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## Training Differences and Earnings Inequality: A Comparative Study of German and United States Youth

by Robert I. Lerman and Julia I. Lane

The stagnation of earnings and the rising inequality of earnings in the United States has become a major national concern. The highly publicized W.T. Grant Commission (1988) report, *The Forgotten Half*, focused attention on one part of the problem, the declining real earnings of America's non-college educated workers. Young workers (ages 25-34) with no more than a high school education have suffered sharp reductions in real earnings between 1975 and 1990. In contrast, United States college graduates have enjoyed modest increases in real earnings over this period (Council of Economic Advisers, 1992).

An extensive academic literature has confirmed the trends toward rising overall inequality and the widening earnings gap between high school educated workers and college educated workers. (Burtless 1990, Bound and Johnson 1992, Katz and Murphy 1992, Levy and Murnane 1992, and Murphy and Welch 1993). As Freeman and Katz (1993) point out:

"Many researchers using several data sources...have documented that wage inequality and skill differentials in earnings and employment increased sharply in the United States in the 1980s if not earlier."

In their comparison of OECD countries, Freeman and Katz suggest that a reduction of income inequality can be achieved by reliance on national strategies. One strategy attracting United States policy analysts (Hamilton 1990, Lerman and Pouncy 1990) is to develop a youth apprenticeship system based partly on the German system as well as apprenticeship systems in Switzerland, Austria, and Denmark. During the 1992 Presidential campaign, both Bill Clinton and George Bush embraced the idea. Several United States state governments — including Wisconsin, Maine, and Arkansas — are currently trying to implement a system that combines work-based training with traditional schooling for certifications in specific occupational areas.

The goal of the apprenticeship initiative is to improve the earnings potential of American non-college educated workers, by raising their productivity. The improvement in quality and increased relevance of apprenticeship training should make non-college educated American workers closer substitutes for college educated workers and thus should reduce the earnings gap between the two groups.

Until a youth apprenticeship system emerges in the United States, it will be impossible to verify this expectation. Yet, the issue is too important to ignore completely. We have chosen to examine the potential role of youth apprenticeship in influencing earnings inequality and skill differentials by examining the role of educational differences in the earnings patterns of German and United States young workers. Our focus is on workers in their 20s and early 30s and on the following questions:

- Do the United States and Germany generate different patterns of earnings differentials related to the level of education and training? In particular, is the earnings advantage of college educated workers higher in the United States than in Germany?
- To what extent is overall earnings inequality lower in Germany than in the United States? How do the two countries differ with respect to the stratification of workers grouped by their level of education and training? That is, are earnings highly segmented so that the earnings distributions of different educational groups have little overlap?

We use a recently developed technique developed by Yitzhaki and Lerman (1991) that examines mean earnings differences by educational groups in the context of overall inequality, as measured by the Gini coefficient. This approach decomposes inequality into a within-group term, a between-group term, and a third, interaction term that is a multiple of both within-group inequality and an index of group stratification.

This approach captures the extent to which educational groups are stratified with respect to earnings. Briefly, we view stratification as the extent to which groups do not overlap. In a completely stratified hierarchy, the highest earners of each educational group would always earn less than the lowest earners of the higher educational group. For example, no high school graduate would ever earn more than any college graduate. Thus, an increase in stratification can contribute to earnings inequality and increase the importance of the role of education.

It has already been empirically documented elsewhere (Lane et al. 1992) that apprenticeship and vocational training have long-term effects on earnings and employment outcomes for youth. Indeed, Abraham and Houseman (1992) tentatively suggest that one reason for the stability of the German income distribution is its distinct education and training system. Does this stability lead to lower inequality by lessening educational differentials in earnings? We try to answer this question by a United States-German comparative study that decomposes earnings inequality of young workers by educational subgroups as they age from their mid-20s to their early 30s. We use the U.S. National Longitudinal Survey (NLS) and the German Socio-Economic Panel (GSOEP) for the years 1984-1990, both of which follow individuals over time.

### Methodology

The decomposition of the Gini coefficient developed by Yitzhaki and Lerman (1991) calculates three terms by educational subgroups: 1) between-group inequality, which depends largely on differences in mean earnings by education subgroup; 2) wage inequality within educational categories, which captures the role of non-education factors; and 3) an interaction term that combines in a multiplicative way the joint effect of within-group inequality

and stratification. Thus, the decomposition, which uses the standard inequality measure (the Gini coefficient), illustrates a number of dimensions of earnings patterns by education.

The Gini decomposition is:

$$G = \sum S_i G_i + \sum S_i G_i Q_i (P_i - 1) + G_b \quad (1)$$

where  $S_i$  is the wage share of group  $i$ ,  $G_i$  is the Gini coefficient of group  $i$ ,  $Q_i$  is the stratification index of group  $i$ ,  $P_i$  is the population share of group  $i$ , and  $G_b$  is the between group Gini coefficient. The first term is the weighted sum of within-group Ginis, the last term is the between-group Gini coefficient, and the middle term is a weighted sum of the stratification indices.

Two of these terms need more discussion. The index of stratification,  $Q_i$ , of group  $i$  is defined as:

$$Q_i = \text{Cov}_i((F_i - F_{ni}), y) / \text{Cov}_i(F_i, y), \quad (2)$$

where  $y$  is wages,  $F_i$  is the normalized ranking of members of group  $i$  in terms of group  $i$ , and  $F_{ni}$  is what the normalized ranking of members in group  $i$  would be were they in group  $ni$  (all those outside group  $i$ ). Thus, the numerator of  $Q_i$  is the covariance over group  $i$  between wages and the differences in rankings between groups. The normalizing denominator is the covariance between wages and the own ranking in group  $i$ .  $Q_i$  has the following properties.

$Q_i = 1$  if no members of other groups are in the range of group  $i$ . In this case there is no overlapping membership in other strata.

$Q_i = 0$  if the normalized ranks of members in group  $i$  are identical to their normalized ranks in the overall population. In this case, group  $i$  does not form a stratum at all.

$Q_i < 0$  implies that the divergence within the rankings of members of group  $i$  in the overall population is greater than the divergence in their own group. In this case, it is not a homogenous group.

$Q_i = -1$  implies that group  $i$  is composed of two groups, with identical members in each group located at extremes of the overall distribution.

$G_b$  is a measure of between-group inequality as defined in Yitzhaki and Lerman (1991). It is twice the weighted covariance between each group's average income and the average rank divided by the overall mean income. Thus, in the Gini decomposition, the larger the level of between-group inequality the larger the  $G_b$  term, and hence the greater the role of education in contributing to inequality. The larger the within group dispersion, the greater the role of other characteristics.

## Data

The individuals selected for analysis from the GSOEP are those who were 24 to 28 years of age in 1984. We used gross monthly earnings<sup>1</sup> as the income measure and se-

lected all those who had positive earnings. We then classified the education categories as: apprentice (Gewerbliche or kfm. sonst. Lehre), trade school (Berufsfachschule, Schule, Gesundheitswesen, Fachschule, Beamtenausbildung or Ingenieurschule), university (Universität), and high school only, and deleted those individuals who did not fall into one of these categories. We then exploited the longitudinal nature of the data set by looking at the same individuals in 1990. We updated their education level to reflect their achievements in this period and used their 1990 gross monthly earnings as their income measure.

The sample from the NLS is chosen in a similar fashion, with youths aged 24 to 27 in 1984. The United States education categories differ from the German categories, partly because of the substantial variation in the educational structures of the two countries. Since we compare the effect of different institutional frameworks on the earnings differentials of young people in the two countries, we used the natural groupings in the United States: high school dropouts, high school graduates, subbaccalaureates training and baccalaureate qualifications. We defined the education levels by the highest grade completed in the year considered. The earnings measure is the annual wage and salary earnings (including military) divided by the hours worked in the calendar year, or average hourly earnings. The same individuals are used in the 1990 results, if they reported positive earnings. All calculations are weighted using the appropriate sample weights. Appendix Tables A1 and A2 present the descriptive statistics for the two samples.

## Education and Earnings Inequality of German Workers

Given how highly regarded the German apprenticeship system is, we expected to find that those completing apprenticeships enjoyed substantial wage advantages over high school graduates and only a modest discount relative to university graduates. In 1984, as Table 1 shows, this pattern broadly prevailed, especially for young women workers. Female apprentices actually averaged higher earnings than female university graduates and 52 percent above females with only a high school education. The advantage of apprenticeship and trade school was less for male workers, as they had lower earnings than university graduates and only a 22 percent gain over high school graduates.

Surprisingly, these gains of apprenticeship eroded substantially by 1990 as young workers moved into their early 30s. Note the sharp drop in the earnings ratios of apprentices to high school graduates. German young workers with a trade school degree also found their earnings advantage over high school graduates decline sharply. Equally

<sup>1</sup> The results are unchanged when we broaden the earnings definition to include one twelfth of the 13th or 14th month allowance and overtime.

Table 1

## Earnings Inequality of Young German Workers within and between Educational Groups: 1984 and 1990

Educational Groups	Mean Earnings of Group/ Mean Earnings of High School Only		Decomposition of Gini Coefficient	
	1984	1990	1984	1990
High School Only	1.00	1.00	0.27	0.32
Male	1.00	1.00	0.19	0.22
Female	1.00	1.00	0.32	0.36
Apprentices	1.33	1.15	0.18	0.26
Male	1.22	1.09	0.17	0.18
Female	1.52	1.13	0.18	0.33
Trade School	1.25	1.17	0.17	0.23
Male	1.23	1.09	0.12	0.17
Female	1.39	1.34	0.20	0.28
University	1.48	1.75	0.29	0.16
Male	1.48	1.50	0.25	0.13
Female	1.32	2.12	0.28	0.17
Overall Gini			0.21	0.27
Male			0.18	0.19
Female			0.23	0.33
Within-Group Component			0.20	0.25
Male			0.12	0.18
Female			0.20	0.30
Between-Group Gini			0.02	0.03
Male			0.08	0.02
Female			0.03	0.04
Stratification Term			0.00	-0.01
Male			0.00	-0.01
Female			-0.01	-0.02

striking is the dramatic rise in the advantage of university graduates over apprentices<sup>2</sup>.

One possibility for the declining premium for apprenticeship is that even those who do not participate in a formal apprenticeship receive a great deal of on-the-job training. This may reduce the importance of formal credentials. Alternatively, demand and supply conditions may have changed in the six-year period. This possibility is, as Abraham and Houseman (1992) point out, difficult to disentangle, although the longitudinal nature of the analysis makes supply factors less likely to be of importance than demand factors.

*Inequality Decomposition.* The results for the inequality decomposition are presented in Tables 1 and 2. Almost all of the Gini for all wage-earners took place within educational groups. In 1984, the within-group Gini was greater

than the overall Gini in two of the four educational categories and the between group Gini accounts for only about 8 percent of total inequality. Interestingly, wage dispersion was greatest at both ends of the education spectrum, possibly because some of the university graduates are just beginning their jobs.

As these individuals aged, total inequality increased, as did within-group inequality. Although the between-group component explained a greater proportion of inequality (now over 11 percent), this was still not the main cause of wage dispersion. In 1990, wage dispersion was greatest within the least educated groups and least within the most educated group — which suggests that the least educated were more heterogeneous than the most educated.

<sup>2</sup> Note that some of the university graduates will have only just begun work in 1984, and also that this cell size is rather small.

Table 2

**Earnings Stratification of Young German Workers:  
1984 and 1990**

<b>Educational Groups</b>	<b>1984</b>	<b>1990</b>
High School Only	0.17	-0.04
Male	0.19	-0.09
Female	0.18	0.03
Apprentices	0.09	0.06
Male	0.08	0.07
Female	0.12	0.05
Trade School	0.12	0.08
Male	0.13	0.04
Female	0.02	0.04
University	-0.25	0.34
Male	-0.25	0.32
Female	-0.28	0.57

The patterns differed by sex. Earlier comparative empirical work (Lane et al. 1992) found that the employment and earnings effects of apprenticeships and vocational training were very different for young men and women. These data show that earnings inequality was also in almost every case much greater for women than for men. Between-group inequality was considerably more important among men than among women in 1984. In fact, 44 percent of the earnings inequality among men was associated with between-group differences. But by 1990 the declining wage gaps lowered the between-group component among men. This was offset by the growth in their within-group inequality. For women, the growth in inequality took place almost entirely within educational groups.

Inequality within the apprenticeship and university categories showed considerable variability over the two years. Women apprentices started out with roughly the

same wage dispersion as men (.1754 and .1717 respectively), but the dispersion almost doubled in the next six years. Earnings inequality in 1990 was substantially lower among women university graduates than among other female education groups. The pattern was also similar among young men.

The stratification trends (Q's) appear in Table 2. Rising inequality within low and/or highly educated groups should have reduced stratification, by causing the earnings of members of other groups to fall within the earnings of specific educational subgroups. Table 2 shows that individuals in all three sub-baccalaureate educational categories became less stratified over the period, with both males and females displaying similar patterns. Thus, the effect of the within-group wage dispersion was to increase the overlap with other educational groups. However, individuals with university qualifications moved from being a heterogeneous group (with a negative index of stratification) to being the most stratified of all the categories. This was especially marked for women. The high rates of stratification among university graduates resulted from their much higher wage advantage and their low within-group inequality.

An alternative way to examine the overlap is to calculate where the average person in a lower educational group would fall in the earnings distribution of higher educational groups (and vice versa). The pattern described above is even more evident from a glance at Table 3, which indicates the rankings that the average worker in each category would have if that worker were ranked in another category. In 1984, an individual whose earnings were in the 50th percentile of the high school-only distribution would have been in the 28th percentile of the earnings of those who trained as apprentices, the 32nd percentile of the earnings of those who had trade school training and the 33rd percentile of the distribution of earnings of university graduates. By 1990, the median high school only worker had gained in the relative distribution of each of the trade school and apprentice categories, but lost substantially relative to university graduates. The pattern is the same (although not presented in the paper) for both men and women.

Table 3

**Rankings of Median German Worker within each Educational Category  
in the Earnings Distribution of other Educational Categories: 1984 and 1990**

<b>Source Category</b>	<b>High School Only</b>		<b>Apprentice</b>		<b>Trade School</b>		<b>University</b>	
	<b>1984</b>	<b>1990</b>	<b>1984</b>	<b>1990</b>	<b>1984</b>	<b>1990</b>	<b>1984</b>	<b>1990</b>
High School Only	0.50	0.50	0.26	0.41	0.29	0.38	0.30	0.15
Apprentice	0.74	0.59	0.50	0.50	0.55	0.48	0.46	0.19
Trade School	0.71	0.62	0.45	0.52	0.50	0.50	0.45	0.21
University	0.70	0.85	0.54	0.81	0.55	0.79	0.50	0.50

These results seem to substantiate the view that the importance of formal training falls the further away the workers get from that training. In this sense, our findings concur with those of Abraham and Houseman, who suggest that the German training system creates workers of different backgrounds better able to substitute for each other.

The results in Table 4 illustrate the ages during which the college wage premium emerges. Workers with either some college credits or even those with a college degree actually averaged less than high school graduates in 1984, when the individuals were in their mid-20s. By 1990, the wage gap between college and high school graduates exceeded 50 percent. A substantial 25 percent premium also developed for those with less than four years of college. They received 25 percent more in 1990 than did high school graduates.

One surprising result is workers who dropped out of high school gained relative to high school graduates between 1984 and 1990. The idea that high school graduates are more trainable than dropouts would suggest the opposite, that earnings differentials rise with age.

#### Education and Earnings Inequality among American Workers

Young American workers experienced a much higher degree of earnings inequality than German youth. The United States Gini coefficient was .41 in 1984 and .38 in 1990, well above the .21 and .27 levels that occurred in Germany. The decline in the Gini coefficients showed up among women (from .47 to .39), but not among young men in the United States.

Table 4  
Earnings Inequality of Young United States Workers within and between Educational Groups: 1984 and 1990

Educational Groups	Mean Earnings of Group/ Mean Earnings of High School Only		Decomposition of Gini Coefficient	
	1984	1990	1984	1990
High School Dropout	0.60	.91	0.38	0.44
Male	0.75	.83	0.37	0.36
Female	0.38	1.04	0.31	0.54
High School Graduates	1.00	1.00	0.48	0.35
Male	1.00	1.00	0.34	0.34
Female	1.00	1.00	0.61	0.34
Subbaccalaureate	0.80	1.25	0.33	0.38
Male	0.97	1.23	0.34	0.34
Female	0.65	1.38	0.30	0.39
College Graduate	0.92	1.55	0.27	0.34
Male	1.11	1.53	0.27	0.35
Female	.75	1.65	0.25	0.31
Overall Gini			0.41	0.38
Male			0.34	0.36
Female			0.47	0.39
Within-Group Component			0.40	0.36
Male			0.33	0.34
Female			0.46	0.37
Between-Group Gini			0.01	0.03
Male			0.01	0.03
Female			0.01	0.04
Stratification Term			0.00	-0.02
Male			-0.01	-0.02
Female			0.01	-0.02

Given the emphasis in the literature on wage differentials between educational groups, it is striking that virtually all the earnings inequality took place within educational categories. For young men in 1984, the within-group component was .33, nearly as high as overall inequality (.34). Even in 1990, when wide earnings gaps opened between high school graduates and college graduates, the between-group component was only .03 of the .38 total Gini.

Within individual groups, the highest wage inequality took place among the lowest educated group. Female high school dropouts had a Gini coefficient of .54. Although inequality among college educated workers (both graduates and others with some college) was similar to inequality among other groups, the level of inequality for each increased over the period. Thus, as average earnings of the college educated increased, so did inequality. The expected differentials among fields of study began to emerge.

Gender differences over time were marked. Earnings inequality increased for women in almost every educational category except high school graduates, yet remain relatively stable for men. By 1990, however, female wage dispersion was very similar to that of males, except in the high school dropout group.

The stratification indices reported in Table 5 reinforce the results of the previous tables. In general, the educational groupings in 1984 do not form separate strata. Individuals within each category, with the exception of college graduates, cannot even be characterized as belonging to a homogeneous group. As the individuals age, however, there is clearer evidence of stratification with the exception of the largely heterogeneous high school dropouts. The heterogeneity of high school dropouts is further em-

phasized by the fact that almost 40 percent of the 1984 group do not report earnings in 1990, suggesting that their earnings inequality may be understated.

Clearer evidence of the pattern for United States youth is provided in Table 6. This shows the rankings of the median worker in each educational category if that worker were ranked in another educational category. Increased stratification would typically reduce group overlap and lower the average individual's ranking in a higher educational category. This pattern prevailed for high school graduates, as the average graduate's ranking went from the 48th percentile in the subbaccalaureate distribution in 1984 to the 42nd percentile in 1990. High school graduates also dropped from the 37th percentile in the university graduates' distribution to the 30th percentile. A similar pattern is evident for both subbaccalaureate and university graduates. However, the stability of group overlap for high school dropouts is evident from the fact that the average dropout would have placed in the 36th percentile of high school graduates earnings in 1984, but in the 40th percentile in 1990. This is consistent with the results in Table 7, suggesting that stratification, and hence overlap, did not increase for this educational group between 1984 and 1990.

### Comparison of German and United States Earnings Inequality among Young Workers

We expected the primary role of the German apprenticeship in the wage distribution would be to reduce substantially the wage premium for university education and to provide a considerable wage premium for journeymen over high school graduates who had no further formal training. We expected earnings inequality to be higher in the United States than in Germany, mainly because of the deteriorating earnings position of high school-educated (dropouts and graduates) workers. In fact, earnings inequality was lower in Germany than in the United States. In particular, the overall Gini coefficient in the United States for 24- to 28-year-old youth was approximately twice the size of that in Germany. By the time these youths were 30 to 34, the differences between countries had narrowed, but the United States Gini was still 40 percent higher than the Gini in Germany.

However, contrary to our expectations, virtually all of the differences were associated with the much higher within-group inequality in the United States and not higher earnings across educational categories. In fact, the wage premiums for German university graduates relative to apprentices were actually higher than the college wage premiums (over high school graduates) in the United States among women and almost as high among men.

Another unanticipated result is the higher degree of stratification among German than among United States university graduates. Many fewer workers from other educational categories fall within the college-educated ear-

Table 5  
Earnings Stratification of Young United States Workers:  
1984 and 1990

Educational Groups	1984	1990
High School Dropout	-0.07	-0.10
Male	-0.06	-0.03
Female	0.14	-0.22
High School Graduate	-0.01	0.00
Male	0.04	0.01
Female	-0.09	0.04
Subbaccalaureate	0.01	0.07
Male	-0.02	0.08
Female	0.01	0.09
College Graduate	0.15	0.23
Male	0.13	0.22
Female	0.15	0.25

Table 6

**Rankings of Median United States Worker within each Educational Category  
in the Earnings Distribution of other Educational Categories: 1984 and 1990**

Source Category	High School Dropout		High School Graduate		Subbaccalaureate		University	
	1984	1990	1984	1990	1984	1990	1984	1990
High School Dropout	0.50	0.50	0.36	0.40	0.35	0.33	0.25	0.22
High School Graduate	0.64	0.60	0.50	0.50	0.48	0.42	0.37	0.30
Subbaccalaureate	0.65	0.68	0.52	0.58	0.50	0.50	0.40	0.37
University	0.75	0.78	0.63	0.71	0.61	0.63	0.50	0.50

nings distribution in Germany than in the United States. In part, this is due to the much lower degree of inequality within the university grouping. The Gini coefficient among male university graduates in Germany was only .13, only about one-third of the .35 level in the United States. This differential emerged entirely over the period as workers aged from their mid-20s to their early 30s. Inequality for university graduates almost halved for these individuals in Germany, but increased by almost a quarter in the United States. In contrast, earnings dispersion jumped for non-college youth in Germany, with mixed patterns in the United States. As a consequence, stratification of university graduates was greater in Germany than the United States, but the stratification of the other educational categories was similar in the two countries.

One explanation for the observed cross-country differences in the college wage premiums, college stratification, and within-group inequality is that only about 7 percent of young German workers have a university degree. In contrast, United States college graduates make up about one-quarter of all young workers. Thus, when comparing the university educated in the two countries, we are looking at a smaller proportion at the top in Germany than in the United States.

One important caveat to these results concerns the sample sizes drawn from the German data. As Appendix 1 shows, we constructed our calculations for Germany on the basis of only 30 university graduates in 1984 and 33 in 1990.

### Summary

Overall earnings inequality was less in Germany than in the United States in both 1984 and 1990. However, virtually all of the difference was associated with the higher within-group inequality in the United States rather than with smaller wage premiums for university graduates. Interestingly, the difference in inequality between countries declined as the cohorts aged. The rise in German inequality is surprising given the greater role of unions in Germany. It warrants further research into the impact of unions on earnings inequality in the two countries.

The United States and Germany did generate different patterns of earnings differentials related to the level of education and training. In particular, the various educational groups of non-college educated youth appear to be closer substitutes over the long term in Germany than in the United States. That is, graduates of German high schools, apprenticeships, and trade schools were not stratified and showed low earnings differentials relative to the wider differentials between United States high school graduates and those with some college education. Furthermore, even though the college wage premium is less in Germany among men than in the United States, college graduates are more stratified from others in their age cohort, indicating limits to German upward mobility. The higher stratification in Germany resulted mainly from the low level of inequality within the group of university graduates and the fact that they represent more of an elite within Germany than college graduates represent in the United States.



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## Appendix 1

### Descriptive Statistics — German Data

Education Category	1984		1990	
	Gross Monthly Earnings	N	Gross Monthly Earnings	N
High School	DM 1,783.18	167	DM 2,797.65	165
Apprentice	2,365.92	223	3,227.15	231
Trade School	2,237.00	102	3,273.98	89
University	2,639.23	30	4,889.07	33

## Appendix 2

### Descriptive Statistics — United States Data

Education Category	1984		1990	
	Gross Hourly Earnings	N	Gross Hourly Earnings	N
High School Dropout	\$ 5.39	841	\$ 9.53	544
High School Graduate	9.07	2247	10.46	1834
Subbaccalaureate	7.20	1201	13.08	1011
University	8.32	784	16.22	563