84	83497.00	165049.02	165075.92	29305.00	43779.00	16179.00	75812.92
1999	1984561.00	17495.95	922586.00	813354.71	351534.00	141016.31	81602.00	160091.84	155608.00	15813.00	25379.00	14742.00	99674.00
2000	1869409.00	16523.02	899198.00	794768.18	344753.00	133708.81	77373.00	152825.94	132468.12	8944.00	23996.00	11654.00	87874.12
2001	1903225.00	16965.04	918540.00	818771.76	346766.00	135734.81	78039.00	154040.07	158736.26	20209.00	28776.00	13940.00	95811.26
2002	1994981.00	18088.11	970320.00	879770.29	346763.00	133118.00	74552.00	147061.61	110848.40	17058.00	29379.00	13216.00	51195.40
2003	1920455.00	17577.06	950232.00	869704.36	318738.00	127453.43	72320.00	144852.02	161764.71	13755.00	26039.00	12519.00	109451.71
2004	1894887.00	17736.09	977266.42	892600.60	305241.00	117154.81	72272.00	144418.99	174425.45	10584.00	36993.00	12432.00	114416.45
2005	1983603.00	18515.76	998216.27	908885.55	312056.00	121682.27	73264.00	146141.21	169978.85	13603.00	25233.00	13824.00	117318.85
2006	2117421.00	20207.19	1062876.78	990049.83	327889.00	118814.44	75655.00	152024.79	174583.62	20421.00	33914.00	15674.00	104574.62
2007	2157985.00	20638.61	1073470.00	1026648.99	359640.00	132898.11	79109.00	158573.60	279865.86	24831.00	40181.00	15185.00	199668.86
2008	2227990.00	21683.95	1081160.00	1052240.73	383130.00	149202.84	85603.00	165405.13	243526.52	21085.00	33274.00	17958.00	171209.52
2009	2079401.00	20585.34	988050.00	978134.68	353479.00	161909.34	82648.00	152767.66	231728.53	34528.00	42084.00	15831.00	139285.53
2010	2116685.00	21036.16	954424.00	948530.90	375010.00	166366.69	85812.00	166814.53	242277.98	22443.00	29830.00	16060.00	173944.98
2011	2115544.00	21155.44	910613.00	910613.00	389207.00	140342.70	82335.00	161047.98	210627.49	14661.00	27221.00	12663.00	156082.49
2012	2070161.00	21043.20	913245.00	928314.35	377453.00	138549.10	84993.00	165290.30	256606.25	19581.00	39248.00	14756.00	183021.25
2013	2095730.00	21416.47	920108.00	940267.38	389737.00	137111.77	83690.00	163909.43	204547.75	25879.00	34222.00	15459.00	128987.75
2014	2264637.00	22854.21	1076675.00	1086556.53	416954.00	138629.91	86749.00	170881.44	223113.86	29213.00	34012.00	17378.00	142510.86
2015	2345000.00	23898.38	1103161.00	1124254.28	398048.00	148018.62	87926.00	173959.02	277742.42	25614.00	36888.00	14947.00	200293.42
2016	2361463.00	24586.37	1066751.00	1110647.77	406093.00	148864.55	88988.00	174752.10	281987.70	28882.00	41242.00	18181.00	193682.70

Statistics on Medical Device Manufacturing Industry in Japan (Continued)

Name	Real Investment					Capital Stock					Land Market Value Stock	Total Factor Productivity	
		Structures and Constructions	Machinery and Equipment	Others	R&D		Structures and Constructions	Machinery and Equipment	Others	R&D		Production Based	Value Added Based
Unit	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY	million JPY		
1994	251579.99	15943.82	24648.92	8596.04	202391.21	678323.43	257534.16	139015.43	33229.38	516476.82	272234.53		
1995	213005.93	14719.97	23182.72	8366.28	166736.96	910079.55	262570.84	138537.72	33019.16	605742.25	269725.52	-0.0351239	-0.0097100
1996	152951.28	19643.03	25543.27	8302.62	99462.36	1255353.56	272341.21	140501.88	32799.54	614343.27	263521.01	-0.0550232	-0.0297839
1997	141606.49	17298.91	25073.55	9774.40	89459.63	1483343.64	279400.09	141662.01	34108.38	611651.41	261016.60	-0.0447056	-0.0917114
1998	153953.03	29869.34	38582.13	10442.66	75058.90	1680582.77	298763.98	156133.27	35747.67	594962.59	258540.28	-0.0039297	-0.0481979
1999	148811.93	16353.10	22768.81	10248.08	99441.94	1844190.86	303883.56	152328.19	36769.28	605160.15	253051.85	-0.0043997	0.0310160
2000	126488.23	9236.14	21842.17	7886.60	87523.33	1891786.41	301693.67	148244.10	35165.72	601909.45	244061.09	-0.0443585	-0.0102604
2001	154422.04	21037.08	26668.26	10394.61	96322.09	1809593.23	311387.07	149681.22	36484.06	607945.12	235202.22	0.0431517	0.0465064
2002	107643.78	18032.63	27180.75	10739.15	51691.26	1873553.69	317711.54	151386.22	37806.68	568444.61	222339.12	0.0707178	0.0784735
2003	160188.02	14515.72	24883.03	10764.96	110024.31	1784062.14	320281.31	150503.32	38813.73	593202.23	210057.87	0.0039879	0.0211405
2004	171321.64	11158.84	34461.67	10848.94	114852.20	1707538.27	319397.57	159349.32	39644.85	619074.09	197731.35	0.0342113	0.0511901
2005	168027.62	14167.18	24164.49	12276.51	117419.44	1668227.97	321555.40	156392.55	41689.03	643632.42	184721.40	0.0507000	0.0257593
2006	170849.66	21022.42	32112.94	14260.13	103454.17	1635212.83	330487.34	161887.48	45189.22	650541.73	176442.24	0.0813609	0.0794807
2007	274259.16	25145.20	38224.06	13619.77	197270.13	1661534.67	343206.22	172558.29	47145.65	750230.60	172253.78	-0.0064976	0.0086771
2008	235126.11	20381.47	31874.59	16093.93	166776.11	1679883.76	350683.13	175063.46	51071.29	804472.13	163343.26	0.0235888	-0.0011979
2009	232197.87	34302.06	40932.19	14990.40	141973.22	1710091.23	371799.50	186199.85	52880.19	825774.53	159653.34	-0.0204837	-0.0415203
2010	242237.15	22561.70	29550.71	15550.45	174574.28	1708937.06	380381.54	184059.35	54782.26	876482.63	155913.43	-0.0259189	-0.0783155
2011	210627.49	14661.00	27221.00	12663.00	156082.49	1693521.91	380740.20	179953.45	53305.96	901092.72	151120.84	0.0297179	-0.0167329
2012	256531.12	19587.94	39042.14	15000.42	182900.62	1717385.94	386012.31	188367.51	54548.11	948829.43	145958.23	-0.0261963	-0.0016245
2013	204199.88	25655.47	33639.80	15769.95	129134.66	1726822.93	397153.71	189947.16	56239.19	935639.68	140313.57	0.0199916	0.0152029
2014	220497.54	28408.08	33046.53	17543.13	141499.80	1772496.37	410628.81	190664.69	59266.99	936793.53	140112.60	0.0304055	0.1100347
2015	274217.31	24659.10	35468.67	14945.75	199143.80	1863893.02	419848.27	193682.23	58915.92	995418.29	140599.66	0.0107898	0.0002210
2016	279829.57	27896.19	39906.37	18181.78	193845.22	1933867.20	431958.17	200623.88	61891.51	1039950.77	136799.57	0.0079261	-0.0326320