

**Canada's Wage Distribution
in the First Half of the Twentieth Century**

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The first half of the twentieth century was a time of impressive tumult in the Canadian economy. It included two world wars and a major depression but was also a time of considerable structural change, combining the filling of the nearly empty expanses of the west with significant technological changes. At the same time, there were substantial changes in institutions affecting the functioning of the labour market, including attempts to introduce unemployment insurance, the introduction of minimum wages, and changing roles of unions. Yet, in spite of the importance of this period in setting many of the foundations of the current Canadian economy, our knowledge about the wage structure in this period is relatively sparse. This is not to say that information is non-existent. Accessible wage and price series have been developed by several authors (Bertram and Percy(1979), Mackinnon(1996), Emery and Levitt(2002)) and there are wage series in the Historical Statistics of Canada (Urquhart and Buckley(1965)). But these are either aggregated or relate only to a few occupations in the construction and manufacturing trades plus labourers. There is, to this point, no research on the evolution of the entire wage structure over this period. In this paper, we present evidence on movements in the entire wage structure, focusing on the period from 1911 to 1931, and relate it to the existing knowledge about movements in some individual wage rates.

Understanding the movements in the overall wage structure is important for two reasons. First, it allows us some insight into the degree and form of inequality among Canadian workers in the first half of the twentieth century. Since this is a period of considerable change in public policies related to the labour market, studying movements in the overall wage distribution allows us to see the impact of different policy regimes on inequality in the Canadian context. It also provides information on the background against which policy decisions were made which ultimately led to the creation of Canada's current redistributive system. Second, relative movements in key factor prices, such as the prices of different types of labour, are key to understanding the impact of the major technological, institutional, political and business cycle events that occurred during this period. Competing theories of the impacts of large scale immigration, technological change and mass education, to name a few, can ultimately be tested using their implications for relative factor price movements. We do not attempt to assess

competing theories of how the wage structure moved in this paper. Instead, our goal is to provide the basic grist for that mill.

The lack of previous work on the evolution of the overall wage structure is somewhat surprising given the data availability. In contrast to the US, where the Census did not begin to ask questions about earnings until 1940, Canadian Censuses included questions on earnings and weeks of work throughout our time period. We use data from the 1911, 1921, 1931 and 1941 Censuses to construct wage distributions for each of these points in time. Unfortunately, we do not have access to microdata files from these Censuses, but we do have tables showing number of persons, annual earnings, and annual weeks worked for groups defined by a combination of gender, detailed occupation, and age. The downside of this data is that we do not observe any within-occupation variation. But the level of detail of the reported occupations is large enough that we can still get a good feeling for movements in the overall wage structure.

We restrict our attention to the Montreal labour market. Thus, in contrast to previous research which examined a small number of types of wages aggregated to the regional or national level, our research strategy is to focus on one labour market (Montreal), and within it examine wage changes across a broad range of occupations. Montreal's population was about a half million in 1921 (about the same as Toronto). Between 1901-1911 and 1911-1921 the city grew by 54% and 31% respectively (Mackintosh, 54-55). Furthermore at the turn of the last century it was the largest light manufacturing city in the country and a main center for commerce. As a result of its size and location it provides us with a wide range of economic activity. At this stage our work, therefore, we assume that Montreal is a window on the economy as a whole. We also, at this point, constrain our attention to males aged 15 and over.

The main result of our investigation is that the inequality in the wage distribution increased immensely between 1911 and 1931. This expansion occurred in two steps. Between 1911 and 1921, wage movements represent a mixed bag in terms of inequality. There were substantial real declines in the lowest percentiles of the wage distribution, relatively small changes near the median, and large real declines in the upper half of the distribution. Thus, if we were to examine the lower half of the distribution alone, we would conclude that there was increased inequality over this period, while an examination of the upper half would lead to the opposite conclusion. Interestingly, the occupation typically used to exemplify low skilled

workers, labourers, experiences relatively small wage declines in this period. It is younger workers, particularly in the service sector, who populate the occupations in the lower tail of the distribution that experience large real declines. Thus the Census, with data on a wide variety of occupations broken down by age group, allows us to see what earlier examinations focusing on a single, age-invariant wage for a few occupations misses.

While the changes from 1911 to 1921 are somewhat confused, the movements in the wage structure in the twenties is very clear. The lower tail of the distribution (ie low wage workers) essentially remains at the low level it descended to by 1921. However during the 1920's the upper end of the distribution exhibits a massive increase in inequality. The end result is a substantial inequality from 1911 to 1931, with shifts outward in both tails in 1931 relative to 1911.

We decompose these inequality movements into components related to changes in the age composition of the workforce, changes in the occupational composition, and movements in relative wages across occupational categories. That exercise indicates that neither age nor occupational compositional changes account for much of the observed increase in inequality. Thus, the overall changes we observe mainly reflect changes in the wage structure. We compare the relative wage movements with those observed by earlier authors using other data for the set of occupations studied by those authors. To reiterate, those occupations (mainly, labourers and machinists) have wages that place them in the centre of the distribution and thus this exercise misses the very substantial movements in the tails of the wage distribution. But comparisons with them are useful because they link our results to earlier discussions and because they allow comparisons to the types of conclusions one might draw if it were possible to compare cyclically similar years rather than the (non-cyclically comparable) Census years. The result of those comparisons is mixed. There is some disagreement among existing wage series and so it is not possible for the Census data to agree with all existing sources. There is strong agreement across all sources in the levels of labourers' wages after WWI and the level of trades worker wages before the war. Otherwise levels and patterns differ. Several of the series, including the Census, point to a reduction in the skilled/labourer differential from 1911 to 1920 followed by strong increases in the 1920s and then declines in the 1930s, but manufacturing trade wages in the Labour Gazette show relative increases beginning during WWI. Thus, there is not a clear

consensus even on whether the war generated a compression of the wage scale. On balance, though, the evidence appears to point to strong increases in wage ratios and inequality more generally over the 1920's. Goldin and Katz(1998, 2001) and Phelps Brown(1977) argue that for the US much of the first half of the century can be characterized as following a pattern of wage compression. Certainly, it is clear from the evidence presented here that this is not the case for Canada over this period. At the very least, skilled/unskilled manufacturing wage ratios were flat and the overall dispersion of the wage distribution increased substantially.

1) Weekly Wage Distributions

1.1) Data Sources

We begin with an examination of (somewhat restricted) weekly wage distributions in Montreal for males over the age of 15 for the years 1910/11, 1920/21 and 1930/31. The data come from Census tables showing number of persons, total number of weeks worked and total annual earnings in detailed occupation by age categories for each of a set of large cities. The earnings and weeks worked refer to the twelve month period preceding June 1 of the Census year. Annual earnings refer to wage, salary, commission or piece rate earnings from all jobs in that period. Weeks worked are constructed by subtracting responses to questions about total weeks of work lost due to lay-off, illness, accident or strike from 52. The tables correspond to “wage-earners” which, in both the introductions to the 1921 and 1931 Censuses is defined as “a person who works for salary or wages, whether he be the general manager of a bank, railway or manufacturing establishment, or only a day labourer.” This definition excludes the self-employed (both those who employ others and those who do not) and unpaid family workers (e.g., farmers sons). Based on tables showing all the gainfully occupied (i.e., wage-earners, the self-employed and unpaid family members), the term wage-earner encompasses x% of all workers. The 1910/11 data comes from an unpublished tabulation found in Mac Urquhart’s papers in the Queen’s University archives and were originally gathered as part of Urquhart’s work on the Canadian Historical Statistics. The 1920/21 data is from Table 40 in Volume III of the 1921 Census. The 1930/31 data is from Tables 34 and 35 in Volume V of the 1931 Census. In each case we loaded all of the numbers recorded in the tables into spreadsheets.

The occupation dimension in these tables corresponds to the jobs held at the time of the

Census while earnings and weeks worked correspond to all jobs in the previous twelve months. Thus, when we construct the average weekly wage for an occupation-age group this is not, strictly speaking, the average weekly price of labour in that group. For example, if workers employed in a semi-skilled occupation at the time of the Census spend parts of their year working as common labourers then our calculated average weekly earnings would be lower than the rate firms paid to semi-skilled workers in that occupation for a week's work. As we will see, though, the weekly wages constructed for various occupations in this way correspond quite well to some other wage data sources in this time period. Thus, it is not clear this represents a major shortcoming of the data.

The occupation categories for each Census are quite detailed. The 1911 table includes earnings and weeks data for 325 occupations, the 1921 table has data for 442 occupations and the 1931 table has data for 353 occupations. In the age dimension, the 1911 table has three age groupings while the 1921 table has 5 age groupings and the 1931 table has 8 age groupings.¹ Our goal is to compare the weekly wage distribution across the three Census years. To do this, we need to use the same age and occupation groups in each year, otherwise we would likely observe greater variability in the weekly wage in years with more occupation and age categories. Thus, our examinations from this point forward will correspond to the three age groups that are evident in the 1911 Census: 15-24, 25-64 and 65+. These same groupings can be constructed from the age categories in the other Censuses. Matching occupation categories to create one consistent set of occupations across Censuses is obviously more difficult and subject to the interpretation of the individual researcher. We created a concordance in which we combined occupations into categories that could be compared across years. We provide a description of our main matching decisions along with a comparison of the distribution constructed from the complete set of data and that based on the concordance matched data in Appendix A1. There we show that the two distributions are, in fact, quite similar and argue that our main conclusions are unlikely to be affected by the fact that we are forced to switch to this restricted set of occupations in order to permit comparisons across Census years. In creating these concordance categories, we were

¹ Table 34 has data on 7 of the age groups (starting at age 20) plus the totals for all workers regardless of age. We use data from Table 35, which has the same data by occupation for various age groupings for 10 to 19 year olds, to construct the numbers for the 15 to 19 year old group.

forced to drop some occupations in each Census year which we could not confidently place in a particular concordance occupation group. However, the number of people represented in the remaining occupations correspond to 90% of all male wage earners in Montreal in the 1911 Census, 84% of those in the 1921 Census and 89% of those in the 1931 Census. Thus, we still capture the large majority of workers. For 1911, we are left with 378 occupation-age groups with positive earnings, while we have 391 and 392 such groups for 1921 and 1931, respectively.

We construct weekly wage distributions from this data by first dividing annual earnings by annual weeks worked within each occupation-age category.² We also know the number of wage earners in each occupation-age category. We created a dataset by assigning each of these people the average weekly wage associated with their category. Thus, we effectively weight the occupation-age wages according to the number of wage earners. This creates a dataset in which all of the variability arises across occupation-age groups and which necessarily misses within group variation. We convert all wages into 1920/21 dollars. To do this, we use the Montreal cost of living index presented in Emery and Levitt(2002). Because our earnings data correspond to 12 month periods spanning half of two consecutive calendar years, we actually used the average of the listed 1910 and 1911 values for the first Census, the average of the 1920 and 1921 values for the second (base year) Census, and the average of the listed 1930 and 1931 values for the third Census. Unfortunately, this assumption is not completely innocuous. Because of rapid deflations in both 1921 and 1931, choosing to average in this way yields quite different results from just using one year's index value in each case. Thus, the actual index values we use (compared to a 1920/21 base of 100) are 56 for 1911 and 85 for 1931. If, instead, we had used the values for 1911, 1921 and 1931, the index values would have been 60, 100 and 85, respectively, thus affecting the 1911-1921 comparisons. However, we believe that the averaging approach is the most reasonable given the timing of the earnings reporting.

1.2) Basic Depiction of the Distributions

In figure 1, we plot kernel smoothed weekly wage densities, constructed as just described,

² Note that these are essentially weeks weighted average wages. That is, the weekly wages of workers who work more weeks are weighted more heavily.

corresponding to each of the Census years.³ Table 1 contains various percentiles and other summary statistics for the three distributions to allow for a more concrete comparison. In all three cases, the distributions are somewhat bimodal. The first mode is dominated by labourers in the middle age group (25-64) while the second consists mainly of government workers and some skilled workers such as tailors and bricklayers. The distribution means listed in Table 1 indicate a substantial real decline in average weekly earnings between 1911 and 1921 followed by a large increase to 1931. However, the median values for the three years are very similar, indicating that much of the differences across the three distributions is accounted for by the tails of the distributions. Figure 1 indicates that between 1911 and 1921 both the left and right tails of the distribution shifted to the left. This is evident in the percentiles reported in Table 1. Between 1921 and 1931, the left tail recovers to some extent but is more similar to the 1921 than the 1911 distribution. At the same time, the right tail becomes much fatter, yielding an overall distribution that has much a much lower left tail and a much higher right tail than the 1911 distribution.

The complexity of these movements over time is reflected in the various summary inequality measures reported at the bottom of Table 1. The standard deviation first declines slightly between 1911 and 1921 and then increases dramatically between 1921 and 1931. However, the implication that inequality decreased to any marked degree between 1911 and 1921 is undone once we take account of the relative locations of the two distributions. Thus, the squared coefficient of variation (a measure of inequality that is most sensitive to movements at the top of the distribution) changes very little between 1911 and 1921, though it again shows very large increases between 1921 and 1931. Both the variance and the coefficient of variation are susceptible to being strongly influenced by outliers. We have actually truncated our data at \$93 (the 99.9th percentile of the 1931 distribution) to avoid this to some extent. However, the log 90-10 ratio provides an alternative measure that does not suffer from these difficulties. According to that measure, inequality rose from 1911 to 1921 and then rose even more sharply between 1921 and 1931. The 50-10 and 90-50 ratios break this movement down into lower and upper tail components. These measures support what is evident from Figure 1. In particular,

³ The kernel smoothing is done in Stata and uses the Epanechnikov kernel. We chose to oversmooth the figure relative to the smoothing parameter automatically chosen by Stata since our goal at this stage is simply to display the general shapes of the densities without added distracting detail.

inequality rises in the lower tail of the distribution between 1911 and 1921 as the median stays the same but the lower tail experiences substantial declines. As we discussed earlier, the right tail of the distribution also shifts left in this period and this implies a decrease in inequality in the upper tail of the distribution. The result, as the previous lines in the table show, is conflicting results about the change in inequality from different summary measures of inequality. From 1921 to 1931, though, the movements are less equivocal. There is a slight decline in inequality in the left side of the distribution due to small improvements in lower end wages but there is a massive increase in inequality in the right tail of the distribution. Thus, the large increase in inequality from the 1911 to the 1931 distribution occurs in two steps. In the first, the bottom tail drops substantially and in the second, the lower tail roughly stays at its new, lower level while the upper tail rises substantially.

Figure 2 contains a more complete and easier to read depiction of the changes in the real weekly wage distribution over time. The solid line in this figure corresponds to the difference between the log weekly wage in 1921 and the log weekly wage in 1911 at each percentile, and thus roughly shows the percentage differences in the distributions at each percentile. The line with squares shows the same difference between 1931 and 1911. The horizontal dashed line corresponds to zero change between the years. It is worth noting that we are comparing percentiles not specific occupations across years. Thus, when we say that, say, the 10th percentile declined by 15% this does not necessarily mean that the occupation that was at the 10th percentile in 1911 experienced a decline of real decline of 15% in its weekly wage. The occupation at the 10th percentile in 1921 may be different. Thus, the movements depicted in this figure reflect a combination of shifts in real wages within occupations, related changes in rankings of occupations, and changes in the proportion of workers in each occupation.

In figures of this type, a line sloping up to the right reflects an increase in inequality between the pair of years because in that case increases at the top of the distribution are greater than at the bottom (or decreases are less). Looking at the line capturing the difference between 1911 and 1921, there is clear evidence of an increase in inequality below about the 30th percentile. Between the 30th and 50th percentiles, the distribution declines by a relatively even 6%. Between the median and the 85th percentile there is evidence of a decrease in inequality as the higher percentiles decline more than the lower. Finally, there are mixed movements in the top

decile. This, again, is the reason that different summary inequality measures generate different conclusions about movements in inequality between 1911 and 1921. Though the figure makes very clear that there were very substantial declines at the bottom of the distribution.

The comparison of the 1911 and 1931 distributions indicates similar sized real declines below the 15th percentile to those between 1911 and 1921. That is, there is only limited improvement from the low point reached in 1921 for those at the bottom end. However, between about the 15th and 85th percentiles there is generally little difference between the 1911 and 1931 distributions. This corresponds to a substantial gain relative to 1921 for those in the range from about the 55th to the 85th percentiles. Above the 85th percentile, the 1931 distribution is dramatically superior to both earlier distributions. The sharp declines at the bottom and the equally strong increases at the top of the 1931 distribution relative to the 1911 distribution are the source of the significant increases in inequality measures between the two years.

It is interesting to consider what occupations and age groups are represented in each part of the distributions and, thus, what groups are experiencing declines and increases. Table 2 provides a listing of some of the occupations in each part of the overall weekly wage distribution in 1921, broken down by age. Thus, for example the top left cell in the table says that workers age 15 - 24 whose wages placed them in the bottom decile of the overall (i.e., workers of all ages combined) distribution worked in personal service and the other listed occupations. The centre column of the table, which shows the occupations for the numerically largest, 25-64 age group, shows a progression of occupations that is much as one might expect. At the bottom of the distribution are servants and other service workers whose work is primarily related to cleaning. Just above them, but still relatively low in the overall distribution, are hotel and restaurant service workers and low skilled resource sector workers. The latter is not a numerically large group since our attention is focused on the city of Montreal. Next in the order, in the category just below the median, are mainly skilled and semi-skilled workers in the non-metallic manufacturing sectors. At the bottom end of this category are labourers, messengers and sailors. This grouping also includes clergymen, who likely received part of their pay in kind. Between the 50th and 75th percentiles of the overall distribution are workers mainly in the elite blue collar occupations: carpenters, blacksmiths, miller, cabinet makers. Teachers are also in the middle of this group. The range between the 75th and 90th percentiles includes more skilled manufacturing

workers (tool makers and engine makers) as well as physicians, and some, likely union, workers from the transportation and communication sectors. Between the 90th and 95th percentiles are mainly managers and foremen as well as brakemen and conductors from steam railways. Above the 95th percentiles are a range of managers and professionals.

The ranking for the middle age group differs substantially from that for the younger and older age groups. The bottom two categories for the 15-24 year old age group include labourers, apprentices for skilled and semi-skilled manufacturing occupations, and with some occupations where one expects to see young workers (messengers and boot blacks). The lowest paid occupations in this age group (and thus the lowest paid overall) are boot blacks, messengers and the clergy. In the 25th to 50th percentile range are young workers in the elite blue collar occupations (carpenters, blacksmiths, millers) along with young professionals and workers in the transportation and communications industries. From an examination of the occupations where apprentices are separated from other workers, this wage range appears to include few apprentices. Instead, it contains mainly young workers at the start of their careers in occupations that we saw above the median for the middle age group. The remaining categories for the youngest workers mainly contain workers who have attained management jobs at a young age. Thus, through much of the distribution, one can see the youngest workers in a given occupation in a wage category one or more categories below where they can expect to be as they gain experience. The same is true, to some extent, for the over age 65 group. While there are often some of the same occupations in a given wage range as are observed for the middle age group there is also a strong tendency for there to be occupations that are in a higher wage range for the middle group. Thus, the table reflects an age trajectory in which workers in a given occupation see their wages first rise then fall with age.

What is most important for our discussion is what occupations are experiencing the largest real changes over our period. A similar ranking of occupations in 1911 shows that there are no age 25-64 workers below the 10th percentile in that year. In 1921, the middle age workers below the 10th percentile are in 5 occupations: bootblacks, char workers, laundry workers, servants, and missionaries. Thus, part of the decline at the bottom appears to be related to declines in real wages for service workers. To investigate this further, in Table 3 we present real wages for various age-occupation groups for our three years, with the occupation-age groups

arranged from the lowest to the highest 1911 wage. The fourth column of the table shows the percentage change in the real wage from 1911 to 1921 for each group. As figure 2 would suggest, the largest wage declines tended to occur at the bottom and top of the distribution between 1911 and 1921. The wages at the bottom of the distribution correspond mainly to young, less skilled workers. This immediately raises the question of whether the real declines observed at the bottom of the distribution between 1911 and 1921 reflected a reduction in weekly wages for younger workers, a reduction for low skilled jobs or some combination.

1.3) Investigating the Changes Across Censuses

As a first step in investigating the collapse of the lower tail of the distribution, we recreated the 1911-1921 percentile differential from Figure 2 but using a counterfactual 1921 distribution in which we holding the real wages for 15 -24 year olds at their real 1911 values but allow the wages for the older workers to assume their true 1921 values. This allows us to see how much of a role age plays in the patterns we are observing. Figure 3 contains the plot of the difference between this counterfactual and the 1911 distribution at each percentile. It also contains the 1911-1921 true differential line from Figure 2 for comparison. The fact that there are often zero differences between the counterfactual distribution and the 1911 distribution below the median indicates that most of the losses below the median were experienced by young workers. It is worth noting, though, that this is not universally true. In particular, there are still some very large declines at the very bottom of the distribution which are associated with older workers.

The age related nature of the declines at the bottom end of the distribution could arise either because there was an increase in “returns to experience” over this period or because young people just happen to be concentrated in occupations in which there were particularly large wage declines for all workers. Changes in returns to experience would be reflected, in our data, in increased wage differentials between young and older workers within occupations. For several occupations in Table 3, we present real wages for both the 15-24 age group and the 25-64 age group. Comparisons of wages for these different age groups, holding occupation constant, suggests that this period was characterized by strong relative declines in wages for younger relative to older workers. Thus, servants aged 15 to 24 experienced a 37% decline in real wages between 1911 and 1921 while servants aged 25 to 64 faced a 24% decline. Similarly, younger carpenters’ wages fell by 22% while older carpenters’ wages fell by 12%. On average, the real

weekly wage across all occupations fell 21% for the 15 to 24 age group but only 11% for the 25 to 64 age group between 1911 and 1921. In part, though, this is a reflection of differential shifting across occupations. When we examine changes in average wages for each age group holding the occupational composition constant, the decline between 1911 and 1921 amounts to 18% for the youngest group and 15% for the middle age group.⁴ Thus, there is some evidence of what is typically referred to in the labour economics literature as increased returns to experience but this is not a large part of what is going on. Instead, the wage decline they suffered is due to their concentration in declining wage sectors. For example, they are disproportionately represented in service sector jobs where wages for workers (other than labourers and managers) fell by 28.6% for 15-24 year olds and 28.7% for 25 to 64 year olds.

Between 1921 and 1931, as described earlier, we observe small changes in weekly wages in occupations at the low end of the distribution and larger and larger increases as we move up the distribution. In this case, there does appear to be a substantive increase in returns to experience. Holding the occupational distribution constant at its 1921 values, the average wage of 15 to 24 year old workers increased 7.9% from 1921 to 1931 while the average wage of 25 to 64 year olds increased by 21%. Interestingly, as we will see below, this occurred at a time when the proportion of workers who were under age 25 was declining. Thus, a simple story built on the relative sizes of birth cohorts cannot explain this phenomenon.

Given the nature of our data, there are three possible explanations for the changes in the weekly wage distribution in this period that we can investigate: changes in the age composition of the workforce; changes in the occupational composition; and changes in relative weekly wages between occupations. Of course, it is also possible that combinations of these factors are important. Thus, changes in the occupational composition of the workforce may involve shifts of workers toward sectors with the largest changes in wages, thus enhancing the effects of relative occupational wage changes. As a first step in investigating these factors, we examine whether there were, in fact, changes in the age and occupational composition of the workforce. Thus, Table 4 contains the age distribution of male wage earners in Montreal at each Census. The

⁴ Mechanically, what we do to create occupation constant wage distributions is to match the numbers of men employed in a given occupation in 1911 with the average wage for that occupation in 1921. Using these, we can construct a weighted average wage that reflects 1921 occupational wages but the 1911 occupational distribution.

results show a clear shift away from the youngest age group toward the middle group, as the proportion of the workforce aged 15 to 24 declines from .30 in 1911 to .23 in 1931. This, alone, would tend to increase average wages across Censuses.

Table 5 contains the distribution of wage earners across broad occupational groups for the three Censuses. The rise of white collar occupations as a share of the workforce jumps out strongly from these numbers. Clerical workers formed only about 5% of the workforce in 1911 but 12% in 1921 and 1931. Combining professionals, clerical workers and managers, the overall white collar sector rose from 8.5% in 1911 to 19.1% in 1921 to 19.5% in 1931. This increase accords well with US evidence of increases in the share of workers listed as “non-production” workers among manufacturing workers between 1909 and 1919 (Goldin and Katz(1998)). These increases were balanced by declines in construction and manufacturing occupations. Since labourers and managers for all industries are collected in other categories, these occupations essentially correspond to semi-skilled and skilled trades workers. At the same time, labourers maintain a constant proportion of the workforce between 1911 and 1921 then increase in importance substantially between 1921 and 1931. This contrasts with evidence reported in Goldin and Katz(1998) that labourers declined in importance in US manufacturing during and after WWI.

To investigate the relative importance of these compositional changes and changes in the wage structure, we carry out a decomposition of the changes depicted in Figure 2. We do this in two stages for each of our decennial changes. Thus, for the 1911-1921 change we first construct an alternate 1921 distribution that reflects 1921 wages and the 1921 distribution of workers across occupations within each age group but the 1911 distribution across age groups. Next, we construct a second counterfactual 1921 distribution which reflects 1921 occupational wages but uses the 1911 distribution of workers across age-occupation groups. We plot the true differential at each percentile along with the differentials between each of our counterfactual distributions and the true 1911 distribution in Figure 4. The difference between the true differential line and the differential line when age is held constant shows the impact of variations in the age composition on the wage distribution. That difference is small across the distribution, with the exception of the region near the 15th percentile and the regions near the 25th percentile. Thus, the shifts in the age distribution depicted in Table 4 explain little of the differences between the 1911

and 1921 wage distributions. The difference between the line reflecting the differential if the age composition were held constant and the line reflecting the differential if both the age and occupation differentials were held constant shows the impact of the occupational shifts presented in Table 5. This difference is quite small in the lower half of the distribution but quite large in the upper half, reflecting a shift away from manufacturing trades and toward white collar occupations. The fact that the differential holding age and occupation constant is lower than both the true differential line and the line holding just age constant implies that these occupational shifts corresponded to movements toward higher paying occupations: without such shifts, the shortfall of the 1921 distribution relative to the 1911 distribution at the top end would have been even larger. This is particularly true in the region just above the 90th percentile, a region dominated by purchasing and sales agents in 1921.

We repeat the decomposition exercise for the changes between 1921 and 1931 in Figure 5. It is worth pointing out that this figure decomposes the changes over the 1920s, while in Figure 2 we compare both the 1921 and 1931 distributions to the common benchmark of 1911. Thus, the true change in Figure 5 corresponds to the difference between the two lines in Figure 2. Again, one can see that there were small changes at the bottom of the distribution between 1921 and 1931 but quite large increases above the median. As in the 1911-1921 period, age composition changes explain little of this overall pattern. Though, the figure does indicate that without the changes in the age composition, the lowest weekly wages would have decreased much more dramatically over the 1920s. The changes in the occupational distribution also played little role in the overall wage distribution changes from 1921 to 1931 with the noticeable exception of the region between the 35th and 65th percentiles. Over this region, the wage distribution in 1931 would have had greater superiority if the occupational composition had not changed. This indicates that there was some amount of movement away from the higher paying occupations in this part of the distribution.

The main conclusion from the decomposition exercises is that the majority of the shifts in the real wage distributions depicted in figure 1 and 2 are due to changes in shifts in occupational wages rather than changes in the age and occupation composition of the workforce. For the 1911-1921 period, once we hold age and occupation compositions constant, the wage changes essentially correspond to real losses for all workers, with workers in occupation-age groups

between about the 30th and 55th percentiles gaining relative to both higher and lower paid groups. From Table 3, this group is dominated by middle age labourers along with skilled and semi-skilled workers in less well paid trades, i.e., in services and non-metal manufacturing. It also contains younger workers in higher paid trades and professions. From 1921 to 1931, once we hold age and occupation constant, the wage changes can be broken down into three parts: below the 35th percentile, where there are small real wage improvement in 1931 relative to 1921; from the 35th to the 80th percentiles, where there are relatively constant improvements of about 15%; and above the 80th percentile, where there are much more substantial improvements. The latter range is dominated by professionals, high paid trades, and managers.

1.4) Movements in Relative Weekly Wages

These types of changes in the wage structure are commonly depicted using wage ratios between pairs of occupations. In the upper portion of Table 6, we present wage ratios of several occupations relative to common labourers. All ratios correspond to the 25-64 age group, in order to hold age composition effects constant. The first ratios in the table compare manufacturing and construction trade workers wages to those of labourers. The movements in those ratios from 1911 to 1921 are a mixed bag. For the most part, the ratios decline, though the declines are typically small and there are examples of increases. From 1921 to 1931, however, the skilled trade/labourer ratios invariably increased and generally reached higher levels than had existed before the war. A similar fall then more than compensating rise is also seen in comparisons of semi-skilled and skilled white collar workers to labourers. Reflecting the earlier discussion of the left tail of the distribution, servants' wages fell relative to labourers from 1911 to 1921 and did not recover from 1921 to 1931.

In the lower part of the table, we provide other comparisons. The standard comparisons of labourers to tradesmen is generally seen as demonstrating returns to investment in training: labourers in construction or manufacturing might be seen as men who were potential candidates to enter the trades at some point in their lives. A similar type of comparison might be made between servants and more skilled service workers, who are likely also separate from one another by some combination of training and capital. While both servants and barbers earn less than their manufacturing counterparts (labourers and skilled tradesmen), the ratio of the wages of the latter to the former are similar in magnitude to the skilled/unskilled ratios in manufacturing. The ratio

also follows a pattern of increasing in the 1920s to a level above its 1911 level. In the case of this specific ratio, though, there was also an increase between 1911 and 1921. Using a similar argument, we further compare clerks to accountants and engineers. Clerical workers would undoubtedly have had more education than labourers (and, as seen in Table 3, were paid 50% more) but would have been positioned similarly at the lower end of a pay structure, below others with further training in the same broad set of skills. Comparing the wages of workers holding more of those skills, we again witness mixed relative changes between 1911 and 1921 followed by strong increases in returns to skill between 1921 and 1931. Finally, a comparison of retail managers to salesmen (again, on the notion that the latter might aspire to the jobs of the former) show no particularly strong sign of increase or decrease over the period.

2) Hourly Wages

Our discussion to this point has been in terms of weekly wages, which is what is directly available in the Census. However, as Altman(1999) discusses, this is also a period of substantial changes in hours of work per week. Using data from the Labour Gazette and the Canada Year Book, Altman constructs regional hours per week indexes for manufacturing and construction workers. His final summary series for Central Canada shows average hours moving from 53.7 in 1910 to 51.6 in 1918 and then falling sharply to 49.1 by 1920. Examining series for specific trades in Montreal from the Labour Gazette, one finds that machinists in metal trades are reported to work 55 hours per week from 1901 through to 1919, with hours then falling to 50 in 1919 and 1920. Similarly, carpenters are reported as working 54 hours per week from 1904 through 1917 but then experience declines to 50 hours per week in 1918 and 48 hours per week in 1920. Herb Emery has constructed hours and hourly wage series for common factory labourers from 1911 to 1940 using supplements to the Labour Gazette. His series show 58 hours per week on average from 1911 through to 1917 and then falling to approximately 53 hours per week by 1920. The closest one can get to white collar workers in these publications is telegraphers. Their hours per week in Montreal are constant at 60 from 1901 to 1917 and then fall precipitously to 48 by 1920. For all the occupations reported, hours worked per week change much less in the 1920's.

We wish to draw two conclusions from these movements in hours worked per week. First, the period directly following the end of WWI was clearly a time of great upheaval and

change in the Canadian labour market. As we will see in a moment, some of the implications of our wage data differ from those drawn from other sources in this period and this upheaval may provide part of the answer.

The second, more substantive, conclusion is that hours declined sharply between our 1911 and 1921 observations. The Labour Gazette based series appear to indicate a relatively robust finding of a decline in hours worked per week of approximately 9% over this period. This is the number reported in Altman's constructed index and is present in many of the individual series for 1921. The implication is that the 12% decline in real weekly earnings between 1911 and 1921 reported in Table 2 corresponds to only a 3% decline in average real hourly earnings. For labourers, the implied real hourly wages, using Emery's common factory labourer's number for hours per week, are .38 in 1911, .39 in 1921 and .39 in 1931. For machinists, the implied real hourly wages are .56, .55, and .62 for 1911, 1921 and 1931, respectively. Thus, in both cases the declines in real weekly wages between 1911 and 1921 correspond to constant real hourly wages plus declining hours per week. Inspection of individual hours series in the Labour Gazette does not reveal a noticeable pattern of larger or smaller declines for more versus less skilled workers and, thus, there is no reason to question the types of relative wage movements presented in Table 6. However, the general decline in hours per week does alter our picture of what happened to wage levels over this period. To demonstrate that point, in figure 6, we replot the percentile differences that we initially presented in figure 2 but now convert to hourly wages based on an assumption that all occupations experienced a 9% fall in hours per week between 1911 and 1921 and no further fall between 1921 and 1931. From this, one can see that, in contrast to the weekly wage distribution where negative changes are recorded at all percentiles between 1911 and 1921 and at all percentiles below the median between 1921 and 1931, the implied hourly wage distributions show real increases for most percentiles above the 25th between 1911 and 1921 and for all percentiles above the 15th between 1921 and 1931. It is worth emphasizing, though, that this is a somewhat rough exercise since we do not know actual hours of work for most occupations.

2.1) Comparisons With Other Data Sources

We next turn to extending our discussion to a comparison of the real wages from the Census with those from other sources. This is useful both for understanding the robustness of the

conclusions we have presented here and for examining time patterns at a higher frequency than is possible with the Census. The two series we will consider are the hourly wage series in Emery and Levitt(2002), based on Labour Gazette data, and the wage data from the Canadian Pacific Railway records collected by Mary Mackinnon (Mackinnon(1996)). It is worth noting at the outset that there is some degree of controversy about the reliability of both data sources. As Mackinnon(1996) discusses, the Labour Gazette data for the metal trades, printing trades and building trades are likely union scales and may not have corresponded to what was paid to non-union workers, or even to what was actually paid to unionized workers.⁵ However, Altman(1999) argues that some of the non-metal manufacturing data corresponds more to non-union workers so series such as Emery's common factory labourer wages, constructed as average wages across labourers in manufacturing firms reporting to the Labour Gazette may be more representative. On the other side, the CPR data comes from company pension-related records. As such, they are likely to be accurately recorded but might be questionable in terms of their representativeness relative to the rest of the workforce. Mackinnon(1996) examines and rejects the main potential objections to the data on these grounds but she also states that government control of railway wages and prices between 1917 and 1921 led to disproportionately large increases in wages in that period relative to the rest of the workforce. Both Mackinnon(1996) and Emery and Levitt(2002) provide comparisons across the various wage data sources, including the Census. We will discuss their conclusions as we proceed.

As a starting point, in Figure 7 we plot Emery and Levitt(2002)'s common factor labourers wage series and Mackinnon(1996)'s CPR labourer's series.⁶ We also plot the implied hourly wage rates from the Census data using Emery's hours per week for common factory labour to convert to hourly wages. We plot the Census numbers with a linear interpolation linking each point. In all cases, we deflate the wages using Emery and Levitt(2002)'s price index for Montreal and report all numbers in 1920/21 real dollars to match our reporting of the Census

⁵ Urquhart and Buckley(1965) report that unionized labour made up 8% of the non-agricultural workforce in 1911, 14% in 1920 and 11% in 1931.

⁶ We are grateful to Herb Emery for providing us with his common factory labourer series. This series was constructed by collecting all the plant specific wages for each city reported in the supplements to the Wages and Hours publications.

numbers above.⁷ Two features stand out in this figure. The first is the relatively high value for 1921 in the CPR data. This occurs because the official nominal wage for labourers actually increases in a year with substantial deflation. The second feature is the relative values of wages from the three sources. Putting aside the seemingly anomalous result from the CPR in 1921, which may be a reflection of special contracting conditions at the railway, the interpolated Census value and the observed values for the Labour Gazette and CPR data are extremely close to one another in 1920 and in 1930. The Census and Labour Gazette data are also very close in 1911, with both being substantially above the CPR wage. This pattern echoes a remark made by Emery and Levitt(2002). Commenting on Mackinnon(1996)'s claim that weekly wages in the 1911 Census may have been abnormally high because workers were putting in overtime in a work year, Emery and Levitt note that dividing Census weekly wages by their common factory labour hourly wage yields implied hours per week that are very close to those reported in the Labour Gazette.

There are some other sources against which to compare the various wage series. Mackinnon(1996) reports daily wages for labourers employed by the government to work on the canals around Montreal. In 1911, these reported wages were \$1.50 per day. If these labourers worked 9 hour days then this would correspond to an hourly wage (in 1920/21 dollars) of approximately 30 cents per hour. This is above the CPR value but well below the Census and Gazette numbers. We also examined data collected by Immigration Agents in Montreal in the very first years of the century. For labourers, these take values of \$1.25 per day in 1900, \$1.50 in 1901, \$1.38 in both 1902 and 1903 and \$1.50 in 1904. These compare to values of \$.13, \$.12, \$.12, \$.12 and \$.13 per in the CPR data. Thus, they are again above the CPR data but not to the same degree as we observe for the other series in 1911 in Figure 7. The Labour Gazette in February 1912 reports that 1,800 street labourers working for the city of Montreal received an increase in pay from \$2.00 to \$2.10 per day in January, 1912 (Department of Labour(1912)). If we then assume that the \$2.00 figure is relevant for 1911 and again assume a 9 hour day, the implied hourly wage (in 1920/21 dollars) is 0.40. If we assume they worked a 10 hour day then the relevant hourly wage is 0.36. In either case, the hourly wage is very close to those derived from the Census data and reported in the common factory labourers series from the Labour

⁷ As above, we average the index numbers from 1920 and 1921 to create our base.

Gazette. In the end, the congruence of two such different sources (the Gazette data and the Census) combined with the evidence on street labourers' wages and the evidence that the CPR data seems to be habitually below other sources in the pre-war period suggests to us that we should put more credence in the Gazette and Census wages. Those sources indicate an essentially flat real wage across the decades.

In Figure 8, we repeat this exercise but examine machinists wages. Machinists are a skilled trade for which wages are readily available from all three sources.⁸ Both Emery and Levitt(2002) and Mackinnon(1996) emphasize the broad agreement of various sources on skilled wages. All three sources are in close agreement on the real wage for this occupation in 1911 and all three suggest relatively substantial increases in machinists real wages between 1911 and 1930/31. However, there are also some strong differences among the series. In particular, both the CPR and Gazette data show large increases in machinists real wages between the pre-war period and the immediate post-WWI period. In contrast, the Census data indicates that the real wage for machinists was essentially unchanged between 1911 and 1921. It is worth noting that the Labour Gazette data is again closer to the implied Census data than the CPR data. The differences between the implied Census hourly wages and the other two series in 1921 might be accounted for by the extremely tumultuous nature of the labour market in the immediate post-war years. As we have already discussed, hours per week changed dramatically in the span of a few years. There was also rapid deflation in 1921. The common factor labourers' wage series tracks this deflation quite closely while the more skilled workers' official wages follow with a lag. It is possible that the relative lack of flexibility in machinists' wages induced other adjustments, such as in hours of overtime available. In the longer run, though, the Census data also shows increases in the real wage of machinists to a degree comparable to but not quite as large as what is

⁸ The Labour Gazette publications on hours and wages actually include two different versions of the machinists' wages for Montreal for 1921. In the reports near the actual date (Reports number 4 and 6), the wage range for machinists is listed as, .55 to .70 cents per hour. However, starting with report 7 the range is listed as .55 to .90. We used the mid-point of the former range because this is in closer accord with other evidence, particularly machinists' wages in Toronto. Throughout the Labour Gazette data the Toronto wage ranges have mid-points very similar to those for Montreal. The one exception to this is the 1921 range listed for Montreal in Reports 7 and later. In 1921 the listed wage range for machinists in Toronto is .50 to .75. Thus, we believe that data was added later on a plant that was an outlier and stick with the earlier listed data.

observed in the Labour Gazette data.

One reason to examine the sources other than the Census is that this allows us to compare wages at cyclically similar points. The 1911 Census was taken at the time of a boom while the 1921 and 1931 Censuses correspond to a recession and a depression of differing severity. To this end, we could compare the real wages in 1911 with a prosperous year from the 1920s such as 1927. The common factory wage labourers real wages in those two years are very similar (\$0.353 and \$0.36, respectively). For machinists, the Labour Gazette data shows a marked increase from \$0.544 to \$0.65. Thus, the picture from the Census that skilled wages had increased substantially while unskilled wages had changed little from the pre-war period to the end of the 1920s appears to hold up to comparison at cyclically similar points.

In Figure 9, we plot wage ratios between skilled trades and labourers from various sources. In particular, we plot ratios of machinists to labourers wages based on the CPR data, the Labour Gazette data and the Census. We also plot the ratio of carpenters' to labourers' wages based on series from the Labour Gazette.⁹ The Census ratios are based on calculated hourly wages using hours reported in the Labour Gazette and are somewhat different from what is reported in Table 6 because of differential movements in hours for the two occupations up to 1930. We also extended the Census series by using wage data from the 1941 Census.¹⁰ Figure 9 displays two main patterns. The first is the one observed in the Census data, the CPR data, and the carpenters/labourers ratio from the Labour Gazette. All three series show declines from 1911 to 1920 or 1921, strong increases during the 1920's and declines in the 1930s. By the start of the 1930s both the Census and relative carpenter series ratios are well above their 1911 values and both end up at or above that level by the end of the 1930s. The Census ratio for machinists to labourers is well below that in the other data for most of the period. This may be a reflection of the point mentioned earlier that data collection in the Census implies that a person who responds they are in a given occupation will have all their earnings associated with that occupation, even if they spent a substantial part of the year working in another occupation. We have seen earlier that

⁹ We are grateful to Herb Emery for providing with the building trade series.

¹⁰ The 1941 Census tables do not have break downs by age. In order to have comparability across Censuses, we use overall average (i.e., not conditioning on age) wages for the earlier Census years as well.

implied hourly wages for labourers in the Census tend to match the Labour Gazette data very well. Thus, the difference is mainly due to different levels of wages for trades workers. If trades workers main alternative employment option when not working in their own trade is unskilled work then it would make sense that the Census data would display lower average wages for skilled workers and lower wage ratios.

While the CPR, Census and Gazette data on carpenters and labourers display very similar over time patterns to one another, the ratio of machinist to labourer wages from the Labour Gazette follows quite a different pattern. That data also shows a long term increase in the skilled/unskilled ratio over time but with almost all the increase occurring during WWI. Examining the individual series, the CPR machinist and the Gazette carpenters data both show constant nominal hourly wages through the first years of the war while the Gazette machinist series shows strong nominal increases in both 1915 and 1916. This latter pattern is present across a range of cities in Central and Eastern Canada. The Gazette also includes data on other trades. Examining those series for the period from 1911 to 1921 one finds two broad sets of patterns. The first is for the building trades, which show substantial declines relative to the common factory labour series throughout the war years and for a few years afterward. The series for printing trades also shows relative declines during the war years but with upward surges beginning around 1917 rather than around 1919 or 1920. The metal trades (blacksmiths, boilermakers, iron moulders, machinists, and sheet metal workers) on the other hand follow a common pattern of constancy relative to labourers until sometime between 1915 and 1918, followed by strong relative increases. The exact turning point varies across the trades but the machinists differ only in that they make the move first, not in the basic pattern. Thus, it is hard to tell from this data exactly what is going on with the skilled/unskilled ratio in these years. One possibility is that the pattern in the CPR data is correct and the Census data is reflecting the same relative wage pattern. The other possibility is that the Gazette metal trades data is correct and the relative decline in the skilled/unskilled ratio in the Census data over this period actually reflects a greater number of skilled workers having to spend some time working as unskilled workers because union scales priced them out of the market. The relative declines in the proportion of the workforce in these trades in Table 5 might fit with this. In truth, though, it is simply not possible to be sure of the true pattern during the War at this point.

Before becoming overwhelmed by the uncertainty of the latter conclusion, it is worth reiterating that these standard occupational comparisons correspond to a narrow part of the wage range. To make this point, note that the ratio of machinist to labourer wages from the Census presented in Figure 9 are 1.43 in 1911, 1.39 in 1921 and 1.58 in 1931. The ratio of the 75th to the 25th percentile weekly wages from Table 1 are very similar and follow a very similar pattern: 1.52, 1.47, 1.57, respectively. On the other hand, the ratio of the 90th to the 10th percentile weekly wages are 1.84 in 1911, 1.94 in 1921 and 2.35 in 1931. Thus, they follow the broad pattern discussed for the overall distribution: possible increases in dispersion over the first decade and very large increases over the second. Focusing just on trades and labourers wages is equivalent to focusing just on movements in the centre of the distribution. But, as Figures 1 and 2 show, the real action is in the bottom and top tails. The clear conclusion is still that there was a massive increase in inequality between 1911 and 1931.

3) Comparisons to Earlier Work

There is only limited work that explicitly looks at wage differentials across occupations for Canada. As we have discussed, using a sample of weekly wages drawn from the employee record cards for the CPR between 1903 and 1930 MacKinnon (CJE 1996) was able to construct wage rates for skilled and unskilled (eg machinists versus labourers), employees of the CPR. over the period from 1900 to 1926.. MacKinnon's data series shows that skilled wages increased faster than unskilled wages during the years leading up to the outbreak of WWI. During the war real wages declined for both skilled and unskilled workers but the greater fall was experienced by machinists (i.e., the war brought about some wage compression). However, Mackinnon points out that this was reversed during the 1920's as skilled workers wages increased slightly faster than the wages of unskilled workers. This is the pattern depicted in our Figure 9, which plots Mackinnon's series. MacKinnon suggests that the widening of wage inequality before the war was due primarily to large scale immigration which was dominated by unskilled workers. No explanation was offered for the war time pattern of wage compression nor to the slight widening in wage inequality that occurred during the 1920's.

Meltz and Stager(1979) examine wages in 52 occupations across the 1931,41,51,61 and 71 Censuses. They argue that the 1931-41 and 1941-51 periods are both characterized by

compression. This fits with the patterns for the 1931-41 period shown in Figure 9. Fortin and Huberman(2003) examine movements in male/female differentials over time for Canada. Since we have not yet looked at female data, it is not possible for us to match our results to theirs.

Patterns of wage inequality for the United States have been studied extensively by Williamson and Lindert (Lindert and Williamson(1980)). Their series do not show compression in the wage structure before World War II but Goldin and Katz claim that this is due to a data mistake and that once this mistake is corrected the series show compression over the 1910's a slight widening over the 1920s but an overall decline in dispersion. More recently Goldin and Katz have examined the causes of wage compression in the US during the early decades of the 20th century (Goldin, JEH June, 2001). Goldin and Katz argue that wage compression began during the late 1910's and early 1920's and then increased during the 1940's (Goldin, 2001, Table 5, p, 285) Wage differentials continued to narrow until the mid 1950's and then a widening trend reappeared in the 1970's as the returns to high school and college education rose sharply. The explanation offered by the authors for the period of wage compression is the rapid growth in the number of high school graduates. The supply of the latter exceeded the demand for skilled blue collar and white collar workers. The latter was driven by the spread of the "new economy" which got under way around the time of the First World War. As a result of the expansion of post-elementary education, the wages of skilled workers converged towards that of unskilled workers.

In an earlier work Phelps Brown examined the change in wage inequality for a number of countries during for the first half of the 20th century, (Phelps Brown, 1977, 68-81). At this stage our interest is limited to the results for Canada and the United States. Using data on machinists and common factory labour drawn from the **Labour Gazette** and other published sources, Phelps Brown found for Canada that wage inequality contracted during the First World War. It then widened dramatically during the 1920's. Compression set in during the thirties and continued through World War II and into the late 1950's.

The pattern of wage inequality in the US followed a different path from that of Canada during the first half of the last century. Phelps Brown found that, with the exception of the decade of the twenties, the US experienced a contraction in the ratio of skilled to unskilled labour. This compression in wages began in 1914 and covered both world wars. Unlike Canada the

increase in wage inequality in the 1920's was quite modest .Throughout the whole test period the level of wage inequality in the US was less than it was in Canada.

This paper differs from these earlier works in several respects. First, our study of long run trends in wage inequality covers over 100 inter- census matched occupations This provides us with view of changes not only across a wide variety of occupations but across industries as well. The studies set out above limit their investigation to only a few occupations. For example most studies use machinists to represent skilled workers and common factory or farm labour for unskilled workers. Second, virtually all extant studies use a single average wage to cover all employees in a particular occupation Since we use census' as the main source of our observations, we are able to examine wages by broad age cohorts. Hence we can study how wages change by age across occupations. We also have information on hours of work derived from **Wages and Hours Worked** annual publications. These latter data then allow us to adjust earnings to reflect short run changes in economic activity.

It is interesting to contrast Goldin and Katz's results with ours.¹¹ Their finding of compression before WWII is based on a comparison of wages for male non-production manufacturing workers. If we restrict our attention to manufacturing trades and labourers only then the 90-10 differential grows 11% from 1911 to 1931. This compares to 25% growth among all workers. Once again, restricting attention to production workers misses the action in the tails of the distribution and tends to understate movements in overall inequality. Goldin and Katz also examine wage movements for various white collar workers who are in the upper tail of our distribution. In particular, they argue that from the start of the century to 1960, full professors

¹¹ It would also be interesting to compare other, non-earnings evidence with their results. Goldin and Katz place strong emphasis on increases in school attainment as a driving force for their results. While we do not have evidence that matches theirs exactly, a 1931 Census manuscript provides details on school attainment over the previous decades for Canada (McClellan(1931)). Goldin and Katz report an increase in high school enrollment for 14 to 17 year olds from approximately 19% in 1921 to 29% in 1931. The closest match in the Canadian data is the percentage of 15 to 19 year olds attending school. That number increases from 24.8% in 1921 to 34% in 1931. Thus, Canada appeared to be experiencing similar size educational improvements at similar levels of attendance over this period. To the extent that Canada and the US experienced quite different movements in wage structures in the 1920s, this casts some doubt on school attainment as a main determining driving force. This, along with other potential explanations for the shifts in the wage structure, is something we wish to investigate further in future work.

saw their earnings relative to the average manufacturing worker fall by half. They also argue that engineers saw similar compression. We can compare their patterns to the ones in our data. They report that the earnings ratio of full professors to the average manufacturing worker is 3.66 in 1911, 2.69 in 1921, 3.27 in 1931 and 3.21 in 1940. In our data, the ratio of average weekly earnings for professors to those of labourers is 2.04 in 1911, 1.97 in 1921, 3.33 in 1931 and 4.40 in 1941. Thus, both series follow a pattern of decline in the 1910s and increase in the 1920s. As Phelps Brown argues, the decline in the 1910s is large for the US and the rise in the 1920s does not compensate for it. In the Canadian case, the opposite is true: the increase in the ratio in the 1920s far outstrips the decline in the 1910s, leading to a long run increase in the differential. In the 1930s the two series completely part paths, with the ratio being relatively stable in the US but increasing markedly in Canada. It is worth noting that the long run decline in the ratio pointed out by Goldin and Katz for the US occurs almost entirely in the world war decades. The ratios increase in the 1920s and are stable in the 1930s. Canada also experiences compressions in parts of the wage distribution in the WWI decade but the superior Canadian data allows us to see that there is also increased dispersion in the lowest part of the distribution. As a result, it is difficult to know whether observed differences in specific occupational ratios between Canada and the US reflect more profound differences in the impacts of forces such as immigration, education, technological change and institutional change or whether more complete US data would lead to a picture more like that seen in Canada. On the basis of what we can compare, though, Phelps Brown's conclusion seems accurate: Canada experienced less compression of differentials in the 1910's and much more expansion in the 1920s.

Saez and Veall(2004) and Piketty and Saez(2003) provide some evidence that the Canadian and American experiences may be more similar than is apparent from comparisons of a few occupational differentials. Using tax data in both countries, they find that the share of total income received by the top percentiles of the income distribution move in quite similar ways in the US and Canada after 1920 and once again find evidence that the major declines in this share occurred during the Second World War. Based on their tables, for example, the share of total income going to those between the 95th and 100th percentiles was 36.6 in 1920/21, 34.4 in

1930/31 and 37.2 in 1939 for Canada.¹² The same numbers were 29.0, 31.0 and 31.3 for the U.S.. Thus, Canada has more inequality by this measure and the patterns over time are not identical, but neither shows very sizeable movement in the figure over time. It is worth noting that the 1940/41 figures do show a large difference: for Canada the number is 32.2 (a large drop from 1939) while for the U.S. it remains unchanged at 31.3. This is likely the effect of Canada having entered the war in this period while the US had not.

The Piketty, Saez, Veall evidence does not provide a strong benchmark against which to compare our results because their data includes earnings and capital income. Thus, the decline from 1920/21 to 1930/31 in income share for the top 5% for Canada may reflect declines in capital income following the stock market crash. However, Saez and Veall present other interesting evidence in the form of a series formed from Urquhard and Buckley(1965) and the The Canada Yearbook showing the ratio of average earnings of salaried workers to the average earnings of wage earners. That ratio falls from about 2.2 in 1915 (the first year in their data) to 1.75 in 1921, rises to 2.0 in 1931 and falls again to 1.8 in 1939 and 1.49 in 1941. Thus, the pattern broadly matches what we see in the Census data and some of the wage ratios shown above: declines during the decade of WWI, a sharp rise in the 1920s, moderate declines across the 1930s, and further sharp declines with the onset of WWII.

4) Conclusions

In this paper, we examine movements in the Canadian wage structure over the first half of the twentieth century. We primarily rely on Census data and focus our attention on the 1910/11, 1920/21 and 1930/31 Census years. We enter tabulated data on weekly earnings for males over age 15 in Montreal by detailed occupation and age categories and use this to construct a version of the wage distribution. Because it is based on occupation-age group level earnings, we miss variation within occupations and, thus, likely understate the dispersion in the distribution. Nonetheless, the occupational coding is detailed enough to suggest that we are able to capture a significant portion of wage inequality. We are certainly able to depict the cross-occupation wage structure and its movements.

¹² We use a simple average of each pair of years in order to more closely match the Census data used in our analysis.

Using this data, our main finding is that the wage distribution experienced a dramatic increase in dispersion between 1911 and 1931. This increase occurred in two steps. Between 1911 and 1921, the real wages corresponding to the lowest percentiles of the distribution fell sharply, those in the middle fell by much less, and those in the top half of the distribution fell quite strongly. The result is a mixed bag in terms of inequality movements: there is an increase in inequality in the lower half of the distribution but an increase in the upper half. Between 1921 and 1931, the lower tail of the distribution essentially remained at the inferior values attained by 1921, the middle part of the distribution showed large real increases and the top 15 percentiles grew very strongly. As a result, by 1931, both the lower and upper tails of the distribution had shifted out substantially relative to 1911. Using simple decompositions, we show that this movement is mainly accounted for by shifts in relative differences in real wages across distributions with little accounted for by shifts in the age or occupational composition of the workforce.

We compare our results to those in other data and earlier work by examining occupational differentials between specific occupations reported in other papers. Those results are somewhat mixed. In general, they suggest reduction in skill differentials between 1911 and 1921 and then sharp increases in the 1920s, with mild declines in the 1930s. However, this is not true of all differentials, as some data records increases in trades/labourer differentials in the 1910s. Indeed, the Census data also records some instances of the trades/labourer differentials increasing between 1911 and 1921. While this points to somewhat mixed conclusions, it is worth noting that the occupations that are typically examined (building and manufacturing trades and labourers) have wages that place them toward the middle of the distribution. Thus, they miss the dramatic changes in the upper and lower tails recorded in the Census data. In the end, this is the major change in the wage structure and the major generator of movements in inequality that needs to be examined. Having established those patterns in this paper, we intend to move on to examining implications of competing theories for these types of movements in future work.

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Table 1
Summary Statistics For Census Based Weekly Wage Distributions
(1921 Dollars)

Statistic	1911 Census	1921 Census	1931 Census
Percentile			
1	15.63	11.16	10.94
5	18.42	15.47	16.30
10	19.25	15.58	16.55
25	21.26	18.53	21.15
50	25.69	24.59	24.86
75	31.69	27.91	33.18
90	34.98	31.01	39.53
95	38.52	37.98	51.97
99	55.62	43.36	68.76
99.9	87.17	61.52	92.16
Mean	26.97	23.97	27.57
Standard Dev.	7.88	6.92	11.67
Squared Coef. Of Variation	0.085	0.084	0.17
log 90-10 Ratio	0.60	0.69	0.87
log 50-10 Ratio	0.29	0.46	0.41
log 90-50 Ratio	0.31	0.23	0.46

Based on Census tables described in text.

**Table 2 :
Occupations by Location in Overall Weekly Wage Distribution and Age**

Percentile Range	Age 15-24	Age 25-64	Age 65 +
Below 10 th Percentile	<ul style="list-style-type: none"> - personal service (char workers) - apprentices (construction, boot and shoe making) - teachers - salesmen - messengers 	<ul style="list-style-type: none"> - service related to cleaning (char workers, laundrymen) - servants - missionaries 	<ul style="list-style-type: none"> - service related to cleaning - some non-metal manufacturing (tobacco makers, bakers) - messengers
10 th - 25 th Percentile	<ul style="list-style-type: none"> - manuf., likely mostly apprentices (pottery makers, canners, iron founder) - barbers - drivers - clerks - labourers 	<ul style="list-style-type: none"> - hotel and restaurant service (janitors, hotel workers) - resource workers (agricultural labourers, shantymen) 	<ul style="list-style-type: none"> - resource workers - hotel and restaurant workers - labourers
25 th - 50 th Percentile	<ul style="list-style-type: none"> - construction trades (carpenters, roofers), not including apprentices - metal manuf. trades, mainly not apprentices (blacksmiths, machinists) - millers - professionals (architects, electrical engineers, lawyers) - transportation and comm. skilled and semi-skilled (baggage men, conductors) 	<ul style="list-style-type: none"> - barbers -cooks - non-metal manufacturing skilled and semi-skilled (Textile workers, bakers, brewers, box and bag makers) - clergy - messengers - sailors - labourers 	<ul style="list-style-type: none"> - skilled and semi-skilled construction - non-metal manufacturing skilled and semi-skilled - teachers - photographers and artists - salesmen - longshoremen - clerks

50 th - 75 th Percentile	<ul style="list-style-type: none"> - managers and foremen in service and non-metallic manufacturing - skilled and semi-skilled transportation (brakemen, street rr conductors) 	<ul style="list-style-type: none"> - construction trades (carpenters,plumbers) - metallic manuf. skilled (blacksmiths, machinists, gold and jewelry makers) - skilled clothing (furriers, hat and glove makers) - millers - furniture makers - teachers - transportation skilled (conductors) - longshoremen 	<ul style="list-style-type: none"> - construction trades - metallic manufacturing, skilled - skilled clothing - millers - transportation skilled and semi-skilled - warehousemen
75 th - 90 th Percentile	<ul style="list-style-type: none"> - construction and transportation managers - civil and mechanical engineers 	<ul style="list-style-type: none"> - tailors - skilled metal (tool makers, boiler makers) - arts (artists, photographers) - physicians and surgeons - transportation and communication skilled and semi-skilled (baggage men, telephone linemen) 	<ul style="list-style-type: none"> - transportation and communications skilled and semi-skilled (brakemen, locomotive engineers, telephone linemen)
90 th - 95 th Percentile	<ul style="list-style-type: none"> - Pulp and paper managers - Steam RR managers 	<ul style="list-style-type: none"> - construction foremen - service, food, beverage manuf. managers) - dentists - brakemen - conductors 	<ul style="list-style-type: none"> - manufacturing managers - mechanical engineers
Above 95 th Percentile	-	<ul style="list-style-type: none"> - constr. managers - manuf. managers (pulp and paper, chemical) - professionals (engineers, lawyers, accountants, professors) - financial managers - retail managers - steam rr and communications managers 	<ul style="list-style-type: none"> - manufacturing managers - professionals - financial and insurance managers - steam rr managers

Table 3: Weekly Wages and Changes, Various Occupation-Age Groups (1921 Dollars)

Age-Occupation Category	1911 Census	1921 Census	1931 Census	% Change 1911- 1921	% Change 1921-1931
Constr. apprentices, 15-24	12.13	11.16	11.39	-0.083	0.020
Servants, 15-24	16.19	11.22	10.94	-0.37	-0.025
Messengers, 15-24	16.49	8.71	8.38	-0.64	-0.039
Labourers, 15-24	18.42	15.84	16.25	-0.15	0.026
Servants, 25-64	19.73	15.47	15.74	-0.24	0.017
Bakers, 15-24	21.53	15.26	15.02	-0.34	-0.016
Clerks, 15-24	21.98	17.63	19.23	-0.22	0.087
Labourers, 25-64	22.21	20.74	21.17	-0.068	0.021
Telephone Linemen 25-64	22.44	29.60	36.26	0.28	0.20
Machinists, 15-24	23.63	19.62	20.11	-0.19	0.025
Messengers, 25-64	23.97	23.62	25.85	-0.015	0.090
Carpenters, 15-24	25.69	20.56	26.47	-0.22	0.25
Longshoremen, 25-64	26.45	24.82	22.97	-0.064	-0.077
Bakers, 25-64	28.29	22.14	25.00	-0.25	0.12
Carpenters, 25-64	29.52	26.14	29.20	-0.12	0.11
Machinists, 25-64	30.62	27.76	31.11	-0.098	0.11
Tailors, 25-64	31.69	28.77	28.66	-0.097	-0.0038
Boiler Makers, 25-64	32.69	29.34	31.09	-0.11	0.058
Clerks, 25-64	35.79	28.50	33.48	-0.23	0.16
Serv. Managers, 25-64	46.88	31.66	46.31	-0.39	0.38
Civil Engineers 25-64	57.13	46.72	68.76	-0.20	0.39
Accountants 25-64	57.74	42.59	61.28	-0.30	0.36
Clothing Manuf. Managers 25-64	65.06	43.36	55.17	-0.41	0.24
Financial Managers 25-64	87.17	47.66	85.07	-0.60	0.58
Mean	26.97	23.97	27.57	-0.12	0.14

Table 4
Age Distribution of Wage Earners, By Census Year

Age Group	1911 Census	1921 Census	1931 Census
15-24	0.30	0.27	0.23
25-64	0.67	0.71	0.75
65 +	0.021	0.024	0.024

Table 5
Occupational Distribution of Wage Earners

Occupation	1911 Census	1921 Census	1931 Census
Construction Trades	0.18	0.11	0.12
Service	0.045	0.040	0.056
Government	0.036	0.047	0.021
Resource Sector	0.004	0.0071	0.0064
Non-Metal Manufacturing	0.15	0.11	0.088
Metal Manufacturing	0.080	0.078	0.057
Professional	0.018	0.029	0.037
Transportation, Trade and Communication	0.26	0.27	0.21
Clerical	0.047	0.12	0.12
Labourers	0.16	0.15	0.24
Managers and Foremen	0.020	0.042	0.038

Table 6
Weekly Wage Ratios

Occupation	1911 Census	1921 Census	1931 Census
Ratios Relative to Labourers			
Bakers	1.27	1.07	1.18
Tool Makers	1.34	1.45	1.57
Machinists	1.38	1.34	1.47
Boiler Makers	1.47	1.41	1.47
Carpenters	1.33	1.26	1.38
Bricklayers	1.56	1.33	1.70
Servants	0.89	0.75	0.74
Barbers	1.12	1.01	1.08
Clerks	1.61	1.37	1.58
Accountants	2.60	2.05	2.89
Civil Engineers	2.57	2.25	3.25
Service Managers	2.11	1.53	2.19
Financial Managers	3.92	2.30	2.61
Other Comparisons			
Barbers/Servants	1.25	1.35	1.46
Accountants/Clerks	1.61	1.50	1.83
Civil Engineers/Clerks	1.59	1.64	2.06
Retail Managers/Salesmen	1.67	1.63	1.62

Appendix A

Occupational Concordance across the 1911, 1921 and 1931 Censuses

In this appendix, we describe some of the main decisions we made in generating a consistent set of occupational categories for comparisons across Censuses. The Excel spreadsheets containing the actual data (including occupation numbers assigned by us) and a concordance linking our assigned occupation numbers from each Census to the Concordance Grouping occupations is available upon request. From those files, the reader can see every decision we made and make different ones of their own. In this appendix, we explain only the major decisions we made.

Labourers are reported under separate industry categories in both the 1911 and 1921 Censuses but are collected together in one category for the 1931 Census. Thus, we create one “labourer” category in all three years. The introduction to Volume V in the 1931 Census says that the labourer categories in the 1921 Census include “a number of males in the occupations, ‘boiler firemen’ and ‘packers’” who are classified elsewhere in the 1931 tables. In response to this, we added the “packers, wrappers and labellers” category to the labourers in 1931. There is also a separate “boiler firemen” category in 1931 but the average wage in that occupation is \$4 per week higher than for labourers and so we decided to leave it in the “electrical and gas workers” category rather than move it into the labourers category.

Clerical workers are listed separately by industry in the 1921 Census but grouped together in the 1931 Census and sub-divided according to occupations. We match all the 1921 clerical workers with the clerical occupations in the 1931 Census. In addition, the introduction to volume 5 in the 1931 Census states that the 1921 clerical group includes data on the same occupations as for 1931 plus, shippers, proofreaders, weighmen, accountants and postmen. We include the shippers, proofreaders, weighmen and postmen in our general clerical category. We did not incorporate accountants because there is a separate accountant category to match with in the 1921 Census and because accountants earn approximately \$30 per week more than other clerical workers in the 1931 Census, suggesting they do not truly belong in the clerical worker category. For the 1911 Census, the clerical group is formed from “office employees” in all industries plus “stenographers and typists”.

Both the 1921 and 1931 Censuses report data on separate “managers” and “foremen” categories for various industries. However, the 1911 Census documentation typically only states “managers and superintendents” in each industry, with “and foremen” written in for some cases. It seemed plausible to us that this category included foremen in all cases in 1911 and so we combined managers and foremen in 1921 and 1931. We constructed an alternative “conservative” concordance in which, among other decisions, foremen were omitted from the 1921 and 1931 data. Our general conclusions were unaffected by this change.

The 1911 documentation lists “agents” as a separate category in many industries. We matched those with “sales and purchasing agents” in 1921 and with “purchasing agents and buyers”, “sales agents, canvassers, demonstrators” and “commercial travelers” in 1931. In both of the latter years, these categories are collected in one place rather than being listed separately by industry.

The 1911 documentation lists a “builders and contractors” category. There is no such category in the other Censuses. It is worth recalling that there are no “own account” workers in these tabulations for any of the Census years. We suspect that these are actually carpenters or other tradesmen who sometimes work on their own and sometimes hire themselves out. Their

weekly wages are certainly very close to those of carpenters in 1911 (\$16.95 per week versus \$16.34 for carpenters). We group them with carpenters in our main data. In our conservative concordance, we drop them altogether.

Apprentices are sometimes listed as a separate occupational category affiliated with another category (e.g., “boot blacks apprentices”). However, only in the case of the building trades are these apprentice categories consistently listed across all three Censuses. In the other cases, we believe that apprentices have been combined with other workers in the main occupational category (e.g., boot blacks) when they do not appear as a separate category and we set up our occupational groupings accordingly. In our conservative concordance, we simply drop apprentices in all cases other than the building trades.

Government employees are reported in varying degrees of specificity in the various Censuses. To form a consistent categorization, we combined all government workers other than labourers from all levels of government into one category. This is a very diverse category, including everything from firemen to managers in the federal government.

In all Census years there are miscellaneous manufacturing occupation categories. We matched these together but did not throw into them occupations for which we could not find a match in other years. The latter types of categories we simply dropped.

The categories in all years are really combinations of occupations and industries. For example, there are separate entries for managers in different manufacturing industries. The 1931 tables have more aggregated industry categories than the earlier Censuses and, as a result, it is those groupings we are forced to use when building the concordance. In both the 1911 and 1921 data, iron and steel manufacturing is separated from other metal manufacturing but this is not the case in 1931. Thus, we are forced to combine categories from iron and steel with non-ferrous metal manufacturing in the 1911 and 1921 data, creating, for example, one machinist occupation category rather than two.

The key question for our purposes is whether merging and dropping categories in this way significantly alters the distributions we are considering. In figure A1, we plot the kernel smoothed density for 1911 constructed using all the data at our disposal with the density for the same year based only on the data that we could use in our concordance categories. The two densities are extremely similar, although the distribution associated with using all the data has a larger standard deviation (8.29) than that for the concordance categories distribution (7.88). The same pattern exists for the other two years, suggesting that using the concordance categories in order to allow comparisons across years will not affect our conclusions.

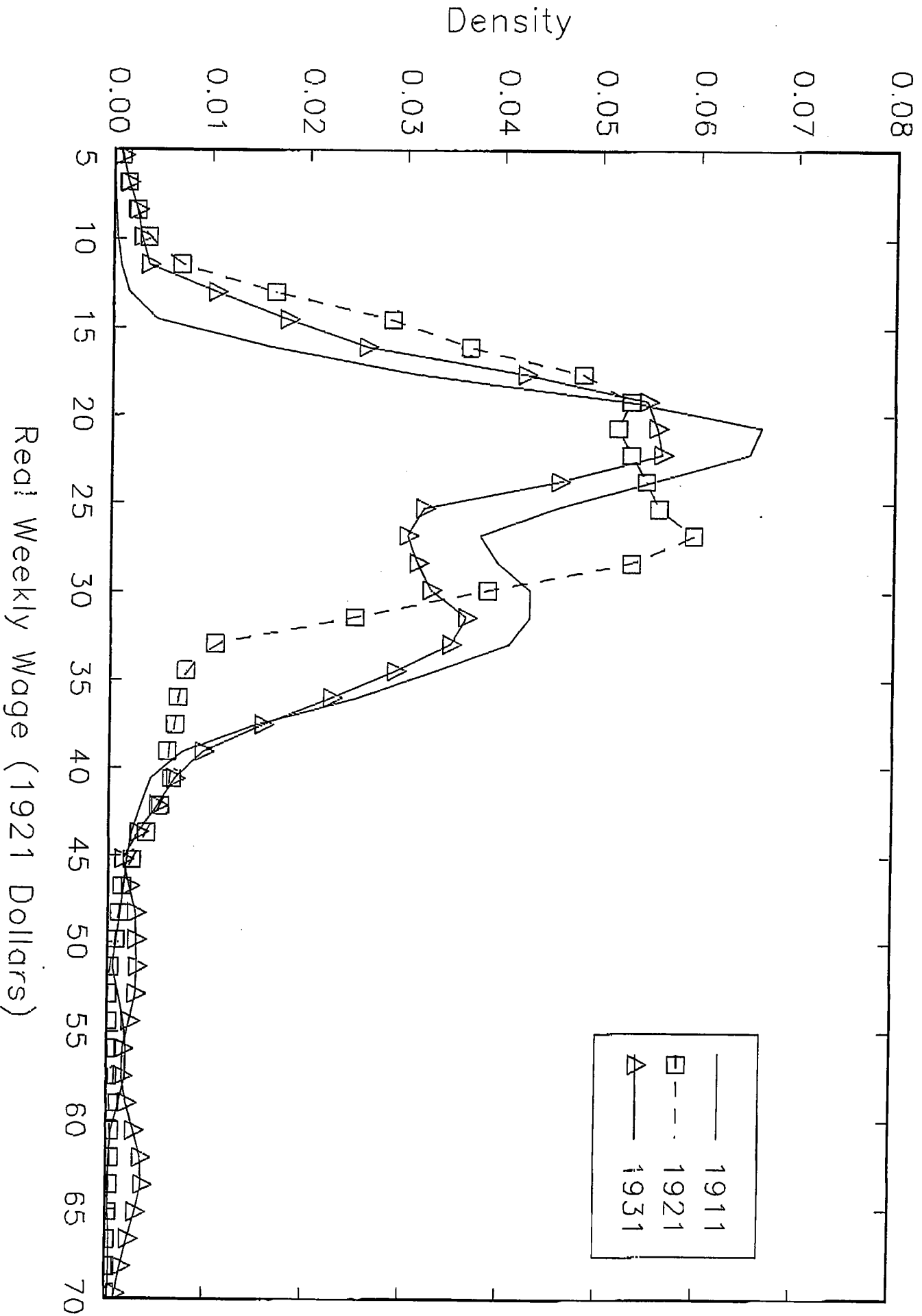


Figure 1:
Kernel Density Plots for 1911, 1921 and 1931

Figure 2: Differences in Log Percentiles,
Weekly Wages, 1921 versus 1911 and 1931 versus 1911

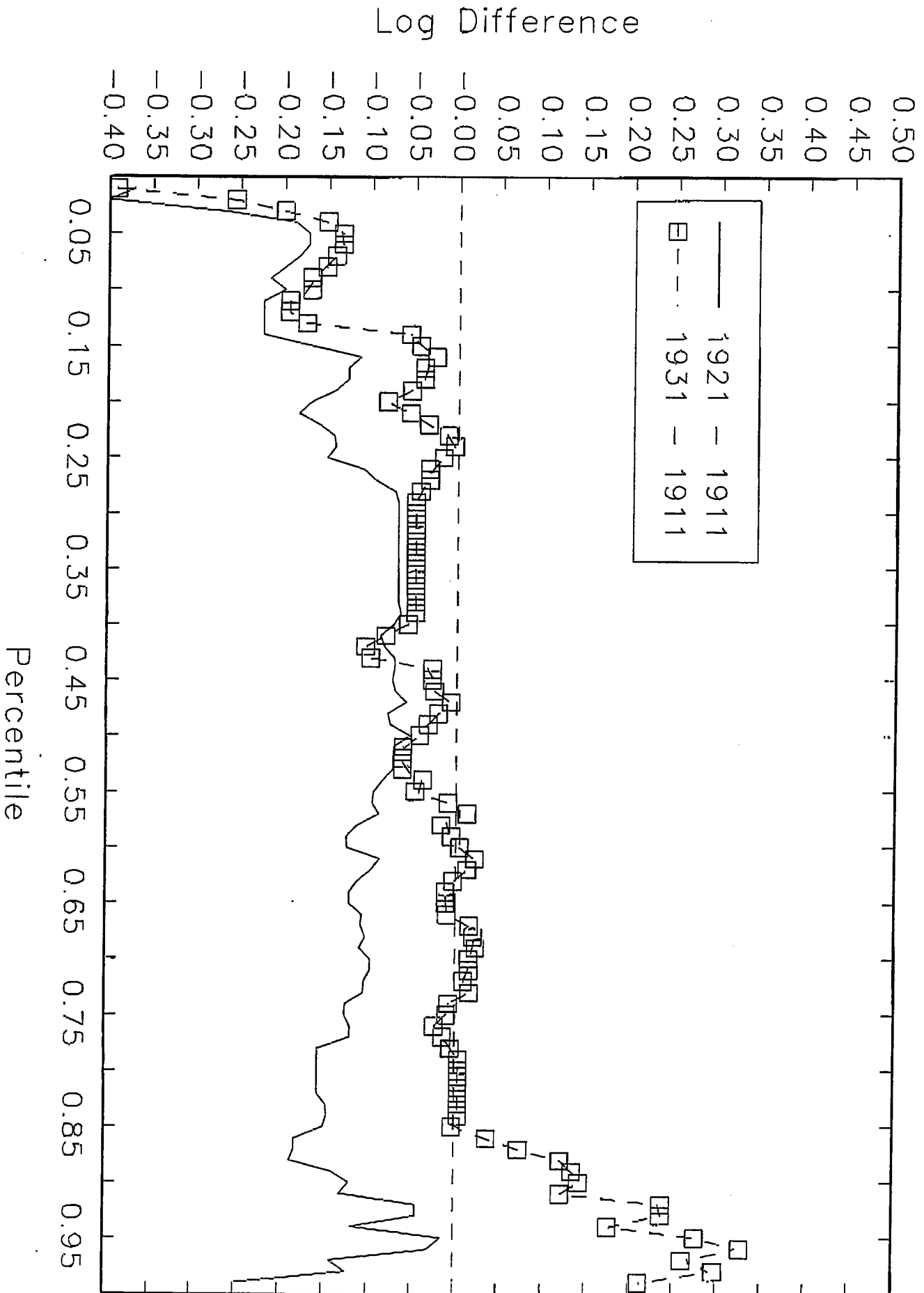


Figure 3: Differences in Log Percentiles, Differences Allowing Young People to Have Their 1911 Wages

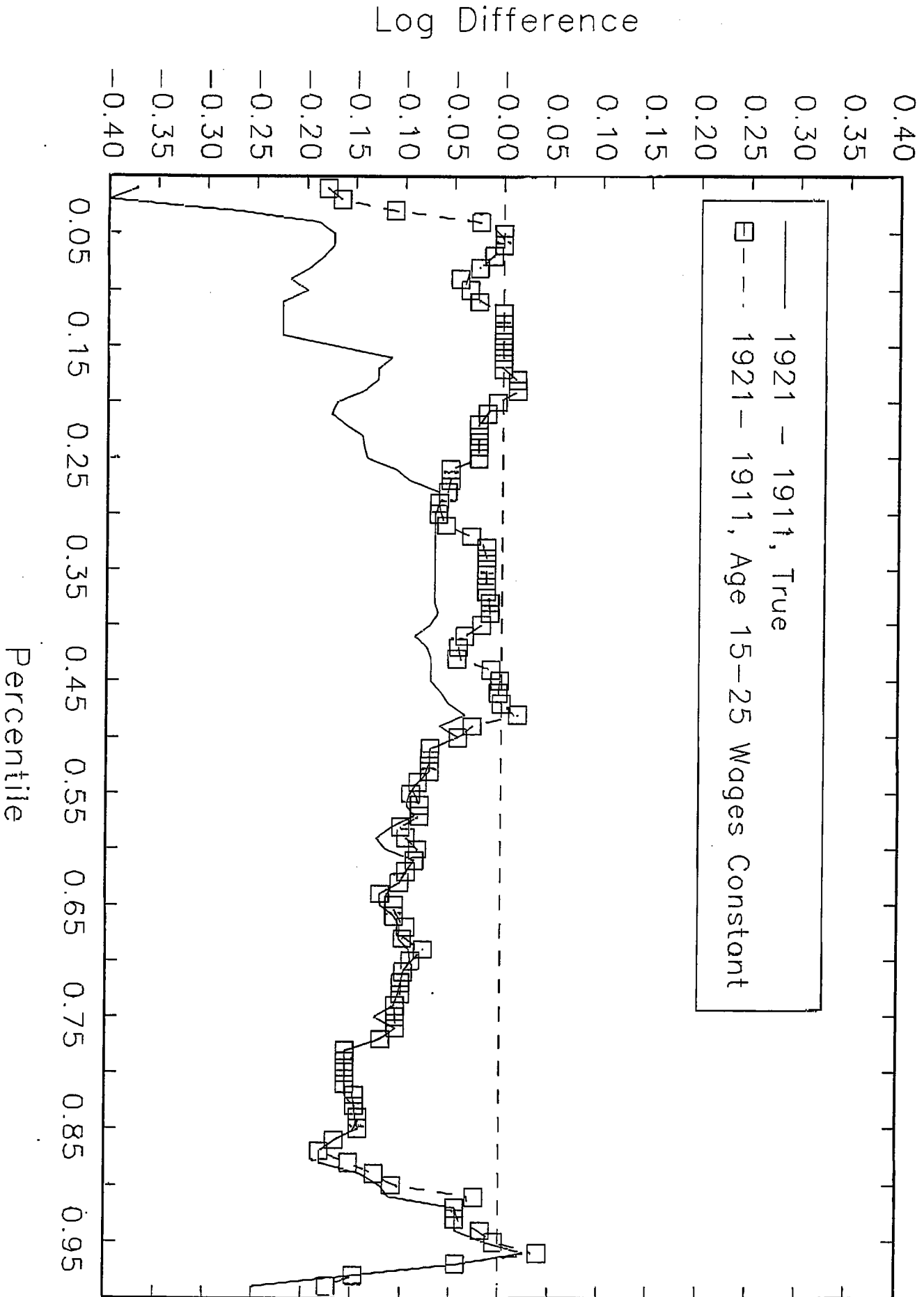


Figure 4: Differences in Log Percentiles,
Decomposition of 1911 - 1921 Difference

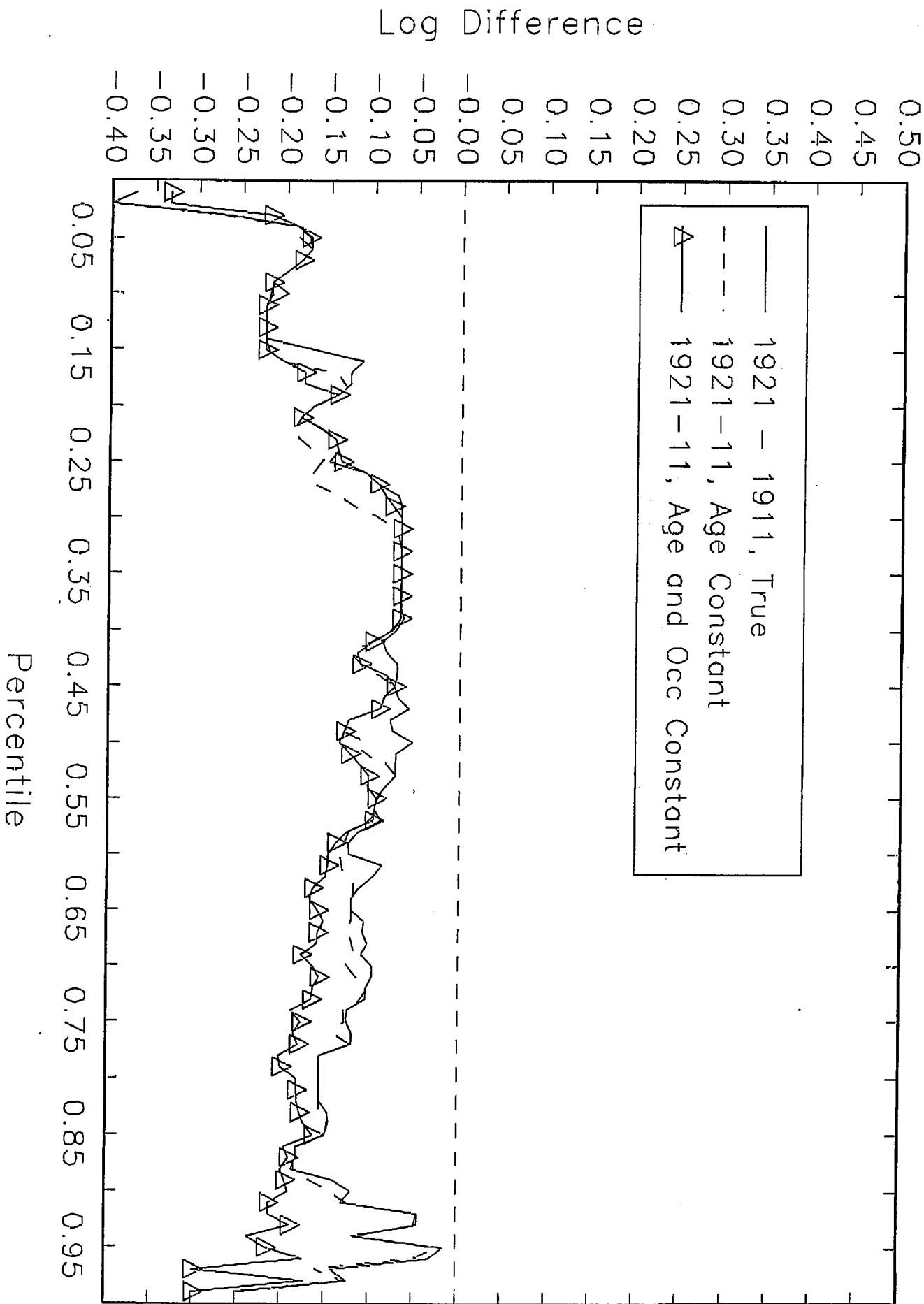


Figure 5: Differences in Log Percentiles,
Decomposition of 1921 - 1931 Difference

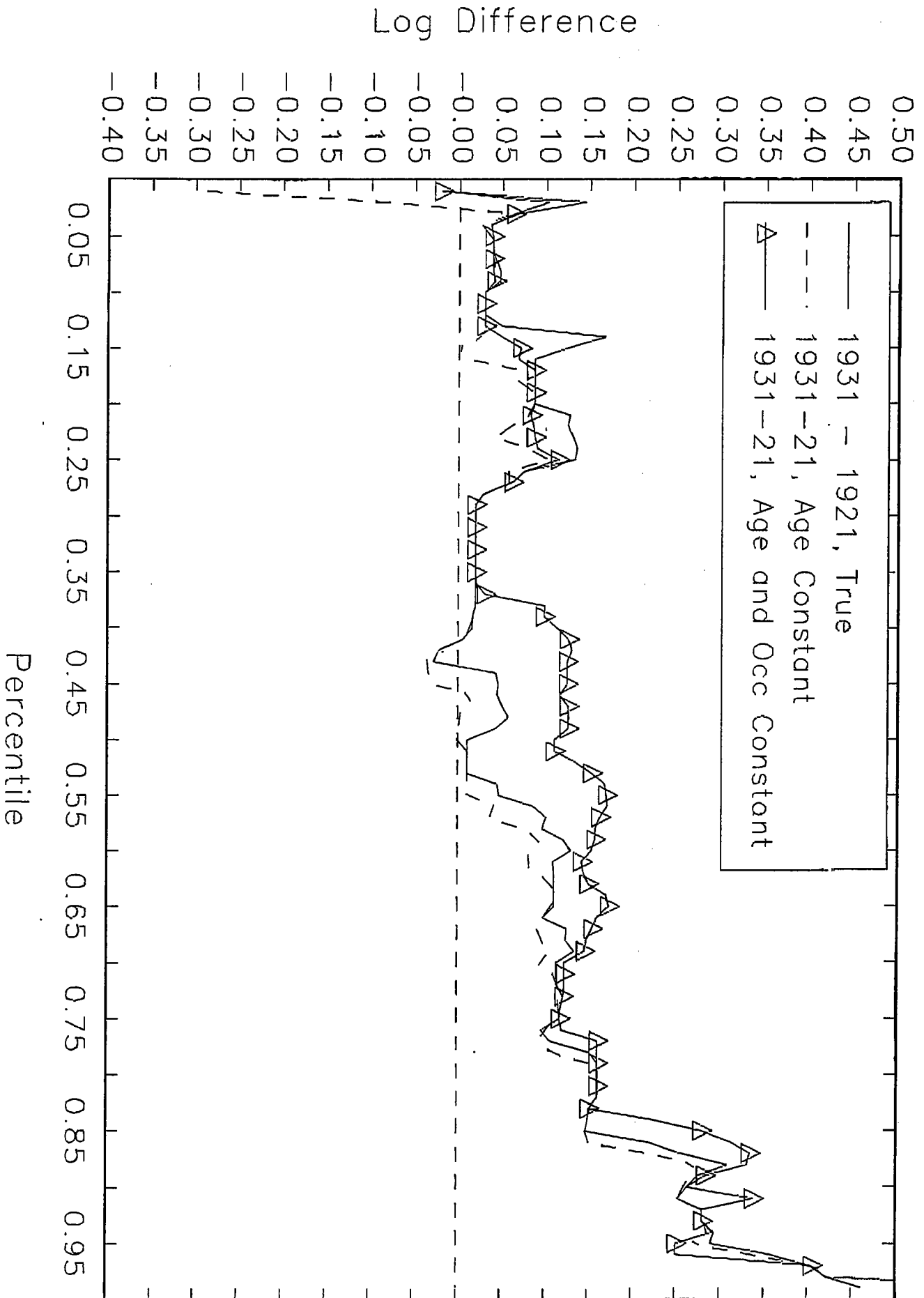
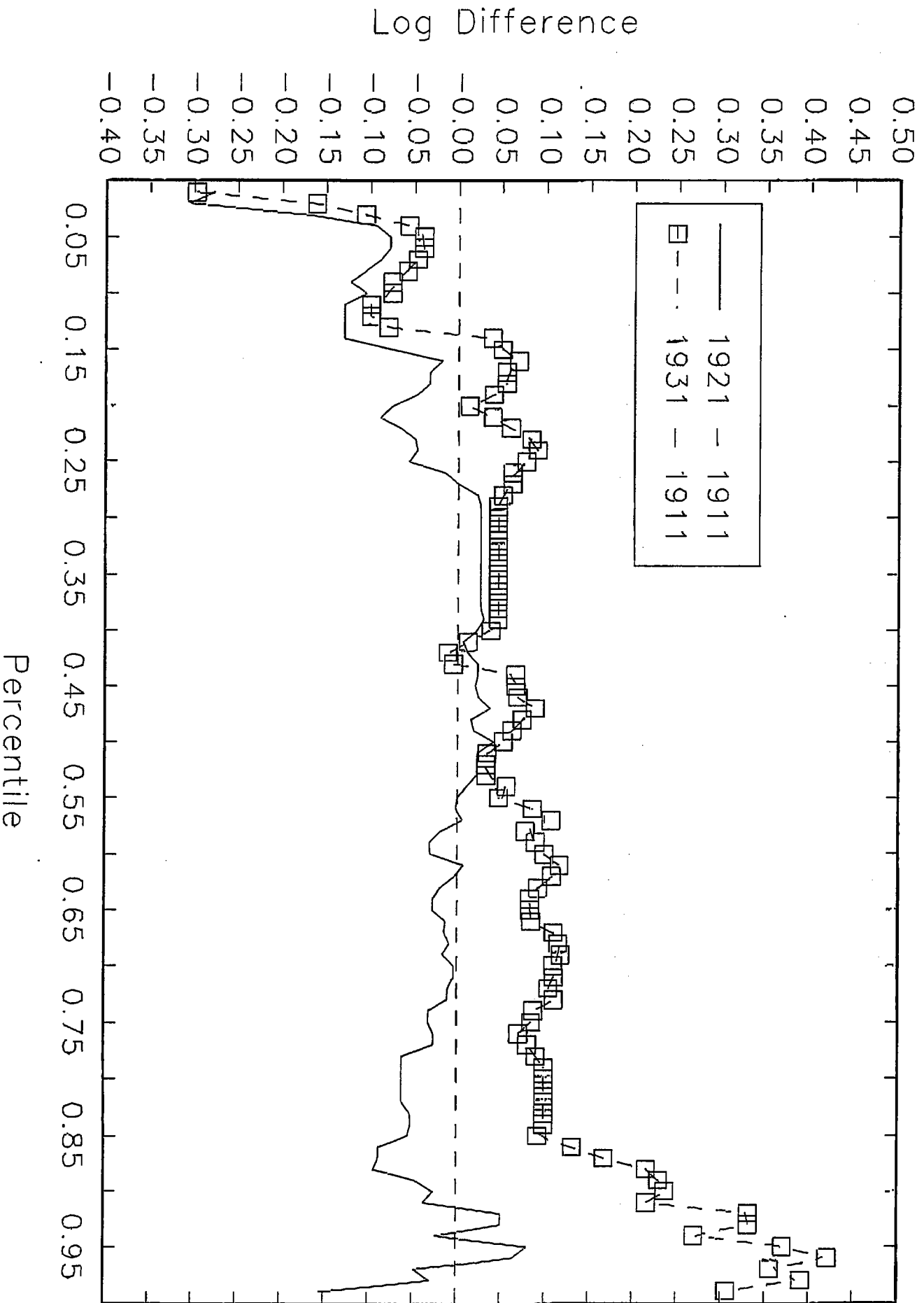


Figure 6: Differences in Log Percentiles, Implied Hourly Wages, 1921 versus 1911 and 1931 versus 1911



Real Wage

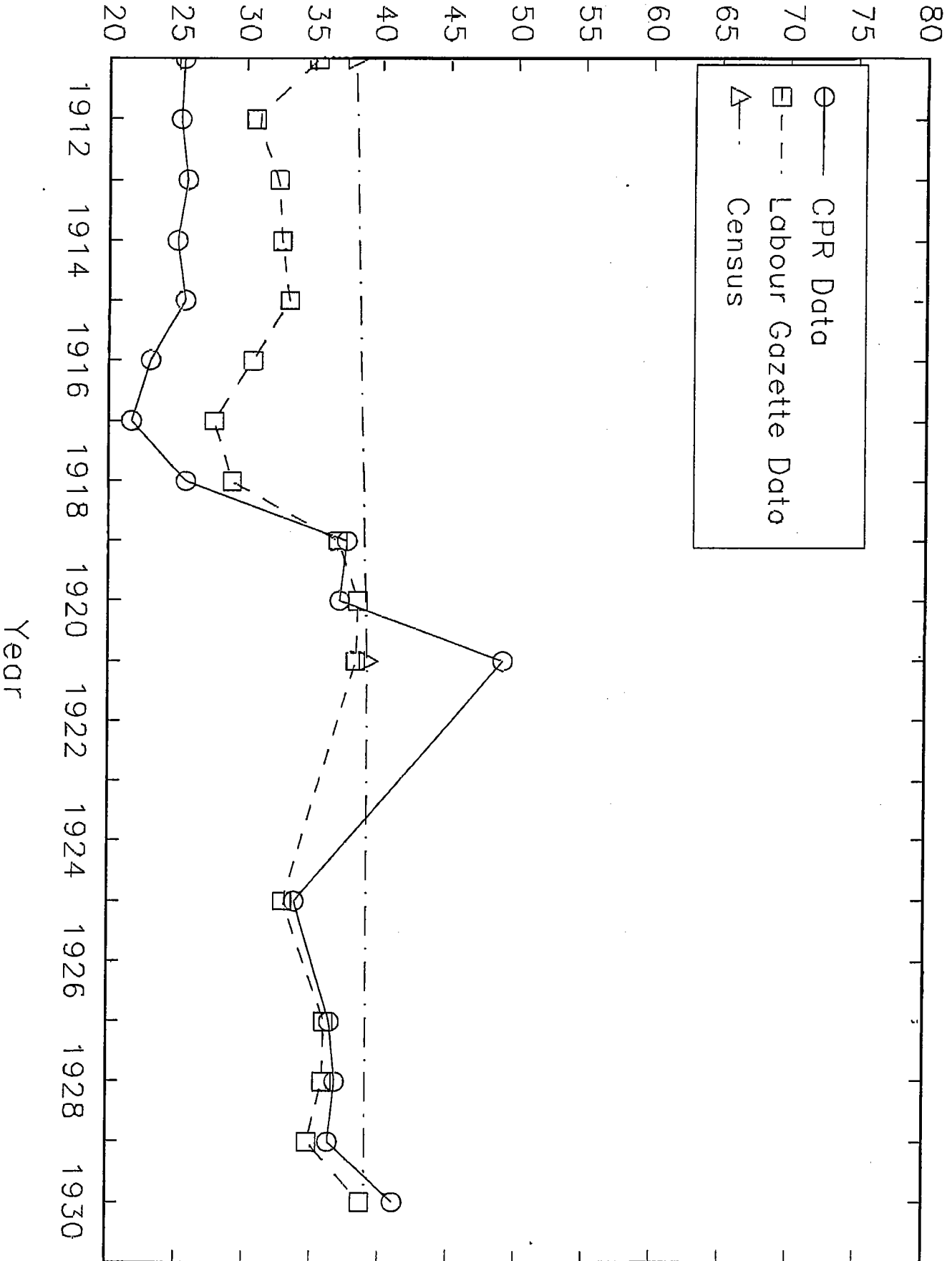


Figure 7: Real Wages, Labourers
1920/21 Cents

Real Wage

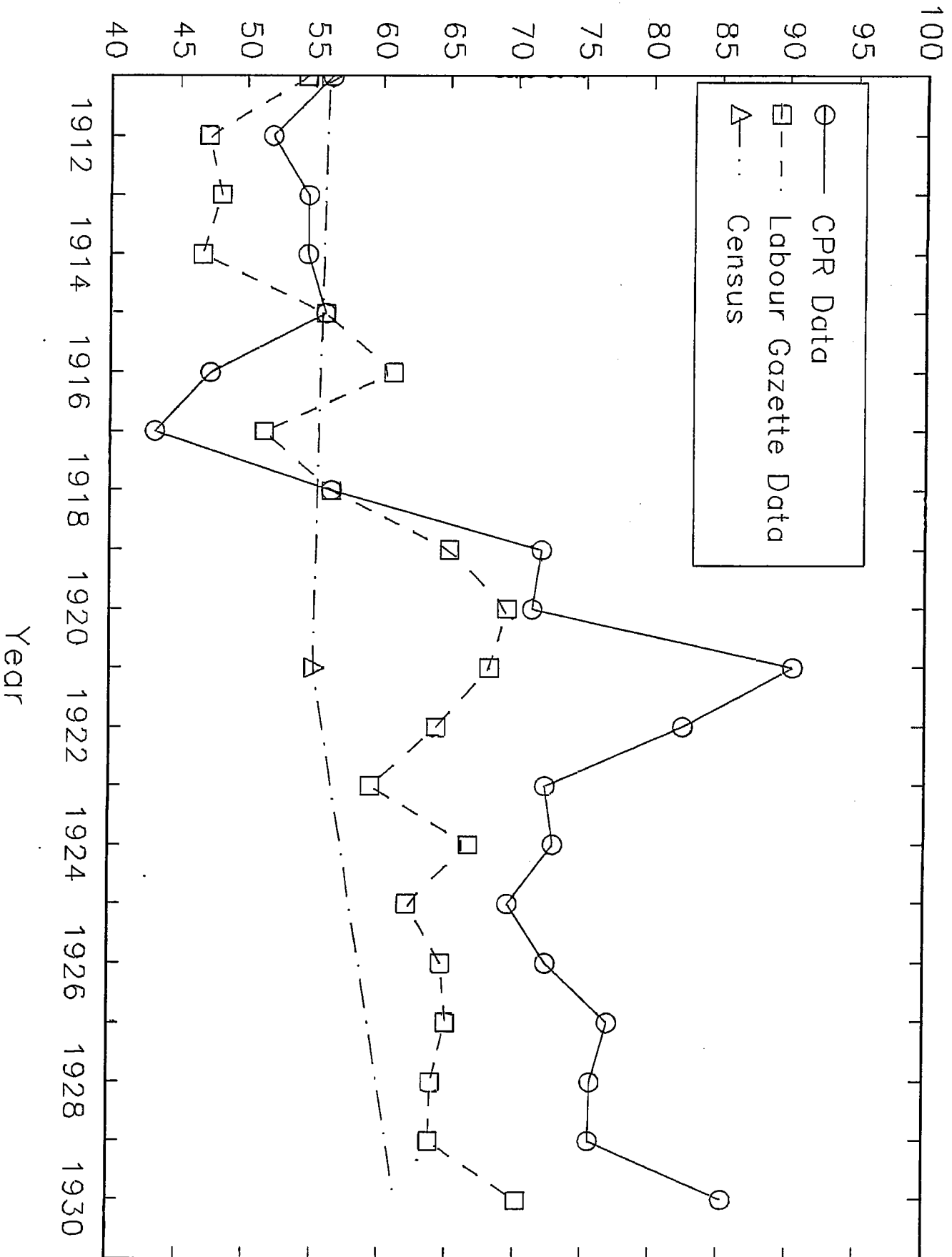


Figure 8: Real Wages, Machinists
1920/21 Cents

Figure 9: Wage Ratios

