Japan's Prefectural-level KLEMS: Productivity Comparison and Service Price Differences[1]

Joji Tokui[2]
Shinshu University and RIETI
Takeshi Mizuta
Institute of Economic Research, Hitotsubashi University

Abstract

We compile Japan's prefectural-level KLEMS database and conduct productivity comparison among Japanese 47 prefectures. One of the difficulties in compiling regional KLEMS database is how to handle possible variation in service prices across different regions. To cope with this problem, we estimated cross-regional price-level differences in each industry in the service sector (construction, electricity, gas and water, real estate, transportation and communication, and other services in the private sector) based on prefectural-level item-wise data of service prices compiled by the Japan's Statistic Bureau. In estimation, we applied the Country-Product-Dummy (CPD) method, a method used to estimate absolute purchasing power parities among countries, to cross-prefectural data in Japan. As a result of re-calculation, the standard deviation of cross-regional TFP difference indices in 2009 decreased by around 13 percent. In addition, by using the derived cross-regional price difference indices, we tested whether the Balassa-Samuelson effect, which holds among international economies, also holds among regional economies in Japan.

Keywords: Regional price level differences, Regional productivity differences, Absolute purchasing power parities
JEL classification: L80, O47, R11

---

[1] This paper is part of the results of the project, "Refinement and Analysis of the Regional-Level Japan Industrial Productivity Database: Providing basic information for Japan's regional development policy" carried out by the Research Institute of Economy, Trade and Industry (RIETI). I would like to express my gratitude here to the members of the review meetings for RIETI Discussion Papers for providing many valuable comments about the draft of this paper.
[2] E-mail: tokui@shinshu-u.ac.jp

1. Introduction

For the purpose of conducting productivity comparison among Japanese 47 prefectures, we compile Japan's prefectural-level KLEMS database, wich we call the Regional-level Japan Industrial Productivity (R-JIP) database[3]. One of the difficulties in compiling regional KLEMS database is how to handle possible variation in service prices across different regions[4]. Japan is not a geographically large country, and the prices of many easily-transported goods can converge among regions by arbitrage transactions. However, many service prices do not hold the same property because they are produced and consumed at the same time in the same place.

How we handle the possibility of variation in prices of the same product across different regions is more important due to the one of the distinguishing features of the R-JIP database. Faithful to the KLEMS spirit, the databese takes accont of regional differences in labor input composition and their wage levels and measures differences in quality of labor input among regions[5]. Because of this feature of the database, if we ignore differences in output price among regions, we may get baiased measurement of productivity differentials that cannot be ignored, particularly for service industries.

In order to cope with this problem, we apply the absolute purchasing power parity (PPP) method, the CPD method of Rao and Timmer (2000), to the variety of service prices among prefectures to calculate price differences in service among prefectures. Item-wise data of prices of services in each prefecture are available in the Retail Price Survey compiled by the Statistic Bureau of the Ministry of Internal Affairs and Communications[6]. We estimate cross-regional price-level differences in five service industries, which are construction, electricity/gas/water, real estate, transportation and communication, and other services in the private sector.

Applying estimsted cross-regional price-level differences, productivity comparison among prefectures are recalculated. As a byproduct, we can obtain the cross-regional price difference index in the Törnqvist formula, by taking the difference between cross-regional TFP difference before and after reflecting regional differences in price levels. The index is used to test whether the Balassa-Samuelson effect, which holds among international economies, also holds among regional economies in Japan.

[3] For R-JIP Database 2017 see the RIETI's website at https://www.rieti.go.jp/en/database/r-jip.html. The R-JIP 2017 contains real value added, quantity of labor input (man-hours), quality of labor input, and capital service input, covering 23 industry classifications in 47 prefectures, which are comprehensively measured for a period from 1970 to 2012.

[4] The System of National Accounts 2008 points out two main difficulties regarding regional accounts. One difficulty stems from transactions with other regions of the country, and the other from possible variation in prices of the same product across different regions.

[5] See Tokui et al. (2013) for the detailed characteristics of the R-JIP database and its construction.

[6] We used the results of surveys conducted in the capital city of each prefecture.

In the following Section 2, we explain how to measure regional differences in price levels of services and its results. Section 3 reports the results of our recalculated productivity analysis factoring in the measured price-level differences among regions. Section 4 reports whether the regional version of the Balassa-Samuelson effect holds, by seeing the correlation between cross-regional price difference index values and cross-regional differences in labor productivity.

2. Measuring Service-Price Differences across Regions

To compare productivity levels in absolute terms among different countries, one must convert prices as they are expressed in different currencies. This problem becomes easy when arbitarage by trade is at work so that law of one price holds internationally. However, there are some goods that are "non-tradable," thus complicating the issue. Likewise, in our study of different regions within the same country, although no adjustment for differences in price levels is necessary for goods whose prices can be arbitraged between regions through domestic trade, any goods that "cannot be traded" across regions even in the same country pose the same problem as in the context of the international economy. The service sector is typically known for its "simultaneous consumption and production," where, for many types of services, price arbitrage is unlikely to happen through inter-regional trade.

Hence, our task is to measure different price levels of services across regions. This can be accomplished by simply applying a method used in international economics to measure absolute purchasing power parities. We used the CPD method of Rao and Timmer (2000) that developed absolute purchasing power parities based on results of regression analyses of price data collected for individual items in each country.

As for prices of individual items in each region, we used data of the Statistic Bureau of the Ministry of Internal Affairs and Communications that tracks prices of items in each prefecture over time and publishes them in its Retail Price Survey. The Survey, as one would expect, has changed its composition over years through replacement of items. Some price data may not be necessarily available in all prefectures. Such replacement and missing data in some regions can be handled by the CPD method, which is one of the method's advantages. The Survey makes efforts to ensure consistency in the quality of covered items by specifying them in detail. Although we are rather doubtful of how much they can ensure such consistency in items of the service sector, we would not delve into this topic here.

The CPD method has another advantage of only needing price data of individual items, unlike the conventional method of constructing an index that requires data of each item's weight, something loke each item's share. This is accomplished by using an assumption specific to the CPD method as expressed in the following equation:

$$(1) \quad p_{ri} = \pi_r^* \cdot \eta_i^* \cdot \nu_{ri}^*$$

p_{ri} : Price of item i in prefecture r

π_r^* : Cross-regional price-level ratio at industry classification level in the R-JIP database

η_i^* : Relative price among items within the same industry classification in the R-JIP database

ν_{ri}^* : Random disturbance term

This means that the price of a certain item in each region, if ignoring the random disturbance term, can be expressed by a product of the cross-regional price ratio at industry classification level and the relative price of the item within that industry classification. In other words, relative prices of items within an industry classification are assumed to be the same regardless of region.

Under these assumptions, we take the log of both sides of Equation (1) to obtain Equation (2) below:

$$(2) \quad \log p_{ri} = \log \pi_r^* + \log \eta_i^* + \log \nu_{ri}^* = \pi_r + \eta_i + \nu_{ri}$$

Equation (2) can be estimated by ordinary least squares, using an equation with the following dummy variables:

$$(3) \quad \log p_{ri} = \pi_1 D_1 + \pi_2 D_2 + \cdots + \pi_{47} D_{47} + \eta_1 D_1^* + \eta_2 D_2^* + \cdots + \eta_n D_n^* + u_{ri}$$

where these two kinds of dummy variables are defined as below:

D_r: The value is 1 if p_{ri} on the left side of the equation is a data of prefecture r, and equals zero otherwise.

D_i: The value is 1 if p_{ri} on the left side of the equation is a data of item i, and equals zero otherwise.

Since this formula will generate perfect multicollinearity among explanatory variables if left as it is, we imposed a restriction where data of the first prefecture is taken as the numeraire, i.e., $\pi_1^* = 1$ or $\pi_1 = \log \pi_1^* = 0$. Here, we decided to take data of Tokyo as the basic standard (r = 1 for Tokyo) and measure relative price levels in all other prefectures. The value of $\hat{\pi}_r$ thus estimated gives the cross-regional price ratio at industry classification level in the R-JIP database by using the following equation:

(4) $\hat{\pi}_r^* = \exp\left(\hat{\pi}_r\right)$

In our measurement of regional differences in service-price levels, we choose five industries: construction, electricity/gas/water, real estate, transportation and communication, and othe private service sectors (including private non-profit sectors). In recent years, these five industries account for 40% - a significantly large share - of total nominal value added in the nation[7]. The largest among them is othe private service sectors, accounting for between 23 percent (in 2000) and 29 percent (in 2009) of value added by all industries.

Other than those five industries, the R-JIP database contains wholesale and retail, finance and insurance, and the government sector as service-sector industries. However, we excluded those three industries from our study of measuring regional differences in price levels due to conceptual difficulty in measuring prices[8]. But in the next section of this paper, in our analysis of productivity levels output of government sector is adjusted by regional differences in price levels of other private service sectors. Consequently, we made adjustment to the productivity analysis for regional differences in price levels, covering 6 industries in the service sector, which account for between 50 percent and 60 percent of total value added by all industries.

---

7 The share was stable at between 43 percent and 44 percent during the period from 2000 to 2008, which, however, jumped to 47.5 percent in 2009 due to the global financial crisis precipitated by the collapse of Lehman Brothers, decreasing value added by manufacturing industries.

8 The shares of the 3 industries excluded from adjustment for regional price differences in this study in value added by all industries in Japan in 2009 were 13 percent for the wholesale and retail industries, 6 percent for the finance and insurance industries, and 12 percent for the government service. For the wholesale and retail industries, one possible method would be to calculate cross-regional price difference index values based on regional differences in commercial margins. This method, however, requires significantly large numbers of merchandise items and data points. As such, we will address this issue in future.

Table 1 shows the number of items in those five industries covered in the Retail Price Surveys at 10-year intervals from 1970 to 2010. The total number of items for all of those five industries in the Survey gradually increased from 78 in 1970 to 200 in 2010[9]. Because the number of data in a single fiscal year is not sufficient to estimate the intended regression equation, we pooled data for every five years up to a year whose last digit was zero or five (for instance, an estimating equation for 1970 used data from 1966 to 1970) and conducted regression at 5-year intervals. Accordingly, the approximate number of data points used for each estimating equation is the number of items in Table 1 times 47 prefectures times five years[10].

(Table 1: Number of Items by Industry in Our Study [1970 to 2010])

Using these data we estimate Equation (3) for five service industries at the end of this paper at 5-year intervals from 1970 to 2010. We dropped prefecture dummies for Tokyo to express estimated values relative to Tokyo as a reference prefecture[11]. We can get quite robust estimated coefficients for each prefecture dummies. As estimated coefficients of Equation (3) are expressed in logarithmic form, we used the exponential function of Equation (4) to get regional relative price levels relative to Tokyo (=1). These results are shown in Tables 2 through 6 for each industry: Table 2 is for the construction industry, Table 3 for the electricity, gas and water industry, Table 4 for the real estate industry, Table 5 for the transportation and communication industry, and Table 6 for other private service industries (including non-profit private services).

(Table 2: Relative Price Levels by Prefecture in the Construction Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010)

(Table 3: Relative Price Levels by Prefecture in the Electricity, Gas and Water Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010)

(Table 4: Relative Price Levels by Prefecture in the Real Estate Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010)

---

9 Details of items in this study for 1970, 1980, 1990, 2000, and 2010 are described in Appendix 3.

10 The actual numbers of data points used for estimation are shown in the second to the last line along with each estimated result in Appendix 1, which are somewhat less than these numbers because some data were missing for merchandise items that were not used in certain prefectures.

11 Estimated results for 1970 were obtained without data of Okinawa Prefecture before its reversion to Japan due to their unavailability. For estimated results for 1975 and thereafter, we used 46 dummy variables for prefectures including Okinawa.

(Table 5: Relative Price Levels by Prefecture in the Transportation and Communication Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010)

(Table 6: Relative Price Levels by Prefecture in Other Private Service Industries (including Non-profit Private Services), Tokyo = 1, Comparisons in Years 1970, 1990, and 2010)

Among those five industries, the real estate industry shows the largest differences in relative price levels across regions. This reflects large differences in levels of rents of various properties across regions in the underlying data for the estimation[12]. In the electricity, gas and water industry, regional differences narrowed during the period between 1970 and 1990 but started widening in 2010, showing fluctuations, presumably in reflection of energy price movement during this period. Similar trends are observed in the transportation and communication industry. We also believe this is due to the inclusion of the transportation industry that greatly consumes energy.

Most notable among all is other private service industries (including non-profit private services) shown in Table 6. In this industry, relative price levels in most of the prefectures had been lower than those in Tokyo from the beginning and price differentials relative to Tokyo have been getting even wider in recent years in many prefectures. To illustrate this trend, we depicted the case of Hokkaido in Graph 1, which shows changes in price levels in this industry relative to Tokyo in every five years. Graph 1 shows that this trend occurred from 1980s through the first half of the 1990s. After that, the situation has been stable. Other private service industries (including non-profit private services), accounting for between 20 percent and slightly less than 30 percent of value added by all industries, may also give a significant impact on measurement of productivity, which is recalculated as described in the next section[13].

(Graph 1: Changes in Relative Price Levels in Other Private Service Industries (including Non-profit Private Services) in Hokkaido, Tokyo = 1, 1970 through 2010)

---

[12] Although regional differences in levels of rent on real estate may be divergent from those of real estate brokerage fees, their possible influence on recalculated productivity should be small because the real estate industry accounts for 2 percent - not a large share - of value added by all industries.

[13] The impact of regional price differences in the service industry (private sector and non-profit) was even greater, because they were also applied to the government service industry when we recalculated for the productivity analysis as mentioned above.

3. Productivity Analysis Corrected for Regional Differences in Service-price Levels

Using the R-JIP database, indices to compare productivity levels across prefectures have been developed and analyzed by Tokui et al. (2013) and Fukao et al. (2015). Their studies, as shown below, measured relative productivity levels of individual industries in each prefecture (hereinafter referred to as relative TFPs), by assuming a translog productivity function for each prefecture and each industry based on value added, and by using the method of Cave, Christensen and Diewert (1982) for constructing an index for cross-sectional productivity comparison. Adjustment for quality was made only to labor input. For capital input, industry-specific quality was taken into consideration, but regional differences were not presumed.

(5) $$RTFP_{ir} = \log\left(\frac{V_{ir}}{\overline{V}_i}\right) - \frac{1}{2}\left(S_{ir}^K + \overline{S}_i^K\right)\log\left(\frac{K_{ir}}{\overline{K}_i}\right) - \frac{1}{2}\left(S_{ir}^L + \overline{S}_i^L\right)\left\{\log\left(\frac{H_{ir}}{\overline{H}_i}\right) + \log\left(\frac{Q_{ir}^L}{\overline{Q}_i^L}\right)\right\}$$

V_{ir} : Real value added by industry i in prefecture r

K_{ir} : Real capital stock in industry i in prefecture r

H_{ir} : Labor input in man-hours in industry i in prefecture r

Q_{ir}^L : Labor quality in industry i in prefecture r

Variables with a bar on top represent the national averages (geometric means) of individual industries, which are expressed by the following equations:

$$\log\overline{V}_i = \frac{1}{47}\sum_{r=1}^{47}\log V_{ir}$$

$$\log\overline{K}_i = \frac{1}{47}\sum_{r=1}^{47}\log K_{ir}$$

$$\log\overline{H}_i = \frac{1}{47}\sum_{r=1}^{47}\log H_{ir}$$

$$\log\overline{Q}_i^L = \frac{1}{47}\sum_{r=1}^{47}\log Q_{ir}^L$$

Here, S^K_{ir} represents the cost share of capital and S^L_{ir} the cost share of labor. Those with a bar on top are the national averages (arithmetic means) of the respective shares of individual industries, which are obtained from:

$$\overline{S}_i^K = \frac{1}{47}\sum_{r=1}^{47}S_{ir}^K$$

$$\overline{S}_i^L = \frac{1}{47}\sum_{r=1}^{47}S_{ir}^L$$

The prefecture- and industry-specific relative TFPs are multiplied with value-added weights and aggregated over all industries with the following equations to derive the relative TFP for each prefecture. S^V_{ir} stands for the value-added weight of an industry in a particular prefecture. The symbol with a bar on top is the national average (arithmetic mean) of the industry.

(6)
$$RTFP_r = \sum_{i=1}^{23} \frac{1}{2}\left(S_{ir}^V + \overline{S}_i^V\right) RTFP_{ir}$$

$$\overline{S}_i^V = \frac{1}{47}\sum_{r=1}^{47} S_{ir}^V$$

In this study, we estimate differences in price levels across prefectures for each service industry as explained in Section 2. We use these estimated results to recalculate relative TFPs[14]. To distinguish the symbol for the real value added by an industry in a

[14] In the case of comparing productivity levels among different countries, currencies' valuations should be converted, which requires estimation of absolute purchasing power parities. See, for example, Jorgenson, Kuroda and Nishimizu (1987) who made such international comparison in their work to estimate differences in productivity levels between Japan and the U.S. In case currencies' valuations were not converted, for instance, the EU KLEMS project, which compared productivity levels within the Eurozone with the single currency, amounts were converted by absolute purchasing power parities to reflect differences in price levels in the zone. The project produced output PPPs, intermediate input PPPs, labor input PPPs, and capital input PPPs to convert the corresponding nominal values into real values. See Inklaar and Timmer (2008) to know the method used in the EU KLEMS project. Our R-JIP database has already dealt with labor input PPPs, as labor input values are obtained while taking into account regional differences in the compositions of worker attributes and wages. The database, however, does not factor in capital input PPPs on the assumption that there is no regional difference in capital cost in each industry. Also, instead of implementing double deflation by calculating output PPPs and intermediate input PPPs as EU KLEMS did, which is a more exact approach, we settled with a simplified method in which we derived regional price differences in each industry as the equivalent of output PPPs and apply them to value added in a single deflation approach, as our study was limited to the service sector. If there are inter-industry tables by prefecture compiled under a uniform standard that can be used to derive value added ratios by industry and prefecture, we will be able to obtain value added PPPs in a manner consistent with the R-JIP database with output PPPs and intermediate input PPPs as shown with the equation below. This is an issue to be addressed in future. The value added PPP is given by

$$\log\frac{P_{ir}^{VA}}{\overline{P_{ir}^{VA}}} = \frac{1}{\frac{1}{2}(w_{ir}+\overline{w_i})}\left\{\log\frac{P_{ir}^{GO}}{\overline{P_{ir}^{GO}}} - \left[1-\frac{1}{2}(w_{ir}+\overline{w_i})\right]\log\frac{P_{ir}^{II}}{\overline{P_{ir}^{II}}}\right\}$$

where

P_{ir}^{GO} : Price level of output in region r and industry i. The same with a bar on top is its geometric mean for the whole region.

P_{ir}^{VA} : Price level of value added in region r and industry i. The same with a bar on top is its geometric mean for the whole region.

P_{ir}^{II} : Price level of intermediate input in region r and industry i. The same with a bar on top is its geometric mean for the whole region.

prefecture that reflected regional differences in price levels of output from the previously used symbol, we expressed it by ($V_{ir}^{\#}$) with the superscript sharp. The cross-regional price difference for output of industry i is denoted Pir (for those industries that were not subject to our adjustment for regional price differences, the index always takes the value of 1.) Then the relationship between the two can be expressed as follows:

(7) $$V_{ir}^{\#} = \frac{V_{ir}}{P_{ir}}$$

By letting the variables in the above equation with a bar on top denote the respective national averages (geometric means) of the industry, we get:

(8) $$\log\left(\frac{V_{ir}^{\#}}{\overline{V_i^{\#}}}\right) = \log\left(\frac{V_{ir}}{\overline{V_i}}\right) - \log\left(\frac{P_{ir}}{\overline{P_i}}\right)$$

$$\log\overline{V_i^{\#}} = \frac{1}{47}\sum_{r=1}^{47}\log V_{ir}^{\#}$$

$$\log\overline{P_i} = \frac{1}{47}\sum_{r=1}^{47}\log P_{ir}$$

Relative TFPs that factor in cross-prefectural price level gaps can be computed by replacing real value added in Equation (5) with the newly calculated $V_{ir}^{\#}$, which gives us the following equation.

$$RTFP_{ir}^{\#} = \log\left(\frac{V_{ir}^{\#}}{\overline{V_i^{\#}}}\right) - \frac{1}{2}\left(S_{ir}^{K} + \overline{S_i^{K}}\right)\log\left(\frac{K_{ir}}{\overline{K_i}}\right) - \frac{1}{2}\left(S_{ir}^{L} + \overline{S_i^{L}}\right)\left\{\log\left(\frac{H_{ir}}{\overline{H}_i}\right) + \log\left(\frac{Q_{ir}^{L}}{\overline{Q}_i^{L}}\right)\right\}$$

Comparing this equation and the original Equation (5) and considering the relationship expressed in Equation (8), we found the following relationship between the newly calculated and previously calculated TFPs.

(9) $$RTFP_{ir}^{\#} = RTFP_{ir} - \log\left(\frac{P_{ir}}{\overline{P_i}}\right)$$

The prefecture- and industry-specific relative TFPs obtained above can be aggregated over all industries in the way we did with Equation (6) so that we can compare levels of prefectural productivity, as with the following equation:

---

w_{ir} : Value added ratio in region r and industry i. The same with a bar on top is its arithmetic mean for the whole region.

$$\mathrm{RTFP}_r^{\#} = \sum_{i=1}^{23} \left(S_{ir}^{V} + \overline{S_{\imath}^{V}} \right) \mathrm{RTFP}_{ir}^{\#}$$

Substitution of Equation (9) into this equation produces Equation (10), which reveals that the difference between the newly calculated and previously calculated prefectural relative TFPs can generate a value that represents cross-prefectural price-gap index values for output for individual industries aggregated over all industries with the Törnqvist Index.

$$\text{(10)} \qquad \mathrm{RTFP}_r^{\#} = \mathrm{RTFP}_r - \sum_{i=1}^{23} \left(S_{ir}^{V} + \overline{S_{\imath}^{V}} \right) \log \left(\frac{P_{ir}}{\overline{P_{\imath}}} \right)$$

Now, let us look at the result of the calculated relative TFPs that reflect differences in price levels among prefectures[15]. Graphs 2, 3, and 4 show calculation results for 1970, 1990, and 2009, respectively. Points on the line graphs are relative TFPs previously calculated before price adjustment. The white bar graphs show newly calculated relative TFPs. The black portions of bars show the magnitude of corrections made by adjusting for relative price levels in the service sector. In prefectures where relative price levels in service industries were high, their relative TFPs that had been inflated without such adjustment decreased and in prefectures with lower service-price levels, adjustment went in the opposite direction.

(Graph 2: Relative TFPs that reflect differences in price levels among prefectures, 1970)
(Graph 3: Relative TFPs that reflect differences in price levels among prefectures, 1990)
(Graph 4: Relative TFPs that reflect differences in price levels among prefectures, 2009)

In each graph, prefectures are sorted in the ascending order of labor productivity from right to left. As we will see in the next section, generally, the higher the labor productivity and per-capita income are in a region, the higher the relative price level tends to be in its service sector (Balassa-Samuelson effect). In many prefectures in the left half of each graph, their relative TFPs were adjusted downward (the previously calculated relative TFP less newly calculated relative TFP, i.e., the price adjustment, was positive), and in many prefectures in the right half, their relative TFPs were adjusted upward (i.e., negative price adjustment).

Comparison between Graph 2 for 1970 and Graph 4 for 2009 shows that

[15] Here, the relative TFP is recalculated based on the R-JIP Database 2014 covering the data period between 1970 and 2009.

incorporation of regional differences in price levels of services gives greater impact on regional differences in relative TFPs in 2009. This is because, as mentioned in the previous section, the value-added weight of service industries over all industries became larger in 2009 and because in other privte service industries (including non-profit private services), which had a large weight among them, regional price differences were wider.

It is hard to tell whether the degree of differences in relative TFPs across prefectures narrowed or widened on the whole only by looking at the bar graphs of Graphs 2 through 4 after making the corrections. Hence, we calculate standard deviations that show degrees of dispersion of the newly calculated and the previously calculated relative TFPs across prefectures and compared them at 10-year intervals as shown in Table 7. The result shows that, in all of the years, the values for relative TFPs that reflected prefectural price-level differences were smaller than those without reflecting such price-differentials. This means that the measures of cross-regional productivity gaps had been somewhat exaggerated by not considering regional price-level differentials in the service sector. Difference between the two is larger in and after 1990. For instance, our result shows that for 1970, the standard deviation of cross-regional TFP difference index values decreases by around 7% from 0.089 to 0.083, while for 2009, the standard deviation of the index decreases by around 13 percent, going from 0.079 to 0.069.

(Table 7: Standard Deviations Indicating Dispersion of Newly Calculated and Previously Calculated Relative TFPs across Prefectures, from 1970 to 2009)

Let us conclude this section by looking at how cross-prefectural differences in labor productivity are decomposed (into capital-labor ratio, labor quality, and relative TFP) based on our results of newly calculated relative TFPs obtained by reflecting regional differences in service-price levels. The bar graphs of Graphs 5, 6, and 7 illustrate the results of decomposition for 1970, 1990, and 2009, respectively. Forty years ago, regional differences in capital-labor ratios (bars in black) played a major role in regional differences in labor productivity. Their influence had gradually decreased in recent years to be replaced by regional differences in relative TFPs (bars in white), which plays a significant role. This is the same results found by Tokui et al. (2013), Fukao et al. (2015), and others. To put it another way, although factoring into regional differences in service price levels has an effect of moderately correcting overestimation of cross-regional differences in relative TFPs, such effect is not significant enough to correct the conclusion that regional gaps in relative TFPs have become an important factor in explaining regional differences in labor productivity in recent years[16].

(Graph 5: Decomposition of Differences in Regional Labor Productivity in 1970)
(Graph 6: Decomposition of Differences in Regional Labor Productivity in 1990)
(Graph 7: Decomposition of Differences in Regional Labor Productivity in 2009)

4. Regional Differences in Service-price Levels and the Balassa-Samuelson Effect

Our results, so far, showed not only that regional differences in productivity still exist even within Japan, but also that regional differences in price levels are observed in the service sector. This led us to the question of whether such regional differences in price levels observed within Japan are consistent with the Balassa-Samuelson effect, which is well-known in international economics[17]. Balassa (1964) and Samuelson (1964) explained that absolute purchasing power parities across countries do not hold even in the long-run because of differences in productivity levels between the tradable and non-tradable goods sectors. The Balassa-Samuelson effect explains that domestic prices are inflated in developed countries than in developing countries.

If we assume that difference between developed and developing countries in international economics corresponds to difference between regions with high and low labor productivity levels within a country, we would expect that in regions with high levels of labor productivity, relative price levels should be inflated due to inflated prices of non-tradable services. As we can obtain cross-regional price difference index values by using Equation (10) as explained in the previous section, we can look at the correlation between these values and levels of regional labor productivity to test whether the domestic version of the Balassa-Samuelson effect holds.

Graphs 8, 9, and 10 are scatter plot diagrams to analyze correlation between cross-regional price difference index values and differences in labor productivity at prefecture level for 1970, 1990, and 2009, respectively. Each graph shows a regression line where the cross-regional price difference index is regressed on the labor

---

[16] Tokui et al. (2013) and Fukao et al. (2015) conducted more detailed analyses and concluded that many of the differences in relative TFPs, the major source of regional differences in labor productivity still remaining in recent years, were caused by regional differences in the service sector. It is important that this study has confirmed the importance of regional differences in relative TFPs, even after factoring in regional price differences in the service industry.

[17] This paper defines the "Balassa-Samuelson (BS) effect" as the phenomenon that prices of services (non-tradable goods) are higher in relatively rich countries and lower in relatively poor countries. As a mechanism behind such phenomenon observed, they focused on differences in productivity levels between traded and non-traded goods. This paper, however, does not include discussion of such underlying mechanism.

productivity difference along with its 95 percent confidence interval. These scatter plots indicate weak positive correlation between the two. Table 8 summarises these scatter plots in correlation coefficients between the two variables and their level of significance. With the exception of 2009, in nearly all of the years in the table, the correlation coefficient is significant at the 1 percent or 5 percent level. We can conjecture that in regions with high labor productivity levels, wages get relatively higher in excess of productivity differences in the service sector, which inflate relative price levels of services in these regions.

(Graph 8: Correlation between Regional Differences in Price Levels and Differences in Labor Productivity in 1970)

(Graph 9: Correlation between Regional Differences in Price Levels and Differences in Labor Productivity in 1990)

(Graph 10: Correlation between Regional Differences in Price Levels and Differences in Labor Productivity in 2009)

(Table 8: Correlation Coefficients between Regional Differences in Price Levels and Differences in Labor Productivity and Their Significance Level from 1970 through 2009)

5. Conclusion

The objective of this study is to make up for the shortcoming of the R-JIP database, which has been published without reflecting regional differences in price levels in service industries, even though service industries are thought to have gained importance in cross-regional productivity analysis, as indicated by the analyses conducted by Tokui et al. (2013) and Fukao et al. (2015). Based on the R-JIP database, these works conclude that, as the underlying factors to explain regional differences in labor productivity in Japan in recent years, differences in productivity levels within an industry, as measured by relative TFPs, came to play a more important role, and among industries, differences in relative TFPs in service industries were getting more important.

To estimate cross-regional relative price levels, we use item-wise price data compiled by the Retail Price Survey, and we apply the CPD method that is developed to measure absolute purchasing power parities. The results are then incorporated into our productivity analysis to make recalculation. Our study finds out that although factoring in regional differences in service price levels has an effect of moderately correcting overestimation of regional differences in relative TFPs, such effect is not large enough to correct the conclusion that cross-regional differences in relative TFPs have become an important factor in explaining the regional differences in labor productivity in recent years. Furthermore, we test an intra-national version of the Balassa-Samuelson effect by seeing the correlation between the cross-regional price difference index values, a byproduct of our productivity analysis, and regional differences in labor productivity. We find that relationships indicative of the Balassa-Samuelson effect can be observed among Japanes regions.

The issue of regional price-level differences in service industries discussed in this study, while not going so far as to significantly correct the previous studies on decomposition of regional differences in labor productivity, is likely to gain more importance because the share of service industries in the total value added by all industries has been expanding in recent years and because regional price-level gaps have widened in other private service industries. This suggests that, in cross-regional productivity analysis, it is necessary to carefully handle regional price-level differences arising from service industries' salient feature of simultaneous consumption and production.

We conclude this paper by pointing out two major issues that could not be covered in this study. One issue is about the wholesale and retail industry that was not included here. We did not adjust for regional price-level differences in the wholesale and retail industry due to unavailability of appropriate item-wise data that would fit the method used in this study. However, the wholesale and retail industry, accounting for more than 10 percent of value added by all industries, might affect our result in this paper. Therefore, we need to devise ways to include it in our adjustment for regional price-level differences by imposing some assumption, for instance, an assumption that regional price-level differences for merchandise are deemed to be regional price-level differences in commercial margins. Another issue is about how to deflate value added. Given that output is measured by value added in the R-JIP database, it should be preferable to adopt double deflation. That, however, requires inter-industry data by region, indicating the needs to refine and expand our database.

References:

J. Tokui, T. Makino, K. Fukao, T. Miyagawa, N. Arai, S. Arai, T. Inui, K. Kawasaki, N. Kodama, and N. Noguchi (2013), "Todofuken-betsu Sangyo Seisansei (R-JIP) Database no Kochiku to Chiiki-kan Seisansei Kakusa no Bunseki

[Construction of the Regional-Level Japan Industrial Productivity (R-JIP) Database and Analysis of Prefectural Productivity Differences]," *The Economic Review (Keizai Kenkyu)*, Vol. 64, No. 3, pp. 218-239 (in Japanese).

Balassa, B. (1964), "The Purchasing Power Parity Doctrine: A Reappraisal," *Journal of Political Economy*, Vol. 72, pp. 584-96.

Caves, D., L. Christensen, and W. Diewert (1982), "Multilateral Comparisons of Output, Input and Productivity Using Superlative Index Numbers," *Economic Journal*, Vol. 92, No. 365, pp. 73-86.

Fukao, F., J.-P. Bassino, T. Makino, R. Paprzycki, T. Settsu, M. Takashima, and J. Tokui (2015), Regional Inequality and Industrial Structure in Japan 1874-2008. Maruzen Publishing Co., Ltd.

InKlaar, R., and Marcel P. Timmer (2008), International Comparisons of Output, Inputs and Productivity at the Industry Level, *Groningen Growth and Development Centre Research Memorandum*.

Jorgenson, D. W., M. Kuroda, and M. Nishimizu (1987), Japan-U.S. Industry-Level Productivity Comparisons, 1960-1979, *Journal of the Japanese and International Economies*, Vol. 1, pp. 1-30.

Samuelson, P. (1964), "Theoretical Notes on Trade Problems," *Review of Economics and Statistics*, Vol.23, pp.1-60.

Table 1. Number of Items by Industry in Our Study: 1970-2010

	R-JIP industries	1970	1980	1990	2000	2010
16	Construction	15	16	17	17	19
17	Electricity/Gas/Water	13	15	24	28	27
20	Real estate	3	3	9	7	7
21	Transportation and Communication	8	8	18	35	49
22	Other private service industries	39	50	78	85	98
	計	78	92	146	172	200

Table 2: Relative Price Levels by Prefecture in the Construction Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010

	prefecture	1970		1990		2010	
		Relative price	Std.Err.	Relative price	Std.Err.	Relative price	Std.Err.
1	Hokkaido	0.961	0.039	1.035	0.037	0.973	0.031
2	Aomori	0.925	0.037	0.901	0.032	1.005	0.032
3	Iwate	0.888	0.035	0.848	0.030	0.992	0.032
4	Miyagi	0.930	0.037	0.917	0.032	0.944	0.030
5	Akita	0.981	0.039	0.871	0.031	0.932	0.030
6	Yamagata	1.053	0.042	0.822	0.029	0.971	0.031
7	Fukushima	0.934	0.038	0.880	0.031	1.001	0.032
8	Ibaraki	0.900	0.036	0.907	0.032	0.973	0.031
9	Tochigi	0.917	0.037	0.829	0.029	0.979	0.032
10	Gunma	0.929	0.037	0.904	0.032	0.926	0.030
11	Saitama	0.970	0.039	0.885	0.031	0.942	0.030
12	Chiba	0.965	0.039	0.889	0.031	0.955	0.031
13	Tokyo	*1.000*		*1.000*		*1.000*	
14	Kanagawa	1.009	0.040	1.046	0.037	1.105	0.036
15	Niigata	0.955	0.038	0.907	0.032	1.000	0.032
16	Toyama	0.926	0.037	0.870	0.031	0.949	0.031
17	Ishikawa	0.957	0.038	0.954	0.034	0.983	0.032
18	Fukui	0.888	0.036	0.939	0.033	1.023	0.033
19	Yamanashi	0.900	0.036	0.917	0.032	0.940	0.030
20	Nagano	0.996	0.040	0.908	0.032	0.934	0.030
21	Gifu	0.928	0.037	0.949	0.034	0.935	0.030
22	Shizuoka	0.959	0.039	0.890	0.032	0.988	0.032
23	Aichi	1.089	0.043	1.063	0.038	0.990	0.032
24	Mie	0.886	0.036	0.890	0.032	0.990	0.032
25	Shiga	0.908	0.036	0.923	0.033	1.022	0.033
26	Kyoto	1.015	0.041	0.995	0.035	0.957	0.031
27	Osaka	0.920	0.037	0.967	0.034	1.027	0.033
28	Hyogo	0.967	0.039	0.980	0.035	0.983	0.032
29	Nara	0.981	0.039	0.893	0.032	0.948	0.031
30	Wakayama	0.986	0.040	0.941	0.033	1.058	0.034
31	Tottori	0.922	0.037	0.863	0.031	0.976	0.031
32	Shimane	0.978	0.039	0.887	0.031	0.981	0.032
33	Okayama	0.914	0.037	0.869	0.031	0.960	0.031
34	HIroshima	0.981	0.039	0.951	0.034	0.932	0.030
35	Yamaguchi	0.962	0.039	0.873	0.031	1.018	0.033
36	Tokushima	0.936	0.038	0.897	0.032	0.941	0.030
37	Kagawa	0.900	0.036	0.783	0.028	0.876	0.028
38	Ehime	0.934	0.038	0.876	0.031	0.854	0.028

39	Kochi	0.956	0.038	0.854	0.030	0.954	0.031
40	Fukuoka	0.903	0.036	0.880	0.031	0.955	0.031
41	Saga	0.895	0.036	0.782	0.028	0.980	0.032
42	Nagasaki	0.879	0.035	0.957	0.034	1.010	0.033
43	Kumamoto	0.951	0.038	0.877	0.031	1.046	0.034
44	Oita	0.924	0.037	0.768	0.027	1.009	0.032
45	Miyazaki	0.861	0.035	0.781	0.028	0.887	0.029
46	Kagoshima	0.899	0.036	0.779	0.028	0.935	0.030
47	Okimnawa		.	0.778	0.028	0.884	0.028

Table 3: Relative Price Levels by Prefecture in the Electricity, Gas and Water Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010

prefecture		1970		1990		2010	
		Relative price	Std.Err.	Relative price	Std.Err.	Relative price	Std.Err.
1	Hokkaido	1.274	0.077	0.899	0.032	1.201	0.053
2	Aomori	1.752	0.104	0.808	0.028	1.141	0.050
3	Iwate	0.922	0.056	0.763	0.027	1.128	0.049
4	Miyagi	1.092	0.065	0.679	0.024	1.080	0.049
5	Akita	1.023	0.061	0.847	0.030	1.182	0.053
6	Yamagata	0.975	0.058	0.932	0.033	1.167	0.052
7	Fukushima	0.991	0.059	0.861	0.030	1.211	0.054
8	Ibaraki	0.970	0.059	0.809	0.028	1.131	0.050
9	Tochigi	0.914	0.054	0.906	0.032	1.101	0.050
10	Gunma	1.104	0.066	0.773	0.027	1.056	0.048
11	Saitama	1.073	0.064	0.851	0.030	1.114	0.050
12	Chiba	1.114	0.068	0.815	0.029	0.960	0.042
13	Tokyo	*1.000*		*1.000*		*1.000*	
14	Kanagawa	1.035	0.063	0.936	0.033	0.990	0.043
15	Niigata	0.969	0.059	0.781	0.028	1.054	0.047
16	Toyama	1.051	0.062	0.741	0.026	1.095	0.048
17	Ishikawa	0.931	0.055	0.824	0.029	1.064	0.047
18	Fukui	0.938	0.056	0.724	0.026	1.014	0.044
19	Yamanashi	0.948	0.056	0.855	0.031	0.987	0.044
20	Nagano	0.994	0.060	0.917	0.033	1.093	0.048
21	Gifu	0.932	0.055	0.888	0.031	1.021	0.046
22	Shizuoka	0.931	0.055	0.808	0.028	1.000	0.044
23	Aichi	0.901	0.055	0.919	0.033	1.159	0.051
24	Mie	0.973	0.059	0.673	0.024	0.885	0.039
25	Shiga	0.996	0.060	0.920	0.033	1.135	0.051
26	Kyoto	0.999	0.061	0.921	0.033	1.161	0.052
27	Osaka	0.936	0.057	0.766	0.027	0.977	0.043
28	Hyogo	1.025	0.062	0.952	0.034	1.097	0.049
29	Nara	1.121	0.068	0.934	0.034	1.125	0.052
30	Wakayama	1.006	0.060	0.831	0.029	1.043	0.046
31	Tottori	0.968	0.058	0.789	0.028	1.035	0.045
32	Shimane	1.017	0.060	0.972	0.034	1.212	0.053
33	Okayama	0.924	0.055	0.807	0.028	1.102	0.048
34	HIroshima	0.955	0.057	0.793	0.028	1.053	0.045
35	Yamaguchi	0.940	0.056	0.937	0.033	1.172	0.051
36	Tokushima	0.964	0.057	0.740	0.026	1.066	0.047
37	Kagawa	0.972	0.058	0.843	0.030	1.145	0.051
38	Ehime	0.999	0.059	0.843	0.030	1.058	0.046

39	Kochi	0.953	0.058	0.817	0.029	0.904	0.039
40	Fukuoka	1.016	0.062	0.958	0.034	1.005	0.044
41	Saga	1.069	0.064	0.955	0.034	1.293	0.058
42	Nagasaki	1.089	0.066	0.996	0.035	1.125	0.051
43	Kumamoto	1.001	0.061	0.742	0.026	1.110	0.049
44	Oita	0.977	0.059	0.831	0.030	1.200	0.054
45	Miyazaki	0.966	0.059	0.863	0.031	1.140	0.052
46	Kagoshima	0.843	0.052	0.757	0.027	0.980	0.043
47	Okimnawa		.	0.865	0.031	1.215	0.054

Table 4: Relative Price Levels by Prefecture in the Real Estate Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010

	prefecture	1970		1990		2010	
		Relative price	Std.Err.	Relative price	Std.Err.	Relative price	Std.Err.
1	Hokkaido	0.652	0.057	0.571	0.036	0.503	0.022
2	Aomori	0.422	0.037	0.489	0.033	0.430	0.021
3	Iwate	0.443	0.039	0.501	0.034	0.435	0.022
4	Miyagi	0.648	0.057	0.681	0.043	0.494	0.022
5	Akita	0.433	0.038	0.501	0.033	0.506	0.024
6	Yamagata	0.482	0.042	0.494	0.033	0.476	0.024
7	Fukushima	0.363	0.032	0.398	0.027	0.437	0.021
8	Ibaraki	0.535	0.047	0.554	0.037	0.488	0.023
9	Tochigi	0.469	0.041	0.525	0.034	0.569	0.027
10	Gunma	0.384	0.034	0.386	0.025	0.482	0.023
11	Saitama	0.972	0.085	0.667	0.043	0.731	0.033
12	Chiba	0.820	0.072	0.634	0.041	0.674	0.030
13	Tokyo	*1.000*		*1.000*		*1.000*	
14	Kanagawa	0.948	0.083	0.737	0.047	0.835	0.037
15	Niigata	0.540	0.047	0.576	0.039	0.556	0.025
16	Toyama	0.425	0.037	0.514	0.035	0.466	0.023
17	Ishikawa	0.428	0.037	0.550	0.035	0.487	0.022
18	Fukui	0.519	0.045	0.440	0.028	0.426	0.020
19	Yamanashi	0.455	0.040	0.547	0.035	0.481	0.023
20	Nagano	0.335	0.029	0.493	0.033	0.499	0.023
21	Gifu	0.508	0.045	0.525	0.034	0.414	0.019
22	Shizuoka	0.576	0.050	0.594	0.038	0.573	0.027
23	Aichi	0.664	0.058	0.654	0.042	0.666	0.029
24	Mie	0.341	0.030	0.466	0.030	0.437	0.020
25	Shiga	0.392	0.034	0.520	0.034	0.557	0.026
26	Kyoto	0.484	0.042	0.740	0.047	0.614	0.027
27	Osaka	0.620	0.054	0.710	0.045	0.745	0.032
28	Hyogo	0.759	0.066	0.716	0.045	0.657	0.028
29	Nara	0.463	0.041	0.497	0.033	0.567	0.027
30	Wakayama	0.524	0.046	0.419	0.028	0.509	0.024
31	Tottori	0.376	0.033	0.455	0.029	0.378	0.018
32	Shimane	0.379	0.033	0.536	0.034	0.435	0.020
33	Okayama	0.550	0.048	0.388	0.024	0.407	0.019
34	HIroshima	0.611	0.054	0.590	0.037	0.471	0.021
35	Yamaguchi	0.412	0.036	0.371	0.024	0.453	0.021
36	Tokushima	0.486	0.043	0.482	0.031	0.413	0.019
37	Kagawa	0.512	0.045	0.485	0.032	0.473	0.022
38	Ehime	0.474	0.042	0.430	0.029	0.370	0.019

39	Kochi	0.483	0.042	0.518	0.034	0.442	0.021
40	Fukuoka	0.737	0.065	0.526	0.033	0.565	0.025
41	Saga	0.395	0.035	0.410	0.027	0.452	0.023
42	Nagasaki	0.518	0.045	0.547	0.037	0.514	0.024
43	Kumamoto	0.434	0.038	0.541	0.035	0.512	0.023
44	Oita	0.435	0.038	0.410	0.027	0.424	0.020
45	Miyazaki	0.448	0.039	0.483	0.031	0.422	0.019
46	Kagoshima	0.593	0.052	0.538	0.034	0.462	0.020
47	Okimnawa		.	0.575	0.037	0.502	0.023

Table 5: Relative Price Levels by Prefecture in the Transportation and Communication Industry, Tokyo = 1, Comparisons in Years 1970, 1990, and 2010

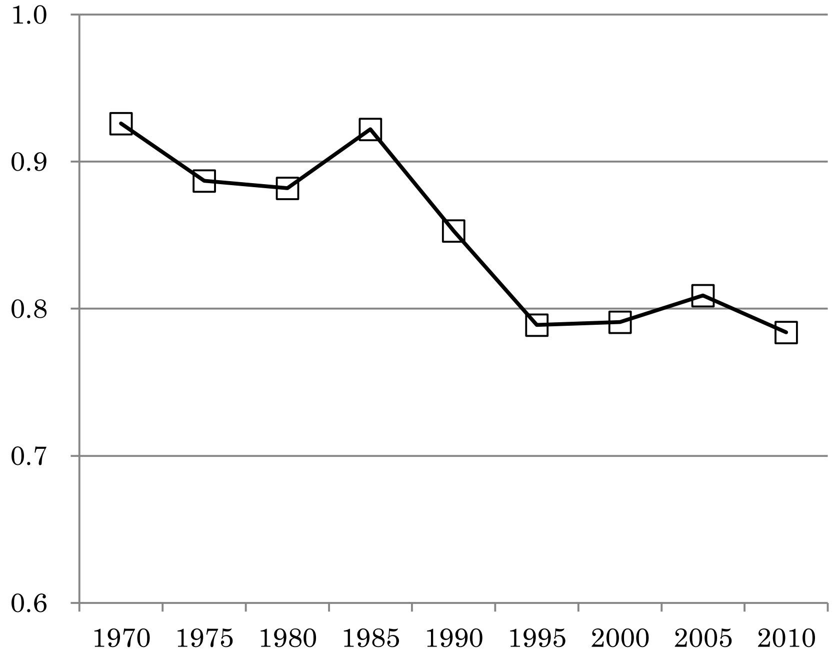
	prefecture	1970		1990		2010	
		Relative price	Std.Err.	Relative price	Std.Err.	Relative price	Std.Err.
1	Hokkaido	1.029	0.062	0.952	0.030	1.026	0.019
2	Aomori	1.061	0.068	0.933	0.031	0.926	0.017
3	Iwate	1.100	0.071	0.923	0.030	0.955	0.018
4	Miyagi	1.149	0.071	0.976	0.032	0.940	0.017
5	Akita	1.061	0.068	0.913	0.030	0.954	0.018
6	Yamagata	1.070	0.069	0.912	0.030	0.946	0.018
7	Fukushima	1.246	0.077	0.946	0.028	0.900	0.016
8	Ibaraki	0.977	0.060	0.975	0.032	0.970	0.018
9	Tochigi	0.969	0.060	0.931	0.027	0.934	0.017
10	Gunma	1.015	0.063	0.966	0.029	0.931	0.017
11	Saitama	1.142	0.074	1.001	0.033	0.944	0.017
12	Chiba	0.982	0.061	0.827	0.025	0.900	0.017
13	Tokyo	*1.000*		*1.000*		*1.000*	
14	Kanagawa	1.269	0.075	0.918	0.027	0.985	0.018
15	Niigata	1.011	0.060	1.011	0.029	0.928	0.017
16	Toyama	1.002	0.060	1.018	0.029	0.969	0.018
17	Ishikawa	1.210	0.073	1.067	0.032	0.978	0.018
18	Fukui	1.201	0.071	1.081	0.031	0.968	0.018
19	Yamanashi	1.081	0.070	0.954	0.031	0.933	0.017
20	Nagano	0.980	0.060	0.933	0.028	0.959	0.018
21	Gifu	1.150	0.068	0.962	0.028	0.927	0.017
22	Shizuoka	0.977	0.060	0.907	0.027	0.932	0.017
23	Aichi	1.234	0.073	1.020	0.030	0.950	0.017
24	Mie	1.180	0.073	0.940	0.028	0.943	0.017
25	Shiga	1.040	0.064	0.934	0.029	0.907	0.017
26	Kyoto	1.247	0.074	0.927	0.027	0.961	0.018
27	Osaka	1.286	0.077	0.947	0.027	0.984	0.018
28	Hyogo	1.273	0.076	0.964	0.028	0.936	0.017
29	Nara	1.155	0.071	0.926	0.027	0.956	0.017
30	Wakayama	1.256	0.077	0.968	0.029	0.929	0.017
31	Tottori	0.997	0.064	0.881	0.029	0.924	0.017
32	Shimane	0.958	0.059	0.956	0.029	0.938	0.017
33	Okayama	0.852	0.051	0.854	0.027	0.873	0.016
34	HIroshima	1.142	0.068	0.837	0.024	0.955	0.017
35	Yamaguchi	0.970	0.063	0.904	0.030	0.906	0.017
36	Tokushima	1.060	0.068	0.909	0.030	0.921	0.017
37	Kagawa	1.195	0.074	0.906	0.027	0.982	0.018
38	Ehime	0.988	0.059	0.956	0.028	0.951	0.017

39	Kochi	1.022	0.061	0.948	0.030	0.954	0.017
40	Fukuoka	1.185	0.070	0.990	0.029	0.875	0.016
41	Saga	0.979	0.063	0.931	0.031	0.896	0.017
42	Nagasaki	0.988	0.061	0.887	0.028	0.878	0.016
43	Kumamoto	0.942	0.056	0.911	0.027	0.891	0.016
44	Oita	0.991	0.064	0.934	0.031	0.896	0.017
45	Miyazaki	0.984	0.063	0.947	0.031	0.918	0.017
46	Kagoshima	1.012	0.062	0.957	0.030	0.905	0.017
47	Okimnawa		.	0.945	0.031	0.922	0.018

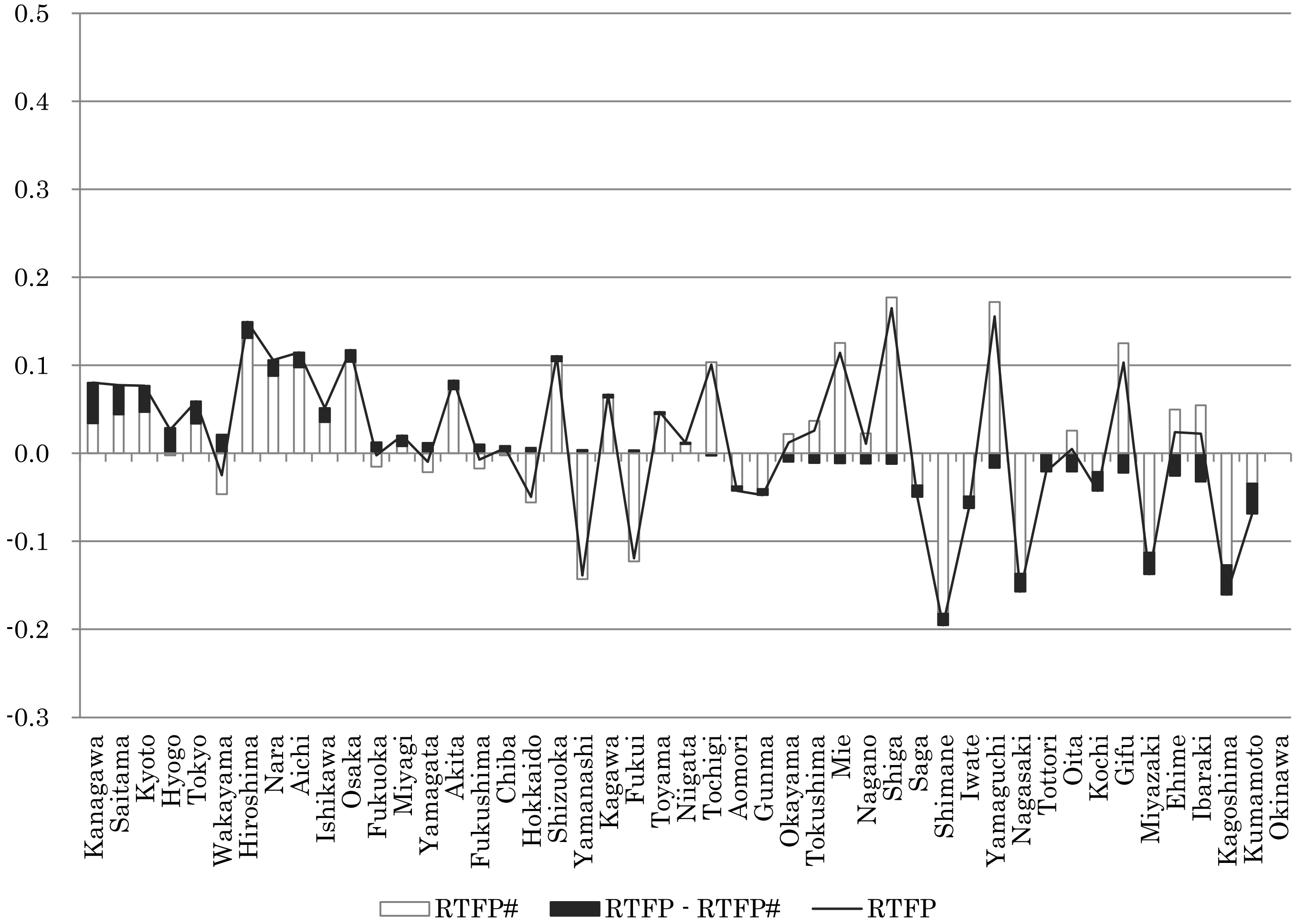
Table 6: Relative Price Levels by Prefecture in Other Private Service Industries (including Non-profit Private Services), Tokyo = 1, Comparisons in Years 1970, 1990, and 2010

	prefecture	1970		1990		2010	
		Relative price	Std.Err.	Relative price	Std.Err.	Relative price	Std.Err.
1	Hokkaido	0.926	0.035	0.853	0.017	0.784	0.020
2	Aomori	0.903	0.035	0.765	0.015	0.762	0.020
3	Iwate	0.914	0.035	0.802	0.016	0.855	0.022
4	Miyagi	0.945	0.036	0.864	0.017	0.863	0.022
5	Akita	0.987	0.038	0.826	0.016	0.843	0.022
6	Yamagata	0.946	0.036	0.864	0.017	0.893	0.023
7	Fukushima	0.974	0.037	0.877	0.017	0.857	0.022
8	Ibaraki	0.837	0.032	0.866	0.017	0.845	0.022
9	Tochigi	0.996	0.038	0.887	0.017	0.881	0.022
10	Gunma	0.941	0.036	0.875	0.017	0.896	0.023
11	Saitama	1.006	0.038	0.939	0.018	0.928	0.024
12	Chiba	0.927	0.035	0.917	0.018	0.876	0.022
13	Tokyo	*1.000*		*1.000*		*1.000*	
14	Kanagawa	1.024	0.039	0.925	0.018	1.013	0.026
15	Niigata	0.959	0.037	0.867	0.017	0.894	0.023
16	Toyama	0.987	0.038	0.865	0.017	0.810	0.021
17	Ishikawa	0.995	0.038	0.874	0.017	0.800	0.020
18	Fukui	0.952	0.037	0.874	0.017	0.785	0.020
19	Yamanashi	0.996	0.038	0.846	0.017	0.828	0.021
20	Nagano	0.920	0.035	0.853	0.017	0.919	0.023
21	Gifu	0.829	0.032	0.839	0.016	0.899	0.023
22	Shizuoka	0.988	0.038	0.941	0.018	0.905	0.023
23	Aichi	0.897	0.034	0.850	0.017	0.927	0.024
24	Mie	0.918	0.035	0.870	0.017	0.793	0.020
25	Shiga	0.931	0.036	0.918	0.018	0.898	0.023
26	Kyoto	1.003	0.038	0.895	0.018	0.947	0.024
27	Osaka	0.932	0.035	0.907	0.018	0.899	0.023
28	Hyogo	0.966	0.037	0.874	0.017	0.877	0.023
29	Nara	0.981	0.037	0.886	0.017	0.901	0.023
30	Wakayama	0.970	0.037	0.903	0.018	0.896	0.023
31	Tottori	0.906	0.035	0.857	0.017	0.788	0.020
32	Shimane	0.922	0.035	0.833	0.016	0.872	0.022
33	Okayama	0.989	0.038	0.891	0.018	0.887	0.023
34	HIroshima	0.979	0.037	0.819	0.016	0.878	0.022
35	Yamaguchi	0.912	0.035	0.817	0.016	0.856	0.022
36	Tokushima	0.905	0.035	0.840	0.016	0.826	0.021
37	Kagawa	0.941	0.035	0.839	0.016	0.843	0.021

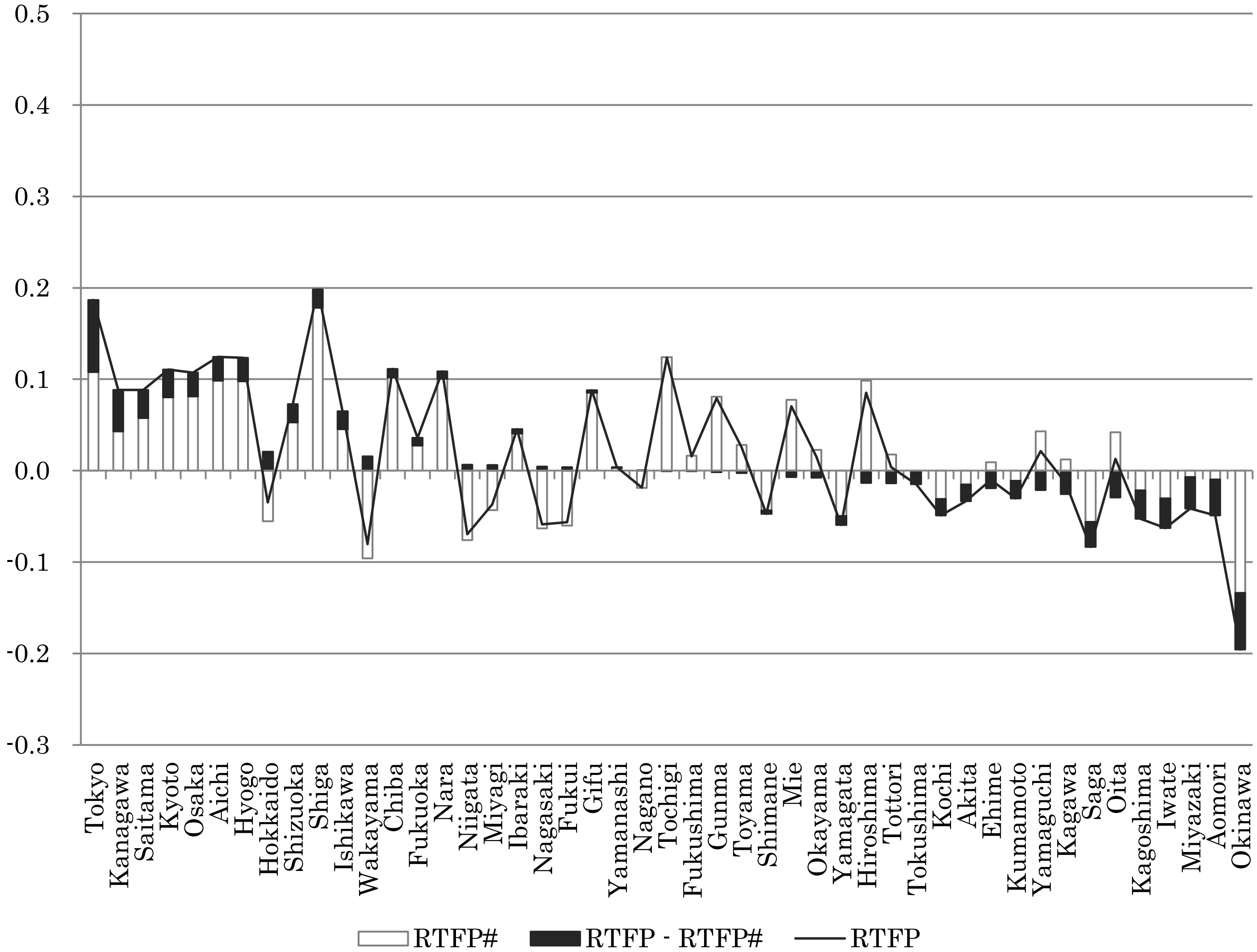
38	Ehime	0.856	0.033	0.817	0.016	0.841	0.021
39	Kochi	0.873	0.033	0.830	0.016	0.848	0.022
40	Fukuoka	0.940	0.035	0.869	0.017	0.882	0.023
41	Saga	0.942	0.036	0.831	0.016	0.803	0.021
42	Nagasaki	0.899	0.034	0.843	0.017	0.883	0.023
43	Kumamoto	0.859	0.033	0.828	0.016	0.839	0.021
44	Oita	0.895	0.034	0.844	0.017	0.834	0.021
45	Miyazaki	0.918	0.035	0.816	0.016	0.833	0.021
46	Kagoshima	0.854	0.033	0.828	0.016	0.787	0.020
47	Okimnawa		.	0.755	0.015	0.819	0.021



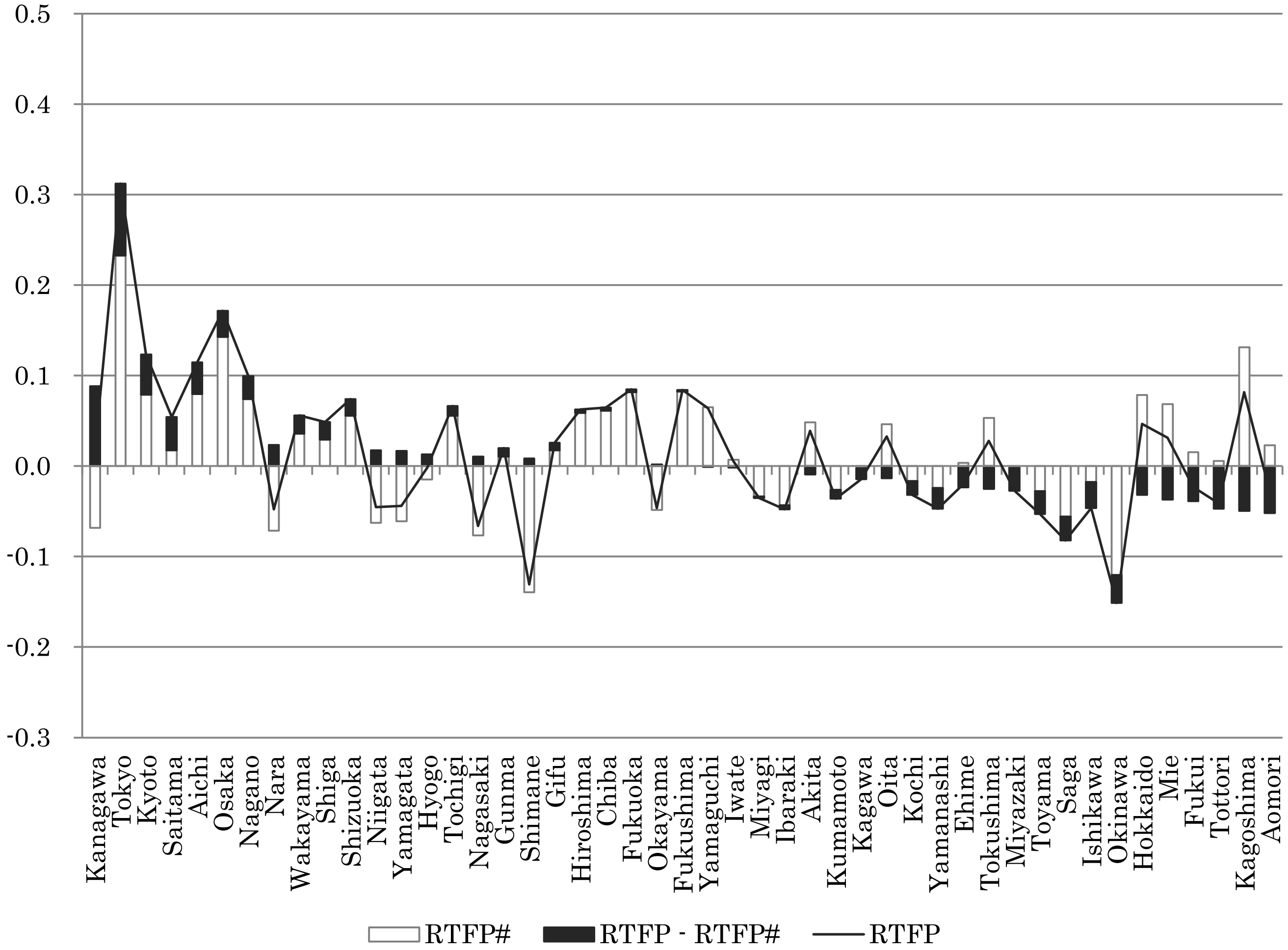
Graph 1: Changes in Relative Price Levels in Other Private Service Industries (including Non-profit Private Services) in Hokkaido, Tokyo = 1, 1970 through 2010



Graph 2: Relative TFPs that reflect differences in price levels among prefectures, 1970



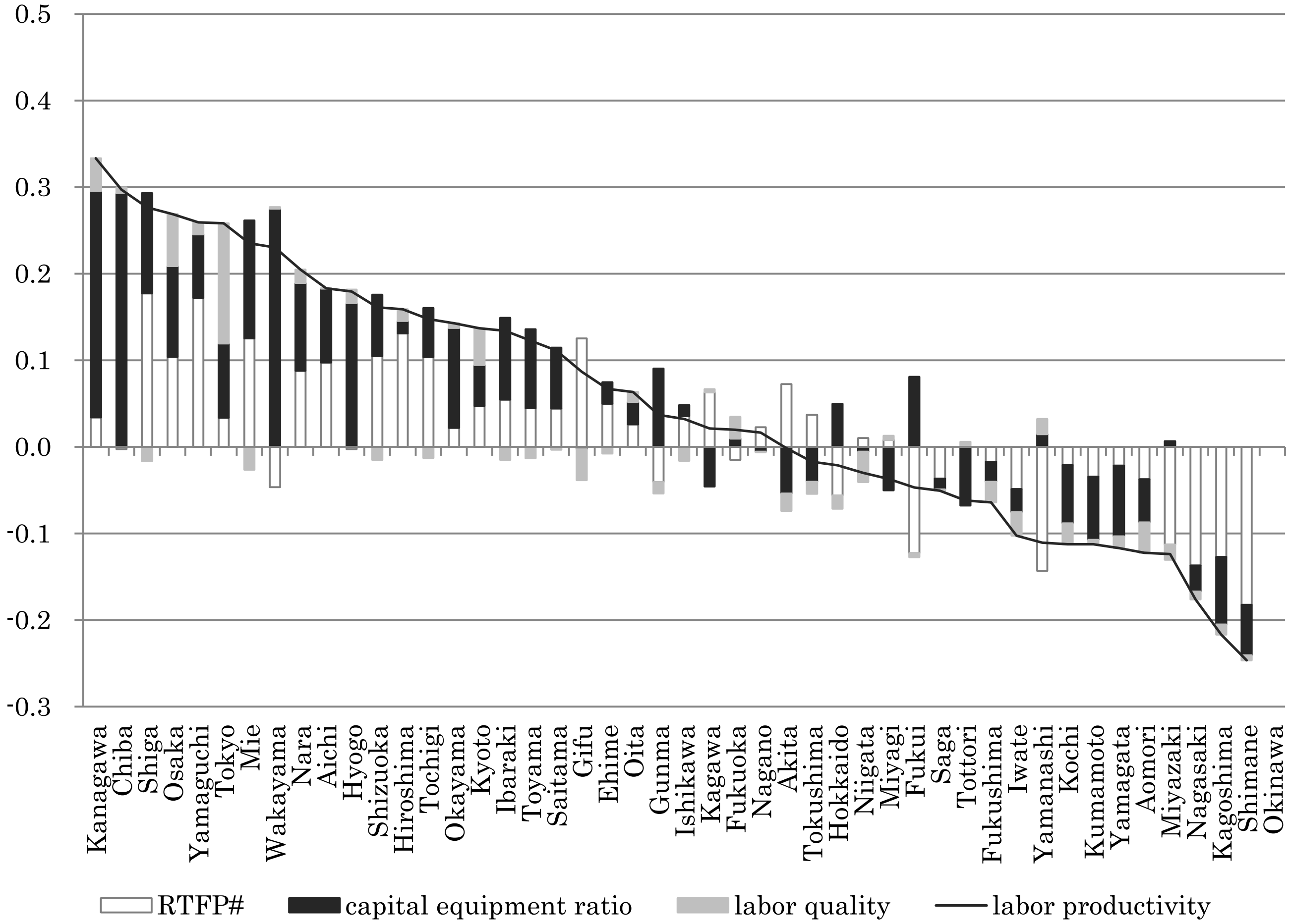
Graph 3: Relative TFPs that reflect differences in price levels among prefectures, 1990



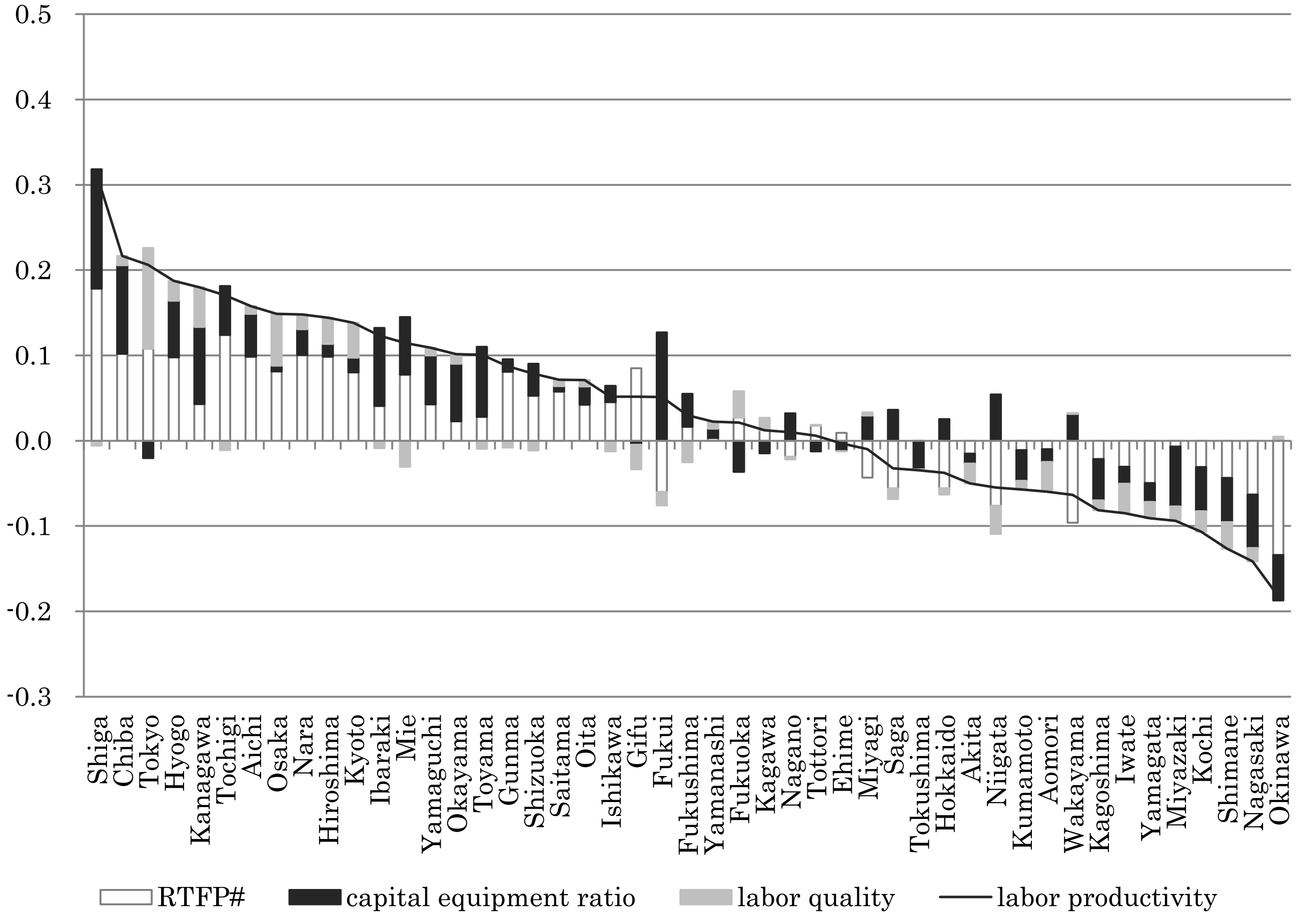
Graph 4: Relative TFPs that reflect differences in price levels among prefectures, 2009

Table 7. Comparison of standard deviations of two regional TFP indexes

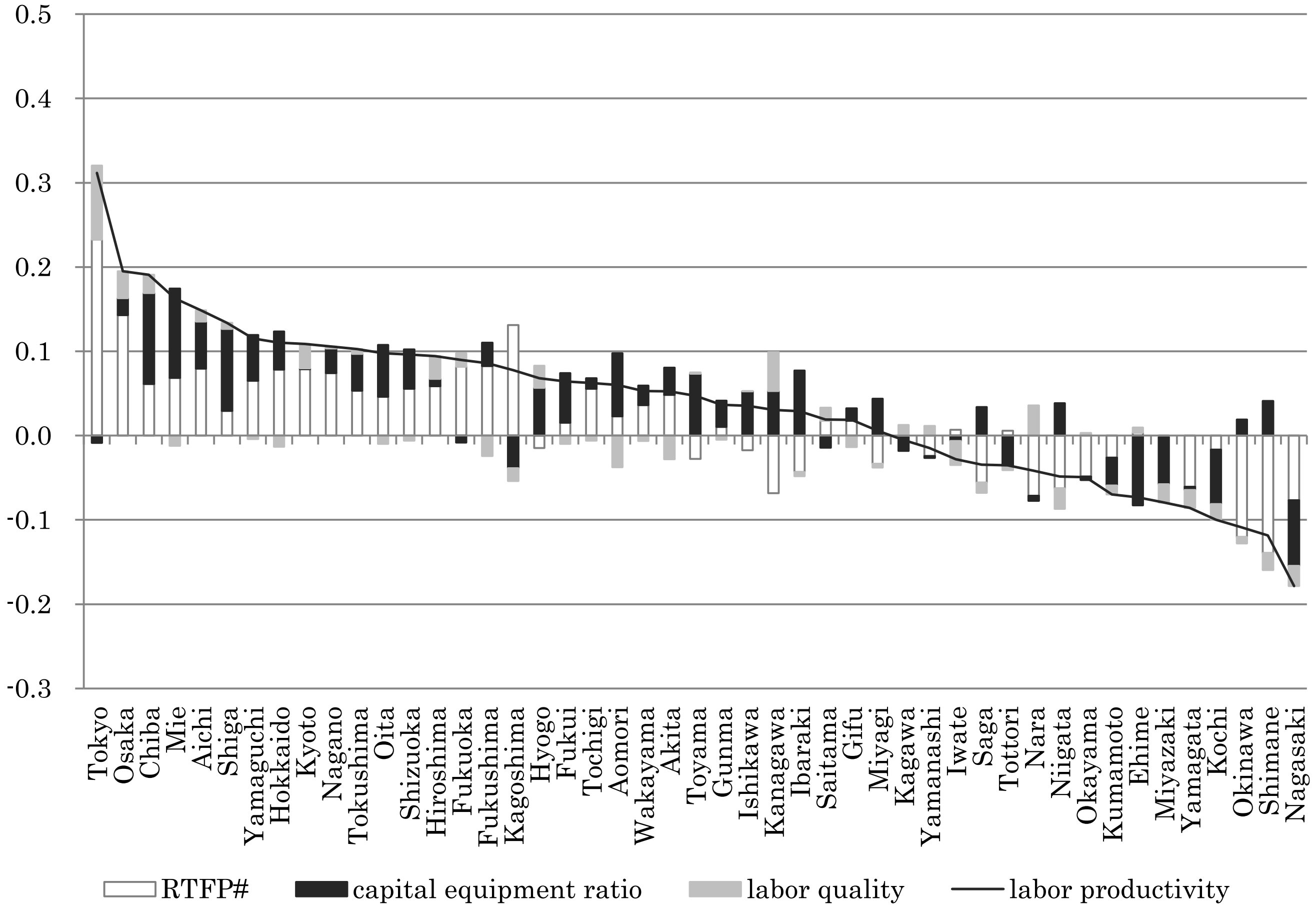
	1970	1980	1990	2000	2008	2009
Old regional TFP	0.089	0.074	0.080	0.069	0.084	0.079
New regional TFP	0.083	0.070	0.065	0.055	0.072	0.069



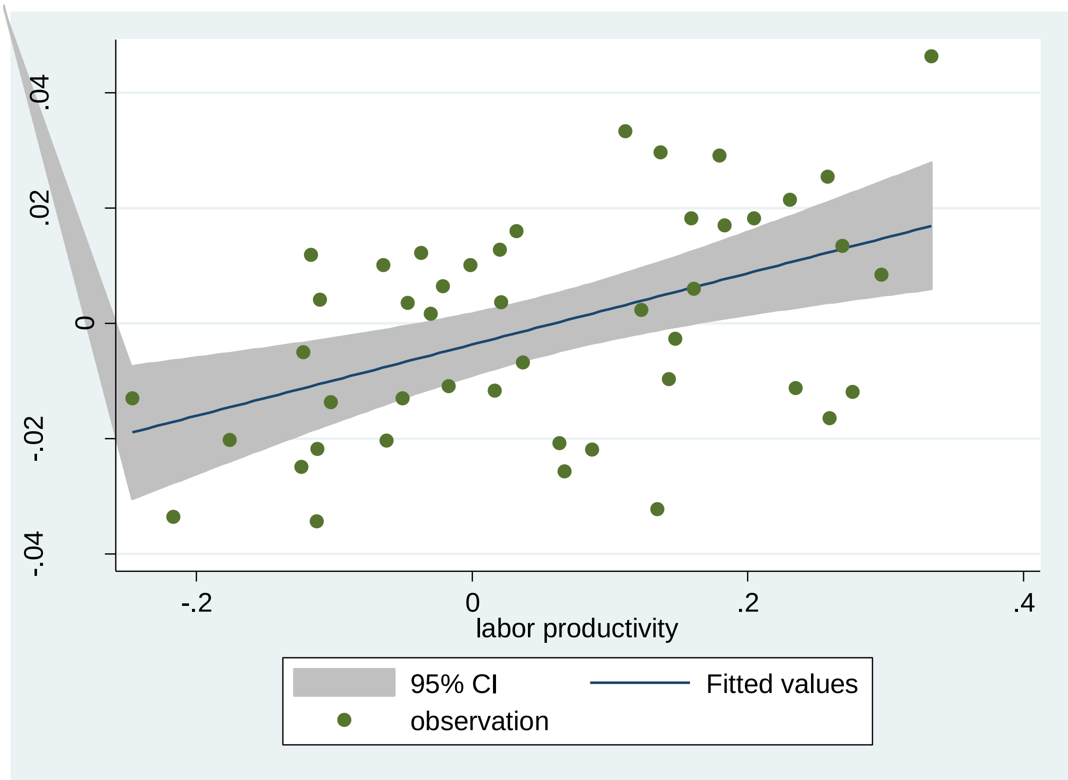
Graph 5: Decomposition of Differences in Regional Labor Productivity in 1970



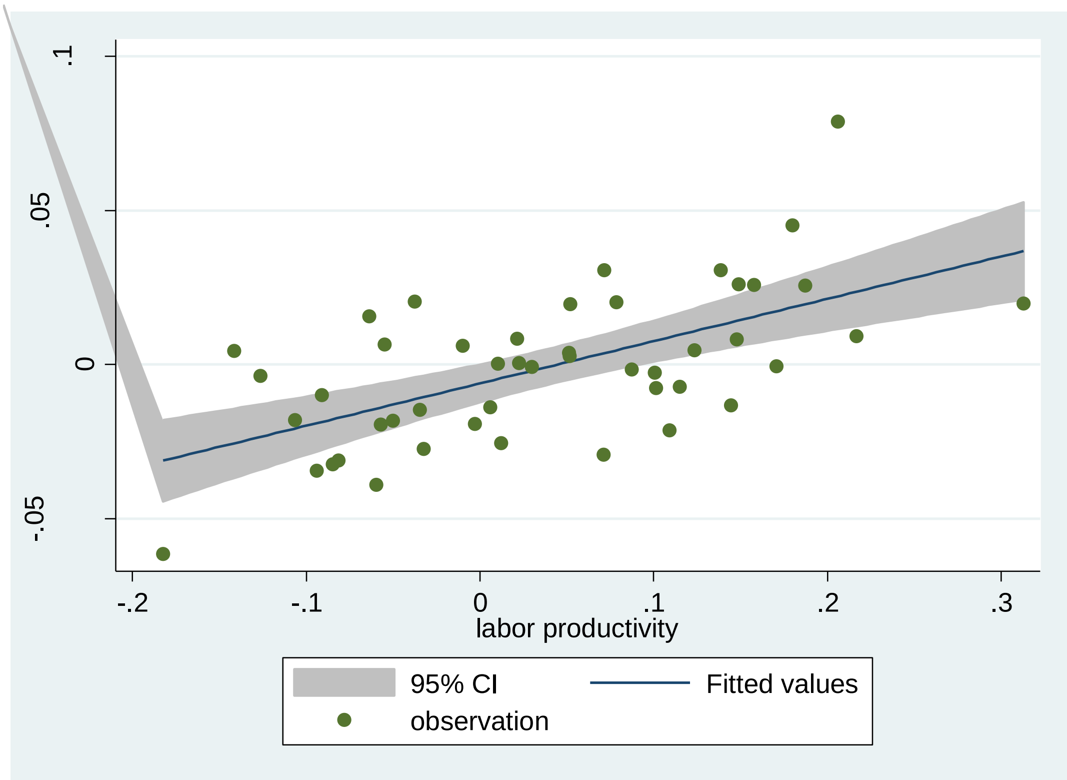
Graph 6: Decomposition of Differences in Regional Labor Productivity in 1990



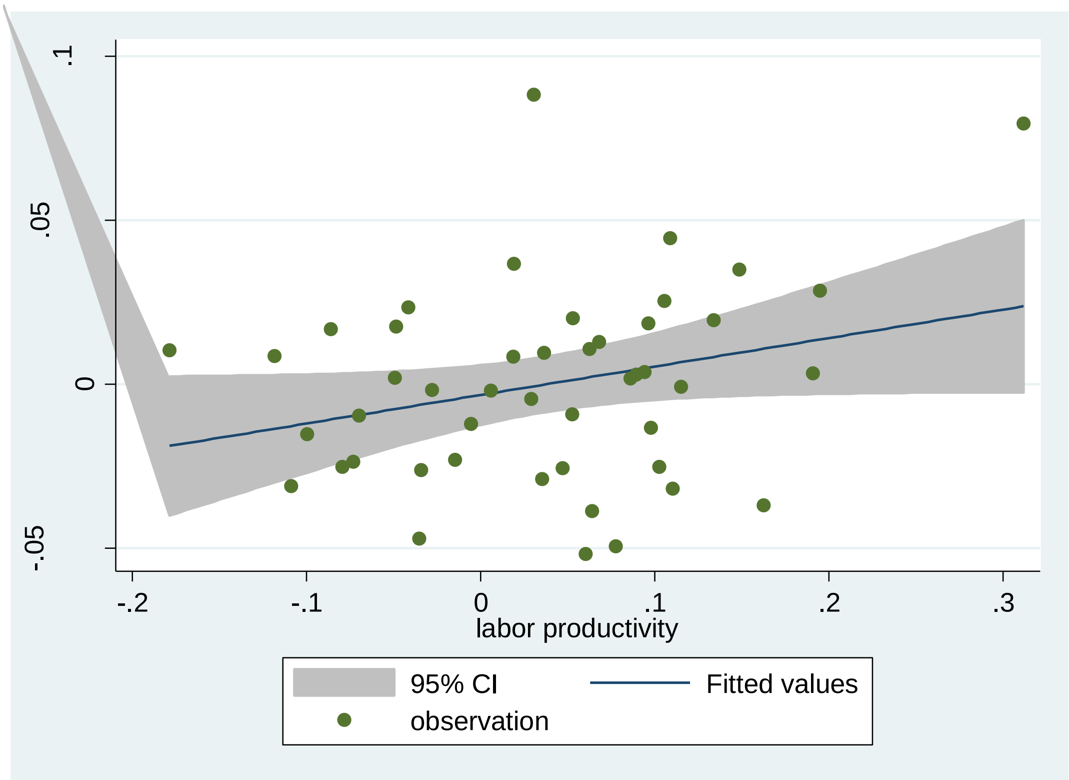
Graph 7: Decomposition of Differences in Regional Labor Productivity in 2009



Graph 8: Correlation between Regional Differences in Price Levels and Differences in Labor Productivity in 1970



Graph 9: Correlation between Regional Differences in Price Levels and Differences in Labor Productivity in 1990



Graph 10: Correlation between Regional Differences in Price Levels and Differences in Labor Productivity in 2009

Table 8: Correlation Coefficients between Regional Differences in Price Levels and Differences in Labor Productivity and Their Significance Level from 1970 through 2009

	1970	1980	1990	2000	2008	2009
Correlation coef.	0.478	0.366	0.610	0.330	0.323	0.277
Significance level	0.001	0.011	0.000	0.024	0.027	0.059