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by

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NATIVITY AND INCOME DISTRIBUTION IN FRONTIER UTAH COMMUNITIES

ABSTRACT

Careful studies of the distribution of income in nineteenth-century United States have been hampered by a paucity of available data. This study undertakes the analysis of factors influencing the distribution of personal income in communities in the Great Basin region of the western United States for the years 1860-61 and 1870. The study utilizes estimates of full income by individual based on information contained in the General Economic Records of the Church of Jesus Christ of Latter-day Saints, demographic and economic data from the manuscript censuses of 1860 and 1870, and other relevant data from contemporary sources. Mean income and Gini ratios are calculated for nearly all Great Basin communities, and econometric analysis is undertaken to identify the impact on income distribution of changes in mean income, community size, crop destruction by grasshoppers, and the percentage of the population born in non-English speaking countries. The econometric results are compared to the results of an earlier study that looked at factors influencing income inequality for the Great Basin as a whole over the period 1855-1900. Of particular interest is the impact of ethnic mix on relative income inequality. While the earlier study found that Gini ratios for the Great Basin region rose as the fraction of the population born in non-English speaking countries increased, the current study finds that Gini ratios first rose, then fell as the percentage of the community born in non-English speaking countries rose. At the territorial level, grasshopper infestation increased relative inequality, but at the community level it decreased inequality. The completion of the transcontinental railroad allowed a few individuals in urban communities to earn large incomes in capital-intensive activities, increasing community income inequality, ceteris paribus, but community access to the railroad had a leveling effect on labor income and product prices, reducing community income inequality.
NATIVITY AND INCOME DISTRIBUTION IN FRONTIER
UTAH COMMUNITIES

I. Introduction

In recent decades economists have produced a large body of literature on the subject of economic justice or equity. Much of the literature deals with the distribution of income. While contemporary income distributions have been estimated for almost every country, and theoretical and empirical work has been directed toward identifying the factors that influence the distribution of income in various regions, there has been little analysis of income distribution in the nineteenth century, and even less analysis of income distribution by community within a given region.

An important barrier to the testing of income distribution models has been the unavailability of appropriate data. The data problem is particularly acute for those interested in studying nineteenth-century America. The Civil War income tax records provide the only U.S. data heretofore available for that period. Those records have not been very useful, however, because they cover on average the top five percent or less of the income distribution, the tax was evaded, and income was underreported. The first study of income distribution on the Great Basin frontier was conducted by Leonard J. Arrington [1956], based on the federal income tax records of 1866-72. In that study, Arrington demonstrates a significant increase in the degree of relative inequality among Utah's taxpayers from 1866-67 to 1871. He cites as the reason for increased income equality the completion of the transcontinental railroad in 1869, which resulted in increased opportunities for a few individuals to make large profits in mining, smelting, merchandising, and manufacturing. Because the scope of his study was limited by the available data, Arrington was able to examine only

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the very top of the income distribution, and was not able to estimate income distribution by community.

The current study identifies the determinants of income distribution in frontier Utah, based on individual income information contained in the General Economic Records of the Church of Jesus Christ of Latter-day Saints. This information, reported by individuals to ecclesiastical authorities, allows the calculation of mean incomes and Gini concentration ratios by community and for the territory as a whole. Using this data, Israelsen [1976] looked at the impact of the railroad on relative income inequality in Utah Territory for the period 1866-72, and Israelsen [1998] examined the impact of changes in mean income, population, urbanization, crop destruction by grasshoppers, and the percentage of the population born in non-English speaking countries on territorial income distribution over the 1855-95 period. The current study uses the same explanatory variables as does the 1998 study, along with crop failures and proximity to a railroad, to explain differences in income distribution among Utah communities in 1860-61 and in 1870. The results of the study are then compared to Israelsen’s 1998 results for the territory as a whole.

II. Data

The practice of tithepaying—paying 10 percent of full income to the church—was well-established among the Latter-day Saints by the 1850s. The amount of tithing owed by each individual was identified, and an accounting was made at the end of each year. At that time, accounts were settled by comparing the amount of tithing owed with the amount paid. The estimates of full income by individual that form the basis for this study are calculated as ten times the amount of tithing owed as indicated in the church records. For 1861, our sample includes 8,139 individuals, and for 1870, 10,867 individuals. These numbers represent about two-thirds of the territorial labor
force and four-fifths of Mormon workers in 1861 and somewhat over one-half of the territorial labor force and three-fourths of Mormon workers in 1870. The study includes practically all established communities in the territory in both years, 28 in 1861 and 65 in 1870. The measure of distributional inequality used in this study is the Gini ratio, which ranges from zero—absolute equality, to one—absolute inequality. The Gini ratios are calculated as maximum likelihood estimates based on the gamma distribution function. For 1861, the community Gini ratios range from .3937 to .7327, with an average community Gini ratio of .5424 and a territorial Gini ratio of .4782. For 1870, the Gini ratios range from .3368 to .7293, with an average community Gini ratio of .5307 and a territorial Gini ratio of .5595. The purpose of this study is to identify the factors that led to this strikingly large variation in the relative degree of income inequality across frontier Utah communities.

The independent variables used to explain differences in relative income inequality among communities include mean worker income by community (MEAN), the percent of community family heads born in non-English speaking countries (NBS), that percent squared (NES²), the number of income earners in the community (SIZE), the Gini concentration ratio for wealth by community (WG), and dummy variables for each of the following: grasshopper infestation (GH), grasshopper infestation where serious damage to crops was reported (GHD), and crop failure (CROP). Because the agricultural year spans over two calendar years, and grasshopper infestations generally occur either in the spring or the fall, one-year lagged values of the grasshopper and crop destruction variables are also used, and are indicated by the addition of an L to the variable name (GHL, GHDL, and CROPL). Data on grasshopper infestation and destruction are taken from contemporary newspaper accounts, diaries, and community, county, and territorial histories. Six other dummy variables are used to capture the effects of the railroad on income distribution. These
variables include communities through which a railroad passed (RR), communities within 25 miles of a railroad (RR25), and communities within 50 miles of a railroad (RR50). Railroad variables lagged one year are represented by an L added to the variable name (RRL, RRL25, and RRL50). Railroad dummy variables are based on territorial maps and historical accounts. Because of the extreme variation in physical and meteorological conditions from north to south through Utah Territory, dummy variables are included for the northern (N) and southern (S) regions of the territory, with the central region being the control.

III. Model

The basic model of community income inequality is described in functional form as follows:

(1) \[ GINI = F(\text{MEAN}, \text{NES}, \text{NES}^2, \text{SIZE}, \text{WG}, \text{GH}, \text{GHD}, \text{GHL}, \text{GHDL}, \text{CROP}, \text{CROPL}, \text{RR}, \text{RR25}, \text{RR50}, \text{RRL}, \text{RRL25}, \text{RRL50}, \text{N}, \text{S}) \]

The estimated model for 1860-61 uses 1860 census data to calculate NES and WG. No grasshopper infestations were reported for any of the communities in the sample for 1860, and no crop failures were reported for either 1860 or 1861. Hence, GHL, GHDL, CROP, and CROPL are excluded from the 1860-61 model. Because the transcontinental railroad was not completed until 1869, the railroad variables are also excluded from the 1860-61 model. GINI, MEAN, SIZE, GH, and GHD data are for 1861. The 1870 model contains all variables.

\textit{A priori}, it is not clear in every case whether an increases in an independent variable will cause the Gini ratio to increase or decrease, \textit{ceteris paribus}. Most empirical time series studies have found an inverted U-shaped relationship between mean income and the Gini ratio over the course of economic development, with increases in mean income being associated with increasing income inequality during the early stages of industrialization and with decreasing income inequality during
later stages of industrialization. Israelsen [1998] found that increases in mean income were associated with increased inequality in Utah Territory between 1855 and 1895, indicating that Utah was in the early stages of economic development throughout the territorial period. Within a small frontier community, one or two individuals who gain large incomes can significantly alter average community income and the Gini ratio in the same direction. On that basis, we would expect a positive relationship between mean community income and community income inequality in this study, hence, the expected sign of the estimated MEAN coefficient is positive.

The percentage of family heads born in non-English speaking countries would be expected to affect community income inequality if non-English speaking immigrants had relatively low incomes because of lower skills, more difficulty in transferring human capital, or because of problems related to communication or discrimination. If such were the case, an increase in the fraction of family heads born in non-English speaking countries would be expected to increase relative income inequality, at least until the fraction became significantly large. At some high percentage of non-English speaking foreign born, the process might well reverse, with relative income inequality being reduced as almost all workers earned similar incomes. This argument will not hold true if non-English speaking workers experienced large differences in incomes relative to each other. Based on the first argument, we expect that the sign of the NES regression coefficient will be positive and the sign of the NES\(^2\) coefficient will be negative, reflecting the expected inverted U-shaped relationship between GINI and NES discussed above.

To the extent that the size of a community can be viewed as a measure of urbanization, we expect the estimated coefficient of SIZE to be positive, reflecting the high concentration of capital characteristic of early stages of urbanization, and the opportunities for a relatively few individuals to take advantage of monopoly positions created by their capital ownership.
The impact of wealth inequality on income inequality is expected to be positive, since wealth produces income. Hence, the less equal the distribution of wealth in a community, the less equal should be the distribution of income, *ceteris paribus*. The expected sign of WG, therefore, is positive.

Another factor that might have a significant impact on income inequality in early Utah communities is the marginal nature of agriculture on the Utah frontier. With most individuals deriving most of their incomes from agriculture, periodic disasters such as grasshopper invasions, late and early frosts, droughts, floods, and plant diseases would tend to almost completely destroy agricultural incomes in various regions of the territory. While this would have the effect of increasing the disparity in income across the territory, it might be expected to reduce inequality within the affected communities, as all incomes, large and small, would be driven toward zero. Of course, such problems experienced by only a few individuals in the community would have the opposite effect on income distribution. The grasshopper variables and the crop failure variables should increase or decrease income inequality according to the severity of the problem, and the degree to which the entire community was affected. Other things equal, the more severe and widespread the destruction, the more likely the Gini ratio would fall. Thus, "grasshopper infestation" might increase income inequality, while "grasshopper destruction" might decrease it. On the basis of this argument, we expect the signs of the estimated coefficients for GH and GHL to be positive, and the signs of GHD and GHDL coefficients to be negative. Because reported crop failures, like grasshopper destruction, are likely indicative of serious economic problems at the community level, the expected signs of CROP and CROPL coefficients are also negative.

In 1869, the transcontinental railroad was completed in Utah. The railroad brought about profound changes in Utah's economic conditions by greatly reducing the costs of transporting goods
and resources within the territory and between Utah and the markets of the East and West. Israelsen [1976] found that the widening and deepening of markets associated with the completion of the railroad led to reductions in income inequality in the Great Basin region as a whole. The railroad's expected effect on intracommunity income inequality is less clear. As connecting lines were built in or near individual communities, lower transportation costs led to a reduction in the prices of imports relative to those of exports. This effect, particularly in the short run, would be beneficial to those engaged in the import and export of goods, and detrimental to those engaged in the production of import-competing goods. To the extent that both groups were represented in a community, relatively income inequality might increase as a result of the railroad. However, in the long run, the expansion of markets and greater mobility of resources brought about by lower transportation costs would allow for greater specialization of labor and less variation of wages both between and within communities. On the basis of this argument and the results of the 1976 study, we assign negative expected signs to all of the railroad variable coefficients.

The great differences in weather, soil, growing season, availability of water, etc., between the northern, central, and southern parts of Utah Territory suggest that dummy variables might be used to capture regional differences in the distribution of income. It is not apparent in which direction potential regional differences may lie, so we do not place an expected sign on the coefficients for N and S.

IV. Results

1860-61

Table 1 reports the regression results for the 1860-61 model. In that regression, the $R^2$ and adjusted $R^2$ are .41 and .25, respectively, and the F-statistic is significant at the .11 level. Only one variable, MEAN, has an estimated coefficient that is statistically significant at the .10 level or lower.
Table 1. Regression Results for Gini Ratios of Utah Community Income, 1860-61

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Expected Sign</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.6102</td>
<td></td>
<td>7.124***</td>
</tr>
<tr>
<td>MEAN</td>
<td>-2.309E-04</td>
<td>+</td>
<td>-2.476**</td>
</tr>
<tr>
<td>NES</td>
<td>3.346E-03</td>
<td>+</td>
<td>1.291</td>
</tr>
<tr>
<td>NES^2</td>
<td>-6.153E-05</td>
<td>-</td>
<td>-1.306</td>
</tr>
<tr>
<td>SIZE</td>
<td>2.115E-05</td>
<td>+</td>
<td>0.482</td>
</tr>
<tr>
<td>WG</td>
<td>0.04632</td>
<td>+</td>
<td>0.336</td>
</tr>
<tr>
<td>GH</td>
<td>-0.04957</td>
<td>+</td>
<td>-0.503</td>
</tr>
<tr>
<td>N</td>
<td>0.08132</td>
<td></td>
<td>1.197</td>
</tr>
<tr>
<td>S</td>
<td>-0.03699</td>
<td></td>
<td>-1.081</td>
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</tbody>
</table>

n = 28  
R^2 = 0.446  
Adjusted R^2 = 0.213  
F-Statistic = 1.91  
*statistically significant at .10  
**statistically significant at .05  
***statistically significant at .01

Of the remaining variables, four—NES, NES^2, N, and S—have t-statistics greater than one. Contrary to our expectations, mean income is inversely related to the Gini ratio for Utah communities in 1860-61. Whereas for the territory as a whole, increases in mean income over time resulted in increased inequality, higher mean income within a community in 1860-61 was associated with lower inequality. This result can be explained on the basis of the kind of economic activity that characterized typical Utah communities before the completion of the transcontinental railroad. In 1860, Utah had been settled for only 13 years. Agriculture was the dominant economic activity throughout the territory, and most wealth was in the form of land. In a typical community, nearly every family was engaged in agriculture, most of them full time. Under those circumstances, mean income was likely to be higher in communities with more favorable agricultural conditions. More favorable agricultural conditions meant higher incomes for virtually everyone in the community.
As all incomes rise, relative income disparity typically decreases. Hence, within communities, higher mean income meant less inequality, even though for the territory as a whole, increases in mean income over time were associated with more inequality.

The estimated coefficients for the nativity variables show the expected signs, indicating an inverted U-shaped relationship between the percent of family heads born in non-English speaking countries and the degree of income inequality within a community. As the percentage increased, relative income inequality increased until the non-English speakers dominated a community, after which further increases in the percentage of those born in non-English speaking countries reduced relative income inequality. This result is consistent with the hypothesis that those born in non-English speaking countries had lower incomes than native English speakers, but is not proof of that hypothesis. The result is also consistent with the hypothesis that those who were not native English speakers had generally higher incomes, or with other, more complex hypotheses.

The regional dummy variable coefficients indicate that communities in the northern part of the territory had about 15 percent more relative income inequality than the average for the territory, and those in the south had about 7 percent less, ceteris paribus.

The coefficients for the other variables are estimated with relatively low precision, as indicated by their t-statistics, but the signs are interesting. The estimated coefficients for SIZE and WG are of the expected positive signs, indicating that urbanization increased relative income inequality, and that more wealth inequality led to more income inequality. The unexpected negative sign on the GH coefficient may indicate that the grasshopper infestation of 1861 was associated with widespread crop destruction in affected communities, with a leveling effect on incomes.
Table 2 shows regression results for the 1870 model. The $R^2$ and adjusted $R^2$ are .570 and .389, respectively, and the F-statistic is significant at the .01 level. In the 1870 model, four variables have estimated coefficients that are statistically significant at .10 or lower, and three other variables have t-statistics larger than one. It is clear from the regression results that the determination of

<table>
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<th>Coefficient</th>
<th>Expected Sign</th>
<th>t-Statistic</th>
</tr>
</thead>
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<tr>
<td>Constant</td>
<td>0.3981</td>
<td>+</td>
<td>6.477***</td>
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<tr>
<td>MEAN</td>
<td>-1.951E-05</td>
<td>+</td>
<td>-1.106</td>
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<tr>
<td>NES</td>
<td>2.728E-04</td>
<td>+</td>
<td>0.223</td>
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<td>NES$^2$</td>
<td>-1.151E-05</td>
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<td>-0.572</td>
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<tr>
<td>SIZE</td>
<td>1.728E-04</td>
<td>+</td>
<td>2.939***</td>
</tr>
<tr>
<td>WG</td>
<td>0.2032</td>
<td>+</td>
<td>2.102**</td>
</tr>
<tr>
<td>GH</td>
<td>0.01929</td>
<td>+</td>
<td>0.727</td>
</tr>
<tr>
<td>GHDL</td>
<td>0.01215</td>
<td>-</td>
<td>0.403</td>
</tr>
<tr>
<td>GHL</td>
<td>-0.05380</td>
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<td>-1.568</td>
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<tr>
<td>GHDL</td>
<td>0.03347</td>
<td>-</td>
<td>0.885</td>
</tr>
<tr>
<td>CROP</td>
<td>-0.01059</td>
<td>-</td>
<td>-0.243</td>
</tr>
<tr>
<td>CROPL</td>
<td>0.02124</td>
<td>-</td>
<td>0.345</td>
</tr>
<tr>
<td>RR</td>
<td>0.09031</td>
<td>-</td>
<td>1.105</td>
</tr>
<tr>
<td>RR25</td>
<td>-0.05099</td>
<td>-</td>
<td>-0.893</td>
</tr>
<tr>
<td>RR50</td>
<td>-0.02991</td>
<td>-</td>
<td>-0.804</td>
</tr>
<tr>
<td>RRL</td>
<td>-0.1872</td>
<td>-</td>
<td>-1.817*</td>
</tr>
<tr>
<td>RRL25</td>
<td>-0.0459</td>
<td>-</td>
<td>-0.629</td>
</tr>
<tr>
<td>RRL50</td>
<td>-0.0754</td>
<td>-</td>
<td>-1.995**</td>
</tr>
<tr>
<td>N</td>
<td>0.02968</td>
<td></td>
<td>0.903</td>
</tr>
<tr>
<td>S</td>
<td>-0.02804</td>
<td></td>
<td>-0.621</td>
</tr>
</tbody>
</table>

$n$ 65
$R^2$ .570
Adjusted $R^2$ .389
F-statistic 3.14
*statistically significant at .10
**statistically significant at .05
***statistically significant at .01
relative income inequality in Utah communities was different after the completion of the railroad than it had been in pre-railroad years. The most obvious difference in 1870 relative to 1860-61 is the greatly increased significance, both economic and statistical, of urbanization and wealth inequality in determining community income inequality in 1870. The estimated coefficient for SIZE is an order of magnitude larger in the 1870 regression, and it is statistically significant at .01, whereas it is not statistically significant in the 1860-61 regression. Similarly, the estimated coefficient for WG is more than four times as large in the 1870 regression as in the 1860-61 regression, and is statistically significant at .05. Both coefficients have the expected signs, indicating that urbanization was generating increased inequality within communities, and greater wealth inequality was leading to greater income inequality. These results are consistent with the idea that the completion of the railroad started Utah down the path of economic development, with concentration of capital and income in urban communities, and are also consistent with the 1998 study that showed a strong positive effect of urbanization on relative income inequality for the territory as a whole.

Another indication of the change in Utah's economy accompanying the completion of the railroad is the change in the economic and statistical significance of mean income in the determination of relative income inequality at the community level. Whereas MEAN is the most significant determinant of the Gini ratio in the 1860-61 regression, its estimated coefficient is not statistically significant at .10 in the 1870 regression. Furthermore, the estimated coefficient is an order of magnitude smaller in the 1870 regression. Although the sign of the coefficient remains negative in 1870, mean income is clearly not an important determinant of relative income inequality at the community level after the completion of the railroad.
While the completion of the railroad led to structural changes associated with increased inequality as economic development began, community proximity to a railroad was also important, as indicated by the estimated railroad coefficients. All but one of the railroad proximity coefficients have the expected negative sign, indicating that close access to the railroad reduced relative income inequality within the community, other things equal. These results are consistent with the hypothesis that the greater mobility of resources and the widening and deepening of markets associated with reduced transportation costs led to more uniformity in labor and product prices between and within communities. The two railroad proximity coefficients that are statistically significant are RRL, at .05, and RRL50, at .10. Apparently, the impact of the railroad in reducing income inequality took about a year to be felt. If the railroad went through a community in 1869, community income inequality was about 35 percent less than the territorial average by 1870. For communities within 50 miles of a railroad in 1869, inequality was 14 percent less than average in 1870. The lag in the impact of the railroad in reducing community income inequality is emphasized by the positive contemporary impact on inequality of the railroad passing through a community in 1870. The estimated coefficient for RR, however, is only half the magnitude of the RRL coefficient, and is not statistically significant at .10, so we can be confident in concluding that railroad proximity reduced intracommunity income inequality.

The estimated coefficients for the nativity variables show the expected signs in the 1870 regression. However, the variables are not as important in determining community income inequality in the post-railroad period. The estimated coefficients and t-statistics for both variables are much smaller in the 1870 regression than in the 1860-61 regression. It is likely that the increased demand for labor in Utah during and after the completion of the railroad reduced labor market
discrimination and, therefore, reduced the importance of the ethnic composition of communities on income inequality.

In general, the grasshopper and crop destruction variables are not important determinants of income inequality at the community level in 1870. Of the six variables in this group, only two coefficients show the expected sign, and none are statistically significant at .10. The most notable of these variables is GHL, which is significant at .12. The coefficient is negative, rather than positive, however, indicating that communities affected by the grasshopper infestation of 1869 must have suffered general crop destruction during the 1869-70 agricultural year. The usefulness in the model of the grasshopper and crop destruction variables as determinants of community income inequality is somewhat less than expected, and may be due to the subjectivity of the reports that formed the basis of the underlying data.

The regional dummy variables show the same pattern for the 1870 regression as for the 1860-61 regression. Neither estimated coefficient is statistically significant, and their magnitudes indicate that regional differences in income inequality were smaller in 1870 than in the pre-railroad period. Relative inequality in northern communities in 1870 was about 5 percent greater than the territorial average, and inequality in southern communities was about 5 percent less than average. The reduction in regional differences in community income inequality might also be attributed to the expansion of markets accompanying reduced transportation costs after 1869.

V. Conclusions

Israelsen [1998] demonstrates convincingly that Utah Territory was in the early stages of economic development in the 1855-95 period. He finds that urbanization, the fraction of the population born in non-English speaking countries, mean income, and grasshopper infestation are
positively related to relative income inequality for the territory as a whole. The relationships are highly significant both in the economic sense and in the statistical sense. The current study finds that what was true for the territory as a whole was not necessarily true at the level of the community. In Utah communities, size became an important determinant of relative income inequality only after the completion of the railroad. In contrast to the territorial study, increases in mean income at the level of the community actually reduced relative income inequality, particularly before the completion of the transcontinental railroad. While the fraction of non-native English speakers was positively related to the territorial Gini ratio throughout the 1855-95 period, at the community level, increases in the percentage of family heads born in non-English speaking countries increased the Gini ratio only up to a point, then the relationship was reversed. At the territorial level, grasshopper infestation increased relative inequality, reflecting the fact that such infestation tended to be regionalized or localized. At the community level, grasshopper infestation reduced relative inequality, as virtually all income-earners found their incomes leveled toward zero. Finally, it is clear that the completion of the transcontinental railroad led to profound changes in the determination of relative income inequality at the community level. In particular, access to the railroad reduced community income inequality, other things equal, through a leveling effect on labor income and product prices; but at the same time, the railroad allowed a few individuals in urban communities to earn large incomes in capital-intensive activities, which increased inequality, as suggested by Arrington.

While this study has helped create a more complete picture of income inequality on the western frontier, some questions remain. Of particular interest is the question of how the ethnic makeup of a community affected relative inequality. Although the results of both this study and the 1998 study are consistent with the hypothesis that non-native English speakers earned lower incomes
than did native English speakers, the results are also consistent with other hypotheses. Only an examination of the micro data can provide the final answer.

References


General Economic Records (MSS.). Church Archives, Church of Jesus Christ of Latter-day Saints.

