Productivity, Demand and Inter-Sectoral Labor Allocation in Japan

Etsuro Shioji
Hitotsubashi University

This paper first overviews recent trends in inter-sectoral labor allocation in Japan. I find that three sectors have been expanding at the expense of manufacturing. These three sectors are: medical and health services, corporate services, and information services. I study the roles played by both productivity and demand factors behind those changes. As for productivity, the greatest gain has been found not in those growing sectors but rather in manufacturing, especially electronics. Does that mean that Japan should have expanded this sector further? Not necessarily. I show theoretically that, when demand satiation is important, a productivity increase in one sector could actually reduce the optimal labor allocation to that sector, when an endogenous decline in the product price is sufficiently large. In fact, prices of electronics products in Japan have been falling dramatically. In the light of the model, we could argue that labor allocation to the electronics sector should have been contracted faster. As for the demand factor, I study the relationship between population aging and labor allocation to the medical and health service sector. I find that, despite the large labor inflows, this sector suffers from a chronic and massive labor shortage. I hypothesize that this is because prices of those services do not react to market conditions. As a consequence, in spite of the large shortage, wages do not respond, and the sector fails to attract labor fast enough.

I. Introduction

1. Japan's Long Stagnation and the "Productivity View" of Labor Allocation

This paper studies trends in inter-sectoral labor allocation in Japan. I take up its two driving forces, namely relative productivity across sectors (the supply side factor) and the relative demand for goods and services produced by different sectors (the demand side factor), with a special emphasis on the latter.

The main motivation behind the analysis is the long-term stagnation of the Japanese economy. Growth decelerated in Japan since the so-called bubble collapse in the early 1990s. The average growth rate of GDP was 4.7% between 1981 and 1990, but was down to merely 1.2% between 1991 and 2000. Between 2001 and 2010, the growth rate was even lower, at 0.8%. Many researchers believe that this is due to low productivity growth.[1] The best source of information regarding Japanese productivity growth is the JIP (Japan Industrial Productivity) Data Base, which is provided on the web site of the Research Institute of

[*] This paper is a much revised version of Shioji (2013b). I would like to thank Daiji Kawaguchi and Hideo Hayakawa for their discussions on the previous version.

[1] However, this view itself is not without controversy. Refer to Shioji (2013a) for the overview of the heated debate among macroeconomists over the causes of the so-called "Lost Decade (or Two Decades)."

Economy, Trade and Industry (RIETI). This data will be utilized extensively in this paper.[2] According to the latest (2014) version, the Total Factor Productivity (TFP) growth rate of Japan was 1.33% in the period 1980–1990, then went down to -0.03% in the period 1990–2000. In the period 2000–2010, the number was slightly up but was still just 0.50%. It is sometimes argued that this long-term stagnation of the Japanese productivity growth stems, at least partially, from the country's failure to reallocate labor to sectors that are undergoing fast productivity growth. I shall call the view that favors labor reallocation to sectors that are experiencing fast productivity growth the "productivity view."

2. Why the "Productivity View" May Not Be Valid: The Role of Prices

I shall argue in this paper that the productivity view may be to the contrary of the Japanese reality. In fact, it is possible to make a plausible case that Japan has been too slow to *reduce* employment in some of those high-productivity-growth sectors. My conjecture is that this delay is because of the presence of tight regulations in some of the sectors that are characterized by low-productivity-growth and increasing demand for their goods and services. Such regulations prevented wages in those sectors from rising fast enough, thus slowing down the inevitable reallocation of workers out of the high-productivity-growth sector and into the low-productivity-growth sector.

Why should an economy sometimes pull its resources out of a high-productivity-growth sector? This would not make much sense when prices are considered to be fixed. When prices are exogenous variables, an improvement in productivity in one sector in relation to others would improve the relative marginal product of labor in that sector, and thus call for reallocation of labor into that sector. However, in reality, prices are endogenous. In such a case, the relationship between inter-sectoral productivity and the optimal labor allocation can be more intricate. When productivity increases in a certain sector, that sector expands its production of the goods, and this tends to cause the price of their product to fall. If this effect more than offsets the immediate impact on the supply side, the relative value marginal product could actually fall. In such a case, the correct response would be to withdraw labor from that sector. Whether this happens depends on the characteristics of the demand structure. In Appendix B of this paper, I will formally present a two sector model in which it eventually becomes optimal to reallocate labor from the high-productivity-growth sector to the low one.

In light of such a theoretical result, in the first half of this paper, I present evidence that, in some high-productivity-growth sub-sectors of manufacturing, prices have been falling faster than the pace of productivity growth. To the extent that this price decline was foreseeable (which should be the case if it reflects endogenous response of prices to productivity) and given the rigidity in labor movement, Japan should have started moving labor

[2] Refer to Fukao and Miyagawa (2008) for details of the data construction. The numbers quoted in this page are for the macro economy as a whole, and are on the value-added basis.

away from these sectors long ago. However, we shall see that this did not happen.

3. What Is Hindering Smooth Labor Re-allocation? Role of Regulations

The above fact is indicative that, in Japan, sectors that should have been absorbing workers from those sectors were not expanding their employment fast enough. What was going on? In the latter half of the paper, I shall focus on the other major determinant of inter-sectoral labor allocation, namely demand for goods and services. Theoretically speaking, when demand increases for a certain sector, normally, prices of goods and services produced by that sector would go up, which induces wages to go up, and, if labor is freely mobile, would result in increased labor allocation to that sector. However, when prices are not flexible due to, for example, regulations, such a process may not occur to its full strength, even if labor were mobile. In such a case, public intervention to accelerate labor reallocation might be justified.

In this paper, I investigate regional dispersion in prices of services for the elderly care. There are three reasons behind the choice. First, due to the rapid aging of the Japanese population, demand for elderly care has been expanding fast, making it one of the fastest growing sectors of the economy. Second, we can think of this overall society's aging, as well as the differing speed at which it is happening across the regions, to be more or less exogenous. Third, as these kind of services cannot be traded across regions, it is relatively easy to measure the size of the demand, as well as supply, in each region. It will be shown that the prices of the elderly services are not very responsive to the demand situation, and the most likely reason behind this is regulation. At the end of the paper, I utilize time series data to show that there has indeed been a persistent labor shortage in the welfare services sector.

The rest of the paper is organized as follows. Section II gives a brief overview of the recent trends in sectoral labor allocation in Japan. In Section III, I analyze the relationship between the evolution of the relative productivity, relative prices, and allocation of labor. In Section IV, I will study the relationship between the population aging and labor allocation. Section V provides conclusions.

II. Trends in Sectoral Labor Allocation in Japan: An Overview Based on the JIP Data Base

1. On the JIP Data Base

In this section, I will give an overview of the historical evolution of the inter-sectoral labor allocation in Japan. The main source of data is the 2012 version of the JIP Data Base. In this data set, all the production activities in Japan are classified into 97 market economy industries, 10 public and/or non-profit industries, and "Activities not elsewhere classified"; all together, there are 108 industries of production in the data. For each industry, they provide annual statistics on gross output, value added, intermediate inputs, capital stock and labor inputs, for 1970 and all the years between 1973 and 2009. From this data, they also

compute the Total Factor Productivity (TFP for short) for each industry. As for data related to labor inputs, it provides information about the number of employees, man-hour, nominal labor cost, as well as the labor input index which takes into account variations in the quality of labor.[3] If one wishes to study the evolution of labor inputs for each of the individual industries, this index is probably the most suitable one to use. However, as this is an index whose value is normalized to equal 1 in 2000, it cannot be used for the purpose of inter-industrial comparison of the amount of labor inputs. For that reason, in this section, I shall focus on man-hour.

2. Labor Allocation across Broad Sectors

This sub-section aims to provide a big picture on the evolution of sectoral allocation of labor inputs in Japan, using the JIP data base. To demonstrate key features of the historical transformation of the Japanese industrial structure for the past forty years, I find it useful to employ the following re-classification of the sectors. First, I aggregate all the sectors other than Agriculture etc., Mining, Manufacturing into the broadly defined services group: this includes, besides narrowly defined services, construction, utility, distribution, finance, and transportation and communication. Then this group is decomposed into three broad sectors, according to the features of the trends in their respective growth in the man-hours share, into "Stable," "Expanding," and "Others." Each of the three broad sectors consists of the following "semi-broad" or "intermediate" sectors, each of which is constructed by aggregating several of the 108 industries in the JIP data base; their definitions can be found in Appendix A:

Services: Expanding = (1) Medical and Welfare, (2) Business Services,[4] and
(3) Information Services.[5]

Services: Stable = (1) Construction, (2) Utility, (3) Distribution, (4) Finance,
(5) Transportation and Communication, (6) Personal Services, and
(7) Education and Research.

Services: Others = Other Types of Services.[6]

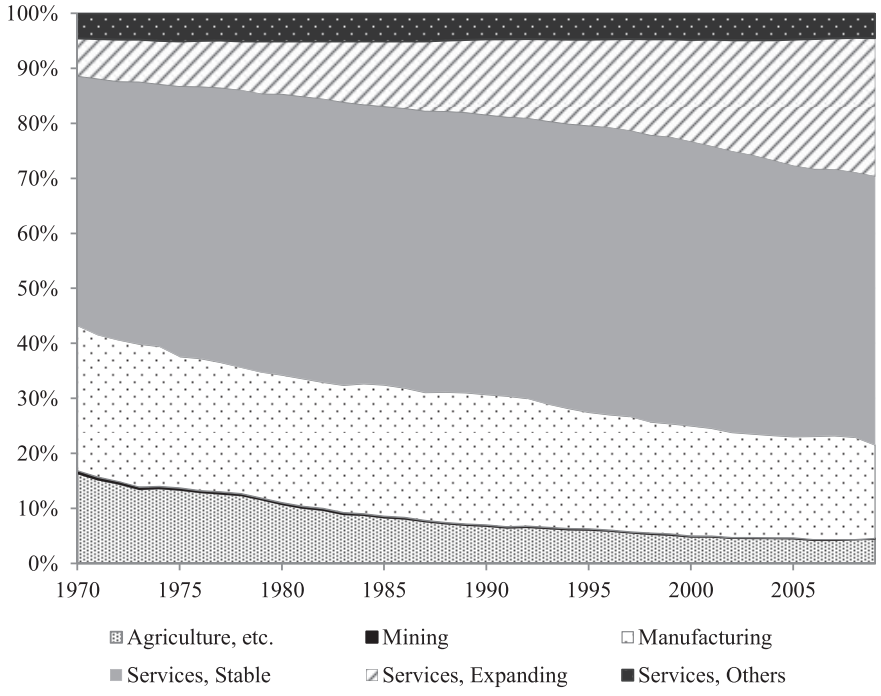
Figure 1 shows the shares of each of the six broad sectors between 1970 and 2009. The share of Agriculture etc. plus Mining was almost 17% in 1970. By 1990, it was down to

[3] They first group workers according to their characteristics such as gender, age group, educational attainment and employment status. In the first step of the index construction, they compute the rate of increase in man-hour for each group. In the second step, they take a weighted average of those growth rates at the group level, by using the cost share of each group as the weight. (To be more precise, information on educational attainment is used for the full time worker group only.)

[4] The largest and the fastest growing industry in this category is the JIP industry "Other Services for Businesses," which includes labor dispatch services.

[5] The fastest growing component is the JIP industry "Information Services and Internet-based Services."

[6] Under this category, the JIP industry "Public Administration" is the largest.



Source: Author's calculations based on the JIP 2012 data base.

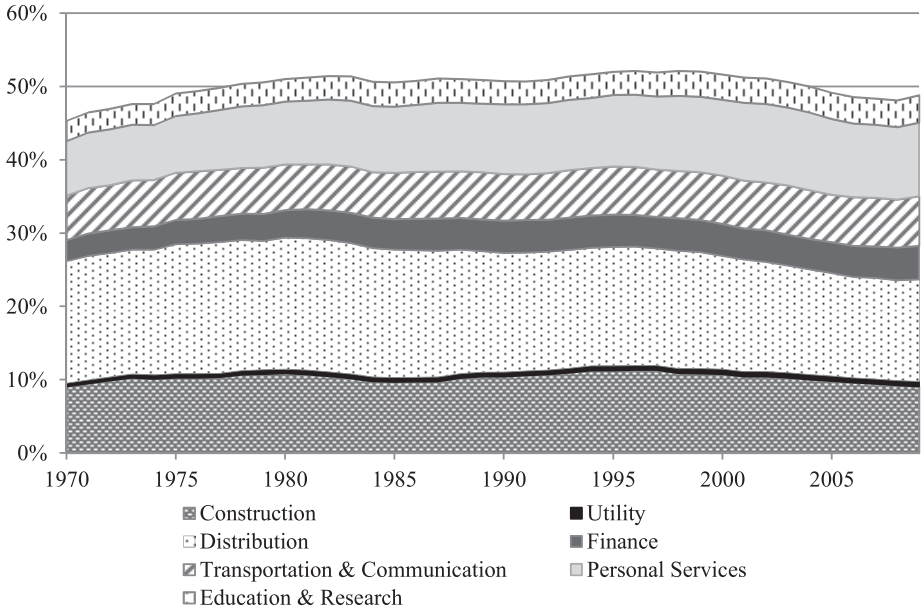
Figure 1. Evolution of the Shares in Total Man-Hours, for Production Sectors Broadly Defined

7%, and, by 2009, the number was down further, to just 4.5%. The share of Manufacturing in 1970 was 26%; even in 1990, it maintained a comparable share, at 24%. However the share was down to 17% in 2009. The losses of the relative labor inputs from these sectors were absorbed by the broadly defined services sector, and, by definition of the sectors, much of the reallocation occurred toward the broad sector of "Services: Expanding." In the next sub-section, I will look into what has been happening inside each of the services sectors.

3. Decomposing the Service Sector Employment

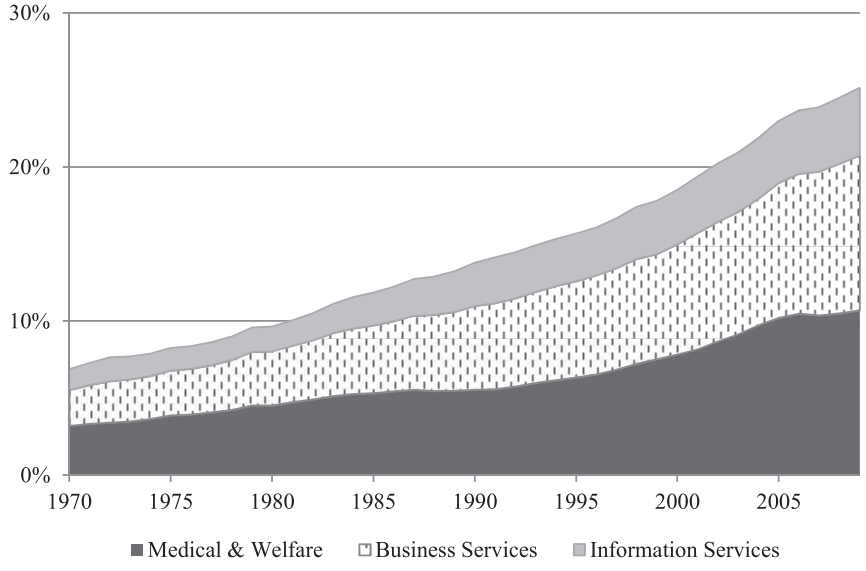
Figure 2 depicts the evolution of the man-hour shares for the intermediate sectors that belong to the broad sector "Services: Stable." We can confirm that the total share of the broad sector remained more or less constant at about 50%. If we look inside, we find that the two intermediate sectors that originally had larger shares, namely "Distribution" and "Construction," have been losing their shares over time. Their losses have been roughly offset by modest increases in the shares of "Personal Services" and "Education and Research."

Figure 3 depicts evolution of the man-hour shares of the three intermediate sectors



Source: Author's calculation based on the JIP2012 data base.

Figure 2. Evolution of the Man-Hour Shares (in the Overall Total) of Intermediate Sectors within the Broad Sector "Services: Stable"



Source: Author's calculation based on the JIP2012 data base.

Figure 3. Evolution of the Man-Hour Shares (in the Overall Total) of Intermediate Sectors within the Broad Sector "Services: Expanding"

that belong to the broad sector "Services: Expanding." The man-hour share of "Medical and Social Welfare" stood at just 3% in 1970, and was only 5.5% even in 1990. Since then, the share has experienced a rapid growth and had gone up to 10.7% by 2009. Growth of "Business Services" is equally impressive; it is suspected that much of its recent growth comes from worker dispatching businesses. As we have already seen in Figure 1, as a result of this spectacular growth, this broad sector has been absorbing almost entire losses of man-hour shares of Agriculture etc. and Manufacturing.

III. Relative Productivity and Sectoral Labor Allocation

1. Basic Theory of Labor Allocation

In this section, I shall start with reviewing implications of economic theory on the relationship between relative productivity across sectors and labor allocation between them. As my overview in Shioji (2010) indicates, theoretically speaking, it is not necessarily optimal to reallocate labor to a sector that has experienced a productivity increase. On the one hand, improvement in productivity makes the marginal product of labor in that sector higher. On the other hand, as the supply of products from that sector increases, their price per unit tends to fall. The latter effect reduces the sector's value marginal product of labor. If the former effect dominates, the "productivity view," namely the argument in favor of allocating labor to a sector with a higher productivity growth, is justified. However, if the latter effect is stronger, the conclusion is reversed, and it becomes optimal to withdraw labor from such a sector.

Shioji (2010) uses a simple two sector model to demonstrate that the crucial parameter is the elasticity of substitution between the products of the two sectors in the consumer's utility function. In his setting, if the products are highly substitutable, namely if the elasticity exceeds one, the demand for each type of product becomes very price-elastic. As a consequence, the relative price is not very responsive to the relative supply of the products. In such a case, the productivity view is justified. If the elasticity is exactly equal to one, the optimal labor allocation becomes independent of the relative price. If the elasticity is below one, the demand curve becomes sufficiently steep and the relative price effect becomes strong, and the "reverse productivity view" applies: it is better to move labor away from the sector.

2. Product Life Cycle and Demand Satiation

As Shioji (2010) argues, it seems rather unrealistic to expect that either one of the opposing views will *always* hold. In particular, it seems more appropriate that the sign of the effect changes depending on the maturity of the product or the sector's current position in the *product life cycle*. When the sector is still young, very few people own its products, and the demand is very elastic. In such a situation, as the sector's productivity improves, it can sell more of its products without cutting the price. However, as the sector matures and

reaches a stage at which one can find its products in almost all households, the *demand satiation* sets in. It becomes harder to sell larger quantities of the products to the consumers. In such a situation, if the sector's productivity improves further, the firms will have to drastically cut the price to find buyers. Hence, the demand elasticity, and thus the impact of a productivity enhancement on labor allocation, is likely to be time-varying.

3. Non-Monotonic Labor Transition in a Model with Satiation

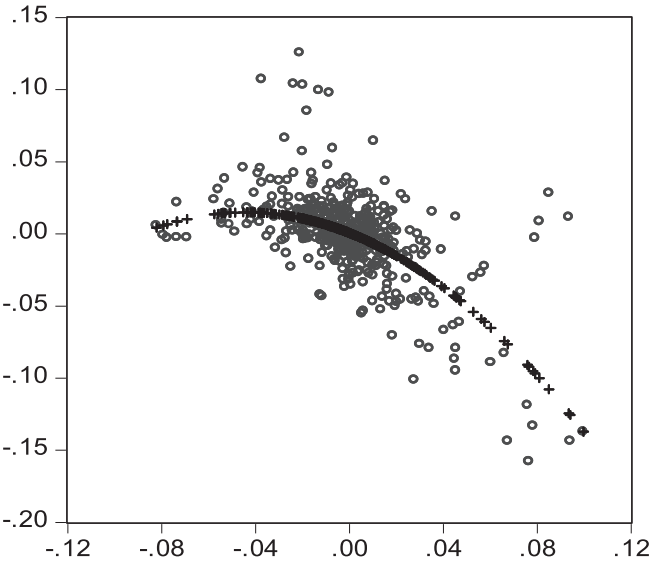
In Appendix B, I present a two sector model developed in Shioji (2010), in which the notion of demand satiation is formally introduced. The defining characteristic of the model is the consumer's utility function which exhibits endogenously varying elasticity of substitution. More specifically, suppose that production of one type of goods experiences a persistent improvement in productivity, while the productivity of the other sector is constant. At the beginning, when output of the first sector is still small, its demand is price-elastic. As a result, the productivity view applies: as productivity improves, this sector's output expands without too much reduction in the relative price, and more workers will flow into this sector. However, as the relative productivity of the first sector improves further, the relative amount of consumption of its products becomes larger, and, gradually, the demand becomes satiated; i.e., it becomes price-inelastic. If the sector's productivity further improves from such a situation, the relative price falls sharply. At some point, this relative price effect will become large enough to dominate the direct effect of the productivity improvement, and the value marginal product of labor in that sector will start to decrease. At that point, workers will start to flow out of the sector.

The argument so far assumed that labor is instantaneously mobile across the sectors. In reality, labor mobility takes time. In such a case, we need to modify the argument suitably. Note that the above reversal of trend in efficient labor allocation is foreseeable. Consequently, when labor mobility takes time, the turning point has to come earlier: it becomes optimal to slow down or even stop allocating labor to the sector experiencing productivity growth, even before the observed value marginal product of labor starts to decline.

4. Cross-Sectoral Evidence on Productivity vs. Prices

In light of the above theoretical argument, I will now go back to the JIP data base and study the relationship between relative productivity growth and relative prices. For that purpose, I have collected data on TFP growth rate for each of the 108 JIP industries for the following four periods: 1970–1980, 1980–1990, 1990–2000 and 2000–2007.[7] For each of the periods, I subtracted TFP growth rate at the macro level from them, to derive the relative TFP growth rate by industry. I also computed the output deflator for each industry for the same set of periods, by dividing nominal output by real output. From the growth rate of this

[7] I chose to drop the years 2008 and 2009 as outliers, as the effect of the Global Financial Crisis was evident for those two years.



Source: Based on the author's calculations using the JIP 2012 data.

Figure 4. Relative TFP Growth (Horizontal Axis) vs. Relative Deflator Change (Vertical Axis): Circles (o's) indicate actual observations, while the plus signs (+'s) signify fitted values from a regression analysis (Refer to the main text for details)

deflator at the industry level, I subtracted its counterpart at the macro level, to arrive at the relative price growth rate by industry. As a result, I obtain the data for the 108 industries for the four time periods, which amounts to the total of 432 observations.

In Figure 4, I place the relative TFP growth by industry on the horizontal axis and the relative price change by industry on the vertical axis. The circles (o's) correspond to the actual data. As expected, there is a downward sloping relationship: when an industry's productivity grows, its output prices tend to fall. What is noteworthy is that the slope of this negative relationship appears to become steeper to the right of the figure: that is, as TFP growth rate becomes higher, the associated price decline becomes disproportionately large. In the figure, the plus signs (+'s) denote the fitted values from the regression which takes the relative price change on the left hand side and the TFP growth, as well as its squared value, as regressors.[8] It can be seen that the relationship is close to being horizontal near the origin. As we move to the right, the slope becomes steeper, and eventually exceeds 1 in the absolute value. That is to say, if we call price times TFP as the "*Value TFP*," its growth

[8] More formally, to eliminate influences of outliers, instead of the standard OLS, I utilized the quantile regression in which the median is the threshold. As a result, the coefficient on TFP growth was -0.649 (t-value = -9.254), while that of the squared TFP growth was -7.360 (t-value = -6.950), and both were statistically significant.

rate is decreasing in TFP growth rate when the latter is sufficiently high.[9]

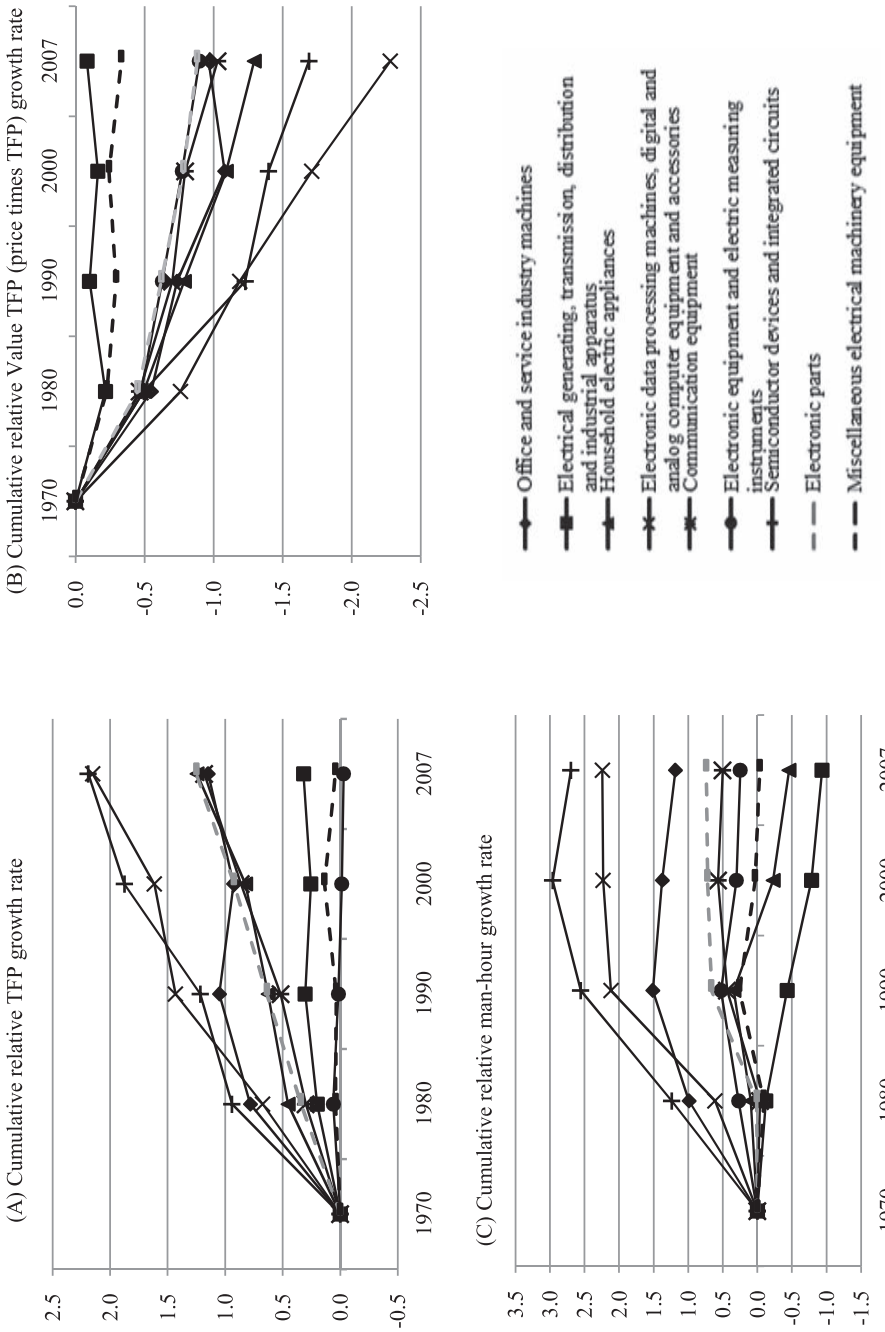
5. Productivity vs. Prices: Evidence from Japan's Electronics Sector

Many of the industries that appear in the lower right section of Figure 4, namely those that experienced fast TFP growth, belong to the electronics sector. In this sub-section, I will focus exclusively on the nine JIP industries that make up this sector. Figure 5A plots their TFP growth rates relative to the macro economy, accumulated over time, starting from 1970.[10] We see that the relative productivity growth was spectacular for "Semiconductor Devices and Integrated Circuits" and "Electronic Data Processing Machines, Digital and Analog Computer Equipment and Accessories," followed by "Office and Service Industry Machines." On the other hand, we do not observe much productivity growth (at least, relative to the aggregate) for "Electrical Generating, Transmission, Distribution and Industrial Apparatus," "Miscellaneous Electrical Machinery Equipment," and "Electronic Equipment and Electric Measuring Instruments." Figure 5B depicts the cumulative "Value TFP" (i.e., output price times TFP) growth rates for the same group of industries. Those sectors with higher TFP growth tend to have lower Value TFP growth. In Figure 5C, I take man-hour growth rates for each industry, subtract the aggregate man-hour growth rate from them for each time period, and accumulate this relative man-hour growth rate, taking 1970 as the starting year. It can be seen that the group of industries that had higher TFP growth experienced faster growth in labor input allocation. That tendency weakens and is partially reversed in the 1990s: however, given the extent of price declines up to that point, this timing, and the speed of reversal of labor reallocation seems rather slow. For the group of industries with relatively low TFP growth, relative labor allocation has been either stable or declining over time.

As we have seen thus far, despite the big fall in the relative prices, high TFP growth portions of the electronics sector continued to attract labor. There is a sign of a reversal, but it only seems to be happening slowly. As the theory in the previous sub-section suggests, if labor mobility takes time, we should be observing worker re-allocation out of them, even before the Value TFP starts to fall, which is not the case in the data. What is behind this seemingly inefficient pattern? One explanation would be myopia or the limited life time of the current generation of workers, which makes their choice concerning which sector to work less forward looking. Another possibility is political economy. Once many workers are hired by a certain sector, it tends to have a larger political power, which makes it easy to press for policies in favor of such a sector. Yet another possibility is that there is an obstacle to workers flowing into new sectors which should be absorbing workers released from the

[9] To check robustness of the results, I also tried eliminating the influences of the prices of the intermediate goods from the (gross) output deflator. The result tended to reinforce, rather than weaken, the argument in the main text.

[10] As the growth rates are defined as log differences, their cumulative values correspond to log differences compared to the starting year.



Source: Author's calculation based on the JIP 2012 data set.

Figure 5. Historical Evolution of Nine JIP Industries in Electronics

high TFP growth sectors. I will turn to this possibility in the next section.

IV. Demand Factors and Inter-Sectoral Labor Allocation

1. Is the Price Mechanism at Work? Evidence from the Municipality Level Data on Elderly Care

As we have already seen, in recent years in Japan, the sectors that have been expanding rapidly in terms of the man-hour share have been a part of the services industry. It is easy to see that they were not expanding because of fast productivity growth. For example, according to the JIP data base, for the seven JIP industries that belong to the "Medical and Social Welfare" intermediate sector, their TFP growth rates were about the same as that of the macro economy, or, if anything, lower (if we take the simple average of the seven industries, the long run TFP growth rate was 0.4% lower annually than that of the entire economy). It is thus clear that their expansion was mostly demand driven. And, at least as far as this intermediate sector is concerned, the most important factor behind the demand expansion was the population aging. The question is whether the sector was expanding its hiring fast enough to keep up with the demand increases.

I will utilize data at the municipality level on the social welfare services to shed some light on the issue. As this type of service (e.g. elderly care) is essentially non-tradable, even across narrowly defined regions, studying the demand-supply relationship on a region by region basis is justified (which is not the case with rice or automobiles or internet-based services).

The first ever Economic Census of Japan, conducted in 2009, gives us information about the number of employees at the municipality level at a much disaggregated level (at the 3 digit level of the Japan Standard Industrial Classification). From this data set, I downloaded the statistics for the "Old-age Welfare and Elderly Care." I also obtained data on the population by age group at the municipality level from the 2010 Population Census. Excluding missing observations, I ended up with 1844 observations.[11]

I computed the ratio of the number of employees of the above-mentioned industry to the population over 65 years old. The mean across the municipalities was 5.2%. There is a fair amount of variation in this ratio across the municipalities: the standard deviation was 2.2%. In Shioji (2013b), I show that this variation in the ratio cannot be explained by the different degrees of urbanization (measured by the population density). Thus, there is a fair amount of heterogeneity in the relative strengths of demand and supply across the regions. The question is whether such a demand-supply relationship is reflected in the price, as would be normally expected in an efficiently functioning market.

[11] For the Ordinance-Designated Cities (as of 2009), I used the ward-level data. Within the short period of time between the Economic Census on July 1, 2009, and the Population Census on October 1, 2010, there was a massive wave of mergers between municipalities. Therefore, the sample size of my analysis is constrained by that of the latter census.

For that question, I turn to the third data set, the National Survey of Prices conducted by the Ministry of Internal Affairs and Communications in 2007 (the survey was terminated after this year). It contains data on two types of fees for elderly care, one for a stay at a day care center, and the other for a home visit by a care giver, for large municipalities. According to this data, for the former, the price is 840 yen almost everywhere. In Hokkaido, for example, it is 840 yen everywhere but in its capital, Sapporo, where it is marginally higher at 855 yen. Exceptions are big cities such as Tokyo where the prices are higher (however, as I emphasized previously, the relative strength of demand and supply is unrelated to the degree of urbanization). The situation is similar for the latter types of fees. It seems safe to conclude that the price mechanism is not at work, most likely due to regulations, for this sector.

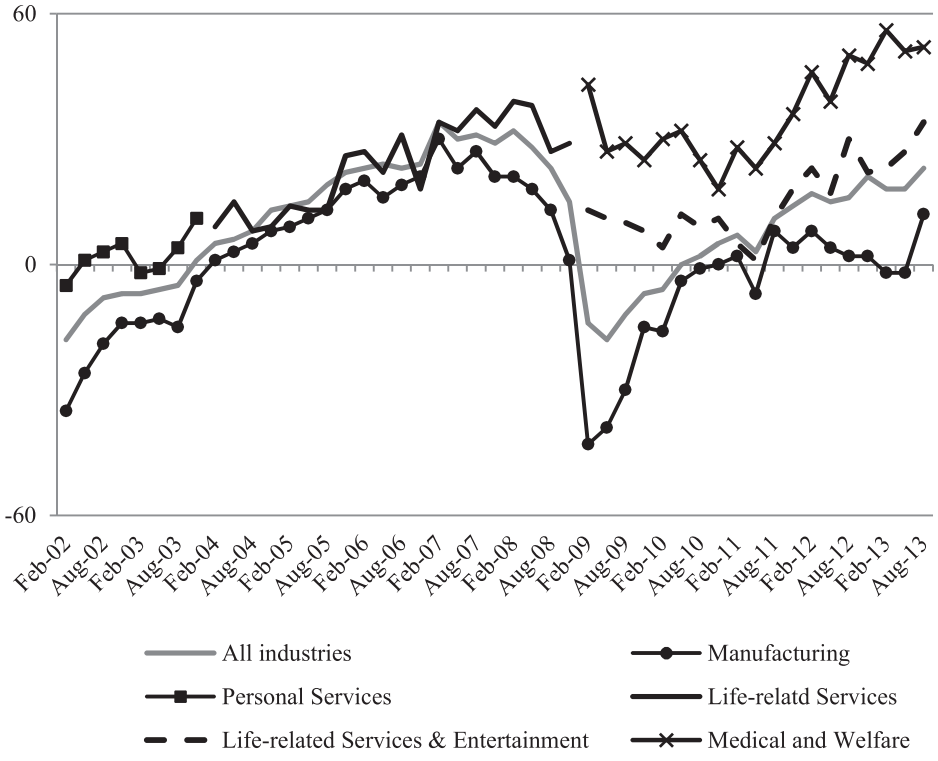
2. Persistent Labor Shortage: Evidence from Time Series Data

This sub-section aims to demonstrate that the lack of price adjustment is causing a persistent excess demand for workers in the intermediate sector "Medical and Social Welfare," despite its rapid expansion in hiring, presumably because regulations are suppressing the service prices at artificially low levels. One difficulty in presenting evidence to support such an idea is that, until the revision of the Japan Standard Industry Classification (JSIC) in March 2002, this sector did not exist as an independent sector in the Japanese statistics. Accordingly, in the following discussion, I will try my best to gain insights into long run tendencies, by mixing evidence based on old classifications with more recent ones.

In the Survey of Labor Economy Trend conducted by the Ministry of Health, Labor and Welfare, each plant or office is asked about its perception about the state of labor shortage (or excess). Each respondent is asked to choose from "very much in shortage," "somewhat in shortage," "appropriate," "somewhat in excess" and "very much in excess." The Percentage of respondents who selected each answer are reported. I have decided to create a diffusion index ("DI") based on those percentages, according to the following formula:

$$\begin{aligned} \text{DI} = {} & 2*(\text{very much in shortage}) + (\text{somewhat in shortage}) \\ & - (\text{somewhat in excess}) - 2*(\text{very much in excess}) \end{aligned}$$

Figure 6 plots evolution of this DI for various categories, starting 2002. The thick solid line is for the overall average. Until 2008, the index is trending upwards, reflecting the modest but long period of recovery. But as the Global Financial Crisis hits, labor suddenly turns into excess. Since then, we see a very gradual process of recovery. The solid line with black dots is for manufacturing. The tendency is very similar to the overall average, except that its level is slightly lower. The other line(s) contains discontinuities due to changes in industrial classifications in the original data. The line corresponds to "Personal Services" for 2002 and 2003, and "Living-related and Personal Services" between 2003 and 2008. And then, this group gets disaggregated into "Medical and Welfare" and "Living-related and



Source: Author's calculation based on the *Survey of Labor Economy Trend.*

Figure 6. Labor Shortage/Excess DI by Industry

personal services and entertainment" (and several other smaller categories) since 2009, and that is why there are two lines after this year.

If we first focus on the period after 2009, perception of labor shortage is much stronger for "Medical and Welfare" than both the overall average and "Living-related and personal services and entertainment." The data indicates a severe labor shortage for "Medical and Welfare," even in the middle of the Global Financial Crisis. Assuming that a similar relationship held between "Medical and Welfare" and "Living-related and personal services and entertainment" prior to 2009, we can conjecture that there has been a chronic labor shortage in the former sector for a long period of time.[12]

[12] Since the fiscal year 2012, the Employment Referrals for General Workers published by the same Ministry started publishing the data for the care service occupation and the health and medical service occupation. According to this statistics, in fiscal year 2012, the active job openings to applicants ratio was 0.74 for all the occupations, but the ratio was 1.80 for care services and 1.22 for health and medical services. This is another indication of a serious labor shortage in this sector.

Table 1. Comparison of Wages

	2001	2005	2012
Male, high school graduates			
All industries			
age 25−29	275	265	258
age 30−34	316	307	293
Health and Social Welfare			
age 25−29	198	210	212
age 30−34	232	229	235
Female, high school graduates			
All industries			
age 25−29	209	199	198
age 30−34	221	214	208
Health and Social Welfare			
age 25−29	210	195	192
age 30−34	221	205	197

Source: Author's calculation based on the *Basic Survey on Wage Structure*.

3. Insufficient Labor Mobility: Evidence from Wage Data

We saw in section II that there has been a vast reallocation of labor toward the "Medical and Welfare" sector in Japan. However, the previous sub-section shows that, despite this, labor is actually flowing into the sector too slowly compared to the speed of the expansion of the demand, resulting in a persistent labor shortage in this sector. One could hypothesize that this is due to the lack of an efficiently functioning price mechanism, as we saw in sub-section 1. That is, as the prices of the services do not go up flexibly, workers are not offered wages that are high enough to induce a sufficient amount of worker inflows to meet the expanding demand. In this last sub-section, I shall give an overview of the evolution of wages in this sector.

Table 1 is based on the Basic Survey on Wage Structure by the same Ministry, and compares wages (scheduled cash earnings) paid to high school graduates, for the age groups 25–29 and 30–34, by gender, between the "Social Insurance, Social Welfare and Elderly Care" (for 2001 only, it is "Social Insurance and Social Welfare") industry and the average of all industries.

Table 1 shows that, despite the labor shortage, male workers in this sector are receiving far lower wages compared to the overall average, with no apparent sign toward a rapid catch-up. Female workers in this sector are receiving about the same as the average, which means that the expansion of demand has not resulted in a significant wage premium for these workers. It seems quite conceivable that this apparent lack of wage adjustment has been behind the long-lasting labor shortage in this sector.

V. Conclusions

In this paper, we have seen that, in recent years in Japan, the service sector, especially the three expanding sectors ("Medical and Social Welfare," "Business Services" and "Information Services") have been absorbing workers while Agriculture, etc. and Manufacturing have continued to release them. On the other hand, productivity increase was more prominent in manufacturing, especially electronics. This paper emphasized that this does not necessarily mean that more workers should have been allocated to manufacturing. If productivity increase causes more than proportionate declines in prices, it becomes optimal to reduce labor allocated to such a sector. According to the analysis in this paper, this was indeed the case with electronics in Japan. What is truly troubling is that, despite this, labor movement out of the industry was slow.

On the other hand, we can think of the observed inflow of labor into the above three expanding sectors to be mostly demand-driven. In the second half of the paper, I have focused mostly on the Social Welfare sector to study the implications of the labor movement. We have seen that, despite the rapid expansion in hiring, this sector has been in a chronic labor shortage. One reasonable explanation is the lack of a well-functioning price mechanism. Despite growing demand due to population aging, service prices in this sector have not responded fast enough, which makes it difficult to absorb workers from other sectors fast enough.

If the above hypothesis is more rigorously supported by future studies, it implies that the Value Marginal Product of Labor, where value is evaluated not on the actual price basis but on the basis of utility, is actually high in the social welfare sector. Promoting faster labor reallocation into such a sector would be an important policy objective, despite the fact that it may not help increase GDP evaluated at the (distorted) price basis.

Appendix A: Definitions of the Intermediate Sectors

In the main text, for the sake of exposition, the author has defined some "intermediate" sectors that belong to the broadly-defined Services sector, by aggregating several industries in the JIP 2012 Data Base. Here is the list of correspondence between the intermediate sectors in this paper and the JIP industries.

Medical and Welfare: "Medical" (Private, Public and Non-Profit),
"Hygiene" (Private and Non-Profit and Public), and
"Social Insurance and Social Welfare" (Public and Non-Profit).

Business Services: "Advertising," "Rental of Office Equipment and Goods,"
"Automobile Maintenance Services," and "Other Services for Businesses."

Information Services: "Entertainment," "Broadcasting,"
"Information Services and Internet-based Services," "Publishing," and
"Video Picture, Sound Information, Character Information Production and

Distribution."
Construction: "Construction" and "Civil Engineering"
Utility: "Electricity," "Gas, Heat Supply," "Waterworks,"
"Water Supply for Industrial Use" and "Waste Disposal"
Distribution: "Wholesale" and "Retail"
Finance: "Finance," "Insurance," "Real Estate," and "Housing"
Transportation and Communication: "Railway," "Road Transportation,"
"Water Transportation," "Air Transportation," "Other Transportation and Packing,"
"Telegraph and Telephone," and "Mail."
Personal Services: "Eating and Drinking Places," "Accommodation,"
"Laundry, Beauty and Bath Services," "Other Services for Individuals."
Education and Research: "Education (Private and Non-profit)," "Research (Private),"
"Education (Public)," "Research (Public)," and "Research (Non-profit)."
Other Types of Services: "Other Public Services," "Public Administration,"
"Other (Non-profit)," and "Activities not Elsewhere Classified."

Appendix B: A Two-Sector Model of an Open Economy with Endogenous Price Elasticity of Demand

This appendix overviews the two sector model of Shioji (2010), which introduces the concept of (relative) satiation into the utility function. This specification implies that the price elasticity of demand for a type of goods changes endogenously with the amount of its consumption. Concretely, it adopts the Dotsey-King type utility function which is sometimes used in the literature on the New Keynesian Macroeconomics (refer to Dotsey and King [2005] and Shirota [2007]).[13]

Consider an economy with two types of goods, 1 and 2. Household utility, denoted C, depends on consumption of the two goods, C_1 and C_2, according to the following implicit form:

$$\frac{1}{2}\left[D\left(\frac{C_1}{C}\right)+D\left(\frac{C_2}{C}\right)\right]=1, \tag{A1}$$

where

$$D\left(\frac{C_i}{C}\right)=\frac{1}{(1+\eta)\xi}\left[(1+\eta)\left(\frac{C_i}{C}\right)-\eta\right]^{\xi}+\left[1-\frac{1}{(1+\eta)\xi}\right], \tag{A2}$$

and

[13] The Dotsey-King type utility belongs to the group of utility functions proposed by Kimball (1995); it is sometimes used to derive the quasi kinked demand curve, which strengthens the degree of real rigidities in macro models.

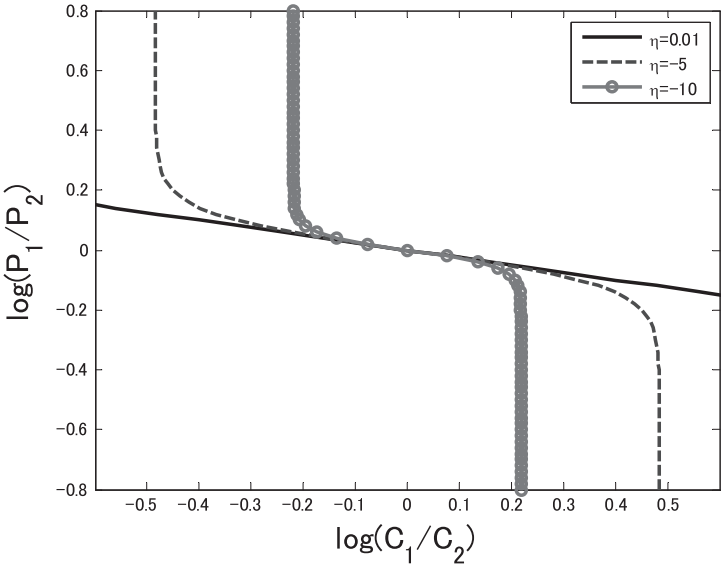


Figure A1. Compensated Demand Curves, in Logarithmic Scales

$$\xi = \left(\varepsilon\left(1+\eta\right)-1\right)/\left(\varepsilon\left(1+\eta\right)\right), \quad \varepsilon > 1.$$

In the above, η can be either positive or negative, but, in what follows, I shall assume it to be negative. The case in which $\eta = 0$ corresponds to the case of the standard CES utility function with the elasticity of substitution between the two goods being ε. Therefore, I shall call ε the "substitutability" parameter. As we shall see, the absolute value of η determines how quickly satiation occurs as demand increases. Therefore, I shall call η the "satiability" parameter.

To understand the nature of this function, consider deriving the compensated demand function, namely how the relative demand for the two goods changes when the relative price between them changes, holding constant the utility level. Figure A1 takes the log of relative price on the vertical axis and the log of relative demand on the horizontal axis. Thus, the inverse of the slope of the curve depicted in the figure is the elasticity of substitution. In the graph, I fix the substitutability, ε, at 4. In the graph, three curves are drawn corresponding to three different degrees of satiability. The solid line depicts the case in which η =0.01 (that is, with almost zero satiability), the dotted line corresponds to the case in which η=-5 (or an intermediate degree of satiability), and the solid curve with circles is drawn under the assumption of η= -10 (which implies a high degree of satiability). In the middle of the graph, when the amounts of consumption of the two goods are roughly equal, the slopes of the curves are essentially independent of the satiability; they basically depend only on the substitutability parameter. That is why the slope is the same for all three. Starting from this situation, let us gradually move to the right, by increasing the relative consump-

tion of goods 1. Under higher degree of satiability, the curve becomes steeper faster. That is, the elasticity of substitution goes down quickly. This reflects that, under this specification, as C_1 increases, satiation sets in very quickly. As a consequence, if we wish this consumer to willingly increase C_1 further, we would have to cut the price of goods 1 steeply.

Consider an equilibrium model under such a preference specification. Assume a small open economy. We assume that goods 1 are tradable goods while goods 2 are non-tradable. Goods 1 are produced from imported raw materials and labor, while the production of goods 2 requires labor only. Let us normalize the price of the raw materials (which will be called goods 0) to be 1. We shall denote the price of goods 1 as p_1, which is determined in the world market and is exogenous to this country. The price of goods 2, p_2, is endogenously determined. Denoting the amount of labor and raw materials devoted to production go goods 1 as L_1 and X_0, respectively, the production function for goods 1 is specified as follows:

$$Y_1 = A_1 L_1^{\alpha} X_0^{\delta} \quad 0<\alpha<1,\ 0<\delta<1, \quad \alpha+\delta<1. \tag{A3}$$

Letting labor input into the production of goods 2 be denoted by L_2, the production function for those goods is:

$$Y_2 = A_2 L_2^{\beta} \qquad 0<\beta<1. \tag{A4}$$

Assuming a trade balance for each period,

$$X_0 = p_1 \cdot (Y_1 - C_1). \tag{A5}$$

Using the profit maximization condition for the goods 1 producing firms, which requires its value marginal product to be equal to the price, (A5) can be rewritten as

$$C_1 = (1-\delta)Y_1 = (1-\delta)\left[\delta p_1\right]^{\delta/(1-\delta)} \left\{A_1 L_1^{\alpha}\right\}^{1/(1-\delta)}. \tag{A6}$$

On the other hand, as goods 2 are non-tradable, we must have

$$C_2 = Y_2 = A_2 L_2^{\beta}. \tag{A7}$$

Finally assuming a fixed labor supply,

$$L = L_1 + L_2 \tag{A8}$$

has to hold, where L denotes the total amount of labor supply which is a positive constant. From the above conditions, we can derive the optimal inter-sectoral labor allocation. Figure A2 depicts such optimal allocation as a function of relative productivity between the sectors.[14] As in Figure A1, the three curves correspond to three different degrees of satiability.

[14] In this example, parameter values are chosen in such a way that the two conditions, $(1-\delta)\left[\delta p_1\right]^{\delta/(1-\delta)} = 1$ and $\alpha/(1-\delta) = \beta$ are always satisfied. Together, they imply $C_1 = A_1^{1/(1-\delta)} L_1^{\beta}$, which makes the computation easier. Refer to Shioji (2010) for the actual set of parameter values used.

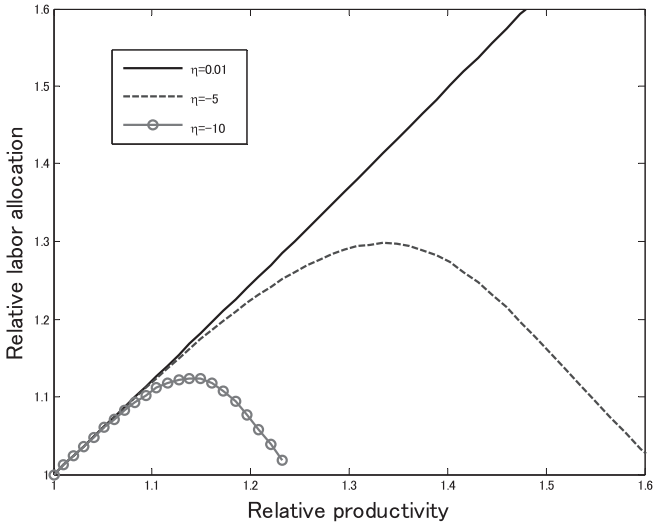


Figure A2. Relative Productivity across the Sectors and the Optimal Labor Allocation

As is clear from the figure, when the productivity is equal across the sectors, labor is split evenly between the sectors. Starting from this situation, imagine that the productivity of sector 1 improves slightly. As demand is still not satiated for either type of goods, consumers wish to purchase more of goods 1, whose price has gone down (as long as the substitutability parameter is large, as is the case in this numerical example). This induces workers to move to sector 1. However, if the sector's productivity improves further, unless the satiability parameter is close to zero, demand satiation sets in, and the price of goods 1 starts to fall rapidly. This results in a decline in the value marginal product of labor in this sector. This induces workers to move back to sector 2 from sector 1. As the figure indicates, this reversal happens earlier when the satiability parameter is larger.

References

Dotsey, Michael, and Robert G. King. 2005. Implications of state-dependent pricing for dynamic macroeconomic models. *Journal of Monetary Economics* 52 (1): 213–42.

Fukao, Kyoji, and Tsutomu Miyagawa, eds. 2008. *Seisansei to nihon no keizai seicho: JIP deta besu ni yoru sangyo, kigyo reberu no jissho bunseki* [Productivity and economic growth in Japan: Empirical analysis at the industrial and the firm level based on the JIP data base]. Tokyo: University of Tokyo Press.

Kimball, Miles S. 1995. The quantitative analytics of the basic neomonetarist model. *Journal of Money, Credit, and Banking* 27, no. 4:1241–77.

Shioji, Etsuro. 2010. Bumonkan shigen haibun to "seisansei kijun": Yottsu no ryuiten [Intersectoral resource allocation and the "productivity view": Four caveats]. Working

Paper Series 10-J-4, Bank of Japan, Tokyo.

———. 2013a. The bubble burst and stagnation of Japan. In *The Routledge handbook of major events in economic history*, ed. Randall E. Parker and Robert M. Whaples, chap. 27. London; New York: Routledge.

———. 2013b. Seisansei yoin, juyo yoin to nihon no sangyokan rodo bunpai [Productivity factors, demand factors, and inter-industry labor allocation in Japan]. *The Japanese Journal of Labour Studies* 55, no. 12:37–49.

Shirota, Toyoichiro. 2007. Phillips correlation and trend inflation under the kinked demand curve. Working Paper Series no. 07-E-5, Bank of Japan, Tokyo.