This paper studies resource misallocation across manufacturing plants and its effect on manufacturing total factor productivity (TFP) in Thailand using data from the 2007 Industrial Census. The study shows that there is more resource misallocation across plants in Thailand than in China, India, and the United States. When misallocation of capital and labor were hypothetically reduced to the extent observed in the United States, manufacturing TFP would increase by about 70 percent. The results also indicate that plants which have government ownership or are located in the northern or the northeastern regions have lower plant productivity and face lower distortions than other plants. In addition, plants with medium size face larger distortions than small and large plants. Future research on resource misallocation thus should focus on plants with government ownership or located in the northern or the northeastern regions.

Keywords: resource misallocation, manufacturing, productivity, TFP, Thailand

e-mail address: fecospd@ku.ac.th

1 Department of Economics, Faculty of Economics, Kasetsart University, Bangkok, 10900
INTRODUCTION

The 1997 Asian financial crisis shed light to the significance of the connection-based economic and financial system in Thailand. McMillan and Woodruff (1999) and Johnson, McMillan, and Woodruff (2002) find that the reliance on connections in developing economies arises from deficiency of formal institutions including the legal system. Leightner (2007) argues that some politicians considered loans from the Bangkok Bank of Commerce, which collapsed in 1996, as bribes and had no intention to repay. In 1996, many Thai financial institutions also faced serious cash flow problems due to non-performing loans which were granted to the real estate sector. Also, Bualek (2000) argues that the founders of most Thai commercial banks set up banks in order to channel funds to their own non-bank businesses. These are signs of a large extent of resource misallocation in Thailand.

Using a model incorporating heterogeneous firms facing different levels of distortions, Restuccia and Rogerson (2008) show that resource misallocation across firms can significantly lower total factor productivity (TFP). Using data on manufacturing plants, Hsieh and Klenow (2009) estimate that, when misallocation of capital and labor across plants is hypothetically reduced to the extent observed in the United States, China’s and India’s manufacturing TFP will increase by about 30-50 percent and about 40-60 percent respectively.

In Thailand, the manufacturing industry has a major contribution to the economy’s output. The manufacturing sector contributes about 40 percent of Thailand’s GDP. The manufacturing TFP therefore might have an important role on Thailand’s aggregate TFP. Specifically, due to potentially large resource misallocation in the manufacturing industry, the productivity of Thai economy may be significantly lowered. This paper applies the model and the method from Hsieh and Klenow (2009) to data on Thai manufacturing plants to study the extent of resource misallocation and its effect on productivity. The data are taken from Thailand’s 2007 Industrial Census which was conducted by the National Statistical Office.

DATA AND METHOD

The data are obtained from Thailand’s 2007 Industrial Census, which was conducted by the National Statistical Office during the third quarter of 2007. The data set is a census of all manufacturing plants with more than ten workers and a stratified systematic sample of manufacturing plants with ten workers or less. The population of manufacturing plants with ten workers or less is stratified by province, class of industry code, and class of size measured by employment. The census provides information on plant characteristics over the calendar year of 2006. The raw data consist of around 70,000 plants.
The variables from the Industrial Census are the plant’s industry (four-digit ISIC), employment, remuneration, intermediate cost of production, value of production, and fixed assets. Specifically, the plant’s remuneration reported by the census includes wage payment, overtime payment, bonus payment, special payment, cost of living allowance, commission, fringe benefits, and employer’s contribution to social security. To get the plant’s value added, the intermediate cost of production is subtracted from the value of production. In addition, the census reports the book value of fixed assets at the beginning and at the end of the calendar year. the capital stock is defined as the average of the book value of fixed assets at the beginning and at the end of the calendar year. The census also provides information on the plant’s region, ownership, age, exports, investment promotion from the board of investment (BOI), and research and development (R&D).

For comparability with other studies, the industry’s labor share is set to that in the corresponding industry in the United States. The data comes from the NBER-CES Manufacturing Industry Database, which is based on the Census of Manufactures and the Annual Survey of Manufactures. Since Thailand’s Industrial Census and the NBER-CES Manufacturing Industry Database use different industry codes, the four-digit U.S. SIC code is matched with the four-digit ISIC Rev.3 code used in Thailand's Census. For any ISIC code with more than one corresponding U.S. SIC codes, the total payroll and the total value added of all corresponding U.S. industries are used to calculate the labor share. The data however is known to omit fringe benefits and employer’s Social Security contributions so that the labor share from this data is about two-thirds of what it is in manufacturing from the National Income and Product Accounts, which take into account nonwage forms of compensation. Following Hsieh and Klenow (2009), each industry’s labor share is scaled up by 3/2 to get the labor share assumed for the benchmark case. After dropping plants that report negative or zero value added and those that report zero employment, remuneration, or fixed assets, there are about 50,000 plants left.

To study resource misallocation in Thai manufacturing industry and its effect on the manufacturing TFP, the model developed by Hsieh and Klenow (2009) is used. It is a standard model of monopolistic competition with heterogeneous firms, which not only have different productivity levels but also face different output and capital distortions. These distortions cause dispersion in the marginal products of capital and labor across firms and consequently lower the TFP.

RESULTS AND DISCUSSION

Figure 1 plots the distribution of plant physical productivity (TFPQ or A). Specifically, it plots

$$\log\left(A_2; M_2^{\frac{1}{2}-1}/\bar{A}_2\right)$$

which measures the log of A relative to industry means, $\log\left(\bar{A}_2/M_2^{\frac{1}{2}-1}\right)$. Compared to China, India, and the United States, studied by Hsieh and Klenow (2009), there is
clearly more TFPQ dispersion in Thailand. Particularly, the left tail of TFPQ is thicker in Thailand. It indicates that there is more TFPQ dispersion in Thailand.

Figure 2 plots the distribution of plant revenue productivity (TFPR). Specifically, it plots $\log(\frac{TFPR_{si}}{TFPR_{s}})$ which measures the log of TFPR relative to industry means. Compared to the United States studied in Hsieh and Klenow (2009), there is obviously more TFPR dispersion in Thailand. This indicates that there are greater distortions in Thailand.

![Figure 1 Distribution of TFPQ. Note: log(TFPQ) are measured relative to industry means.](image1)
![Figure 2 Distribution of TFPR. Note: log(TFPR) are measured relative to industry means.](image2)

The same exercise as in Hsieh and Klenow (2009) is then performed by calculating the TFP gain from equalizing marginal products across plants within the same industry. Specifically, the ratio of the actual TFP to the efficient TFP when TFPR are fully equalized across plants in each industry is calculated using the following equation:

$$\frac{TFP_{actual}}{TFP_{efficient}} = \prod_{s=1}^{S} \left[ \sum_{i=1}^{M_s} \left( \frac{A_{zi}}{A_{s} TFPR_{si}} \right)^{\alpha-1} \right]^{\frac{\theta_s}{\alpha-1}}.$$
where $A_s = \left[ \sum_{i=1}^{N} A_{si} \sigma^{-1} \right]^{\frac{1}{\sigma-1}}$ is the efficient industry TFP calculated assuming $\text{TFPR}_{st} = \text{TFPR}_{s}$ for all $i$. Table 1 shows that the TFP gain from equalizing TFPR within industries in Thailand is about 148 percent. The gain is high compared to those in China, India, and the United States reported by Hsieh and Klenow (2009). Interestingly, manufacturing of automobile parts is one of the industries that contribute most to the reallocation gain. Table 2 reports the proportion of TFP gains relative to that in the United States in 1997. If Thailand moved to the U.S. efficiency, TFP would increase by 73 percent. This increase is high compared to those found for China and India by Hsieh and Klenow (2009).

Table 1 TFP gains from equalizing TFPR within industries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP gain</td>
<td>147.8%</td>
<td>86.6%</td>
<td>127.5%</td>
<td>42.9%</td>
</tr>
</tbody>
</table>

Source: Author’s calculations and Hsieh and Klenow (2009).

Note: Entries are $100\left(\frac{\text{TFP}_{\text{efficient}}}{\text{TFP}} - 1\right)$

Table 2 TFP gains from equalizing TFPR relative to the U.S. gain

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP gain relative to the U.S. gain</td>
<td>73.4%</td>
<td>30.5%</td>
<td>59.2%</td>
</tr>
</tbody>
</table>

Source: Author’s calculations and Hsieh and Klenow (2009).

Note: Entries are $100 \left(\frac{\text{TFP}_{\text{efficient}}/\text{TFP}_{\text{country}}}{\text{TFP}_{\text{efficient}}/\text{TFP}_{\text{US}}} - 1\right)$

So far, the exercise assumes a fixed aggregate capital stock. An increase in TFP however can cause an upward pressure in capital rental rate. To keep the rental rate of capital constant, capital must accumulate. If the aggregate capital stock is allowed to change through, say, the import of capital, the output elasticity with respect to TFP is $1/(1 - \sum_{s=1}^{S} \alpha_s \theta_s)$. Since the weighted average capital share is 45 percent, a 73 percent gain in TFP could yield a 133 percent long-run gain in output.

Figure 3 plots the efficient and the actual size distribution of plants. Size is measured as plant value added. Specifically, the efficient output is given by $\left(\frac{\bar{A}_s}{M_s} \sigma^{-1} \right) R_{st}^{\alpha_s} L_{st}^{1-\alpha_s}$ and the actual output is given by $\left(\frac{P_{st} Y_{st}}{\bar{A}_{st}}\right)^{\frac{\sigma}{\sigma-1}}$. The hypothetical efficient distribution is less dispersed and its peak is
located more rightward than the actual one. This means that there should be fewer small plants and more medium to large plants. The right tail of the efficient distribution however is similar to that of the actual one. This means that the number of very large plants should remain the same. Note that most very large plants are owned by companies and public companies.

![Distribution of plant size](image)

**Figure 3** Distribution of plant size. Note: Plant size is measured as log of plant value added.

How TFPQ and TFPR correlate with plant characteristics are then analyzed by performing some regressions using TFPQ and TFPR as the dependent variables. Specifically, the log of TFPQ relative to industry means and the log of TFPR relative to industry means are regressed on firm characteristics including ownership, export, government support, research and development, age, size, and location. Plants owned by individuals or the government have significantly lower TFPQ, indicating that they have lower productivity than other plants. In contrast, plants owned by companies and juristic partnerships have higher TFPQ, indicating that they have are more productive than other plants. Note that juristic partnerships include general partnerships and limited partnerships. Plants which have foreign ownership, export their products, or have research and development have higher TFPQ or productivity than plants that do not. Plants receiving investment promotion from the Board of Investment (BOI) tend to be more productive than plants that do not. It is however unclear whether such investment promotion increases plant productivity because the coefficient of BOI is no longer statistically significant when other variables are included in the regression. Older plants tend to have higher TFPQ or be more productive than younger plants. It might be because plants with higher productivity have higher probability of surviving. Larger plants tend to have higher TFPQ or productivity than smaller plants. Plants located in the northern, the northeastern, and the southern regions have lower TFPQ or are less productive than plants in Bangkok or the central region.

Plants owned by individuals or the government have significantly lower TFPR, indicating that they face lower distortions than other plants. Lower levels of TFPR of plants owned by the government can be related to subsidies from the government. It is unclear whether plants which have foreign
ownership, export their products, receiving investment promotion from the Board of Investment, or have research and development have higher TFPR or face higher distortions than plants that do not. Older plants tend to have lower TFPR or face lower distortions than younger plants. Lower levels of distortions faced by older plants might be related to more relaxed borrowing constraints, which can result from their longer relationships with banks. Lower levels of distortions of older plants might also be related to their special connections with either banks or the government. Medium plants tend to have higher TFPR or face larger distortions than small and large plants. This might be because medium plants are more prone to bribery and corruption. Smaller plants might not be the target of bribery and corruption while larger plants might have enough ability or special connections to protect themselves from bribery and corruption. Plants located in Bangkok which generally have the highest productivity have higher TFPR or face higher distortions than plants in other regions. Interestingly, plants in the northern and the northeastern regions which generally have the lowest productivity have the lowest TFPR or face the lowest distortions. This might be related to government policies focusing on those regions.

CONCLUSION

To study misallocation and its effect on manufacturing TFP in Thailand, this paper applies the method used by Hsieh and Klenow (2009) to data on Thai manufacturing plants. The data is taken from Thailand’s 2007 Industrial Census and consists of about 50,000 plants. The results indicate that manufacturing plants in Thailand have a wider TFPR dispersion than those in China, India, and the United States, indicating a larger resource misallocation across plants in Thailand. When TFPR or marginal products were equalized across plants within the same industry; that is, misallocation of capital and labor across plants within the same industry were eliminated, manufacturing TFP would increase by about 150 percent which is larger than those found for China and India. If misallocation of capital and labor were reduced to the extent observed in the United States, manufacturing TFP would increase by about 70 percent. Interestingly, one of the industries contributing to the TFP gain most is automobile parts. When comparing actual plant size to the size when marginal products were equalized, the results indicate that there should be fewer small plants but more medium plants.

The results also indicate that plants which have government ownership or are located in the northern or the northeastern regions have lower plant TFPRQ or productivity but face lower TFPR or distortions than other plants. Older plants tend to have higher productivity and face lower distortions than other plants. While plant productivity increases with plant size, plants with medium size face larger distortions than small and large plants. This might be because medium plants are more prone to bribery and corruption. Also, while plants with foreign ownership, export products, or research and development have higher productivity but generally do not face different distortions from other plants.
Future research on resource misallocation should focus on plants with government ownership or located in the northern or the northeastern regions.

ACKNOWLEDGEMENTS

I am grateful to Paul Evans for his guidance and support. I also thank Hu McCulloch, Pok-sang Lam, and anonymous reviewers for their helpful comments and suggestions.

REFERENCES


