

Offshoring and Productivity: Evidence from Japanese Firm-level Data

Banri Ito^a, Ryuhei Wakasugi^b, Eiichi Tomiura^c

Abstract

It is noteworthy that multinational firms are beginning to offshore a wide range of operations. Theoretical studies have showed that offshoring contributes to a higher productivity. This paper aims to provide evidence of the effect of offshoring on productivity, on the basis of original 2006 survey data of offshore sourcing of Japanese firms. Our estimation shows that the offshoring of tasks for production of intermediates goods and final assembly, as well as the offshoring of tasks for R&D and information services, positively affects productivity growth, while the outsourcing of other service tasks has no significant impact on productivity. It also shows that firms outsourcing to the United States or Europe have realized high production efficiency, followed by firms outsourcing to Asia, in comparison with non-offshoring firms.

Keywords: Offshoring, outsourcing, productivity

JEL codes: D24, F14, L14

The authors thank the statistics offices of the Ministry of Economy, Trade and Industry and the Research Institute of Economy, Trade and Industry for granting permission to access firm-level data.

^a Research Institute of Economy, Trade and Industry

^b Institute of Economic Research, Kyoto University

^c Yokohama National University

1. Introduction

It is noteworthy that multinational firms are beginning to offshore a wide range of operations. It is also remarkable that the offshoring of not only production parts, intermediate goods, and final assemblies but also financial, legal, and customer support services increased. There is evidence of recent development of theoretical studies on offshore sourcing. Grossman and Rossi-Hansberg (2006) and Baldwin and Robert-Nicoud (2007) showed that offshore sourcing contributes to higher production efficiency. Antràs (2003) and Antràs and Helpman (2004) indicated that on the basis of productivity and sectoral characteristics, firms decide whether to produce intermediate inputs or outsource them. A number of empirical studies have focused on the effect of offshoring on the labor market in source countries (e.g., Ekholm and Hakkala, 2006; Egger and Egger, 2006; Feenstra and Hanson, 1996, 1999; Geishecker and Görg, 2005; Head and Ries, 2002; Helg and Tajoli, 2005; Hijzen et al., 2005). This paper aims to provide empirical evidence of the effect of offshoring on production efficiency and examine empirically whether offshoring affects growth of firm productivity.

Although previous studies that have explored this issue using industry-level data suggest that offshoring positively affects productivity (e.g., Amiti and Wei, 2006; Egger and Egger, 2006), analyses using firm-level data have reported mixed results. Hijzen et al. (2006) estimated the impact of offshoring on firm productivity using Japanese firm-level data for the period 1994–2000 and found that a 1 percent increase in offshoring intensity raises productivity growth by 0.17 percent. Although they showed the positive impact of offshoring, their offshoring definition was restricted to the manufacturing of goods and materials. Recent

studies that divide operations-based offshoring into two types—materials and services—suggest that the effects of offshoring on firm productivity are different across outsourced tasks. For example, Görg and Hanley (2005), who used Irish firm-level data in the electronics industry over the period 1990–1995, found the impact of offshoring on the TFP to be positive, when estimating the effect of outsourcing of materials and services combined; however, they discovered the effect of outsourcing of services to no longer have a significant impact when distinguishing between two tasks.¹ This result implies that the benefit of offshoring is different across outsourced tasks.

Further, the impact of offshoring on firm productivity is dependent on the destination. It is becoming increasingly important for firms to look for offshore suppliers who can provide high quality at cheaper costs than suppliers in the home country, in order to raise the competitiveness of a firm. Market-specific factors such as institutions, level of development, and costs are expected to affect the productivity of outsourced operations. Therefore, it is interesting to examine how the impact of outsourcing changes with destination. However, this issue has not been analyzed in previous studies owing to a lack of data. In order to examine this issue, it is essential to utilize microdata, including detailed information on offshoring.

By collecting detailed firm-level data about tasks and destinations in the context of offshoring, this paper examined the different impacts of offshoring across various offshored operations on the productivity, as well as the possibly different impacts of offshoring over

¹ Görg et al. (2008), which extended data coverage to 1990–1998 and all manufacturing industries and took into account the status of trade activity and ownership, report similar results on labor productivity.

destinations. With the collaboration of the Research Institute of Economy, Trade and Industry (RIETI), we conducted an investigation on foreign outsourcing carried out by Japanese firms. This survey covered not only production outsourcing but also outsourcing of services such as R&D, information services, customer support, and professional services. The survey identified final assemblies, intermediates, and jigs/dies as the products whose manufacturing was outsourced. Further, the survey collected disaggregation data at the regional level in order to study the effect of outsourcing on geographical destinations. These data helped us examine the different effects of offshoring on firm productivity, in terms of detailed operations and destinations.²

We estimated the dynamic productivity model on a large sample of Japanese manufacturing firms for 1999–2000 and 2004–2005. The estimation results are summarized as follows. First, while the offshoring premium of firm size decreased from 2000 to 2005, the differences in productivity, wages, capital intensity, and skill intensity between offshoring firms and non-offshoring firms increased with the rise in the share of outsourcing firms. Second, the effect of offshored production processes was positive as well as the offshoring of tasks for R&D and information services positively affects productivity but offshored services did not appear to affect productivity. Third, we found that the firms outsourcing to the United States or Europe were the most productive, followed by the firms outsourcing to Asia, as compared to non-offshoring firms.

² Ito et al. (2007) provided a comprehensive description of this survey. This survey cannot be publicly disclosed. The authors are allowed to access this firm-level data set as a part of RIETI research project.

This paper is organized as follows. In the next section, we present an analytical framework to examine the effect of offshoring on firm productivity. Section 3 describes the construction of the data set and general features of offshoring firms. Section 4 presents the estimation results of the effect of offshoring on productivity by tasks and destinations and section 5, the conclusions.

2. Differences between Offshoring and Non-offshoring

This section examines offshoring premia on various firm characteristics. Previous studies that investigate export and FDI premia provide evidence that internationalized firms show superior performance (e.g., Bernard and Jensen, 1999; Kimura and Kiyota, 2006). Regarding offshore outsourcing, Tomiura (2007) estimated the premia of offshoring using firm-level Japanese cross-sectional data in 1998 and reports that outsourcing firms have predominance with respect to size and productivity. Following earlier studies, we further develop the examination of differences between offshoring and non-offshoring firms in various characteristics.

2.1 General Features on Statistical Data

The data with which we examine the differences between offshoring firms and non-offshoring firms were collected by the *Basic Survey of Japanese Business Structure and Activities* (*Kigyo Katsudo Kihon Chosa*, in Japanese) for the period 1997–2005, conducted by the Japan Ministry of Economy, Trade and Industry (henceforth METI survey). This annual national survey is mandatory for all firms with 50 or more employees and whose paid-up

capital or investment fund is over 30 million yen in mining, manufacturing, wholesale, retail, and food and beverage industries. For collecting information on offshoring, we used the *Survey of Corporate Offshore Activities (Kigyo Kaigai Katsudo Chosa*, in Japanese), which is an academic survey conducted by the Research Institute of Economy, Trade and Industry (henceforth RIETI survey) on 14,062 manufacturing firms listed in the METI survey. The RIETI survey succeeded in collecting responses from 5,528 firms. Considering that other previously available firm-level data sets on offshoring include only a limited number of firms and are not designed to cover the entire manufacturing industry, this survey has a clear advantage in terms of its coverage.

Although this survey is a one-shot survey, its data include the status of offshoring five years ago, as a retrospective question. Hence, we matched the METI data and RIETI data in 2000 and 2005. The data set allowed us to create an unbalanced panel data set. As a result, we could draw on 7,971 observations on 4,799 firms with accurate information on the variables of interest. In order to estimate the impact of offshoring, first, we constructed the dummy variable that takes a value of 1 if the firm enters into contracts with foreign suppliers and 0 for non-offshoring firms. This is because the RIETI survey provides a binary choice in the context of offshoring.

In the sample, the share of outsourcing firms increases from 16% to 22% for five years (2000–2005).³ The distribution of firms across the manufacturing industry is shown in Table 1.

³ These figures are almost same as those calculated by all available data in the RIETI survey (see Ito et al., 2007, Table 1).

The table also presents the share of the number of firms carrying out offshoring. Further, it indicates the industry-wise concentration of offshoring, as confirmed by an earlier study on outsourcing by Japanese firms (e.g., Hijzen et al., 2006). The share of the number of outsourcing firms are concentrated in apparel, furniture, rubber products, leather, general machinery, electrical machinery, information and communication equipment, electronic parts and devices, and precision machinery. Among them, the highest shares are reported by the apparel industry and the leather industry in 2000 and 2005, respectively. These industries are representative industries that intensively use unskilled labor. Offshoring in these industries is likely to be active owing to wage differentials between the home and provider countries. On the whole, the share of outsourcing firms increased in these five years, with the increase in the share of machinery industries being conspicuous. This can be attributed to the fact that machinery industries use less skilled labor in certain production processes such as assembly.

Table 1 around here

We calculated the value added as the total sales minus the sum of cost of goods sold and general and administrative costs minus wage, rental, depreciation, and tax costs. The total sales and part of the intermediate input are deflated by the output and input deflators, respectively. The deflators have been taken from the JIP database of 2008, which has comprehensive Japanese industry-level data. The real capital stock is calculated by the perpetual inventory method, using the book value of fixed tangible assets and investment data

from the METI surveys. The deflator of investment goods and the depreciation rate have also been sourced from the JIP database of 2008. The labor input indicates the number of total employees reported in the METI surveys. We estimate the TFP level for each firm using the above statistical data of sampled firms for the period 1997–2005. The direct calculation of TFP using the estimated coefficients of capital stock and labor in the Cobb-Douglas function form suffers from the endogeneity problem. As the benchmark of TFP, the estimated labor share and capital share are 0.76 and 0.23, respectively, when estimating production function by the Levinsohn and Petrin (2003) procedure.⁴

2.2 Offshoring Premia

Using the data of two periods, 2000 and 2005, we estimate offshoring premia in terms of various firm's characteristics. The change in the premia in the last five years will provide important information to identify the dynamic change in the attributes of offshoring firms. Offshoring premia are estimated from the following regression form using data in 2000 and 2005, respectively:

$$(1) \quad \ln Y_i = \alpha_0 + \beta z_i + \theta \mathbf{Ind} + u_i$$

⁴ The purchase of input is used as a proxy variable of productivity shock. We also applied an alternative method by using investment as the proxy, as proposed by Olley and Pakes (1996); however, the results were found to be almost the same. In consideration of omitted firms with zero investment, we relied on the estimator by the Levinsohn–Petrin procedure.

where Y_i indicates firm attributes, α_0 is constant, z_i is a dummy variable for offshoring firms, and **Ind** is a vector of two-digit industry dummy variables. The estimated β represents offshoring premia. The results are presented in Table 2.

Table 2 around here

The numbers indicate the coefficients of z_i estimated in equation (1) and the numbers in parentheses are standard errors. All the coefficients are positive and significant at the 1% level for both years. The result indicates that the largest differences between offshoring and non-offshoring firms are in the areas of total sales and employment. The total sales of offshoring firms are about twice as much as those of non-offshoring firms. The number of employees in offshoring firms is also larger than that in non-offshoring firms by 70%. Our findings corroborate those of previous studies which show that internationalized firms are larger than domestic firms. We found that offshoring firms pay wages that are 7–11% higher. The estimated premia of capital intensity is in the range 25–31%. The capital intensity is significantly higher for offshoring firms. Offshoring may change the composition of skilled and unskilled labor. For example, when the outsourcing of unskilled tasks is carried out, it is predicted that skilled intensity increases. The result shows that the skill intensity of offshoring firms—defined as the number of employee in headquarters over total employee—is 2 to 2.8% higher than that of non-offshoring firms. The average difference in R&D intensity ranges from 2.7 to 3.4%, implying that offshoring firms are more knowledge intensive than non-offshoring

firms. As for productivity, it is found that labor productivity is 11 to 18% higher for offshoring firms, while TFP is 6 to 12% higher. These results are refined by comparing the distributions of firm productivity between offshoring and non-offshoring firms. Figures 1 and 2 present the kernel density estimate of productivity for the two types. Both results indicate that offshoring firms are likely to be more productive than non-offshoring firms.

Figures 1 and 2 around here

On comparing data from 2000 and 2005, it was found that the premia of firm size decreased slightly, while the premia of other attributes and performance increased, except for R&D intensity. These results suggest that relatively small firms begun offshoring operations and that the differences in productivity, wages, capital intensity, and skill intensity between offshoring and non-offshoring firms substantially increased for the period, along with the increase in the share of outsourcing firms. In the next section, we present a specification to conduct further estimate the productivity.

3. A Model of Productivity Growth

3.1 A Framework for Analysis

The production of goods is a multistage process. Each stage of production activity can be considered to be a bundled task in the process of transformation from an intermediate product to a final product. At every stage, capital, labor, and intermediate goods are input. Outsourcing of a task is defined as unbundling the task from the production process and

replacing it with intermediate goods produced outside of the firm.⁵ If (1) the production activity of each stage is competitive, (2) prices of intermediate products are market dependent, and (3) primary factors such as capital and labor are available at a given price in the factor market, similar to the availability of labor at fixed wages in a labor market, a firm may be deficient in some stages of production because of the gap between the value of the marginal product of labor and the wage rate. In such a case, the firm will choose to (1) unbundle a task from the production process and offshore it to a foreign country where the wage rate is lower than the value of marginal product of labor, (2) re-import processed intermediate products, and (3) include them in the production process of the final product. In this manner, outsourcing enables a firm to work around the deficits in its own production process.

Such a shift in resources to more efficient stages of a production process raises the productivity growth. Previous studies have included characterized offshoring by productivity growth in the aggregate production function. Feenstra and Hanson (1999) and Hijzen et al. (2006) estimated the effects of offshoring on the TFP. Our paper also investigates how a one-shot change in the production process affects the TFP.

3.2 Specification for Difference in Productivity

On the basis of the framework of offshoring and productivity growth, we expect that offshoring positively affects a firm's TFP growth. We decompose the sources of TFP growth into a factor of structural change by offshoring, z_{it} ; technical change attributed to the growth

⁵ See Feenstra and Hanson (1999), Jones and Kierzkowsky (2000), Antràs (2003), Grossman and Rossi-Hansburg (2006), Baldwin (2006), and so on.

of knowledge stock, Δr_{it} ; unobserved time-invariant firm individual effect, μ_i ; time-specific effect, λ_t ; and the idiosyncratic error term distributed as iid, u_{it} . Since it is difficult to directly observe the growth of knowledge stock, it is expressed in an alternative manner as follows:⁶

$$(2) \quad \gamma \Delta r_{it} = \gamma \ln \left(1 + \frac{\Delta R_{it}}{R_{it-1}} \right) \approx \gamma \frac{\Delta R_{it}}{R_{it-1}} = \frac{\partial Y_{it}}{\partial R_{it}} \frac{R_{it-1}}{Y_{it-1}} \frac{\Delta R_{it}}{R_{it-1}} = \rho \frac{\Delta R_{it}}{Y_{it-1}}$$

where γ is the knowledge-stock elasticity of output, $\rho = \partial Y / \partial R$, and ΔR_{it} is the R&D investment expressed as flow (I_{it-1}).

We estimate a parameter on the basis of the following equation, wherein we bring the lagged TFP term to the right-hand side in order to account for the persistence of TFP growth:

$$(3) \quad \ln TFP_{it} = \theta \ln TFP_{it-1} + \phi z_{it} + \rho (I_{it-1} / Y_{it-1}) + \mu_i + \lambda_t + u_{it}.$$

On the estimation, we add industry dummy variables for the industry-specific factor. We estimate equation (3) by applying random effects model.

3.3 Specification for Switching Effect of Offshoring

The specification presented in the former section identifies the average difference in the productivity between offshoring firms and non-offshoring firms but it can not clarify the causality. In order to capture the switching effect of offshoring on productivity we estimate the

⁶ For the derivation of knowledge capital flow, we drew on Griffith et al. (2003), Jones (2002), and Fors (1996).

following equation by applying the difference-in-differences technique by Heckman et al. (1997). The estimation is carried out by using the data of two periods, 2000 and 2005.

$$(4) \quad \ln TFP_{it} = \alpha + \theta \ln TFP_{it-1} + \beta O_i + \rho(I_{it-1}/Y_{it-1}) + \gamma T_t + \phi(O_i \times T_t) + \mu_i + \varepsilon_{it}$$

where O_i is a dummy variable taking the unit value if the firm started offshoring during the period and zero in the case of non-offshoring firm for the both periods. T_t is a dummy variable for a second time period. Other descriptions are the same as equation (3). The difference-in-differences estimator is presented as:

$$(5) \quad \hat{\phi} = E[\bar{Y}_{after}^O] - E[\bar{Y}_{before}^O] - (E[\bar{Y}_{after}^{NO}] - E[\bar{Y}_{before}^{NO}]),$$

where Y indicates TFP. O and NO correspond to offshoring firm and non-offshoring firm, respectively. We also estimate the equation (4) applying random effects model.

4. Empirical Study

4.1 Descriptive Statistics

The data used for estimation is the same as the data explained in section 2.1. Although quantitative data are not available on the share of operations each firm outsourced, the data collected includes detailed information on what kind of tasks were outsourced to which regions, in the form of binary data. We classified the outsourced tasks into the following eight categories: final assembly, production of intermediates, production of jigs/dies, R&D,

information services, customer support, professional services, and other tasks. On the basis of outsourcing destinations, the survey identifies the following five regions: China (including Taiwan and Hong Kong), ASEAN countries, other Asian countries, United States or European countries, and the rest of the world.

Table 3 presents the tasks outsourced offshore, with disaggregation across geographical destinations. The table shows that the distribution of offshoring across countries is heavily skewed. Almost all offshoring is concentrated in the Asian area. China is home to half the total number of firms outsourced to, and ASEAN and other Asian countries account for a third of the total share, while the share is much lower in the United States and Europe. These figures indicate that East Asia is the most preferred offshoring destination in terms of services offered for various stages of the production process (Fukao et al., 2003; Wakasugi, 2007). Further, the table suggests that the offshoring of Japanese firms occurs because of wage differentials with Asian countries. As shown in the table, two types of tasks that are most frequently outsourced offshore are the production of intermediates (35%) and the final assembly (35%), followed by the production of jigs/dies (13%). All the three tasks are directly related with production activities. Consequently, it can be said that Japanese manufacturing firms are actively outsourcing production-related tasks overseas. On the other hand, offshoring of service-related tasks is considerably limited. Less than 5 percent firms outsource customer support (4.51%), R&D (3.58%), information services (3.01%), and professional services (2.13%), respectively, to offshore destinations. Since the share of tasks being currently outsourced and that which were outsourced five years ago do not differ by much, the main role

of production-related tasks outsourced offshore has remained the same for Japanese firms in recent years.

The dummy variables of offshoring for tasks and destinations are also constructed from the RIETI survey. Although our data on destinations is disaggregated into five categories, i.e., China (including Taiwan and Hong Kong), ASEAN countries, Other Asian countries, U.S. or European countries, and rest of the world, we aggregate three regions—Asia (China, ASEAN and other Asia), United States or European countries, and the rest of the world. In order to identify the shift of an intercept from non-offshoring firms, we include seven dummies in the equation: (1) all regions, (2) Asia and United States or Europe, (3) Asia and the rest of the world, (4) Asia only, (5) United States or Europe and the rest of the world, (6) U.S. or Europe only, and (7) the rest of the world only. In the estimation, non-offshoring firms are set to be the benchmark used for comparison with offshoring firms with regard to the above destinations. Thus, the estimation identifies the average difference in the productivity of firms outsourcing to each region and non-offshoring firms because of offshoring. Table 4 describes the data descriptions and the summary of the statistics for each variable on the basis of the status of offshoring, respectively.

Tables 3 and 4 around here

4.2 Estimated Results for Disaggregated Tasks

We conduct the estimation by applying the random effects model to equation (3) on the basis of the unbalanced panel of 1999–2000 and 2004–2005.⁷ The estimation results for each outsourced task are presented in Table 5. The first column presents the estimates from a specification employing the dummy for offshoring, and the column from (2) to (9) presents the results for the model employing the dummy for outsourced tasks, in order to examine how the effect of offshoring differs across tasks. In order to avoid the adverse effects of the multi-correlation problem, we added the task dummy to the model independently. Hence, the significance of a coefficient indicates the statistical distinction between the productivity of the firm outsourcing the particular task and that of non-offshoring firms. All models include a set of two-digit industry dummies and a year dummy. The results of the Breusch–Pagan test demonstrate that the random effects model is favorable in comparison with the OLS estimation based on pooling data for all models.

Table 5 around here

The estimated results show that offshoring increases productivity growth. The results in the first column of Table 5, for instance, imply that offshoring leads to a 2.7% increase in

⁷ Since we used unbalanced panel data of two periods, the fixed effects model could not be applied. The result of our estimation based on the balanced data is not different from that of the estimation based on the unbalanced data. Baltagi and Chang (1994) showed that estimating only balanced data extracted from unbalanced data leads to a complete loss of validity. Therefore, we have only presented the results of estimation based on the unbalanced data.

TFP. On the other hand, the results of estimation introducing disaggregated task dummy variables separately indicate that the effect of offshoring on firm productivity is different according to the tasks outsourced. We introduce the dummy variable that assumes values of 1 when the outsourced task is related to a particular task and 0 for non-offshoring firms. As for the outsourcing of production processes, the results of the estimation model in columns (2)–(4) suggest that the positive effect on productivity is significant in the outsourcing of all tasks: jigs/dies, intermediates, and final products. The results indicate that the outsourcing of these production tasks is associated with an increased productivity of 2.6–3.6%.

Interestingly, the results of services are slightly different across tasks. As shown in columns (5)–(8), the coefficients of task dummy R&D and information services are significant and positive, while those of other service tasks such as customer and account services are not totally significant. When estimating a model that includes an aggregated dummy for production or service tasks, we found that the effect of outsourced production processes on productivity is positive and outsourcing of R&D and information tasks is positively related to productivity growth.

4.3 Estimated Results for Destinations

Table 6 displays all the results for the equation (3) including dummies of geographical destinations. The result in column [1] indicates that the coefficients of four dummies are statistically significant and positive without the control for industry-fixed effects. The coefficient of the outsourcing dummy for all three regions show the largest difference

compared to non-offshoring firms. The dummy coefficient for Asia and the United States or Europe is significantly positive at the 1% level, and in addition to this, the coefficient of the dummy for the United States or Europe only is also significant at the 5% level. The results indicate that the productivity of firms outsourcing to Asia and the United States or Europe and only the United States or Europe is higher than that of non-offshoring firms by 9.2% and 8.8%, respectively. The dummy for Asia only is also positively correlated with productivity, while the dummies for combination with the rest of world are not significant. There is an order in the size of the coefficients. It seems that the firm that has contracted out to the United States or Europe is likely to have high productivity, compared with the firm that has contracted out to other regions. This tendency is stable even if the industry dummy variables are included, as shown in column [2]. This result should be interpreted with caution because the difference over regions may be due to the difference in tasks outsourced. In fact, the outsourcing of production processes is dominant in Asia while there is much R&D outsourcing relatively in the United States or Europe. Therefore, the result may be reflecting that the outsourced task changes with areas.⁸

Table 6 around here

⁸ Although it may be controlled by including the task dummy into the equation, the task dummy and destination dummies can not be estimated simultaneously because of the multi-correlation problem.

4.4 Switching Effect from Non-offshoring to Offshoring on Productivity

In order to examine the switching effect from non-offshoring to offshoring on productivity, we use difference-in-differences method presented in the equation (4) using the data of two period 2000 and 2005. The data includes 235 firms switching from non-offshoring to offshoring and 2,897 non-entry firms. The result of random effect model is presented in Table 7. The observations in which corresponding other variable is missing are omitted in the estimation. The column (1) shows the result without industry dummies while the column (2) shows it with those. Both models support applying random effects model rather than pooling estimation. The results of lagged logarithm of TFP and lagged R&D over value added are similar to the previous result in Tables 5 and 6. The difference-in-differences estimate ϕ is statistically significant and positive in the case of equation without industry dummies. This result seldom changes, even if industry fixed effects are taken into consideration as shown in column (2). This finding implies that offshoring raise the productivity by 7%.⁹ Compared with non-offshoring firms, as for the firms which switched offshoring, the remarkable growth of productivity is observed in five years.

Table 7 around here

⁹ We also estimate the equation taken first difference to remove the individual effect using balanced data; however, the results were found to be almost the same.

5. Conclusions

This paper examines the impact of offshoring on productivity growth using Japanese firm-level data in manufacturing industries over the periods 1999–2000 and 2004–2005. We found that the average differences in productivity, wages, capital intensity, and skill intensity between offshoring firms and non-offshoring firms grew with the increase in the share of outsourcing firm in the last five years, while the offshoring premia of firm size were reduced. The empirical result of this paper indicates that offshoring has a positive impact on firm productivity. This is consistent with the findings of related previous studies that used Japanese firm data (e.g., Hijzen et al., 2006; Tomiura, 2007). Further, when classifying outsourced tasks, we found that the outsourcing of production process such as jigs/dies, intermediates and final products has a positive effect on productivity, while the impact of outsourced service tasks is restricted to knowledge-intensive tasks such as R&D and information services. This result on tasks is new and contrastive with the results of earlier studies that reported that service outsourcing has no effect on productivity (e.g., Görg and Hanley, 2005; Görg et al., 2008). Further, from the analysis of destination regions, it is found that the effects of offshoring are varied across destinations. The firms outsourcing to the United States or Europe have received the maximum benefits, followed by firms outsourcing to Asia, as compared with non-offshoring firms. Although the empirical results are in line with those of previous studies that confirmed the positive impact of offshoring on firm productivity, to our best knowledge, this study is the first to show that the benefits of offshoring vary with disaggregated tasks and destinations.

References

- Amiti, M. and S. Wei (2006), "Services Offshoring and Productivity: Evidence from the United States," NBER Working Paper, No. 11926.
- Antràs, P. (2003), "Firms, Contracts, and Trade Structure," *Quarterly Journal of Economics*, 118(4), pp. 1375–1418.
- Baltagi, B. H., and Y. J. Chang (1994), "Incomplete Panels: A Comparative Study of Alternative Estimators for the Unbalanced One-way Error Components Regression Model," *Journal of Econometrics*, 62(2), pp. 67–89.
- Bernard, A. B., and J. B. Jensen (1999), "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics*, 47, pp. 1–25.
- Egger, P. and H. Egger (2006), "International Outsourcing and the Productivity of Low-skilled Labor in the EU," *Economic Inquiry*, 44(1), pp. 98–108.
- Ekholm, K. and K. Hakkala (2006), "The Effect of Offshoring on Labor Demand: Evidence from Sweden," CEPR Working Paper No. 5648.
- Feenstra, R. C. and G. H. Hanson (1996), "Globalization, Outsourcing, and Wage Inequality," *American Economic Review*, 86(2), pp. 240–245.
- Feenstra, R. C. and G. H. Hanson (1999), "The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979-1990," *Quarterly Journal of Economics*, 114(3), pp. 907–941.
- Fors, G. (1996), "Utilization of R&D Results in the Home and Foreign Plants of Multinationals," *Journal of Industrial Economics*, 45(3), pp. 341–358.

- Fukao, K., H. Ishido, and K. Ito (2003), "Vertical Intra-Industry Trade and Foreign Direct Investment in East Asia," *Journal of the Japanese and International Economies*, 17(4), pp. 468–506.
- Geishecker, I. and H. Görg (2005), "Do Unskilled Workers Always Lose From Fragmentation?" *The North American Journal of Economics and Finance*, 16(1).
- Görg, H. and A. Hanley (2005), "International Outsourcing and Productivity: Evidence from the Irish Electronics Industry," *The North American Journal of Economics and Finance*, 16(2), pp.255–269.
- Görg, H., A. Hanley and E. Strobl (2008), "Productivity Effects of International Outsourcing: Evidence from Plant Level Data," *Canadian Journal of Economics*, 41(2).
- Griffith, R., R. Harrison and J. van Reenen (2003), "Technology Sourcing by UK Manufacturing Firms: An Empirical Analysis Using Firm-level Patent Data," Working Paper, Institute of Fiscal Studies, London.
- Head, K. and J. Ries (2002), "Offshore Production and Skill Upgrading by Japanese Manufacturing Firms," *Journal of International Economics*, 58(1).
- Helg, R. and L. Tajoli (2005), "Patterns of International Fragmentation of Production and Implications for the Labour Markets," *North American Journal of Economics and Finance*, 16(2).
- Hijzen, A. (2006), "International Outsourcing, Technological Change and Wage Inequality," *Review of International Economics*,

- Hijzen, A., H. Görg and R.C. Hine (2005), “International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom,” *Economic Journal*, 115(506), pp. 860–878.
- Hijzen, A., T. Inui and Y. Todo (2006), “Does Offshoring Pay? Firm-Level Evidence from Japan,” RIETI Discussion Paper Series 07-E-005.
- Ito, B., E. Tomiura, and R. Wakasugi (2007), “Dissecting Offshore Outsourcing and R&D: A Survey of Japanese Manufacturing Firms,” RIETI Discussion Paper Series 07-E-060.
- Jones, C. (2002), “Sources of U.S. Economic Growth in a World of Ideas,” *American Economic Review*, 92(1), pp. 220–239.
- Kimura, F. and K. Kiyota (2006), “Exports, FDI, and Productivity of Firm: Dynamic Evidence from Japanese Firms,” *Review of World Economics*, 142, pp. 695–719.
- Levinsohn, J. and A. Petrin (2003), “Estimating Production Functions Using Inputs to Control for Unobservables,” *Review of Economic Studies*, 70(2), pp. 317–341.
- Matsuura, T. (2004), “Estimation of Economic Activity of Japanese Multinationals,” *Keizai Toukei Kenkyu*, 32, pp. 1–16.
- Olley, S. G. and A. Pakes (1996), “The Dynamics of Productivity in the Telecommunications Equipment Industry,” *Econometrica*, 64(6), pp. 1263–1297.
- Tomiura, E. (2007), “Foreign Outsourcing, Exporting, and FDI: A Productivity Comparison at the Firm Level,” *Journal of International Economics*, 72, pp.113–127.
- Wakasugi, R. (2007), “Vertical Intra-industry Trade and Economic Integration in East Asia,” *Asian Economic Papers*, 6(1), pp. 26–39.

Table 1. Distribution of firms and offshoring over industries

Industry	number of firms		Offshore outsourcing ratio	
	2000	2005	2000	2005
Food products	407	354	7.6%	9.0%
Bevarages, tobacco and feed	70	62	5.7%	8.1%
Textiles	89	72	12.4%	8.3%
Clothes and other textiles	73	48	37.0%	37.5%
Wood and wood products	44	37	4.5%	8.1%
Building materials	46	34	19.6%	32.4%
Pulp and paper products	150	118	4.0%	8.5%
Printing	188	167	4.8%	4.8%
Chemicals and pharmaceuticals	282	265	16.7%	20.0%
Petroleum and coal products	18	15	16.7%	26.7%
Plastics products	212	186	18.4%	23.7%
Rubber products	38	32	28.9%	40.6%
Leather	5	6	20.0%	66.7%
Ceramics, stone and clay	191	162	8.4%	12.3%
Iron and steel	123	138	8.1%	8.7%
Nonferrous metals	93	80	14.0%	21.3%
Metal	279	289	12.2%	19.4%
General machinery	403	424	23.3%	34.7%
Electrical machinery	241	237	24.9%	33.3%
Information and communication equipment	80	89	16.2%	39.3%
Electronic parts and devices	182	159	29.1%	34.0%
Transport machinery	317	296	17.7%	23.3%
Precision machinery	108	116	26.9%	31.0%
Other manufacturing	76	70	23.7%	31.4%
Total	3,715	3,456	16.0%	21.9%

Table 2. Offshoring Premia of Firm Attributes

	Offshoring premia	
	2000	2005
Total sales	0.949 [0.062]**	0.904 [0.052]**
Total employment	0.700 [0.049]**	0.631 [0.040]**
Average wage (Wage payment / Labor)	0.074 [0.014]**	0.110 [0.015]**
Capital-Labor ratio (Capital stock / Labor)	0.245 [0.048]**	0.313 [0.040]**
Skill intensity (Non-production labor / total)	0.020 [0.005]**	0.028 [0.005]**
R&D intensity (R&D expenditure / Value added)	0.034 [0.004]**	0.027 [0.003]**
Labor Productivity (Value added / Labor)	0.110 [0.019]**	0.182 [0.022]**
Estimated TFP	0.055 [0.019]**	0.119 [0.021]**

Notes: Numbers indicate the estimated coefficient β in equation (3).

Standard errors in parenthesis; *, ** indicate significance at the 5, and 1 percent levels, respectively.

Table 3. Offshore outsourcing disaggregated by tasks and geographical destinations

Task	Region	China	ASEAN	Other Asia	U.S.A. & Europe	ROW	World Total
Jigs/Dies		7.35	2.64	1.93	0.51	0.09	12.52
Intermediates		19.19	7.61	4.37	3.32	0.85	35.34
Final Assembly		19.56	8.57	3.52	2.92	0.68	35.25
R & D		1.22	0.45	0.40	1.39	0.11	3.58
Info services		1.28	0.65	0.20	0.79	0.09	3.01
Customer supports		1.79	0.91	0.51	1.16	0.14	4.51
Professional services		0.71	0.37	0.31	0.65	0.09	2.13
Other tasks		1.70	0.71	0.34	0.71	0.20	3.66
<i>Total</i>		<i>52.80</i>	<i>21.91</i>	<i>11.58</i>	<i>11.47</i>	<i>2.24</i>	<i>100</i>

Source: Ito et al. (2007), Table 4.

Notes: Shown are the percentages in the total number of offshore outsourcing cases. The outsourcing of the same category of tasks to the same region is counted as one offshore outsourcing case even if multiple transactions are involved.

Table 4. Summary Statistics

Variable description	Obs	Mean	Std. Dev.	Min	Max
Growth ($\Delta \log$) in TFP	7097	0.039	0.316	-3.255	7.169
Log TFP in previous year	7971	1.597	0.533	-5.946	5.018
Ratio of R&D expenditure over value added in previous year	7971	0.034	0.072	0	0.889
2005 year dummy	7971	0.514	0.500	0	1
Dummy taking a one for firms with offshore outsourcing	7971	0.187	0.390	0	1
Outsourced task dummy: jig/dies	6835	0.052	0.222	0	1
Outsourced task dummy: intermediates	7444	0.130	0.336	0	1
Outsourced task dummy: final products	7408	0.125	0.331	0	1
Outsourced task dummy: R&D	6588	0.016	0.127	0	1
Outsourced task dummy: information	6554	0.011	0.106	0	1
Outsourced task dummy: customer service	6584	0.016	0.125	0	1
Outsourced task dummy: accounting	6529	0.008	0.086	0	1
Outsourced task dummy: other tasks	6561	0.012	0.110	0	1
Destination dummy all three regions: U.S. or Europe + Asia + Other	7971	0.005	0.070	0	1
Destination dummy all three regions: U.S. or Europe + Asia	7971	0.027	0.162	0	1
Destination dummy all three regions: Asia + Other	7971	0.002	0.046	0	1
Destination dummy all three regions: Asia only	7971	0.143	0.350	0	1
Destination dummy all three regions: U.S. or Europe + Other	7971	0.001	0.030	0	1
Destination dummy all three regions: U.S. or Europe only	7971	0.007	0.081	0	1
Destination dummy all three regions: Other only	7971	0.001	0.022	0	1

Table 5. Estimation Results on Tasks Outsourced

Dependent variable: ln(TFP)	(1) Total	(2) <i>jigs/dies</i>	(3) <i>intermediates</i>	(4) <i>final products</i>	(5) <i>R&D</i>	(6) <i>Information</i>	(7) <i>Customer</i>	(8) <i>Account</i>	(9) <i>Other</i>
Lagged ln(TFP)	0.734 [0.006]**	0.723 [0.007]**	0.727 [0.007]**	0.728 [0.007]**	0.722 [0.007]**	0.719 [0.007]**	0.721 [0.007]**	0.719 [0.007]**	0.719 [0.007]**
Lagged R&D / Value added	0.255 [0.051]**	0.248 [0.056]**	0.284 [0.054]**	0.237 [0.055]**	0.261 [0.059]**	0.253 [0.060]**	0.281 [0.061]**	0.249 [0.061]**	0.274 [0.061]**
Offsoring dummy	0.027 [0.009]**	0.033 [0.017]*	0.036 [0.011]**	0.026 [0.011]*	0.112 [0.030]**	0.079 [0.036]*	0.033 [0.031]	0.06 [0.044]	0.048 [0.034]
Year dummy	0.017 [0.006]**	0.012 [0.006]	0.018 [0.006]**	0.014 [0.006]*	0.012 [0.006]	0.013 [0.006]*	0.014 [0.006]*	0.012 [0.006]	0.012 [0.006]
Industry dummies	Yes								
Constant	0.564 [0.015]**	0.585 [0.015]**	0.576 [0.015]**	0.573 [0.015]**	0.579 [0.016]**	0.585 [0.016]**	0.581 [0.016]**	0.586 [0.016]**	0.585 [0.016]**
Observations	7971	6835	7444	7408	6588	6554	6584	6529	6561
Groups	4799	4214	4537	4528	4079	4059	4076	4041	4056
R ² : within	0.523	0.502	0.525	0.510	0.489	0.485	0.486	0.486	0.486
between	0.729	0.725	0.723	0.725	0.727	0.718	0.717	0.717	0.716
overall	0.692	0.687	0.690	0.690	0.686	0.678	0.678	0.678	0.678
Breusch-Pagan Lagrangian multiplier test (pooling vs random effects)	chi-sq = 27.7 Pr>chi-sq = 0.000	chi-sq = 26.3 Pr>chi-sq = 0.000	chi-sq = 28.6 Pr>chi-sq = 0.000	chi-sq = 24.0 Pr>chi-sq = 0.000	chi-sq = 24.2 Pr>chi-sq = 0.000	chi-sq = 24.6 Pr>chi-sq = 0.000	chi-sq = 22.7 Pr>chi-sq = 0.000	chi-sq = 24.0 Pr>chi-sq = 0.000	chi-sq = 25.0 Pr>chi-sq = 0.000

Notes: Standard errors in parenthesis; *, ** indicate significance at the 5, and 1 percent levels, respectively.

Table 6. Estimation Results on Destinations

Dependent variable: ln(TFP)	[1]	[2]
Lagged ln(TFP)	0.751 [0.007]**	0.733 [0.006]**
Lagged R&D / Value added	0.374 [0.050]**	0.237 [0.051]**
Asia+U.S or Europe+Other regions	0.105 [0.051]*	0.09 [0.050]
Asia+U.S or Europe	0.092 [0.022]**	0.072 [0.022]**
Asia+Other regions	0.036 [0.077]	0.031 [0.074]
Asia	0.034 [0.010]**	0.014 [0.010]
U.S or Europe+Other regions	-0.046 [0.119]	-0.023 [0.115]
U.S or Europe	0.088 [0.043]*	0.084 [0.042]*
Other regions	0.237 [0.156]	0.261 [0.151]
Year dummy	0.015 [0.006]*	0.018 [0.006]**
Industry dummies	No	Yes
Constant	0.41 [0.011]**	0.568 [0.015]**
Observations	7971	7971
Groups	4799	4799
R ² : within	0.518	0.524
between	0.711	0.730
overall	0.674	0.692
Breusch-Pagan Lagrangian multiplier test (pooling vs random effects)	chi-sq = 47.9 Pr>chi-sq = 0.000	chi-sq = 28.2 Pr>chi-sq = 0.000

Notes: Standard errors in parenthesis; *, ** indicate significance at the 5, and 1 percent levels, respectively. "Asia" includes China, ASEAN and other Asian countries.

Table 7. Estimation Results on Difference-in-Differences

Dependent variable: lnTFP	(1) <i>D-in-D</i>	(2) <i>D-in-D</i>
Lagged lnTFP (θ)	0.741 [0.008]**	0.725 [0.007]**
Lagged R&D / Value added (ρ)	0.429 [0.059]**	0.286 [0.062]**
Offsoring entry dummy (β)	0.007 [0.020]	-0.025 [0.020]
2005 year dummy (γ)	0.000 [0.007]	0.001 [0.007]
Offsoring entry dummy \times 2005 year dummy (φ)	0.068 [0.025]**	0.075 [0.025]**
Industry dummies	No	Yes
Constant	0.424 [0.012]**	0.571 [0.017]**
Observations	5750	5750
Groups	3080	3080
R ² : within	0.488	0.495
between	0.731	0.748
overall	0.660	0.679
Breusch-Pagan Lagrangian multiplier test (pooling vs random effects)	chi-sq = 48.2 Pr>chi-sq = 0.000	chi-sq = 28.2 Pr>chi-sq = 0.000

Notes: Standard errors in parenthesis; *, ** indicate significance at the 5, and 1 percent levels, respectively.

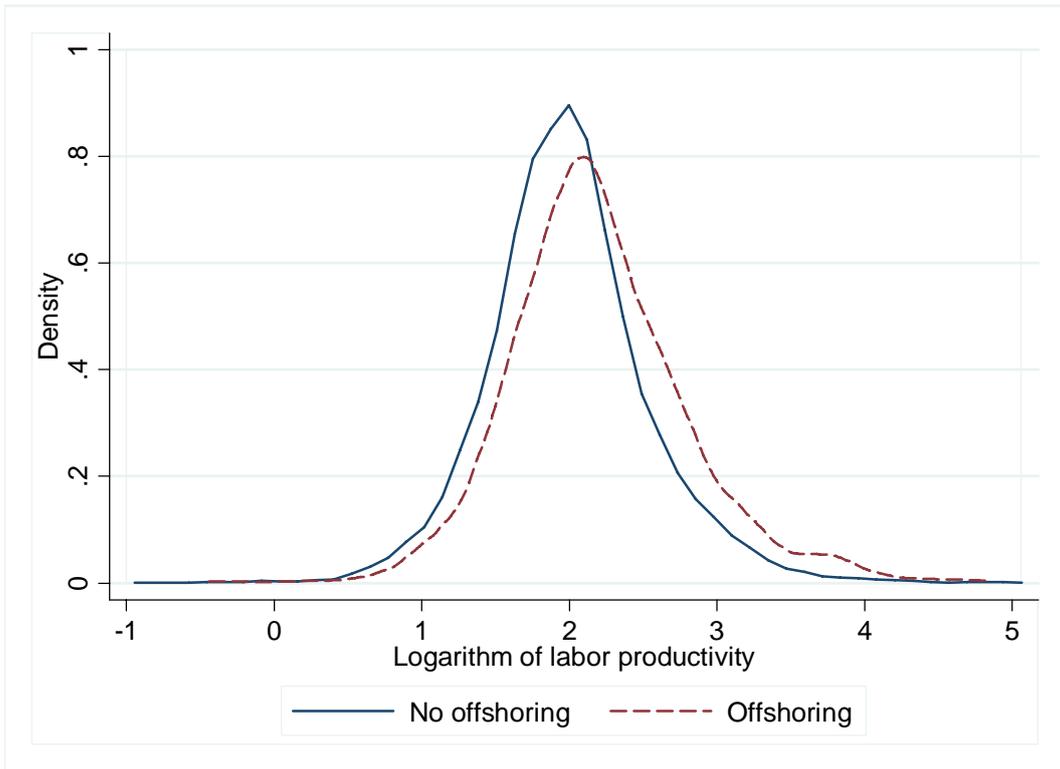


Figure 1. Differences in Labor Productivity

Note: Kernel density estimate is applied to the pooled data of 2000 and 2005.

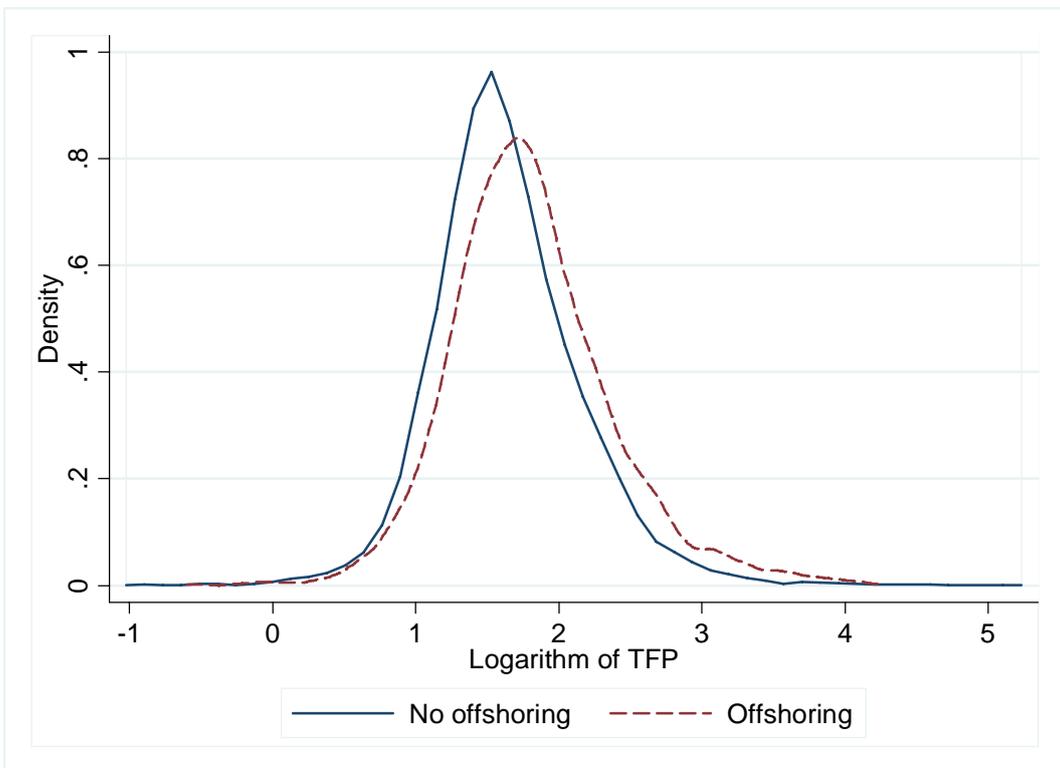


Figure 2. Differences in TFP

Note: Kernel density estimate is applied to the pooled data of 2000 and 2005.