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INCOME INEQUALITY AND GERMAN INDUSTRIALIZATION
A COMMENTARY ON C.-L. HOLTFRERICH AND W. FORSTMANN

Paul B. Huber[+]

I.

The railroad was the most significant technological development of the 19th century. And it generated some of the most precise and detailed quantitative records, not only for Germany but for other countries as well. Statistical giants of an earlier era, such as Ernst Engel, were well aware of this. Seminal efforts and imaginative analyses by Fogel, Fishlow, and Fremdling have reintroduced economic historians to many of these data, but the mother lode is rich and as yet only slightly exploited.[1] One therefore welcomes an attempt to evaluate mid-19th century German railroad statistics on wages and salaries.

Using these data, Holtfrerich and Forstmann (hereafter H&F) address two questions: Did the process of industrialization change regional income differentials; and did it change occupational (skill) differentials? After a brief introduction, their essay falls into three loosely connected parts:

(1) presentation of theories of regional development,
(2) calculation and analysis of cross-sectional coefficients of variation for wages of day labourers with various German railroads, and
(3) calculation and analysis of occupational income differentials for seven types of salaried employees on three railroads.

H&F's findings in part (2) are in their own words "unclear": although there are fluctuations in the coefficients of variation from year to year (period to period), there appears to be no time trend. This absence of trend also applies to daily wages in the Prussian forestry administration, a result which differs from that of Hesse.[2] In part (3), the authors find that occupational differentials were reduced and that salary levels of technically-trained employees fell relative to those in administration over the third quarter of the 19th century.

II.

Both substantive and methodological comments appear warranted. The latter will be made below in part III, where the analytical apparatus is briefly reviewed. In the remainder of this section, the authors' analytical framework is accepted, and questions are raised regarding its application and interpretation.

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1) Do railroad wage and salary data accurately indicate income levels for comparisons among railroads and among occupations? Fremdling (following Engel) suggests that the maximal and minimal salary figures for "Privatbeamte" exclude savings bonuses, travel money, lodging subsidies, meals, and coal bonuses, and thus on average may be less than half of total income.(3) Fremdling gets, for example, average annual incomes for such Beamte and Hilfsarbeiter of 822 Marks in 1854 and 1433 Marks in 1874; and for day labourers, income levels only half as large. The average fixed salary levels for the three railroads selected by H&F are about a third as large as Fremdling's estimates for the same years. Converting H&F's average annual salary rates to hourly rates (at 3000 hours per year) expressed in silver Groschen, one gets values of 0.61 Sg./hr in 1854 and 1.54 Sg./hr in 1874, rates which are only one-half to one-third of the rates they report paid to day labourers on the same railroads! Doubtless, practices with respect to non-salary emoluments varied from railroad to railroad as well as over time; hence, extreme caution should be exercised in interpreting the data in their Tables 6 through 13. Despite this caveat, H&F's conclusions would be qualitatively unaffected if changes in non-salary remuneration for the three railroads examined in these tables were very slow or did not diverge among occupational groups.

2) Are the data used by H&F free of error; if not, how sensitive are their calculations? Statisticians in mid-19th century possessed neither hand calculators nor Xerox machines; they made mistakes not only in calculation, and transcription but also in typesetting, just as they encountered difficulties in defining statistical categories and collecting data.(4) It cannot automatically be assumed that all published statistics are accurate. Of a number of figures used by H&F which appear to be questionable, take two 79amples from 1853. The hourly wage values of 0,566 for the Main-Weser railroad (Table 1, column 4) and of 2,028 for the Berlin-Stettin railroad (Table 2, column 2) appear unduly low and high respectively. If these figures should have been, say, 0,666 and 1,028 respectively, values which appear more reasonable in comparison to the data for 1852 and 1854 and the experience of other lines, then results in Table 4 would be sharply affected: the coefficients of variation for 1853 would then become 15.4 and 12.3 for rail and transport administration respectively, not 19.1 and 22.0.

These - admittedly hypothetical - values would eliminate a large interannual fluctuation, and thus prima facie appear more "reasonable" than those reported. The lesson to be drawn is not that these "reasonable" values are in fact more correct than those of H&F, but instead that their results are indeed very sensitive to errors in the underlying data, a point which H&F themselves come close to recognizing.(5)

3) Are the railroads selected by H&F representative, so that results can be generalized? As the authors recognize, their data relates mainly to Prussian or north German lines. Important railways are included in their analysis of day labourers' wages, but there are also some under-represented areas in Tables 1 and 2, notably the Kingdom of Saxony and the provinces of Silesia, Posen, Pomerania, and Hanover. A comparison of the data for the overlapping group of railroads in Tables 3 and 4 might have clarified the question of representativeness.

With respect to occupational salary structure, only three railroads are examined by H&F. Two, the Berlin-Potsdam-Magdeburg line and the Altona-Kiel

line, carried high volumes of traffic. The third, the Lower Silesian Branch line (a minor part of the Upper Silesian Railroad) was, in contrast, of trivial importance.(6)

4) Are there sufficient observations to permit statistically significant statements? With respect to day labourers, there is clearly no problem. The 5 to 23 railroads analysed by H&F would easily have averaged more than a hundred man-years of such employment in each year examined. Thus, modest differences over time and space in the hourly rate of compensation may be significant. With respect to the fixed-rate occupational pay structure, the situation is far different. Leaving aside the NsZ line for reasons mentioned above, there were at most on the other two railroads combined a half-dozen department engineers, master machinists, and general managers. On the A-K line, there were only two or three clerks. Hence, the only occupations for which comparisons are likely to be statistically valid for both lines are rail guards, firemen and locomotive engineers.

In light of the foregoing critical comments, what can be said about this paper's empirical results? First, lack of time trend in the coefficient of variation of railway hourly wages in mid-19th century appears valid. This may be an important finding; however, it is consistent not only with unchanging regional income disparities, but with many other possibilities as well. Second, without further information on non-salary emoluments, conclusions regardig time trends of income by occupation appear premature. If one instead focuses on salary differentials, firemen clearly lost relative to rail guards (but on the B-P-M line, not relative to clerks). Locomotive engineers on the B-P-M line appear to have maintained their 300 % differential, while those on the A-K line had an initially larger differential eroded to about the same level. With respect to other occupations, no conclusions are warranted. Third, recalculation of coefficients of variation for forestry labourers' wages by H&F improves somewhat upon Hesse's calculations by making fuller use of the available data while improving consistency of coverage.

III.

To explore cliometrically the effects of industrialization on regional and occupational income differentials one needs
(a) consistent and meaningful definitions of income and industrialization,
(b) theories of income differentiation by region and occupation which include industrialization as an argument,
(c) empirical "indicators" or variables which can be used to verify the relationships posited by the theories, and
(d) tests of significance.

Regarding occupational income differentiation, the authors offer little in the way of theory; hence here their empirical efforts must be regarded as exploratory. In the rest of their essay, H&F closely follow Hesse.(7) This is regrettable, because Hesse's theory and methodology are unhappily married. Consider the following issues:

5) Can it be assumed that real and nominal income differentials by region were congruent and arose from identical causes? Since the cost of foodstuffs varied sharply by region, with differentials in rye prices between West and

East shrinking from roughly 75 % in the pre-railroad era to 20 % by the turn of the century, it should be clear that a distinction between real and nominal incomes is crucial for any thorough analysis of regional development in 19th century Germany.(8) Unlike Hesse, H&F focus solely on nominal incomes, but although they recognize the possible influence of business cycles and the possible relevance of variations in the cost of living (their footnotes 20 and 21), they do not incorporate these factors into their analysis.

6) Do coefficients of variation permit a meaningful regional analysis? This statistic compresses all cross-sectional information into a single number. If the problem addressed is the degree of market integration among regions, this is immaterial but if explanations for regional divergences are sought, then such a statistical methodology makes impossible the association of regional characteristics and regional income levels at any level of aggregation. Furthermore, the coefficient of variation is ambiguous. For instance, it might have the same value whether industrialized regions had the lowest or the highest incomes, or despite substantial changes in regional leadership. In the case of the railroad data used by H&F, it is notable that two railroads with consistently above-average rates of pay in Table 2 (the Ostbahn and the Niederschlesisch-Märkische) are located in the supposed low-income East, while the Cologne-Minden line in the West paid below-average wages in the latter part of the period reviewed.

7) Are reported fluctuations in the coefficient of variation statistically significant? Most of Hesse's calculations involve nine to thirteen observations, those of H&F five to twenty-four. For statistical significance at the 95 % level, application of the F distribution yields critical bounds for the ratio of the tested value to the mean of the sample distribution ranging from 2.53 to 1.42. On this basis, only one of H&F's reported values (6.26 in 1852, Table 3) involves a statistically significant fluctuation. Similarly, Hesse's results on physician density, average income tax, and masons' wages involve no statistically significant fluctuations.(9)

IV.

The foregoing issues testify to the difficult challenges posed by cliometry. Quantification in no way relieves the cliometrician of the economic historian's responsibility to weigh the quality of the evidence painstakingly and to reconstruct the past faithfully; instead it introduces new and demanding hurdles of an econometric nature, while opening promising and hitherto unmapped avenues of historical enquiry. The authors are to be commended for accepting these challenges and encouraged to pursue these initial investigations.

FOOTNOTES

1   Fogel, Robert W., Railroads and Economic Growth, Baltimore 1964; Fishlow, Albert, American Railroads and the Transportation of the Antebellum Economy, Cambridge, Mass. 1965; and Fremdling, Rainer, Eisenbahnen und deutsches Wirtschaftswachstum, 1840-1879, Dortmund 1975. For Germany, see also Spree, Reinhard, Die Wachstumszyklen der deutschen Wirtschaft von 1840 bis 1880, Berlin 1977 and Huber, Paul B., Die

deutsche Eisenbahnentwicklung: Wegweiser für eine zukünftige Fernschnellbahn?, Köln 1978.

2 Hesse, Helmut, Die Entwicklung der regionalen Einkommensdifferenzen im Wachstumsprozess der deutschen Wirtschaft vor 1913, in: Fischer, Wolfram (ed.), Beiträge zu Wirtschaftswachstum und Wirtschaftsstruktur im 16. und 19. Jahrhundert, Berlin 1971. Hesse (p.276) reports "an initial divergence and later (light) convergence of the rate of pay" of foresters over the period 1820 to 1910.

3 Fremdling, Eisenbahnen, pp. 174-183. See also Engel, Ernst, Der Preis der Arbeit bei den deutschen Eisenbahnen in den Jahren 1850, 1859 und 1869, in: Zeitschrift des Königlich Preußischen Statistischen Bureaus, 4 (1874), pp. 93-128.

4 For a contemporary commentary on the quality of official statistics, see, inter alia, Reden, Friedrich W. v. Deutschland und das übrige Europa: Handbuch der Bodens-, Bevölkerungs-, Erwerbs- und Verkehrsstatistik, Wiesbaden 1854.

5 Perhaps this is the appropriate juncture to note that in calculating coefficients of variation in Tables 3-5, H&F have not corrected for degrees of freedom. This does not affect their comparisons over time, but it does somewhat influence comparisons among different numbers of railroads at the same point of time in Tables 3 and 4.

6 These lines are referred to below as the B-P-M, A-K, and NsZ lines respectively. Tables 7-9 indicate a forty-fold expansion in the numbers of locomotive engineers and firemen on the NsZ line between 1869 and 1874, a seven-fold increase in the number of master machinists, and a 26-fold increase in clerks, making its apparent fixed employment roll two to three times longer than that of the B-P-M railway. The source of this anomaly is unclear. On the development of these lines, see Kühn, Ernst, Die historische Entwickelung des Deutschen und Deutsch-Österreichischen Eisenbahn-Netzes vom Jahre 1838 bis 1881, in: Zeitschrift des Königlich Preußischen Statistischen Bureaus, Ergänzungsheft 12 (1883).

7 Hesse, Entwicklung, pp. 262-274, discusses in sequence export-based regional income differentiation, the sector theory of Clark and Fisher, the Myrdal thesis, and the Williamson thesis. He then calculates for the Prussian provinces for various periods, unweighted coefficients of variation for density of physicians, income tax per capita, income levels of the full-time teachers in elementary schools, and daily wages of forestry workers. For Germany, he calculates coefficients of variation for hourly wages of masons.

8 See Kuczynski, Jürgen, Zwei Studien über Handels- und Marktprobleme, in: Jahrbuch für Wirtschaftsgeschichte (1960), Part II, pp. 113-141. Note that the phrase "West-East Declivity" (West-Ost Gefälle) was coined by Kuczynski in this article in relation to agricultural prices, not incomes.

9 In testing a distribution of sample values to determine whether two differ significantly from each other, one must remember that even if all observations are truly taken from the same population, twenty samples will on average yield two values which "differ" at the 95 % level of

certainty. Applying the F-test to the two most extreme values is thus improper. Note that the critical bounds in the text are the square roots of the corresponding f-values.