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# Unveiling Historical Occupational Structures and its Implications for Sectoral Labour Productivity Analysis in Japan's Economic Growth

Osamu Saito
Tokihiko Settsu

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**Hi-Stat**
Institute of Economic Research
Hitotsubashi University
2-1 Naka, Kunitatchi Tokyo, 186-8601 Japan
http://gcoe.ier.hit-u.ac.jp

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Project

# Unveiling historical occupational structures and its implications for sectoral labour productivity analysis in Japan's economic growth*

**Osamu Saito**
**(Cambridge Group and Hitotsubashi University)**
**and**
**Tokihiko Settsu**
**(Hitotsubashi University)**

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This paper aims to offer new estimates of gainfully occupied workers in Japan between 1885 and 1940. The estimates are made by taking explicitly widespread farm-family by-employment into account, and then they will be allocated into the primary, secondary and tertiary (PST) sectors. With the new workforce statistics and revised estimates of net output in the tertiary sector for the same period, we would also like to examine the levels of differentials in average labour productivity between the three sectors. The paper will show that labour productivity differentials between agriculture and manufacturing in early stages of Japan's industrialisation were not as wide as both Gerschenkronian and dual structurist arguments tended to assume for late industrialisers.

* This is a revised version of the paper presented at the INCHOS Conference held at King's College, Cambridge, 28-30 July 2009.

## Introduction

Quantitative profiles of Japan's economic development have been delineated by reference to the 14-volume series of *Long-term Economic Statistics of Japan since 1868* (LTES hereafter), compiled by Kazushi Ohkawa, Miyohei Shinohara and Mataji Umemura, and their associates.[1] The series covers both historical national accounts and population and employment statistics from 1885 onwards, thus allowing scholars to conduct historical analysis on the basis of GDP per capita. Most of the LTES tables are sub-divided into industrial categories, so that sectoral analysis can in theory be made without difficulty.

Much praise has been offered to the compilers for their painstaking initiatives and thorough examinations of materials used for estimates. However, there are at least two areas in which estimates are either weak or still have problems. One major area is income estimates in the tertiary sector, and the other relates to sectoral breakdowns of the workforce. Both are related with each other since the number of gainfully occupied workers was used to estimate income series for the sector.

The underlying problem lies in the fact that there were many who had two occupations, i.e. principal and subsidiary, in nineteenth- and early twentieth-century Japan. While it is believed that virtually all tangible products of those subsidiary or 'by-employment' activities were included in major, if not all, surveys and statistics published, the estimation of the size of the workforce and its break-down into industries and sectors were made solely on the basis of information about ones' principal occupations. The compiler of the volume on manpower, Mataji Umemura, was well aware of the problem since there exist a few good indicators of by-employment across the industries at a couple of benchmark years. Yet, it is so difficult to take by-employment into account for the estimation of yearly break-downs of the number of gainful workers into industries and sectors, Umemura published his sector- and industry-specific employment series on the basis of principal occupations only, although he rightly issued warnings to potential users of those series.[2]

Nevertheless, it should be remembered that however serious the warnings may have been, a number of scholars did utilised his sectoral estimates for the sectoral research. For example, Simon Kuznets took LTES's earlier estimates in his analysis of sectoral shares in historical perspective, and Allen Kelly and Jeffrey Williamson went on to test a two-sector

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[1] The 14 volumes were published by Toyo Keizai Shimposha, Tokyo, from 1965 to 1988. Much of the work was conducted at the Institute of Economic Research, Hitotsubashi University. Ohkawa and Shinohara's *Patterns*, published in 1979, is an abridged, one-volume English presentation. Note that both the 1979 English book and the volume on national income of the Japanese series, published in 1974, do not reflect the revisions made in the Japanese volume on manpower, which was published in 1988.

[2] Umemura et al., *Rōdōryoku* (Manpower), p.161. The warnings did not appear in Ohkawa and Shinohara, *Patterns*, however.

model with LTES figures as given.[3] Members of the LTES team were more cautious in dealing with their own data. Yet Ohkawa did touch on sectoral differentials in labour productivity. He showed sectoral NDP per gainfully occupied person in 1885-89, revealing that labour productivity in industry was 2.4 times higher and that in service 4 times higher than labour productivity in agriculture, if current prices are used. Ohkawa offered no attempt to 'explain in detail the wide differentials' in such sectoral comparisons, saying that his concern was just 'to examine the relative changes in subsequent years', especially slower productivity increases and, hence, higher relative price rises in agriculture and services[4]. However, wide sectoral gaps in labour productivity observed from the LTES tables have so far been interpreted as consistent with a Gerschenkronian argument. According to that argument, a latecomer industrialiser tended to place a greater emphasis on capital-intensive (hence labour-saving) manufacturing methods, thus widening a gap between lower-productivity agriculture and higher-productivity industry.[5] Similar but more institutional arguments have also been put forward, stressing on some institutional barriers as a factor accounting for the continuation of a dual structure in the national economy.[6]

By implication, all these arguments assumed that levels of labour input were reflected in the LTES series of gainfully occupied population. However, it is worth reiterating that the LTES series of primary, secondary and tertiary employment over the period from 1885 to 1940 are still flawed. According to the LTES volume, the proportion of gainfully occupied persons in agriculture and forestry was overwhelming, which on the face of it indicates that Japan was totally agrarian before the onset of industrialisation under the Meiji government. It is true that as long as one confines oneself to the analysis of nation-wide series, the margin of errors may well be fairly small. However, if one goes for sectoral analysis of, for example, labour productivity, the problems will become far more serious. If, on the other hand, we can quantify the spread of by-employments in the countryside of the period in question, then the overall picture of the Meiji economy may well change with a number of implications for the studies of sector-specific output and productivity growth as well as labour markets.

This paper aims to offer, first, *new* estimates of gainfully occupied workers in the primary, secondary and tertiary (PST) sectors, which take subsidiary occupations into account, on a yearly basis for the period between 1885 and 1940. With the new workforce statistics and *revised* estimates of the LTES's net output in the tertiary sector for the same period, we would

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[3] Kuznets, *Growth of Nations*, and Kelly and Williamson, *Lessons*. It is interesting to note here that Angus Maddison, another admirer of the LTES achievement, never used LTES data on a sectoral basis.

[4] Ohkawa, 'Production structure', in *Patterns*, pp.40-43. In constant prices, the ratio in 1885-89 becomes 1.5 and 5.4 respectively. Similar tabulations of sectoral productivity derived from sectoral NDP divided by the corresponding number of primary worker are found in Nakamura, *Economic Growth*, p.24, and *Postwar Japanese Economy*, p.159.

[5] Gerschenkron, *Economic Backwardness*, ch.1 and Postscript.

[6] See for example Hayashi and Prescott, 'Depressing effect', for a recent, more sophisticated version of this thesis.

also like to examine the levels of differentials in labour productivity between the three sectors and trace how the sectoral productivity differentials changed over the period in question.

The next section sketches the issue of by-employment in changing occupational structures and offers a hypothetical pattern of its spread and decline. Section 2 turns to technical and data issues, i.e. the ways in which sector-specific estimates of net output and the workforce were made in the LTES series. We will note that although Umemura explored some of the materials showing both principal and subsidiary occupations, he finally gave up the original idea of taking the phenomena of multiple occupations into the estimation. Then, we will present data on which our workforce estimates are made. They will be set out in matrix format for two prefectures in two separates points of time, i.e. 1879 and 1925. This enables us to explore how the size of by-employment in the secondary and tertiary sectors changed in relation to indicators of development, such as the declining proportion of primary employment and to the increasing tempo of urbanisation. On the results of this exercise, section 3 offers our new estimates of the numbers of gainfully occupied persons in the three sectors, and in section 4, sectoral analysis of labour productivity will be conducted with findings and implications in the final section.

## 1. By-employment in changing occupational structure

According to Adam Smith's theory of the division of labour, the separation of different trades and occupations from one another proceeds with economic development. This separation is 'generally carried furthest in those countries which enjoy the highest degree of industry and improvement … In every improved society, the farmer is generally nothing but a farmer; the manufacturer, nothing but a manufacturer'.[7]

This proposition holds as a general tendency for any country or region of the world. As for the early modern period is concerned, however, it is widely recognised, thanks to the debate on proto-industrialisation, that there was a phase in which dual occupation in the form of farm family by-employment increased, rather than decreased, with economic development. Indeed, the Japanese historiography reveals that rural by-employment was widespread. Exceptionally detailed data from Chōshū, a domain in western Japan, indicate that while as many as 80 per cent of the population were classified as farmers, the proportion of non-agricultural produce in gross regional product turns out to have reached the 40 per cent mark. According to a recent work based on the same data, it is likely that non-farm earnings amounted to a quarter of the total pre-tax household income earned by the farm family in the 1840s.[8]

All this suggests that unveiling rural by-employment patterns will have a direct bearing on historical national accounts and sector-specific labour productivity estimates in the

[7] Smith, *Wealth of Nations*, vol.1, pp.15-16.

[8] Smith, 'Farm family by-employments' and Nishikawa, 'Chōshū'. The estimated proportion of non-farm earnings to the total farm household income is from Saito and Nishikawa, 'Tokugawa Nihon'. See also Saito, ''Pre-modern economic growth' and 'By-employment: Japan, 1840-1920'.

period after the Meiji Restoration of 1868, since the age of by-employment may well have turned into the Meiji period. Reflecting, perhaps, this reality in the countryside, some of Japan's early population surveys enumerated both principal and subsidiary occupations. Having examined one Chōshū village survey in the 1840s, a pilot census of Yamanashi prefecture in 1879 and another prefectural census of Shizuoka in 1925, we have hypothesised that the historical relationship between by-employment and developmental phases was an inverse-U shaped one.[9] In early phases of development, an increase in non-farm occupations took the form of farm-family by-employment. The Chōshū village survey shows that by-employments farm families took up included craft and various service occupations but a vast majority were salt sellers, which undoubtedly reflected the very local character of this commercialised, Inland Sea area. The 1879 pilot census gives us a little more comprehensive picture of one of proto-industrialising regions after the opening of the country into world trade, while the 1925 census reflects situations in a period when proto-industry was on the decline.

Figure 1. Principal and subsidiary occupational matrix

| | | Subsidiary Occupation | | | Row total |
|---|---|---|---|---|---|
| | | P | S | T | |
| Principal Occupation | Primary | | | | D |
| | Secondary | | | | E |
| | Tertiary | | | | F |
| Column total | | A | B | C | G |

[9] Saito, 'By-employment: Japan, 1840-1920'.

Table 1. Occupational matrix: men and women in Yamanashi, 1879

A. MEN

| *Principal occupation* | *Subsidiary occupation* | | | Principal only | Total |
|---|---|---|---|---|---|
| | P | S | T | | |
| Primary | 12.2 | 8.3 | 10.2 | 55.6 | 86.4 |
| Secondary | 0.1 | 0 | 0.2 | 4.7 | 4.9 |
| Tertiary | 0.1 | 0.1 | 0.6 | 7.9 | 8.7 |
| Total | 12.4 | 8.5 | 11 | 68.2 | 100 |

B. WOMEN

| *Principal occupation* | *Subsidiary occupation* | | | Principal only | Total |
|---|---|---|---|---|---|
| | P | S | T | | |
| Primary | 4.2 | 9.5 | 0.4 | 64.4 | 78.5 |
| Secondary | 9.4 | 0.8 | 0 | 8.8 | 18.9 |
| Tertiary | 0.1 | 0 | 0.1 | 2.3 | 2.5 |
| Total | 13.7 | 10.3 | 0.5 | 75.5 | 100 |

Source: Tōkei-in, *Kai no kuni*.

Table 2. Occupation matrix: men and women in Shizuoka, 1925

A. MEN

| *Principal occupation* | *Subsidiary occupation* | | | Principal only | Total |
|---|---|---|---|---|---|
| | P | S | T | | |
| Primary | 19.8 | | 3.3 | 23 | 51.0 |
| Secondary | 1.7 | 0.3 | 0.5 | 21.1 | 23.5 |
| Tertiary | 1.8 | 1.4 | 1.2 | 21.1 | 25.5 |
| Total | 23.2 | 6.6 | 5 | 65.2 | 100 |

B. WOMEN

| *Principal occupation* | *Subsidiary occupation* | | | Principal only | Total |
|---|---|---|---|---|---|
| | P | S | T | | |
| Primary | 21.7 | 5 | 0.8 | 36.6 | 64.1 |
| Secondary | 0.5 | 0.1 | 0.1 | 15.1 | 15.8 |
| Tertiary | 0.6 | 0.6 | 0.5 | 18.4 | 20.1 |
| Total | 22.7 | 5.8 | 1.5 | 70.1 | 100 |

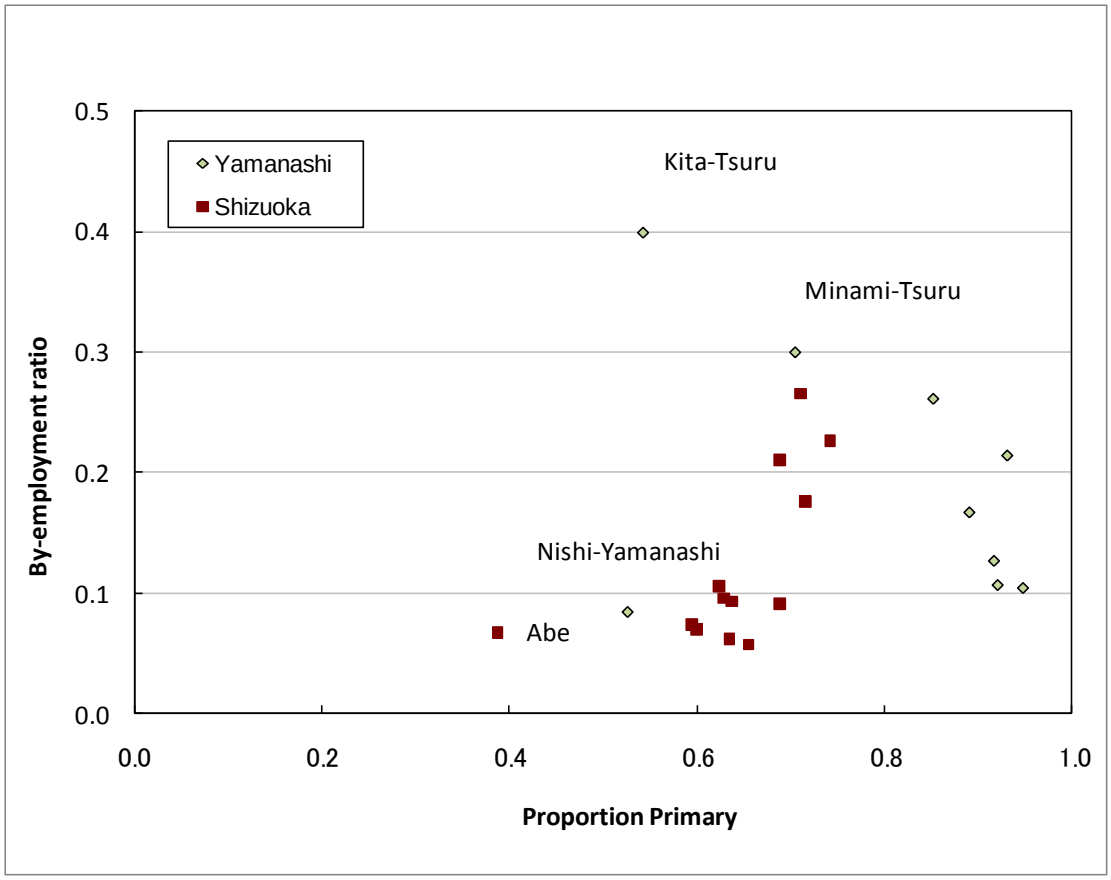
Source: Shizuoka-ken, *Taishō 14-nen*.

Tables 1 and 2 show how occupational structures changed between 1879 and 1925 in the form of a principal-subsidiary occupational matrix, whose PST (primary-secondary-tertiary) version is set out in figure 1. Shaded cells in figure 1 represent cases in which both primary and subsidiary occupations are in the same sector. Although such combinations as farming with sericulture and farming with fishery are not unimportant as historical phenomena, they are not regarded as 'by-employments' in this article and, hence, column totals (A-C) exclude those intra-sectoral by-employments. This is because their existence does not affect estimates of sectoral labour productivity differentials.[10] The Yamanashi and Shizuoka data in tables 1-2—in which the column for those having a principal occupation only is added—are invaluable since no national census reports allow us to tabulate information concerning by-employments in any matrix format. According to the 1879 table for Yamanashi, the weight of farming was as high as 83 per cent of the total number of those having a principal occupation (both sexes combined). At the same time, the table indicates that in the non-primary sectors there were as many subsidiary as principal workers, and that the overwhelming proportion of those non-farm by-employments, especially female by-employments, were from the farm household. Females working as textile workers in the form of farm family by-employment outnumbered those working in textiles without having a subsidiary occupation in any other industries. This finding reflects Yamanashi's rural-centred growth of silk and related industries. However, a glance at the 1925 table for Shizuoka, a prefecture that used to have cotton weaving and some other rural industries, reveals that significant changes had taken place since 1879. First, the weight of the primary sector in the workforce declined to 57 per cent (but the proportion of primary-primary combinations increased). Second, specialisation took place in secondary and tertiary employment. As the 1925 table shows, the proportion of primary-sector females having secondary sector employment—both principal and subsidiary—declined. If the ratio of subsidiary to principal workers is calculated sector by sector, it now stood at 0.27 in the secondary and at 0.12 in the tertiary sector, whereas it had been 0.83 and 1.12 respectively in Yamanashi at the end of the 1870s. By 1925, therefore, the separation of different occupations from one another proceeded. As industry and commerce grew further, therefore, rural by-employment started to decline and the turning point must have reached some time between 1879 and 1925. It is this latter phase to which Adam Smith's proposition applies.

[10] See discussions in Saito, 'By-employment in comparative perspective'.

The above observations seem to suggest an inverse-U shaped pattern of change, which can be more clearly shown if district-level relationships between the proportion primary, a measure of the level of development, and the by-employment ratio in the two prefectures are pooled together. The proportion primary is defined as the share of the primary sector in the district's total number of principal occupations and measured from right to left on the horizontal axis of figure 2. Against this is set the overall ratio of subsidiary to principal occupations (intra-sectoral by-employments are excluded), measured on the vertical axis.

Figure 2. By-employment and the level of economic development: pooled district-level data for Yamanashi, 1879, and Shizuoka, 1925




Source: See tables 1-2.

The scatter gram (figure 2) shows that the extent of by-employment increased when the proportion primary was high, but it started to decline when the proportion primary decreased further. Most if not all of Yamanashi's 9 districts represent the first phase and Shizuoka's 13 the second. Altogether they form an inverse-U shaped curve. There are a few exceptions for this curve: Kita- and Minami-Tsuru, especially Kita-Tsuru, had too high proportions of

by-employments for their levels of the proportion primary, due probably to an unusual concentration of rural-centred silk weaving. Nishi-Yamanashi is located far left as a Yamanashi district, but this is because Kofu city was included in the district. The same is true for Abe district with Shizuoka city. This observation for cities suggests that the level of by-employment was also a function of urbanisation. With these observations, we will explore this set of district-level data in order to identify regression equations from which we may generate a series of the number of gainfully occupied persons in each sector with subsidiary occupations taken into account.

## 2. The LTES and new estimates

Japan's first national census of population was taken as late as 1920. Unfortunately, there is no nationwide, pre-censal statistics of occupations that allows us to link with the first census. Umemura, the compiler of the LTES volume on manpower, found that causes-of-death statistics cross-tabulated with occupations could be utilised for estimation as the statistics started in 1906: this, together with additional information about the number of farm households, urbanisation and school enrolments plus some necessary assumptions for both the 1906-1938 period and extrapolations beyond 1899, enabled Umemura to go back to 1872.[11] One problem with this approach is that the causes-of-death statistics enumerated principal occupations only. The 1920 census contained tables on subsidiary employments, so did the 1879 census of Yamanashi prefecture; but Umemura thought that there would be no way to take subsidiary occupations into the calculations in a comprehensive manner. Umemura himself did touch on the issue of by-employment by exploring those source materials,[12] but he believed that Yamanashi, a small prefecture with brisk cottage industries, could not be representative of the whole nation.

The LTES series thus estimated are summarised in table 3. Data did not allow him to separate the tertiary from the secondary sector for the period before 1885 and to disaggregate the non-primary sectoral total into male and female workers before 1910, nor to break down the total occupied into age groups in early years. However, what the estimates tell us is clear: the economy in the early Meiji period was very agrarian. In 1872, four years after the Meiji Restoration, about three out of four were in agriculture and other primary-sector employment; even in 1900 a little more than six out of ten were in the primary sector. Another feature that emerged from the LTES table is that the size of commercial and service employment was always larger than that of secondary employment from 1885 onwards, as the growth of tertiary employment was substantial over the pre-war industrialisation period. A spurt in heavy industrialisation of the 1930s drove the male percentage share up to a comparable level of the corresponding share of tertiary employment, but before that decade the tertiary sector was

[11] See Umemura et al., *Rōdōryoku* (Manpower), pp.161-164.
[12] Umemura, 'Agriculture and labor supply'.

always substantially larger for both males and females. The problem is whether or not all these observations will hold if the existence of by-employments is taken into account. (There is another problem. Umemura made several revisions before the publication of the LTES volume on manpower in 1988. As a result of this, neither the LTES volume on national income nor the one-volume English publication reflected such changes in estimates.[13] The differences are not large, of course, but when the Umemura figures were used to make another estimate such as tertiary income, the problem may have been non-negligible. See Appendix C below.)

Table 3. The LTES estimates of gainfully occupied population by sector, 1872-1940

| Year | Sectoral share (%) | | | | | | Labour force participation rate (%) | |
|---|---|---|---|---|---|---|---|---|
| | Primary | | Secondary | | Tertiary | | | |
| | Male | Female | Male | Female | Male | Female | Male | Female |
| 1872 | 72.0 | 76.9 | 25.9 | | | | 103.2 | 77.9 |
| 1885 | 67.1 | 72.0 | 14.5 | | 16.3 | | 103.7 | 76.3 |
| 1900 | 61.2 | 65.9 | 17.0 | | 19.8 | | 99.5 | 69.7 |
| 1910 | 56.9 | 64.3 | 18.9 | 15.7 | 24.2 | 20.0 | 97.1 | 63.6 |
| 1920 | 48.8 | 62.5 | 24.0 | 16.9 | 27.2 | 20.6 | 95.8 | 57.7 |
| 1930 | 43.4 | 60.9 | 23.9 | 14.3 | 32.7 | 24.8 | 92.9 | 52.0 |
| 1940 | 35.1 | 57.4 | 32.0 | 15.3 | 32.9 | 27.3 | 91.8 | 54.0 |

Source: Umemura et al., *Manpower*, pp.166-171, 196-201, 204-217, 226-227, 257-258.

Note 1) Labour force participation rate is calculated as the proportion of the total gainfully occupied to the total population aged 15 or over. The male percentage figures over 100, therefore, mean that there were a sizeable number of boys who started working before the age of 15.

2) LTES adopted a classification system somewhat different from the PST. Their secondary sector includes transport, communication, gas and water supply, and construction.

The previous section's findings concerning district-level by-employment patterns provide us a new basis for the estimation of the numbers of subsidiary workers on the PST basis at the national level. For this purpose are needed the proportion primary and a measure of urbanisation. The former is available for the whole nation as well as for regional districts. For

[13] The former was published in 1974 and the latter in 1979.

the latter, however, there are difficulties to apply the same measure for both national and regional levels. Having explored several measures of urbanisation, we have decided to use the crudest of all measures, population density, for it is easy to calculate for individual districts while the annual series for the whole nation is readily available. By applying coefficients estimated separately to these national figures, we are able to estimate the number of those having a subsidiary occupation in ach of the three sectors. And the coefficients will be obtained by regressing the proportion of those having a subsidiary occupation on the proportion primary and population density with all Yamanashi and Shizuoka districts pooled. Our attempt is to estimate all the column and row totals in table 1. For example, we need to know the overall proportion of by-employments that is those having a by-employment in any of the three sectors (corresponding to G to use the symbol in table 1) over the total number of those having a principal occupation; the proportion subsidiary in the primary sector being for a column total of primary by-employments (A in table 3) over those having a principal occupation in the secondary and tertiary sectors; and so on. Similarly, the proportion of non-secondary by-employments is a row total as the sum of primary and tertiary by-employments (E in table 1) over those having a principal occupation in the secondary sector; the proportion of non-tertiary by-employments being the sum of primary and secondary by-employments (F in table 1) over those having a principal occupation in the tertiary sector; and so on. The calculations are made on this PST basis with both sexes combined—given the nature of data, further breakdowns by sex, industry, or employment status are practically impossible.

Regression analysis is conducted with the dependent variable logistic-transformed (to transform a bounded variable to one distributed between 0 and 1). We have tried alternative specifications for all the cases with A through G as the numerator of the dependent variable. First, for the independent variable of proportion primary, two cases are considered: one is the case in which the relationship between the proportion of by-employments and the proportion primary was linear, and the other is the case in which the relationship was non-linear. In the latter case, we introduce the proportion primary-squared as well. Second, in order to control the effect of outliers, we include outlier dummies. Two cases—with Kita-Tsuru only, and with both Kita- and Minami-Tsuru (or simply 'Tsuru')—are tried alternatively. Having examined all these alternative specifications, it turns out that some of the results were very poor and unusable: they are cases with respect to B and D in table 1. The results for the grand total, G, and for the other four cases (A, C, E and F) are statistically satisfactory. Appendix tables 1 through 5 set out the regression results with alternative specifications, and the one with a star mark is the equation used to compute the number in each case. In all those starred regressions, the fit is reasonably good and the sign of the individual term has the expected sign.

Fortunately it is not difficult to compute numbers for B and D by subtracting the estimated numbers of A, C, E and F, so that we now have all the estimated flows of by-employments between the three sectors in the national economy. The true number of

gainfully occupied workers in each sector is calculated by weighting the numbers of those having a principal and a subsidiary occupation in the following way:

> Number of gainfully occupied workers (both sexes combined) in sector *i*
> = 1 × Number of workers having only a principal occupation in sector *i*
> + 0.5 × (number of workers having a principal occupation in sector other than *i* but having a subsidiary occupation in sector *i* - number of workers having a principal occupation in sector *i* but having a subsidiary occupation in sector other than *i*).

This enables us to generate a new series of gainfully occupied population from 1885 to 1940 in the primary, the secondary and the tertiary sector respectively (Appendix table B). Note that here we have simply applied the multiplier of 0.5, although we will see to what extent the results will change if it be 0.25.[14]

Compared with the old LTES estimates based solely on those having a principal occupation (table 3 above), the level of our new estimates is, not surprisingly, higher in the secondary and tertiary sectors and smaller in agriculture and forestry. In 1885, the size of the workforce in the primary sector was *over*stated by 9 per cent, while the size of secondary employment was *under*stated by 33 per cent and that of tertiary employment by 9 per cent (since LTES adopted a somewhat larger definition of the secondary sector, the actual differences must be slightly greater for the secondary and tertiary sectors). In other words, the ratio of new to old estimates in that year was 0.91, 1.33 and 1.09. As time went on, the differences narrowed: the new-to-old ratio in 1920 is 0.94, 1.11 and 1.03 and that in 1940 0.96, 1.04 and 1.02 respectively. As a result, the sectoral share of the secondary sector in 1885 has expanded noticeably, from 14.5 to 19.3 per cent, and that of tertiary employment from 16.3 to 17.3 per cent (table 4). The early Meiji Japanese economy now appears less agrarian. Moreover, the size of the secondary sector is no longer outweighed by the tertiary as far as the first benchmark years are concerned. On the other hand, the faster growth of tertiary employment over the period of industrialisation still holds: in 1910 the shares of the two sectors were at about the same level, but by 1940 the secondary share increased only by 2 percentage points while the tertiary share expanded by 10 points (see table 4).

[14] Ideally, we should be able to assign different multipliers to different groups of by-employed workers. Given the level of available evidence, however, it is impossible to arrive at a meaningful multiplier for any grouping of occupational descriptors.

Table 4. Revised sectoral shares: both sexes combined, 1885-1940

(%)

| Year | Primary | Secondary | Tertiary |
|---|---|---|---|
| 1885 | 62.9 | 19.3 | 17.8 |
| 1900 | 60.9 | 20.0 | 19.1 |
| 1910 | 58.3 | 20.7 | 21.0 |
| 1920 | 55.8 | 21.2 | 23.0 |
| 1930 | 51.0 | 22.6 | 26.5 |
| 1940 | 47.3 | 21.8 | 30.9 |

Sources: See table 3 above and appendix table B.

Table 5. Comparison of LTES and revised sectoral labour productivity differential estimates

| Period | LTES | | Our estimates | | | |
|---|---|---|---|---|---|---|
| | | | Multiplier = 0.5 | | Multiplier = 0.25 | |
| | Secondary | Tertiary | Secondary | Tertiary | Secondary | Tertiary |
| 1885-89 | 2.40 | 4.19 | 1.30 | 3.70 | 1.55 | 4.05 |
| 1894-99 | 2.31 | 3.28 | 1.37 | 3.00 | 1.57 | 3.23 |
| 1901-07 | 2.80 | 3.39 | 1.55 | 3.15 | 1.76 | 3.36 |
| 1908-14 | 2.94 | 3.03 | 1.83 | 3.02 | 2.04 | 3.19 |
| 1915-22 | 3.13 | 2.75 | 2.44 | 2.84 | 2.66 | 2.97 |
| 1927-33 | 4.03 | 3.72 | 3.54 | 4.38 | 3.79 | 4.54 |
| 1936-40 | 4.24 | 2.69 | 4.19 | 3.05 | 4.39 | 3.15 |
| 1947-55 | 3.33 | 2.54 | | | | |
| 1955-60 | 3.46 | 2.69 | | | | |
| 1960-65 | 3.48 | 3.03 | | | | |

Sources: Ohkawa et al., *Patterns*, p.41; for our estimates see text.

## 3. Sectoral labour productivity analysis

The final task of this paper is to determine the levels of sectoral labour productivity. Now that we have the new sector-specific series of gainfully occupied population as the denominator and the existing and revised series of net output in the corresponding sectors as the numerator (for the revised output data, see Appendix C), we are now in a position to re-calculate sectoral labour

productivity differentials annually and to examine how the sectoral productivity differentials changed over time. The annual series of differentials thus estimated are set out in Appendix table D.1 (with that in the primary sector = 1). The secondary series is generally on the rise but the tertiary is not.

The comparison with the corresponding figures derived from the LTES series are shown in table 5, which follows the LTES's periodisation format.[15] Note that both LTES and revised series are based on the assumed multiplier of 0.5 applied to labour input in by-employment. Table 5, therefore, sets out how the sectoral labour productivity differential figures will change with an alternative multiplier of 0.25.

According to the LTES series, in which only information about principal occupations was used to estimate the workforce series, the averaged-out level of differential between agriculture and manufacturing was well above 2 in the period before World War I. On the other hand, our estimates, which have taken subsidiary labour into calculation, indicate that the ratio was well below 2. In the 1880s especially, it turns out that the labour productivity level of the secondary sector was only 30 per cent higher than that in the primary sector, suggesting that in most industries of the manufacturing sector the levels must have been on a par with that in the agricultural sector. Moreover, although the trend was unmistakably a rising one, the differential level remained low before 1914; it was only after World War I when the seven-year differential crossed the line of 2 and started widening noticeably. The pattern seems to fit well with what we know about the course of industrialisation in pre-war Japan. In the period before 1914 was an age of export-oriented industrialisation supported by labour-intensive traditional industries, with much of labour supplied from the farm household in the form of by-employment. Even in cotton spinning, where much of its technology came from Manchester, firms deliberately chose labour-intensive production methods; similarly the newly established iron and steel industry remained labour intensive before 1914.[16] The capital-using industrialisation drive started with a wartime boom in the late 1910s and more markedly in the 1930s.

Turning to the tertiary sector, while a similar magnitude of reduction in the differential is observed, the general level of labour productivity differential remains substantially higher than that in the primary sector. Moreover, there was no particular trend over the 1885-1940 period. In fact, as the annual series in Appendix table D.1 shows, it could have been a slightly declining one in the period before 1920. This finding is a little puzzling. It might be that output per worker in early years was too high either because output data in commerce, transport and services were overstated, or because our estimates of the number of subsidiary labour in those

[15] It is worth noting that there were some inconsistencies in the calculations made by Ohkawa in his 'Production structure', stemmed presumably from the repeated revisions made by Umemura for the gainfully occupied population series (see Appendix C below). If we use figures in column (2), rather than column (1), in Appendix table C.1, the labour productivity differential for the secondary sector in 1885-89 will be 1.86 and that for the tertiary sector 4.43 in the same period; similarly, it becomes 2.91 and 3.10 in 1915-22, and 4.61 and 3.25 in 1936-40.

[16] See Kiyokawa, 'Technology choice', and Okazaki, 'Import substitution'.

branches of the tertiary sector are underenumerated, or both. Whether our statistics of the tertiary workforce are still underestimated or not, should be re-examined in the near future. Also a little puzzling is a high peak in 1927-33. The latter half of the seven-year period happened to overlap the worst years in the Great Depression. After the 1929 collapse, relative prices changed against agricultural producers and it is this that had so far been pointed out as a possible explanation for the sudden rise in the productivity gap. However, there is evidence that disguised unemployment swelled in the urban economy. In Tokyo, for example, petty commerce seems to have absorbed many of unemployed or underemployed people, causing economic and social problems and conflicts within the city.[17] It may suggest that even in the interwar urban service economy, there may have been a non-negligible number of people having a subsidiary job in commerce and services. If this were the case, then it would suggest that the number of tertiary workers was seriously understated in the depression period, causing an implausible productivity estimate for the tertiary sector at large. This is perhaps another agenda for the future research since the equation used for estimation did not adequately absorb this urban aspect of the by-employment phenomenon, especially in times of economic crisis.

Finally, a few words about the choice of the by-employment multiplier. The differences between two alternative estimates with the multiplier of 0.5 and 0.25 shown in table 6 are not great, ranging from 0.2 to 0.25 for secondary-sector employment and from 0.1 to 3.5 for tertiary-sector employment. This is a little surprising but at the same time it is an assuring result, because it suggests that the choice of a multiplier can be less problematic in comparison with the magnitude of impact that the inclusion of by-employments in the counts would exert on the estimates of sectoral labour productivity.

## 4. Concluding remarks

This paper has set out new estimates of gainfully occupied population in the primary, secondary and tertiary sectors between 1885 and 1940. Based on the new series and also on the separately estimated series of tertiary income, we have explored the issue of sectoral differentials in labour productivity over the entire period in question.

The new estimates are based on two sets of regional data, which suggest that the evolution of rural by-employment took place in two stages—an expansion in an early stage, followed by a contraction. And it is likely that it was manufacturing, but not commerce and services, which exhibited such an inverse-U shaped pattern. This lends support to the supposition that much of proto-industrial growth took the form of rural by-employment. It was a phase in which an expansion of industrial by-employment took place in the countryside without any contraction of the farm household sector.

The differences with the previous estimates of gainfully occupied population are not

[17] Settsu, ‘Kindai Nihon’, ch.5.

negligible. It is worth emphasising that this was the direction Umemura initially wanted to take. Crude as the new estimates are, therefore, the alterations made by the adoption of the new estimation method are in a sense what we expected. Japan on the eve of industrialisation was a little more industrial thanks to the spread of farm family by-employments in the countryside. A more articulated take-off came somewhat later than previously imagined, and it is this move which was associated with a decline of farm family by-employments in the countryside.

Finally, the new and revised estimates have proved to have an important implication for sectoral labour productivity analysis. Scholars in the LTES group, except perhaps Ohkawa himself, seldom ventured to do sectoral analysis of labour productivity and its changes over time, presumably because they knew that the widespread phenomena of rural by-employment would make such analysis difficult and misleading, especially for early years of development. Now it is evident that any calculations of sectoral differentials in labour productivity derived directly from the LTES volumes are misleading. Differentials in average labour productivity between primary and secondary industry were not as wide as both Gerschenkronian and dual structurist arguments assumed. In early stages of Japan's industrialisation the traditional sector of manufacturing was larger than previously thought. Initially, the overall level of average labour productivity in the secondary sector was more or less comparable to that in the primary sector; and the gap between the two sectors. This interesting finding suggests, first, that the whole manufacturing sector in the Meiji period was not overwhelmed by the imported modes of capital-intensive and labour-saving production methods widened only slowly as industrialisation proceeded, and second, that levels of labour productivity in agriculture were higher than previously thought. There has been consensus that in Japanese agriculture land productivity was high but it was very labour intensive; what our estimates suggest is that yields per worker were not as low as some of the users of the LTES imagined. And third, the productivity gap between the sectors widened only gradually as industrialisation proceeded, much more so in the period before World War I, and it was in the inter-war period when its tempo quickened. In short, by taking by-employment into account, we are now able to take a little more realistic step towards a better understanding of sectoral differentials in labour productivity in early phases of development.

Appendix A. By-employment equations: regression results

Table A.1. Overall proportion of by-employments (G)

| | ☆ (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Proportion primary$^2$ | -8.13 | -5.73 | -5.91 | -3.42 | -4.84 | |
| | (-1.93¶) | (-1.36) | (-1.28) | (-0.79) | (-0.85) | |
| Proportion primary | 12.9 | 9.50 | 10.453 | 6.76 | 8.25 | 0.69 |
| | (2.15†) | (1.59) | (1.57) | (1.09) | (1.01) | (0.76) |
| Population density | -0.002 | -0.002 | | | | -0.003 |
| | (-2.40†) | (-1.94¶) | | | | (-2.48†) |
| Kita-Tsuru dummy | 1.54 | | 1.93 | | | |
| | (2.83†) | | (3.31*) | | | |
| Tsuru dummy | | 1.20 | | 1.51 | | |
| | | (3.01*) | | (3.89*) | | |
| Constant | -6.44 | -5.36 | -6.27 | -5.00 | -5.18 | -1.88 |
| | (-3.08*) | (-2.64†) | (-2.67†) | (-2.30†) | (-1.81¶) | (-2.54†) |
| $R^2$ adjusted | 0.50 | 0.52 | 0.36 | 0.44 | 0.03 | 0.24 |

Table A.2. Proportion of primary by-employments (A)

| | (1) | (2) | (3) | ☆ (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Proportion primary$^2$ | -38.12 | -31.1 | -37.6 | -32.1 | -35.2 | |
| | (-2.31†) | (-1.92¶) | (-2.40†) | (-2.13†) | (-2.08¶) | |
| Proportion primary | 51.4 | 41.5 | 50.8 | 42.7 | 46.1 | -4.46 |
| | (2.19†) | (1.81¶) | (2.25†) | (1.97¶) | (1.89¶) | (-1.31) |
| Population density | -0.001 | 0.001 | | | | -0.001 |
| | (0.15) | (0.22) | | | | (0.20) |
| Kita-Tsuru dummy | 4.07 | | 4.17 | | | |
| | (1.92¶) | | (2.12†) | | | |
| Tsuru dummy | | 3.52 | | 3.38 | | |
| | | (2.30†) | | (2.49†) | | |
| Constant | -19.9 | -17.0 | -19.9 | -17.2 | -17.6 | -0.058 |
| | (2.44†) | (2.17†) | (2.51†) | (2.26†) | (2.05¶) | (0.02) |
| $R^2$ adjusted | 0.26 | 0.31 | 0.3 | 0.35 | 0.17 | -0.01 |

Table A.3. Proportion of tertiary by-employments (C)

| | (1) | (2) | (3) | (4) | (5) | ☆ (6) |
|---|---|---|---|---|---|---|
| Proportion primary$^2$ | 0.713 | 0.793 | 2.68 | 3.18 | 2.84 | |
| | (0.25) | (0.27) | (0.78) | (0.95) | (0.84) | |
| Proportion primary | -0.125 | -0.185 | -2.32 | -3.01 | -2.64 | 0.915 |
| | (-0.03) | (-0.04) | (-0.47) | (-0.63) | (-0.54) | (1.87¶) |
| Population density | -0.002 | -0.002 | | | | -0.002 |
| | (3.07*) | (2.83†) | | | | (3.50*) |
| Kita-Tsuru dummy | -0.063 | | 0.283 | | | |
| | (-0.17) | | (0.65) | | | |
| Tsuru dummy | | 0.039 | | 0.366 | | |
| | | (0.14) | | (1.21) | | |
| Constant | -2.99 | -3.01 | -2.84 | -2.64 | -2.68 | -3.36 |
| | (-2.08¶) | (-2.10¶) | (-1.63) | (-1.57) | (-1.58) | (-8.53*) |
| $R^2$ adjusted | 0.42 | 0.42 | 0.15 | 0.19 | 0.17 | 0.48 |

Table A.4. Proportion of non-secondary by-employments (E)

| | (1) | (2) | (3) | ☆ (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Proportion primary$^2$ | -28.2 | -22.9 | -25.7 | -20.9 | -23.7 | |
| | (-3.84*) | (-3.32*) | (-3.44*) | (-3.16*) | (-2.41†) | |
| Proportion primary | 37.5 | 30.0 | 34.7 | 27.6 | 30.5 | -3.99 |
| | (3.57*) | (3.07*) | (3.22*) | (2.90*) | (2.16†) | (-2.03¶) |
| Population density | -0.003 | -0.002 | | | | -0.003 |
| | (-1.58) | (-1.02) | | | | (-1.25) |
| Kita-Tsuru dummy | 3.18 | | 3.63 | | | |
| | (3.36*) | | (3.86*) | | | |
| Tsuru dummy | | 2.64 | | 2.92 | | |
| | | (4.04*) | | (4.89*) | | |
| Constant | -13.9 | -11.7 | -13.8 | -11.3 | -11.7 | 0.87 |
| | (-3.82*) | (-3.50*) | (-3.62*) | (-3.41*) | (-2.37†) | (0.55) |
| $R^2$ adjusted | 0.61 | 0.67 | 0.57 | 0.67 | 0.26 | 0.11 |

Table A.5. Proportion of non-tertiary by-employments (F)

| | (1) | (2) | (3) | (4) | (5) ☆ | (6) |
|---|---|---|---|---|---|---|
| Proportion primary$^2$ | -19.3 | -19.4 | -19.3 | -18.7 | -18.8 | |
| | (-2.85†) | (-2.73†) | (-3.00*) | (-2.81†) | (-2.91*) | |
| Proportion primary | 26.0 | 25.7 | 26.0 | 24.9 | 24.9 | -1.75 |
| | (2.69†) | (2.55†) | (2.81†) | (2.61†) | (2.69†) | (-1.24) |
| Population density | 0 | -0.001 | | | | 0 |
| | (0.02) | (0.34) | | | | (0.27) |
| Kita-Tsuru dummy | 0.911 | | 0.916 | | | |
| | (1.04) | | (1.13) | | | |
| Tsuru dummy | | -0.045 | | 0.048 | | |
| | | (-0.07) | | (0.08) | | |
| Constant | -11.3 | -10.9 | -11.3 | -10.8 | -10.8 | -1.80 |
| | (-3.37*) | (-3.17*) | (-3.47*) | (-3.23*) | (-3.32*) | (-1.58) |
| $R^2$ adjusted | 0.27 | 0.23 | 0.31 | 0.27 | 0.30 | 0 |

Notes to appendix tables 1-5:

1) N is 22 for all cases.

2) Figures in parentheses are *t* statistics.

3) * is statistically significant at the 1 per cent level, † at the 5 per cent level, and ¶ at the 10 per cent level.

Appendix B. New estimates of gainfully occupied workers

Table B.1. New estimates of gainfully occupied workers by sector: both sexes combined, 1885-1940

('000)

| | Primary | Secondary | Tertiary | Total |
|---|---|---|---|---|
| 1885 | 14,190 | 4,348 | 4,027 | 22,564 |
| 1886 | 14,155 | 4,385 | 4,065 | 22,606 |
| 1887 | 14,135 | 4,436 | 4,054 | 22,625 |
| 1888 | 14,138 | 4,560 | 4,108 | 22,806 |
| 1889 | 14,139 | 4,569 | 4,303 | 23,011 |
| 1890 | 14,129 | 4,636 | 4,432 | 23,198 |
| 1891 | 14,154 | 4,761 | 4,434 | 23,349 |
| 1892 | 14,153 | 4,835 | 4,506 | 23,495 |
| 1893 | 14,134 | 4,915 | 4,570 | 23,619 |
| 1894 | 14,139 | 4,966 | 4,641 | 23,746 |
| 1895 | 14,159 | 4,979 | 4,709 | 23,847 |
| 1896 | 14,222 | 4,965 | 4,800 | 23,986 |
| 1897 | 14,213 | 5,047 | 4,878 | 24,139 |
| 1898 | 14,248 | 5,098 | 4,957 | 24,303 |
| 1899 | 14,292 | 5,073 | 5,044 | 24,409 |
| 1900 | 14,294 | 5,075 | 5,147 | 24,516 |
| 1901 | 14,284 | 5,126 | 5,221 | 24,632 |
| 1902 | 14,317 | 5,128 | 5,300 | 24,746 |
| 1903 | 14,290 | 5,245 | 5,363 | 24,898 |
| 1904 | 14,288 | 5,324 | 5,417 | 25,030 |
| 1905 | 14,279 | 5,209 | 5,602 | 25,090 |
| 1906 | 14,274 | 5,261 | 5,660 | 25,195 |
| 1907 | 14,328 | 5,351 | 5,661 | 25,341 |
| 1908 | 14,286 | 5,427 | 5,713 | 25,426 |
| 1909 | 14,221 | 5,492 | 5,753 | 25,466 |
| 1910 | 14,247 | 5,415 | 5,873 | 25,534 |
| 1911 | 14,324 | 5,472 | 5,865 | 25,661 |
| 1912 | 14,397 | 5,516 | 5,928 | 25,842 |
| 1913 | 14,446 | 5,594 | 5,981 | 26,020 |
| 1914 | 14,546 | 5,516 | 6,150 | 26,212 |
| 1915 | 14,164 | 5,684 | 6,546 | 26,394 |
| 1916 | 14,182 | 5,324 | 7,154 | 26,660 |

| | | | | |
|---|---|---|---|---|
| 1917 | 14,251 | 5,973 | 6,644 | 26,868 |
| 1918 | 13,770 | 6,081 | 7,181 | 27,032 |
| 1919 | 13,808 | 6,039 | 7,208 | 27,054 |
| 1920 | 13,891 | 6,156 | 7,214 | 27,261 |
| 1921 | 13,930 | 5,874 | 7,593 | 27,397 |
| 1922 | 13,895 | 6,041 | 7,679 | 27,616 |
| 1923 | 13,333 | 6,253 | 8,244 | 27,831 |
| 1924 | 13,718 | 6,281 | 8,076 | 28,076 |
| 1925 | 13,635 | 6,280 | 8,386 | 28,301 |
| 1926 | 13,674 | 6,315 | 8,575 | 28,565 |
| 1927 | 13,855 | 6,568 | 8,397 | 28,820 |
| 1928 | 13,955 | 6,501 | 8,606 | 29,062 |
| 1929 | 13,995 | 6,487 | 8,831 | 29,312 |
| 1930 | 14,006 | 6,469 | 9,145 | 29,620 |
| 1931 | 14,144 | 6,417 | 9,391 | 29,952 |
| 1932 | 14,285 | 6,182 | 9,748 | 30,215 |
| 1933 | 14,325 | 6,241 | 10,104 | 30,671 |
| 1934 | 14,282 | 6,419 | 10,383 | 31,084 |
| 1935 | 14,321 | 6,704 | 10,620 | 31,645 |
| 1936 | 14,442 | 6,866 | 10,751 | 32,059 |
| 1937 | 14,135 | 7,389 | 10,632 | 32,156 |
| 1938 | 13,971 | 7,956 | 10,362 | 32,290 |
| 1939 | 13,890 | 8,334 | 10,428 | 32,652 |
| 1940 | 13,808 | 8,651 | 10,483 | 32,942 |

Source: See text.

Appendix C. Revised estimates of tertiary income, 1885-1940[18]

For estimating aggregate incomes, Kazushi Ohkawa and others took an output approach for most of production branches[19]. As for agriculture, forestry and fishery, manufacturing, mining and construction, and also communication and public utilities and much of transport, domestic product at factor cost was estimated by applying income ratios to gross output figures. So no LTES estimates of primary and secondary incomes are affected by changes that our sectoral estimates of gainfully occupied workers will bring about.

As for commerce and services and also for most of transport, communication and public utilities, however, an income approach was adopted. As Ohkawa himself admits, the income approach is difficult to apply until there emerge well-articulated factor markets. Yet, labour markets in the tertiary sector of the Meiji period were never fully fledged. A vast majority of tertiary workers in the Meiji period were self-employed and many worked as subsidiary workers whose principal occupations were in the primary and, to a lesser extent, the secondary sector. Thus Nobukiyo Takamatsu, who was responsible for much of estimation of tertiary output and incomes, applied the formula, number of those gainfully occupied in the tertiary sector *times* average wage, to the series of employed and self-employed workers. By 'wage' both salaries and wages are meant: it is relatively easy to estimate average salary earnings for those who received salaries, but it is very difficult to do so for wage earners and the self-employed. Some strong assumptions were made to derive a wage series for tertiary employments from that in manufacturing.

More problematic, perhaps, is to estimate the true numbers of workers in commerce, services and transport. Takamatsu recognised the need to include subsidiary workers whose principal occupation was in other sectors. In order to do so, he decided to apply the following ratios of subsidiary to principal employments in the sector of commerce and services to the four sub-periods:[20]

1885-1904: 0.3;
1905-1920: 0.24;
1921-1929: linear interpolation between 1920 and 1930; and
1930-1940: 0.108.

The ratios for the periods of 1905-1920 and 1930-1940 come from sample tabulations of the

[18] This appendix draws on Settsu's phD dissertation ('Kindai Nihon'), ch.1.
[19] Ohkawa, Takamatsu and Yamamoto, *Kokumin shotoku* (National income). For English summary of estimation procedures, see pp.159-173.
[20] Note that for some unknown reason, Takamatsu did not include transport in this estimation of subsidiary workers.

1920 and 1930 national censuses,[21] while that for the first sub-period is a mere guesstimate. These ratios were applied to the number of principal workers of the tertiary sector estimated separately by Umemrura (the series available was a provisional one).[22] The total number thus estimated stood at 640,000 in 1885, for example. Given the paucity of data concerning actual working hours this group of subsidiary workers spent, a half of the wage amount estimated above is used to calculate the incomes they generated.

There remain several problems, however. First, the time-series graph exhibits an irregular, zigzag pattern, a product of the assumption of a fixed ratio applied for a given sub-period. Second, the estimation procedure does not take into account information about the size of the workforce in other sectors, while the number of subsidiary workers whose principal occupation was in other branches of the tertiary sector is included in the numerator of the calculation. To put differently, Takamatsu did not pay attention to the source of subsidiary labour in tertiary employment. Third, the ratio of 0.3 for the first sub-period is an arbitrary one, but there is also an implicit assumption that the proportion of those engaged in tertiary activities as by-employments declined linearly over time. This may or may not be true for the period in question, and is a question to be settled empirically. Finally, it is probably worth pointing out that Takamatsu could not take into account the revisions Umemura did later for his sectoral estimates of principal workers.[23] As far as the tertiary sector is concerned, Umemura's new series gives somewhat lower estimates for earlier years and higher estimates for later years; as a result of this revision, a revised Takamatsu series of subsidiary workers in commerce, services and transport are shown in table C.1.

Unlike what Takamatsu postulated, this paper's new series of the number of persons having a subsidiary occupation in the tertiary sector, estimated above, no longer looks like a zigzag line. Although its long-run tendency is not entirely different from the Takamatsu estimates, this new series enables us, by applying exactly the same method Takamatsu employed, to estimate incomes they earned and the total NDP of the tertiary sector in corresponding years.

According to our revised estimates (set out in table C.1), the number of subsidiary workers in the tertiary sector was 720,000 in 1885, 14 per cent larger than the Takamatsu estimate (it would be 22 per cent larger than that implied by the revised Umemura series). Rather unexpectedly, however, the largest difference between the old and new series is found for 1920. It is evident that Takamatsu overstated the number substantially for this census year. Estimated incomes they earned show virtually the same differences.

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[21] Naikaku Tōkei-kyoku, *Chūshutsu hōhō ni yoru daiikkai kokusei chōsa no gaiyō* (Tokyo: Naikaku Tōkei-kyoku, 1924), and *Chūshutsu hōhō ni yoru Shōwa 5-nen kokusei chōsa no gaiyō* (Tokyo: Naikaku Tōkei-kyoku, 1932).

[22] Umemura's provisional estimates of gainfully occupied workers are published in 'Population and labor force' in *Patterns*, pp.392-395, although no breakdown figures are set out for the period before 1905.

[23] Umemura et al., *Rōdōryoku* (Manpower).

Table C.1. Estimated numbers of subsidiary workers in commerce, services and transport: LTES and our estimates compared, 1885-1940

| Year | (1) LTES1 | (2) LTES2 | (3) Our estimates | (4) [(3)-(1)]/(1) | (5) [(3)-(2)]/(2) |
|---|---|---|---|---|---|
| 1885 | 636,300 | 591,300 | 724,341 | 14% | 22% |
| 1890 | 669,900 | 622,800 | 708,475 | 6% | 14% |
| 1900 | 721,200 | 685,800 | 692,372 | -4% | 1% |
| 1910 | 678,240 | 624,480 | 657,647 | -3% | 5% |
| 1920 | 789,360 | 811,200 | 595,055 | -25% | -27% |
| 1930 | 448,632 | 532,440 | 548,268 | 22% | 3% |
| 1940 | 535,248 | 551,880 | 540,384 | 1% | -2% |

Sources: See text

Note 1) LTES 1 are the Takamatsu estimates used in Ohkawa et al., *Kokumin shotoku* (National income), while LTES 2 are those which should have been if based on Umemura's revised estimates in *Rōdōryoku* (Manpower).

2) Transport and communications are not included in the two LTES series.

Despite these non-negligible differences in the numbers of subsidiary workers and implied incomes earned by them, the two output estimates appear similar. The largest gap is found for the year 1920 but is only 2 per cent. This is because wage earnings by subsidiary labour are assumed to have been half the amount earned by the principal worker, so that the subsidiary wage portion in the sectoral NDP could not be large. The Takamatsu estimates did not go wide of the mark.

Appendix D. Estimated sectoral differentials in labour productivity, 1885-1940

Table D.1. Sectoral differentials in labour productivity, 1885-1940

(Primary sector = 1)

| Year | Secondary | Tertiary | Two non-primary sectors combined |
|---|---|---|---|
| 1885 | 1.06 | 3.45 | 2.21 |
| 1886 | 1.14 | 3.54 | 2.29 |
| 1887 | 1.33 | 3.78 | 2.50 |
| 1888 | 1.40 | 3.95 | 2.61 |
| 1889 | 1.59 | 3.81 | 2.67 |
| 1890 | 0.96 | 2.72 | 1.82 |
| 1891 | 1.11 | 3.18 | 2.11 |
| 1892 | 1.06 | 3.13 | 2.06 |
| 1893 | 1.18 | 3.21 | 2.16 |
| 1894 | 1.04 | 2.86 | 1.92 |
| 1895 | 1.21 | 3.06 | 2.11 |
| 1896 | 1.47 | 3.24 | 2.34 |
| 1897 | 1.62 | 3.22 | 2.41 |
| 1898 | 1.21 | 2.49 | 1.84 |
| 1899 | 1.67 | 3.11 | 2.39 |
| 1900 | 1.52 | 3.09 | 2.31 |
| 1901 | 1.51 | 3.04 | 2.28 |
| 1902 | 1.57 | 3.28 | 2.44 |
| 1903 | 1.31 | 2.80 | 2.06 |
| 1904 | 1.23 | 2.99 | 2.12 |
| 1905 | 1.76 | 3.98 | 2.91 |
| 1906 | 1.75 | 3.23 | 2.52 |
| 1907 | 1.76 | 2.75 | 2.27 |
| 1908 | 1.64 | 2.89 | 2.28 |
| 1909 | 1.88 | 3.25 | 2.58 |
| 1910 | 2.11 | 3.41 | 2.79 |
| 1911 | 1.66 | 2.91 | 2.31 |
| 1912 | 1.58 | 2.65 | 2.14 |
| 1913 | 1.71 | 2.66 | 2.20 |
| 1914 | 2.24 | 3.35 | 2.82 |
| 1915 | 2.57 | 3.36 | 2.99 |

| | | | |
|---|---|---|---|
| 1916 | 3.12 | 3.04 | 3.08 |
| 1917 | 2.74 | 3.14 | 2.95 |
| 1918 | 2.37 | 2.18 | 2.27 |
| 1919 | 1.92 | 1.94 | 1.93 |
| 1920 | 2.17 | 2.70 | 2.46 |
| 1921 | 2.17 | 2.93 | 2.60 |
| 1922 | 2.49 | 3.41 | 3.01 |
| 1923 | 2.22 | 2.96 | 2.64 |
| 1924 | 2.18 | 3.02 | 2.65 |
| 1925 | 2.09 | 2.92 | 2.56 |
| 1926 | 2.42 | 3.44 | 3.01 |
| 1927 | 2.42 | 3.60 | 3.08 |
| 1928 | 2.93 | 4.01 | 3.55 |
| 1929 | 3.20 | 3.98 | 3.65 |
| 1930 | 3.90 | 5.20 | 4.66 |
| 1931 | 4.31 | 5.50 | 5.01 |
| 1932 | 4.13 | 4.53 | 4.37 |
| 1933 | 3.93 | 3.88 | 3.90 |
| 1934 | 4.60 | 4.45 | 4.51 |
| 1935 | 4.32 | 3.88 | 4.05 |
| 1936 | 4.22 | 3.51 | 3.78 |
| 1937 | 4.11 | 3.33 | 3.65 |
| 1938 | 4.71 | 3.36 | 3.95 |
| 1939 | 3.89 | 2.50 | 3.12 |
| 1940 | 4.01 | 2.56 | 3.22 |

Sources: See text.

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