Two processes in the labour market integration: 
British engineers, 1865-1914

Kentaro Saito

I. Introduction

Markets are thought to become better integrated regionally and then nationally as industrialization proceeds. Although major discussions about the integration have been done around commodity markets, labour markets were also integrated during modernization largely in Europe. Certainly, labour markets of some traditional sections of workers, e.g. carpenters and agricultural labourers, were integrated and have been well-researched, and this paper focuses on modern section of skilled workers, engineers, one of typical skilled group in modern Britain.

An index of the labour market integration is convergence of wages or wage-levelling. Eric Hobsbawm claimed in the 1960s that ‘levelling [of wages] must have been a slow, gradual, long-term and not startling affair’ in the nineteenth century, while Eddie Hunt in the 1970s showed more optimistic views of integration. Expanding the focus, Johan Soderberg claimed that wage convergence was generally noticeable throughout the nineteenth century in Europe and that wage differentials were consistently smallest in Britain while continental countries such as France and Prussia delayed relatively. In relatively recent studies, George Boyers and Timothy Hatton claims that various patterns of integrations were proceeding, in urban and rural sections of workers, using the decreases in wage-differential between regions.

On the other hand, wage-convergence has been discussed often in connection with migration. Contrary to Hobsbawm’s discussions, H.R. Southall claimed that frequent migration of skilled workers took place in the 19th century, arguing that migration took place mainly by economic reasons and was accelerated during recessions, while Hobsbawm claims that migration was caused not mainly by market forces, and wage differentials did not narrow down. Recently, Boyer and Hatton, using statistically more elaborate techniques, have extended the area and methods of research on labour migration.

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Against these backgrounds, this paper discusses labor markets of skilled workers in Britain from the middle of the 19th century to the early twentieth century, focusing on skilled engineers. We explore the following three points. Firstly, this paper tries to show a slightly new look about highly skilled worker because previous discussions on tramping artisans are not very comprehensive and not always quantitative. Therefore, we need discuss this group of workers more, by using more quantitative data and new analytical methods. Secondly, we discuss the relationship between the labor migration and the market integration. Skilled workers with highly skills are expected to have had more frequent traveling, or tramping, for jobs and better working conditions. The more mobile commodity or labor force is, the more integrated their markets are. However, most of studies have discussed them separately. Therefore, we explore how the integration was induced by engineers’ migration in details. Thirdly, we will consider the historical meaning of the integration process. This paper deals with the years from 1865 to 1914, the period including the Great Depression which begun roughly from the 1870s and early stages on which the British economy and markers were institutionalised. Over the period skilled workers in the modern and large section like engineers came increasingly to play more crucial roles both in labour market and industrial institutions. Locally separated trade unions were united into national one, in engineering, Amalgamated Society of Engineers (ASE, thereafter) was established in 1851. On the other hand, Engineering Employers Federation (EEF, thereafter) was formed in 1896, which became the starting point of the national collective bargaining. This paper aims to place the discussion of labour market integration into this context, i.e., the development of labour market.

In the followings, in the section II, we will examine regional and national wage series to find the labour market integration of engineers. In the section III, the relationship between the integration and migration will be explored. In the section IV, the factors which influenced on the integration will be discussed, before summarizing them in the concluding section.

II. Engineering industry and its labour market integration

The engineering industry began to develop largely from the late eighteenth century, and the production and the employment increased drastically throughout the nineteenth century to the early twentieth century. Engineering has many branches and mechanical engineering developed from the early 19th century. Employment of engineers was 365,859 in 1851 and grew to 804,784 in the end of the century.6 Together with expansion in new sections like electrical engineering, 1,223,314 engineers were engaged in the industry just before 1914. These changes influenced considerably on its labour market and its industrial relations. In this section we will examine the labour market integration of the engineers on the national level.

The major data for our discussions on the labour market integration are the records of the EEF. There are governmental records on wages, such as Labour Gazette, available from 1893 by Labour Department of the Board of Trade. However, before the period, governments researched them only on irregular basis. On the other hands, the EEF recorded the movements in wage rates of skilled engineers, i.e., fitters and turners, in more than 70 British towns continuously from the 1850s to the 1960s. Although the EEF was established in the end of the nineteenth century, it opened “Statistics Department” in the 1910s and collected wage-records of their federated firms, tracing back to the middle of the 19th century. The EEF wages records cover many cities and towns, and therefore, we have broken them down geographically into mainly 8 regions by using the EEF’s classification of regions; Scotland, Northern counties, West and North Riding of Yorkshire, Lancashire and Cheshire, East Midlands, West Midlands, South Eastern counties and West Country. Fig. 1 shows average weekly wage rates of 8 regions at the nominal level. From Fig.1, firstly we can see that from the middle to the end of the 19th century, wage rates were quite diverse and fluctuated. Wage rates in the South-East are always highest, owing partly to the high wages in London. Region with the lowest wages is Scotland and others show some complex movements.

Wage series on the nominal level is basic indicators for market integration. However, we discuss also on the real wages because as engineers’ labour market increasingly expanded over the country, the level of living cost among the areas became progressively important and influential factors to the policy of the ASE. Monthly Reports of the ASE indicates that officers of the trade

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7 Official wage statistics over this period can be seen in the followings; Labour Gazette (Board of Trade, 1893-1905); Board of Trade Gazette (Board of Trade, 1905-1917). Unpublished Report by Board of Trade in 1908, ‘Rates of Wages and Hours of Labour in Various Industries in the United Kingdom (1908)’ and its supplements are available.
8 MSS.237/7/11, Modern Records Centre of Warwick University (Thereafter, MRC).
9 As for towns and cities covered by the region, see A. Marsh, Industrial Relations in Engineering (London, 1964), pp.236-43.
union were keen to know conditions of living in towns and districts and indicated the ‘the state of trade’ to its members.¹⁰

For this, we have converted the nominal wages into real wages to compare the rates between the areas and to find how the engineers responded to wages on the real level. Of course, cost of livings need to be treated adequately because there were large differences among the areas, especially with urban areas. However, some pointed out that regional variations in prices were small up to the end of the nineteenth century. Therefore, owing partly to the limit of cost of living index, we adjusted nominal data in two ways. Firstly, we referred Phelps-Brown’s data about the London area as the basic series for the consumable index.¹¹ Secondly, we applied the proportions of living-costs among cities and towns by Report by Board of Trade in 1907, which shows the indices in 1905, to the basic series.¹² This report shows cost of livings in some 70 cities and towns over Britain. We have chosen 47 series of the places in common with the records of the nominal wages in the EEF records used for Figure 1. Fig. 2 plots the real wages. In this Figure, 8 series of the real wages in the same regions to the nominal ones are shown.

Now we begin analysing the labour market integration on the national level. As index of wage dispersion, coefficient of variations (CV, hereafter) is used. Fig. 3 plots the CVs both on the nominal and real level over the period with trend for each CV. In this figure, CV is calculated by all the 47 cities. Largely it can be seen firstly that the CV of the real wages are larger than nominal ones, and secondly that the CV of the real wages tended to decrease more than the nominal ones over the period.

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¹⁰ ASE Monthly Reports and Journals, 1851-1914, MSS. 259/4/1-52.
¹² Board of trade, Enquiry into Working Class Rents, Housing and Retail Prices in 1905.
Figure 3. Coefficient of variation, nominal and real wages, 1862-1914

Then, we examined the convergence of the wage differentials statistically. Table 1 shows regression of the coefficient of variation on the time-trend. If there is a tendency of decrease in the time series, its parameter must be minus and certainly not zero. The results show that over the period, i.e., 1862 to 1914, the nominal wages series cannot be said decreasing statistically while the real wage series significantly were integrated. Certainly, in Fig.3, coefficient of variations of the nominal one increased in the early stage of the period, which corresponds to the widening band of wages in actual term (Fig.1). And, after the stage, coefficient of variation seems to have tended to be downward.

Table 1 Coefficient of variation on time-trend, nominal and real wages, 1862-1914

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>CV on Time/100</th>
<th>$R^2$</th>
<th>no. of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal wages</td>
<td>0.064</td>
<td>-0.00054</td>
<td>0.004</td>
<td>53</td>
</tr>
<tr>
<td>($t$-value)</td>
<td>(37.1)</td>
<td>(-0.47)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real wages</td>
<td>0.077</td>
<td>-0.002</td>
<td>0.81</td>
<td>53</td>
</tr>
<tr>
<td>($t$-value)</td>
<td>(-41.9)</td>
<td>(-14.9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: EEF Wage Book, MRC, MSS. 237/13/1-2.

Although statistically significant for integration on the real level, in fact, the process is not simple. As seen in Fig. 3, coefficient of variations fluctuated over the process. For this, we try to find if there are some break-points. If a certain breakpoint is detected before the analysis, statistical method like Chow test can be applied conventionally. But, even if these points are not identified, structural breakpoints can be found by relatively new statistical methods. The models suggested by Bai and Perron can show unknown and multiple breakpoints in time series. Theoretically it is explained by followings; an Auto-regression (AR) process of data is given by:

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\[ X_t = \alpha + \beta \cdot X_{t-1} + \varepsilon_t \]
\[ E(\varepsilon_t^2) = \xi_t \sim N(0, \sigma^2) \]

Where \( E(\varepsilon_t^2) \) is a white noise process with zero mean and constant variance.\(^2\) In the equation above, if there are statistically significant changes in any parameters among \( \alpha, \beta \) and \( \sigma^2 \), we can assume that a structural break takes place at the point.\(^{14}\) Structural breaks indicate changes in trends or means of the time series. We have applied this model to the time series of the coefficient of variation.

Table 2 Structural breakpoints, 1862-1914, real wages (1)

<table>
<thead>
<tr>
<th>Break Year: 1896</th>
<th>Break test</th>
<th>F-statistics</th>
<th>Critical value**</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 vs. 1(^*)</td>
<td>117.16</td>
<td>8.58</td>
<td></td>
</tr>
<tr>
<td>1 vs. 2</td>
<td>3.725</td>
<td>10.13</td>
<td></td>
</tr>
</tbody>
</table>

Note: *Significant at the 0.05 level
Note: ** Bai and Perron (2003) critical values.

Table 3 Structural breakpoints, 1862-1914, real wages (2)

<table>
<thead>
<tr>
<th>Breaks</th>
<th>Estimated break year</th>
<th>Schanz Criterion(^\ast)</th>
<th>LWZ Criterion(^\ast)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>-8.45</td>
<td>-8.41</td>
</tr>
<tr>
<td>1</td>
<td>1896</td>
<td>-10.32</td>
<td>-10.19</td>
</tr>
<tr>
<td>2</td>
<td>1879 1896</td>
<td>-10.45</td>
<td>-10.22</td>
</tr>
<tr>
<td>3</td>
<td>1872 1879 1896</td>
<td>-10.47</td>
<td>-10.14</td>
</tr>
<tr>
<td>4</td>
<td>1872 1879 1887 1896</td>
<td>-10.44</td>
<td>-10.01</td>
</tr>
<tr>
<td>5</td>
<td>1872 1879 1887 1896 1906</td>
<td>-10.31</td>
<td>-9.78</td>
</tr>
</tbody>
</table>

Note: * shows minimum information criterion values and break years are displayed with *Italic figures.*

Table 2 shows its result. The test indicates that there is one structural break in the cv series of the real wage and 1896 is the break point by the Bai and Perron test. And, Table 3 shows the result of another test for structural breaks by “global information criteria”.\(^{15}\) The result by this shows that there are three break-points, 1896, 1879 and 1872.\(^{16}\) The year 1896 is the most robust break point because it is shown by the both results. In this paper, the two years, 1879 and 1986 will be discussed because of historical meanings for our research. British industries witnessed serious depression from the late 1870s and unemployment was most severe for engineering in 1879. And in 1896, as touched, the EEF was established and became a counterpart to the engineering trade unions for collective bargaining on the national level. We will use these dates for further analysis in the fourth section.

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\(^{15}\) Information criteria provide an alternative approach to inference on structural breaks for linear models.

\(^{16}\) This break defines the first year of the subsequent regime.
III. Labour market integration and migration

In the following two sections, we explore the labour market integration and migration as its drivers. For this paper, we have constructed migration data from the travel records of the ASE, which from 1865 recorded monthly travels of its members in England, Scotland and Ireland, to illustrate characteristics of engineers’ inter- and intra-regional migration.

The tramping system begun in 1865 and we can see some features of the migrations themselves. Although the destinations to travel and the pattern of travel were, of course, various, the major destination throughout the period was the North West regions, followed then by Yorkshire and South East. While there were many cases in which engineers travelled over many regions, e.g., starting from a town in Wales to travel North East and then Scotland before coming back home, major migrations tended to take place between neighbour regions. As for the system of traveling, vacancies in a town or district were notified so that the branch secretary could inform to out-of-work members. Monthly Report of the ASE listed the state of trade in every branch and secretaries advised unemployed members to go ‘on travel’. As a total number recorded, there are 254,351 migrations between branches, or house of call, of the ASE over the period. Among them, we have chosen 152,940 cases to meet the places of the branches in the EEF and have broken them down into the 8 regions as in the case of the EEF.

As next step, we have divided migrations into two types; inter-regional migration and intra- or internal- regional migration. Inter-regional migration is movement between regions. Internal- or Intra- regional migration is the one within regions. And, from this classification, two migration rates can be defined; Inter-regional migration rate and Intra-regional migration rate. Migration rate should be defined as the number of migrants divided by the number of people in the region. In the case of migration among workers in a trade union, the number of people should be its membership. However, while the membership kept increasing over the period, migration was cyclical phenomenon, as shown in the next section, and tended to decrease, as a whole. Therefore, in this paper, we use the ratio of inter- migration to the total migration as inter-migration rate. In the middle of the nineteenth century, inter-regional migration rate among the engineers was, continuously around 50 per cent and more. However, the rates tended to decrease over the period, in the late nineteenth century; it fell to around 40 per cent although some exceptional years can be seen in the twentieth century.

Theoretically it is expected that inter-migration should correspond to changes in dispersion of regional wage differentials; the larger wage differentials, the more simulative to migration. Therefore, we have tested the relationship between inter-regional migration rates and the cv of wages at the national level.

Table 4 shows the results of regression. The result shows that the nominal differentials do not support significantly to induce the migration and shows that the differentials of real wages were more influential on the migration. This indicates that engineers responded not to wage differentials on the nominal level but to the real level.

<table>
<thead>
<tr>
<th>Table 4 Inter-migration rate and CV of wages, 1865-1914</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real wages</strong></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>0.359</td>
</tr>
<tr>
<td>(12.4)</td>
</tr>
<tr>
<td><strong>Nominal wage</strong></td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>0.52</td>
</tr>
<tr>
<td>(7.69)</td>
</tr>
</tbody>
</table>


Fig.4 plots the inter-migration rates and coefficient of variation of the real wages. As mentioned, the officers of the ASE were keen to know regional situations in cost of living. As an example, we can see the case of John Burnett, the General Secretary of the ASE between 1875 and 1890 and the labour correspondent of the Board of Trade from 1886. ASE Officers like him begun investigation on regional variations of cost of living for the member from the 1860s. This seems to have reflected onto the “state of trade” in the Monthly Reports. And these activities led to the early labour statistics of the government.\(^{18}\) It is quite likely that information about it through union’s reports influenced much on the directions of its members. In this sense, engineers’ migrations were supported and influenced by the institutional factors, such as, the system of travel card and the policy of the ASE. On the other hands, the integration can be divided into three stages by the two breakpoints. In the next section, we will see the processes of the integration in details.

\(^{18}\) Roger Davidson, *Whitehall and the labour problem in late-Victorian and Edwardian Britain* (King’s Lynn, 1985), p.112, 150.
IV. The breakpoints and two processes of the integration

Figure 5 shows the number of the engineers’ travels and unemployment. The data of unemployment in engineering is not available directly from the ASE records, and we have overlapped the data by Southall onto our data of migration.\(^\text{19}\) Although it is a rough picture, as a comprehensive picture of the migration, the number of the travels tended to decrease and fluctuate with some peaks; in 1868, 1879, 1886, 1994, 1904, and 1909.\(^\text{20}\) The largest peak was the one in 1879, the second break in the integration process. In 1879, more than 18,000 travels of engineers took place. As mentioned, engineers travelled over the country for better working conditions, and job-vacancies. As for boilermakers, it is shown that they travelled largely following the business cycle and unemployment in the first half of the nineteenth century.\(^\text{21}\) Also in the case of engineers, fluctuations of the number of travel seems to have been influenced largely by the trade cycle and matched with the waves of unemployment. Figure 5 shows the fluctuation of the unemployment rates and engineers’ travel synchronised much. The Great Depression in the late nineteenth century and took place roughly in the late 1870s and influenced on the economy and industries all over the Western countries.\(^\text{22}\) Especially in severe situations in the trade, the number of the travel increased. In the engineering, 1879 was the severest year, a break point of the trend of the CV.

![Figure 5. Number of the engineers’ travel and unemployment rates, 1865-1914](image)

Note: There are no travel records of the ASE between 1895 and 1898.

Sources: Monthly Records of the ASE, 1862-1914; Southall (1986), Fig.2

Until 1879, the integration increasingly proceeded. However, from 1880, the integration reversed, and dispersion of the wages begun to increase. It is likely that this was caused by the decrease in the number of engineers’ travels which was in accordance with the decrease in unemployment. And, another of the reason seems to be the increasing influence of the District Committees (DC hereafter) of the ASE during the repression. From 1878, the DC begun to collect

\(^{19}\) H.R., Southall, Regional unemployment patterns among skilled engineers in Britain, 1851-1914’, Fig. 4, p.274, Journal of Historical Geography, 12 (3) (1986).

\(^{20}\) In 1914 only 388 migrations were recorded.


\(^{22}\) As for the influence of the slump to the members of the ASE, see J.B. Jeffery, The Story of the Engineers (London, 1970), Chapter V.
the detail of wage rates paid to the members throughout the country, and the information was reviewed by branches, trying to achieve “uniformity of wages in each District by itself”.\(^{23}\) It is doubtful that the ASU policy influenced on wage-determinations at many workshop and factories straightforward. However, Jeffrey pointed out that varying strengths of these Committees and the uneven cost of living throughout the country led to the marked variations in the district rates established.\(^{24}\) In practice, the Council of the ASE reported “rates of wages, hours of labour and extra pay for overtime ⋯ vary in different districts and there is nothing like uniformity”\(^{25}\) Therefore, it can be said that the depression worked in two directions to the integration; until 1979 it proceeded migration and then hampered it and then the integration through the policy of unions’ regional associations.

From the middle of the 1880s, as seen in Figure 3, the integration begun again. And, the market saw another breakpoint in 1896. Around from this year, CV, i.e., the integration, begun to be stable, with keeping tendency to decrease although slightly. It is quite likely to explain this tendency that the total number and the trend of the number of engineers’ travels decreased. However, the meaning of the year, 1896, can be more important because this was an epoch-making year in which the EEF was established. Employers’ organizations in the engineering had existed over the regions from before and were formed as local associations. However, from the late nineteenth century, the growing strength of trade unions, especially the ASE, and their increasing claims for wages and working conditions brought the employers to consolidate themselves and to take up collective attitude. Just after that EEF was established, large size of industrial dispute took place in London in 1897-98 between the ASE and the EEF.\(^{26}\) After the dispute, in which “the right of management” was claimed by the employers, an extensive agreement was drawn up between the two parties. This agreement is known as “Term of Settlement”.\(^{27}\) Certainly there remained a pivotal role of the regional influence of the union and the employers. However, the most important point in the clauses seemed to be that the procedure for the determination of wage rates was established on the national level. In addition, end of the stoppage was followed by the formation of federated associations in areas where employers participated but no formal employers’ organization existed. To the seven associations before the conflict, 32 were newly added.\(^{28}\) EEF continued to grow and consisted of more than 2000 federated firms which employed about 600,000 persons in 1918.\(^{29}\)

Expanding the focus on the industrial relations in general in the late of the 19th century, it was

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\(^{23}\) Abstract of Report of the Council’s proceeding, 1878.


\(^{25}\) Abstract of Report of the Council’s proceeding, 1884-1887.


\(^{27}\) The agreement was officially called “Condition of management”.

\(^{28}\) These 7 associations were North-East Coast, Clyde, Barrow, Belfast, Manchester, London and Bolton. Arthur Marsh, *Industrial Relations in Engineering* (London, 1964)

not only in engineering also in many other industrial areas that labour disputes and strikes occurred. Together with the rise in “New Unionism”, the government begun to seek for legitimate measures to resolve them. Against these background, the Royal Commission on Labour was set up in 1891 towards the Conciliation Act implemented in 1896, and it was the Board of Trade that was responsible for it. There were a few cases in which the government intervened into the wage-dispute in practice with the Act, and it is quite difficult to show the influence by the governmental policies onto the wage movement in this period. However, again, it seems to be symbolic that this Act was also realized in the second breakpoint. Further research should be needed also in this.

V. Conclusions

The second half of the nineteenth century saw market integration in many areas, especially in product markets and we have shown that labour market of skilled workers was also integrated in this paper. Certainly, the labour market of engineers was being integrated steadily from the middle of the nineteenth century to the early twentieth century on the national level. In the long run, this integration was induced by the workers’ migration for jobs and better conditions for their lives. Inter-regional migration was induced by the real wage differentials between the regions, and then the integration was proceeding over the period.

On the other hands, the integration process can be divided by two breakpoints into three periods; increase, decrease and stable in the integration process. And, the integration can be thought to be divided also in two processes. One process was influenced by the market force like workers’ migration and another was done by the institutional ones like trade unions and employers’ organizations. Market forces were basically proceeded the integration, on the other hand the institutional ones sometimes hampered it and stabilized it. Systems of wage-determination and wage-adjustment changed by the industrial institutions, which increasingly played crucial roles in industries, and then effected on the wage convergence, labour market integration.

In this paper we have shown only some the results of our on-going research briefly. However, there are some important points to be researched further. One point is on the period in which the integration begun because we only showed the changes from the middle of the 19th century. In markets of many other areas, the integration is said to have begun from the late 18th century of the early 19th century.30 Figure 3 might suggest that the market of engineers also begun to integrate earlier. It is quite likely that the convergence of nominal wages took place in the first half of the nineteenth century. We need further examinations on these important topics in more details in the very near future.

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