ON THE LABOR MARKET EFFECTS OF IMMIGRATION AND TRADE

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ABSTRACT

In the 1980s, the wages and employment rates of less-skilled Americans fell relative to those of more-skilled workers. This paper examines the contribution of the continuing inflow of less-skilled immigrants and the increasing importance of imports in the U.S. economy to these trends. Our empirical evidence indicates that both trade and immigration augmented the nation's supply of less-skilled workers, particularly workers with less than a high school education. By 1988, trade and immigration increased the effective supply of high school dropouts by 28 percent for men and 31 percent for women. We estimate that from thirty to fifty percent of the approximately 10 percentage point decline in the relative weekly wage of high school dropouts between 1980 and 1988 can be attributed to the trade and immigration flows. In addition, our analysis suggests that from 15 to 25 percent of the 11 percentage point rise in the earnings of college graduates relative to high school graduates from 1980 to 1985 can be attributed to the massive increase in the trade deficit over the same period, but that the effects of trade on the college/high school wage differential diminished with improvements in the trade balance during the late 1980s.

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I. Introduction

In the 1980s, the wages and employment-population rate of less-skilled Americans, particularly young men, fell relative to those of more skilled workers. The real earnings of 25-34 year old male high school graduates and dropouts declined, continuing a trend begun in 1973 that breaks with the historic pattern of rising real earnings for less-skilled American men.[1]

Two widely suggested causes of this change are the inflow of less-skilled immigrants, including illegal immigrants, and the trade deficit, notably the increase of imports in industries that hire low-skill workers. How much did trade and immigration alter the labor skill endowments of the United States in the 1980s? How great a contribution did they make to the decline in the relative earnings of the less skilled in the 1980s?

We present a conceptual and empirical analysis of these questions. Using demographic data from the 1980 Census and from Current Population Surveys, as well as detailed data on exports, imports, output, and employment for a large number of manufacturing industries, we first estimate the magnitude and educational composition of the labor supply embodied in trade flows and legal and illegal immigrations during the 1980s. We then calculate the percentage growth in the ratio of highly educated to less-educated labor in the United States attributable to these flows. Finally, within the context of a standard model of labor market equilibrium, we assess the potential effect of changes in these skill endowments on earnings differentials by education.

We find that:

1. The annual increase in implicit labor supply due to the mid- and late-1980s trade deficit in manufactures was on the order of 1.5 percent for the economy as a whole and 6 percent for the manufacturing sector. These labor supply shifts exceed the percentage increase in labor supply due to the annual flow of immigrants, which only increased labor

supply by about 0.3 percent per year. However, unlike trade deficits that only change the implicit labor supply annually, immigration permanently increases the nation's work force (as long as immigrants remain economically active). The 1980s immigrant flow raised the share of the U.S. work force that is foreign-born from 6.9 percent in 1980 to 9.3 percent in 1988.

2. Both trade and immigration augmented the nation's effective supply of less-skilled workers by more than they augmented the effective supply of more-skilled workers. The 1985 trade deficit raised the relative supply of high school dropouts to college graduates by 5-12 percent among men and by 10-17 percent among women. Increasing numbers of immigrants with less than a high school degree and declining numbers of native high school dropouts meant that over 20 percent of the high school dropout work force was foreign-born by 1988.

3. Because immigrants consist disproportionately of workers who lack a high school diploma, and because import industries tend to employ relatively low skill workers (including many immigrants), the pattern of trade and immigration observed in the United States during the 1980s fits the Heckscher-Ohlin trade model, in which trade and immigration are alternate ways of increasing the factor that is relatively scarce in the United States compared to the rest of the world; in this case, the declining number of less-skilled native workers.

By applying these supply shifts to the textbook model of labor market equilibrium, we estimate that from 15 to 25 percent of the 11 percentage point rise in the earnings of college graduates relative to high school graduates from 1980 to 1985 can be attributed to the massive increase in the trade deficit over the same period, but that the effects of trade on the college/high school wage differential diminished with improvements in the trade balance during the late 1980s. In contrast, immigration had only a small effect on the supply of high school "equivalent" workers relative to college "equivalent" workers and consequently is likely to have had only a small effect on the college/high school wage differential.

Nevertheless, the large share of new immigrants with less than a high school education and the concentration of the trade deficit on industries that intensively employ high school dropouts means that both trade and immigration are likely to have contributed substantially to the declining earnings and employment opportunities of high school dropout workers. We estimate that between 30 to 50 percent of the 9 log point decline in the relative weekly wage of high school dropouts from 1980 to 1988 can be attributed to trade and immigration flows. The "explanatory power" of these factors is of similar magnitude to that of other variables that have been the focus of recent research, such as the declining unionization of the U.S. labor force.

Our findings regarding the impact of trade on the U.S. labor market are consistent with those of studies which document the influence of trade on earnings and employment at the industry level (Freeman and Katz, 1991; Revenga, 1989; MacPherson and Stewart, 1990). In contrast, our findings with respect to the labor market impacts of immigration differ drastically from those reported in the existing literature. These studies typically find modest and imprecisely estimated differences in earnings and employment rates of workers in cities with greater/lesser immigrant flows (Altonji and Card, 1991; Butcher and Card, 1991; Card, 1990; LaLonde and Topel, 1991). Our results probably differ because we focus on changes in economy-wide factor endowments, while the existing literature focuses on differences in factor endowments across local labor markets. In the concluding section, we reflect on the causes and interpretation of the differences in the results obtained from differing modes of analysis.

II. Trade and Labor Supplies

In the 1970s and 1980s, the U.S. economy became more connected with the rest of the world. The ratio of the sum of exports and imports to GNP increased from 16% in 1970 to

25% in 1990. The balance of trade turned substantially negative in the mid 1980s, with a trade deficit of some 3% of GNP. At the same time, immigration flows increased as upwards of 700-800,000 legal and illegal immigrants entered the country annually. How have these changes altered the implicit supply of labor in the country in total and among skill groups?

To estimate the labor supply equivalents of trade, we transform trade flows into equivalent bodies on the basis of the labor inputs in the domestic manufacturing industries that constitute the bulk of the traded goods sector. We do this by estimating the direct labor supply embodied in trade, ignoring indirect input-output effects. Formally, let T_{it} be the trade flow in industry i in year t; L_{it}/O_{it} be the labor input per unit of output in industry i in year t; and let L_t be the number of personhours needed to produce total traded output -- the labor supply equivalent of the trade flows.[2] Then we have for any given year t:

$$(1) \qquad L_t = \Sigma_i \, (L_{it}/O_{it}) \, T_{it} = \Sigma_i \, L_{it} \, (T_{it}/O_{it})$$

When T_{it} refers to imports, L_t will be positive, as imports are equivalent to an increase in labor supply. When T_{it} refers to exports, L_t will be negative, as exports effectively reduce the labor supply for domestic production. When T_{it} refers to net imports (imports-exports), it can be positive or negative.

To allocate the implicit labor supply in trade among groups of workers with different levels of skill we apply a modified version of equation (1) to different skill groups using:

$$(2) \qquad L_{jt} = \Sigma_i \, a_{ij} \, L_{it} \, (T_{it}/O_{it})$$

where L_{jt} is the implicit labor supply embodied in trade of skill group j in year t; and a_{ij} is the

average proportion of workers in industry i in the jth skill group for the 1967-87 period.

In equation (2) we assume that the effects of trade-induced changes in output on the employment of both production and nonproduction workers are identical to equivalent domestic-induced changes in output. It is also, however, reasonable to treat the labor market effects of the two flows differently. Whereas exports are likely to create employment for both kinds of workers, or possibly create greater employment for production workers than for nonproduction workers, imports have the potential for displacing production workers to a greater extent than nonproduction workers. This possibility is likely because the sales, finance, and related activities of nonproduction workers may be relatively complementary with production workers overseas. Given these considerations we provide two estimates of the effects of trade on employment. In method I we treat the labor market effects of exports and imports identically, as in equation (2); in method II we use equation (2) for exports but allocate the implicit labor supply contained in imports to production workers only.[3] Empirically, the assumption that imports have a greater effect on production than on nonproduction labor implies that the percentage of production workers should drop in industries with increasing imports. This prediction is consistent with our data.

Finally, we transform implicit labor supplies due to trade into "efficiency units" that correct person hours for shifts among industries with different qualities of labor. When trade affects highly skilled labor, an efficiency unit measure translates this into a greater effect on aggregate labor supply than when trade affects less-skilled labor. To estimate efficiency units of labor by industry in a given year, we divide each industry's labor force into 64 groups, based on sex (2 groups), education (4 groups), and experience (8 groups) and weight the proportion of persons in each group by the average weekly wage for full-time workers in the group from 1963 to 1987. We normalize the measure so that the total number of efficiency

units in the economy in each year equals 1.[4] We then estimate implicit labor input in efficiency units from trade in year t for group j (EL_{jt}) as:

$$(3) \quad EL_{jt} = (1/E_t) \; \Sigma_i \; e_{ij} \; E_{it} \; (T_{it}/O_{it})$$

where E_t is the total number of labor efficiency units employed in the U.S. labor market in t; e_{ij} is the average proportion of group j in total labor efficiency units in industry i for the 1967-87 period; and E_{it} is the total labor efficiency units used in industry i in year t. The implicit labor input in trade measured in efficiency units as a fraction of aggregate labor input in t is then given by:

$$(4) \quad EL_t = \Sigma_j \; EL_{jt} = \Sigma_i \; (E_{it}/E_t) \; (T_{it}/O_{it}).$$

Trade Data

Estimates of implicit labor supplies using equations (1)-(4) require information on person hours, the skill mix of workers, and trade flows in the traded goods sector. Our data on person hours, employment, and wages for 64 skill groups are derived from the Annual Demographic Supplements to the March Current Population Surveys (CPSs) for 1964-1988.[5] The March CPS provides information on earnings and weeks worked in the calendar year preceding the March survey that we use to compute total person hours and efficiency units by skill group by year from 1967 to 1985 for the aggregate labor force, the manufacturing sector, and for 21 detailed manufacturing industries.

Our data on imports, exports, output (value of shipments), total employment, and production worker employment are from the NBER Trade-Immigration-Labor Market data

set.[6] The data cover four-digit SIC manufacturing industries for each year from 1967 to 1985. We aggregate these data into the 21 manufacturing industries for which we have estimates of person hours efficiency units by labor skill group from the CPS. We also calculate the average share person hours and efficiency units contributed by production-workers for each skill group in each of the 21 industries.

Table 1 presents our estimates of the implicit change in the supply of person hours due to trade flows in manufactures relative to total labor and relative to manufacturing labor for the period 1967-1985. Columns (1)-(3) record the labor supply equivalence in person hours of U.S. imports (M), exports (X), and the net of the two (imports minus exports) as a percent of the total U.S. labor force. Columns (4)-(6) give the labor supply equivalence of trade in efficiency units as a percent of total efficiency units for the entire U.S. labor force (calculated using the same wage weights as we used to determine the labor supply implicit in trade flows). Column (7) gives the labor supply equivalence in efficiency units of net imports in the major traded goods sector, manufacturing.

Three things stand out in table. First is the marked change in the implicit effects of trade on the labor market between the period of the 1960s and 1970s and the period since the early 1980s. In the 1970s trade reduced slightly the net supply (increased slightly the net demand) of labor in the United States. In the mid-1980s the trade deficit produced a much larger increase in the implicit supply of workers both in person hours and in efficiency units.[7]

Second is the difference between the implicit labor input in person hours and efficiency units between exports and imports. Because export industries are relatively skill intensive, the implicit labor input is roughly 4% higher in efficiency units than in person hours. Imports, by contrast, come increasingly from industries with less-skilled labor. In 1967-69, the implicit labor input in imports was 1% lower in efficiency units than in person hours; whereas

Table 1: Estimates of Trade-Induced "Change" in Aggregate Labor Supply, 1967-1985

	Implicit Labor Input in Manufactured-Goods Trade Flows[a]						
	As a % of Total U.S. Labor Input in Personhours			As a % of Total U.S. Labor Input in Efficiency Units			As a % of U.S. Labor in Mfg. in Eff. Units
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Year	M	X	Net	M	X	Net	Net
1967-69	1.32	1.50	-0.18	1.31	1.57	-0.26	-0.87
1970-72	1.67	1.62	0.05	1.64	1.69	-0.05	-0.18
1973-75	1.86	2.11	-0.25	1.82	2.17	-0.35	-1.39
1976-78	2.11	2.18	-0.07	2.06	2.26	-0.20	-0.80
1979-81	2.37	2.66	-0.30	2.31	2.75	-0.44	-1.86
1982	2.57	2.49	0.08	2.46	2.58	-0.12	..
1983	2.70	2.18	0.52	2.58	2.26	0.32	..
1984	3.36	2.06	1.30	3.16	2.13	1.03	..
1985	3.69	2.06	1.63	3.49	2.15	1.34	6.36

[a]Labor input is measured in either person hours or efficiency units based on a 64 group decomposition of the U.S. labor force. The 64 groups arise from splitting the labor force into 2 sexes, 4 education groups, and 4 experience classes. Efficiency units in year t for group j are the average wage for group j over the 1963-87 period times the total hours of labor input of group j in year t. M - imports, X - exports, and Net - M - X.

Implicit labor input in imports in year $t = \Sigma_i E_{it} (M_{it}/S_{it})$

Implicit labor input in exports in year $t = \Sigma_i E_{it} (X_{it}/S_{it})$

where i is industry, E_{it} is efficiency units (or personhours) used in industry i in year t and S is the value of shipments of domestic producers.

Sources: Data on trade flows are from the NBER Trade-Immigration-Labor Market Data set. Data on labor input and wages are from the March CPS files.

in 1985, the implicit labor input in imports was 5.5% lower in efficiency units than in person hours. As a result of these patterns, the implicit labor supply due to net imports is 18% lower in terms of efficiency units than in person hours in 1985.

Third, the growth of the implicit labor input due to net trade flows in manufacturing shows a much more dramatic picture of the "first stage" effect of trade on workers in that sector. In 1985 the trade imbalance was equivalent to a 6.4% increase in efficiency units of labor in manufacturing. This highlights the fact that the direct effects of trade-induced changes in implicit labor inputs fall on only some workers. Others are affected when those displaced or not hired in manufacturing seek work in other sectors of the economy.

Effects of Trade on Labor Skills

The difference between the person hours and efficiency units measures of implicit labor supply for imports and exports in table 1 indicates that import industries employ relatively less-skilled labor than export industries. Changes in the level of trade and, more importantly, in the trade balance are thus likely to have very different effects on labor of different skills. To assess the magnitude of these differential effects, we used equation (3) to estimate the implicit labor supply in imports, exports, and the net trade balance for four education groups: high school dropouts; high school graduates; persons with some college; and college graduates. We made estimates for all men and women and for those with the least potential labor market experience (up to 10 years after school-leaving).

Figure 1 displays plots of the estimated implicit labor supply embodied in the net trade balance in manufactures relative to the entire domestic labor force in all industries for male workers by education (panel A) and for female workers by education (panel B). The plots with the (o) notation are made under assumption I that imports and exports affect production

Figure 1A: Implicit Supply of Labor in Net Trade in Manufactures
as a Share of Total Domestic Labor Supply, Males

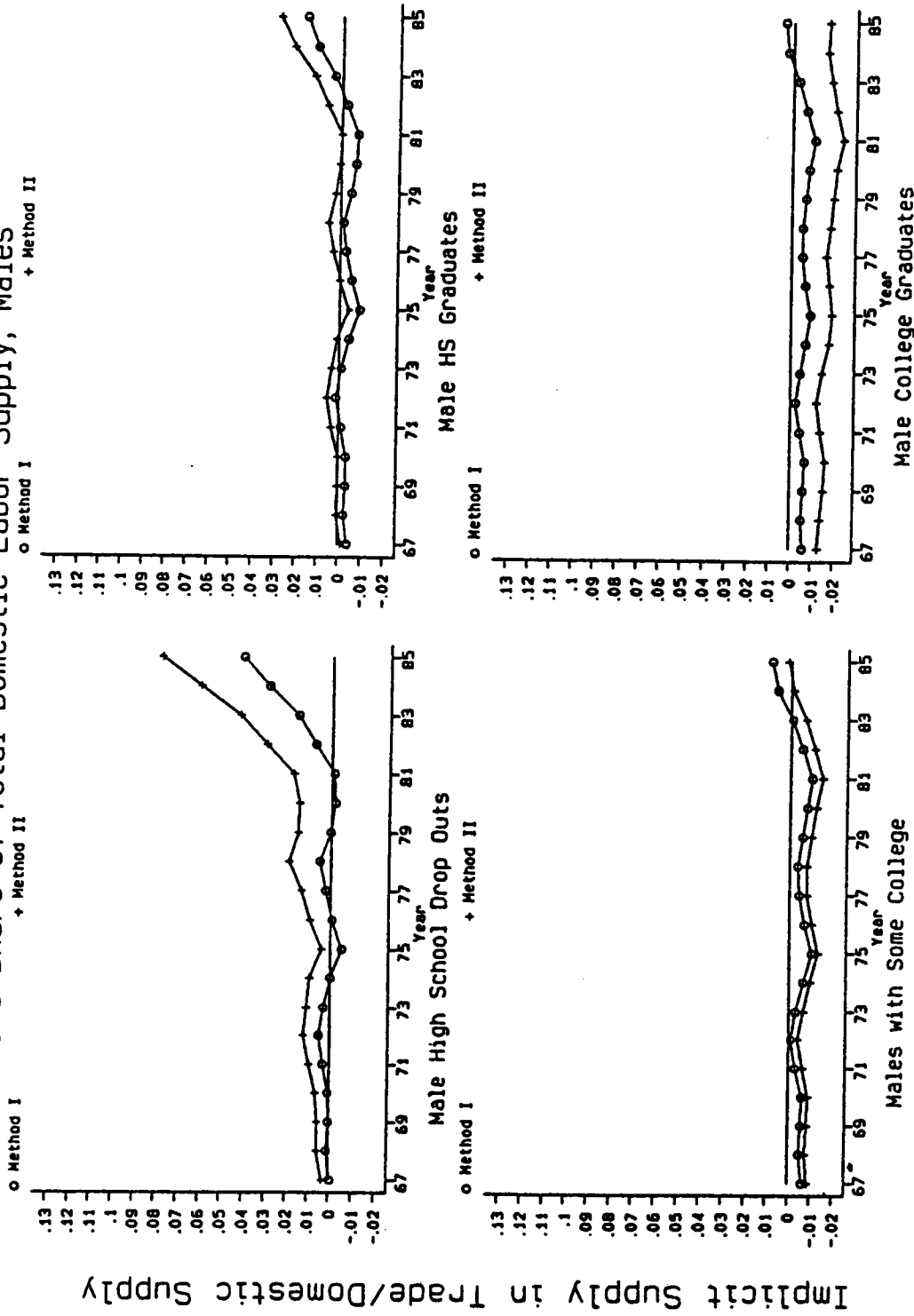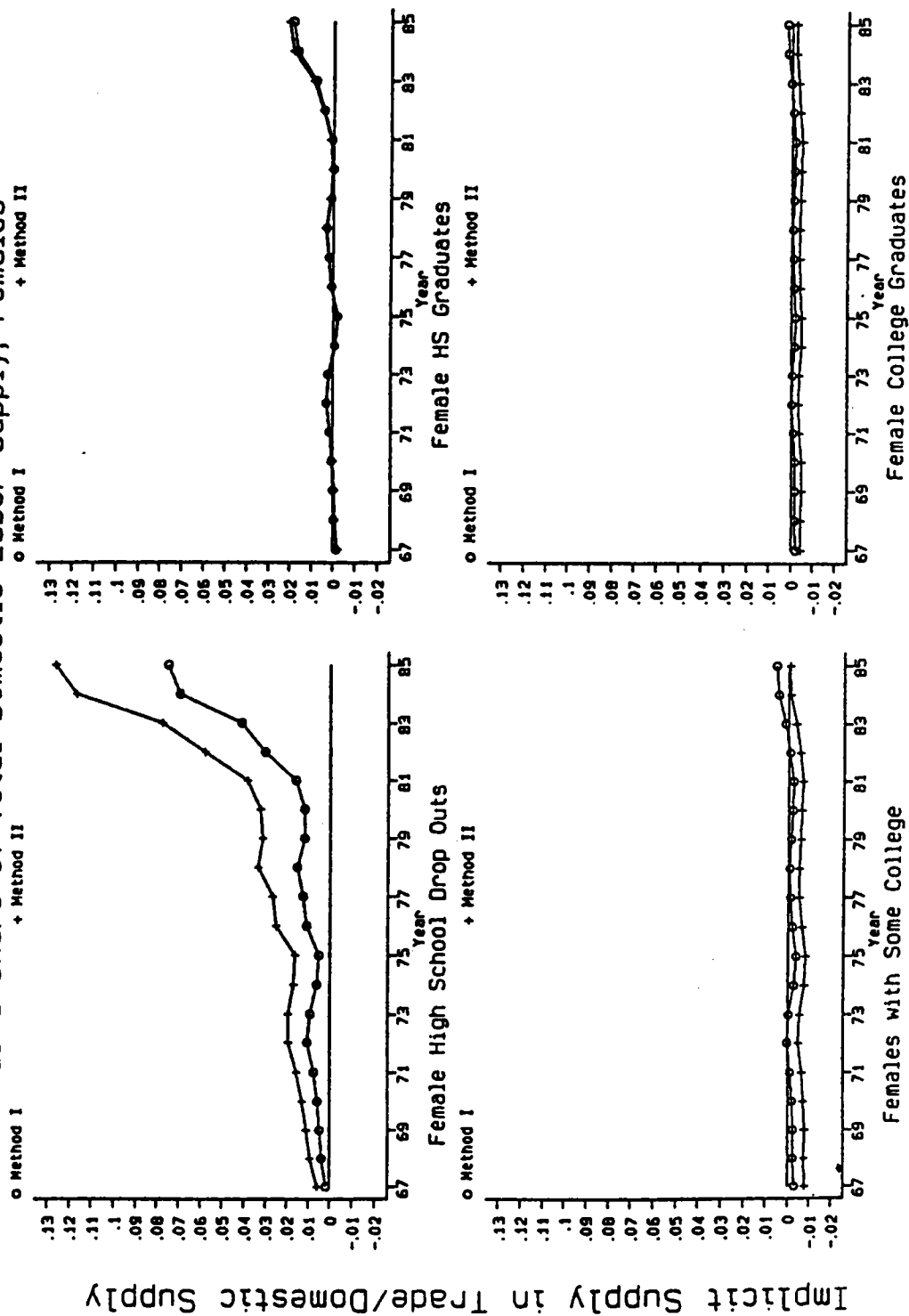Figure 1B: Implicit Supply of Labor in Net Trade in Manufactures
as a Share of Total Domestic Labor Supply, Females

o Method I   + Method II
Female High School Drop Outs

o Method I   + Method II
Female HS Graduates

o Method I   + Method II
Females with Some College

o Method I   + Method II
Female College Graduates

Implicit Supply in Trade/Domestic Supply

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and nonproduction workers in the same manner as an equivalent amount of domestic production. The plots with the (+) notation are made with assumption II that imports affect only production workers while exports affect both groups in the same manner as domestic production.

The figure tells a clear story. Until the trade deficit developed, the implicit change in relative labor supply due to trade was modest -- dwarfed by the ongoing trend in supplies due to changes in the educational attainment of workers. Among males, for example, trade in 1980 increased the implicit supply of high school dropouts by -0.1 percent (using our method I) to 1.5% (using method II) while reducing the implicit supply of college graduates by 0.8% to 2.1%.[8] As a result trade in 1980 decreased the ratio of college to high school dropouts by 0.6% when imports are allocated to all workers and by 3.6% when imports are allocated to production workers only. Among females, trade increased the implicit supply of high school dropouts by 1.2% to 3.2% and reduced the ratio of college graduates to dropouts by 1.4% to 3.7%. These changes are quite modest in comparison to the increase in the ratio of the number of college graduates to high school dropouts in the nation's nonimmigrant workforce in the same period (a 52% increase among men and 87% among women from 1975 to 1980, for example). **Balanced trade of the sort that predominated in the 1970s and early 1980s thus had only modest effects on the market for skills.**

By contrast, the figure also shows that the trade deficit that began in the 1980s produced a large increase in the implicit labor supply of less-educated workers, particularly high school dropouts, but had only a slight effect on the implicit supply of college graduates. In 1985 the implicit supply of male high school dropouts via trade was 4-8% of the number of male dropouts in the U.S. labor force (figure 1A); while the implicit supply of female high school dropouts via trade was 8-13% of the number of female dropouts in the U.S. labor

force (figure 1B). Extrapolating to the end of the 1980s, the continued though declining trade deficit (U.S. Council of Economic Advisors, 1990, p. 297) implies that the U.S. kept "importing" large numbers of less-educated workers through trade for the remainder of the decade.

Figure 2 presents comparable plots for the implicit labor embodied in net trade relative to the domestic **manufacturing labor force.** Since the implicit labor embodied in net trade is the same as in figure 1 while the denominator is about a fifth as large, the relative increases in supply due to trade are correspondingly larger: for high school dropouts, for instance, trade flows increased the implicit supply in manufacturing by 14-27% for males (figure 2A) and by 24-40% for females (figure 2B). These figures highlight the fact that the "first order" impact of the trade deficit is for less-educated workers in manufacturing.

In addition to the implicit labor supply calculations in figures 1 and 2, we also estimated the effects of trade on the implicit supply of workers with less than 10 years of experience. We obtained results similar to those in figures 1 and 2, reflecting the fact that less-experienced workers are distributed in roughly similar proportions among sectors as are more experienced workers. If trade-induced changes in implicit labor supply help account for the exceptionally large decline in the position of younger less-skilled workers, it is because these workers are on the "active market", unprotected by seniority, internal labor markets, and firm-specific human capital, and not because they are disproportionately concentrated in industries facing import competition compared to more experienced less-skilled workers.

Comparing Methods I and II for Estimating Trade Effects

Our first method of estimating the effects of trade on the implicit labor supply of skills assumes that imports and exports affect production and nonproduction labor equally. Our

Figure 2A: Implicit Supply of Labor in Net Trade in Manufactures
as a Share of Domestic Labor Supply in Manufacturing, Males
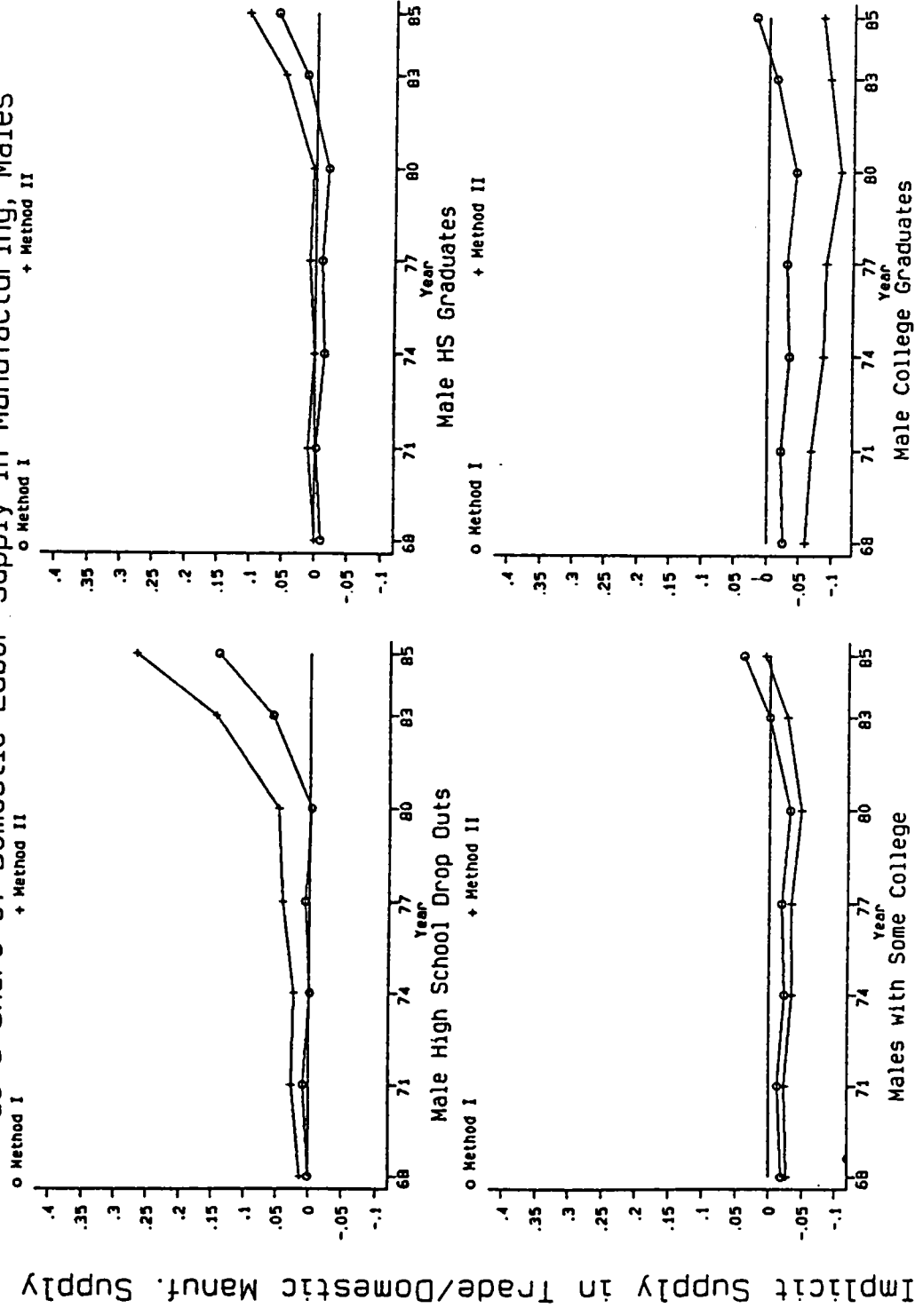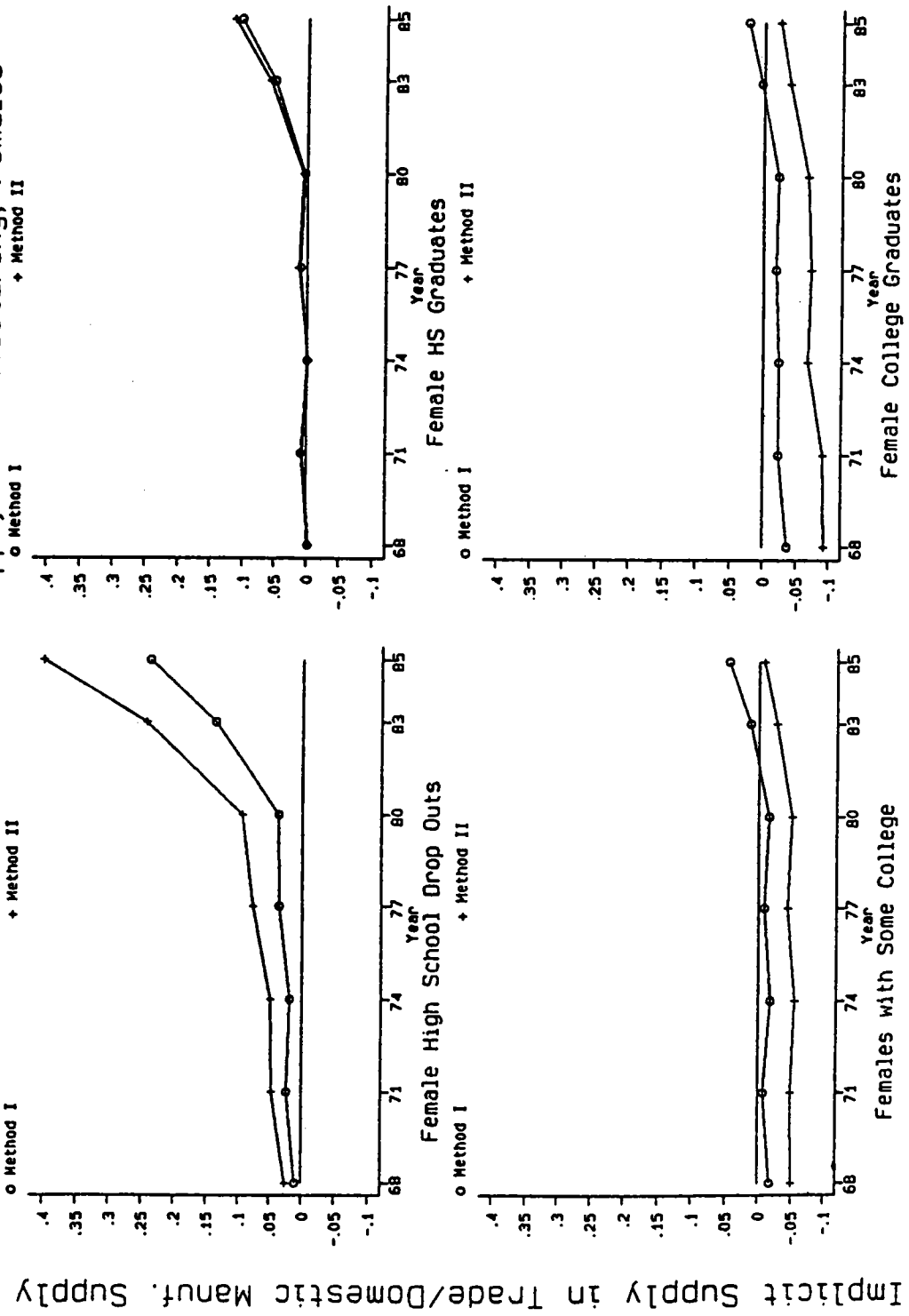

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Figure 2B: Implicit Supply of Labor in Net Trade in Manufactures as a Share of Domestic Labor Supply in Manufacturing, Females

second method assumes that imports have no effect on the employment of nonproduction labor. If imported goods reduce employment of production labor more than nonproduction labor, industries with increasing imports ought to be associated with declines in the production worker share of employment. Accordingly, we regressed the ln change in the production worker share of employment on the change in the ratio of imports to imports plus sales, the change in exports/sales, and the change in ln sales. Our regression for the 1960-85 period shows that changes in import ratios contributed to the decline in the share of production workers in employment while changes in export ratios essentially had no effect:

$$\text{dln (\% Production Workers)} = 0.040 - \underset{(0.049)}{0.159 \text{ d(Import Ratio)}}$$

$$- \underset{(0.071)}{0.005 \text{ d(Export Ratio)}} - \underset{(0.009)}{0.049 \text{ d(ln Sales)}}, \quad n=427 \quad R^2=0.07,$$

where the numbers in parentheses are standard errors.

Over half of the within-sector change in the percentage of workers in production labor occurred in the 1980s. For 1979-85 our regression yields:

$$\text{dln (\% Production Workers)} = -0.029 - \underset{(0.061)}{0.088 \text{ d(Import Ratio)}}$$

$$\underset{(0.071)}{-0.007 \text{ d(Export Ratio)}} - \underset{(0.015)}{0.007 \text{ d(ln Sales)}}, \quad n=427 \quad R^2=0.005.$$

The smaller size and significance of the coefficient on import ratios in the period when there was "most action" makes us hesitant of drawing any strong inference from the data. Although the data are consistent with the notion that increased imports alter the skill mix of

industries away from less-educated production workers and that this process may be associated with the outsourcing of production jobs to other countries, we conclude that the evidence favoring the outsourcing hypothesis is far from overwhelming. It is for this reason that we present our implicit labor supply calculations assuming both that exports and imports affect production and nonproduction workers equally and that imports affect production workers only.

III. The Immigrant Contribution to Labor Supply

What about immigration-induced changes in labor supply? How has the flow of immigrants altered the nation's endowment of more and less-educated workers?

Because immigrants are largely permanent additions to the country's labor force, comparisons of the number of immigrants who enter the work force annually with the implicit labor input in trade can give a misleading picture of how the two flows affect the labor market. Most traded goods displace domestic production in the same period, motivating our calculation of implicit labor supply equivalents based on individual year trade flows. By contrast, an immigrant arriving in the United States in any given year contributes to the economy in every subsequent year in which he is economically active in the United States. Therefore, the effect of immigration on labor supplies is best described by the stock of the work force who are immigrants relative to U.S. domestic labor supply, rather than by the flow of immigrants to labor supply.

Calculating the stock of immigrants in the United States at any point in time is not easy. In 1980 and other census years the Decennial Census reports the number of foreign-born persons. In April 1983, June 1986, and June 1988 the Current Population Survey contained questions on country of birth that can also be used to estimate the number of immigrants.

Both the Census and CPS numbers, however, miss many illegal alien immigrants, who are especially likely to be in the low-skill work force. For purposes of estimating labor supplies due to immigration we need to know the number, labor force participation rate, and educational composition of uncounted immigrants as well as the same information for those counted in the Census and CPS surveys.

Estimating Uncounted Illegal Immigrants

Using the enumeration provided by the 1980 Census as a base, we adjusted the 1980 count upwards to allow for uncounted illegal immigrants, by sex. First, we counted 6.47 million foreign-born persons aged 18-64 who are labor force participants in the 1/1000 file of the 1980 Census. Warren and Passel (1987) indicate that this Census enumeration "found" many more foreign-born persons than would be expected given the legal flows reported by the U.S. Immigration and Naturalization Service. They estimate that the 1980 Census enumerated 2 million illegal aliens, of whom approximately 60 percent were of working force age (aged 18-64). Borjas, Freeman, and Lang (1991) estimate that, based on vital statistics by country of birth, there were approximately 50 percent more illegal aliens in the United States in 1980 than were counted in the Census. This suggests that the Census count fell short of the number of illegal immigrants in the economy by roughly one million persons. Assuming that 60% of these aliens were of working age, and that their distribution by sex is similar to that for counted illegal aliens (55% of counted illegal aliens are men, according to Warren and Passel), we estimate that there were approximately 330,000 uncounted illegal men and 270,000 uncounted illegal women in the U.S. labor force in 1980. Since most counted illegal immigrants came to the United States in 1975-80, suggesting that uncounted illegals also came in that period, we apply the 1980 labor force participation rate of immigrants who

arrived in 1975-80 (76.9 percent for men; 50.0 percent for women) to these numbers to estimate the number of uncounted immigrants in the labor force in 1980. The resultant figures suggest that 253,800 uncounted illegal men and 135,000 uncounted illegal women were in the labor force in 1980. This increases our estimates of the number of immigrants in the 1980 labor force by roughly 6 percent (compare columns 3 and columns 6 in table 2).

To measure the stock of immigrants in ensuing years, we make use of the April 1983, June 1986 and June 1988 CPSs. Each of these surveys included a question on immigrant status. Because the April 1983 CPS had problems with estimating Hispanics, demographers have questioned the sample weights in the survey (Passel and Woodrow, 1987). As a result we pay greater attention to the results for 1986 and 1988.[9]

Our analytic procedure for estimating the immigrant labor force from each CPS is the same. First, we enumerate the number of foreign-born persons aged 18-64 in the labor force in the survey week. Second, we assume that the ratio of uncounted illegals to counted immigrants in each survey is constant over time at the 6 percent estimated for the 1980 Census. This leads us to adjust upwards the 1983 CPS count by 422,100; the 1986 CPS count by 539,500; and the 1988 CPS by 588,100 workers.

Table 2 shows the results of our calculations. It records the unadjusted and adjusted estimated number of immigrants in the U.S. labor force in total and by sex in 1980, 1983, 1986, and 1988, and gives the proportion of the total work force consisting of immigrants. Because immigrant stocks are the cumulation of annual net flows of immigrants in different years, the immigrant contribution to the nation's labor supply exceeds the implicit contribution of trade to the nation's labor supply by over four-fold even during the mid-1980s trade deficit period (compare the 8.6% in table 2 for 1986 with the 1.6% implicit labor supply in column 3 of table 1 for 1985). In addition, the table shows a strong upward trend in the immigrant

Table 2: Immigrants in the U.S. Labor Force, 1980–1988
Labor Force Participants Aged 18–64 Years

| | Number of Immigrants in the Labor Force (thousands) | | | | | | Immigrant Share of Labor Force[a] | | |
| | Counted | | | Counted Plus Uncounted | | | (Ctd + Unctd Imm)/ Total Labor Force | | |
	Male	Female	Total	Male	Female	Total	Male	Female	Total
1980	3771	2701	6472	4025	2836	6861	7.0	6.8	6.9
1983	4312	3056	7368	4601	3209	7810	7.9	7.2	7.6
1986	5294	3697	8991	5647	3884	9530	9.2	8.0	8.6
1988	5719	4083	9802	6102	4287	10390	9.9	8.6	9.3

[a]Total labor force – Native labor force plus counted immigrants plus uncounted immigrants.

Sources:

Counted immigrants: 1980, tabulated from the 1980 U.S. Census of Population; 1983, tabulated from April 1983 CPS, using sample weights; 1986–1988, tabulated from June CPSs, using sample weights.

Native labor force: tabulated from the same surveys as counted immigrants.

Numbers of Uncounted Immigrants: In 1980 the number of uncounted immigrants is assumed to be equal to 50 percent of the number of counted illegal immigrants in the 1980 Census of Population. Estimates of counted illegal immigrants in the 1980 Census are from Warren and Passel (1987). In 1983, 1986, and 1988 the numbers are estimated by applying the ratio of uncounted illegals to counted immigrants in 1980 (0.06).

share of work force among both sexes over the period. From 1980 to 1988 the immigrant share of the work force increased by approximately 35%! Growth in the number of immigrant workers accounted for over 25% of the growth of the U.S. work force in the 1980s.

Immigrants by Education

To determine how the inflow of immigrants altered the educational composition of the U.S. work force, we estimated the number of immigrants by education and sex in 1980, 1983, 1986,and 1988. For persons counted by the Census or CPS, determining years of schooling is a direct matter because schooling is recorded for all respondents, including immigrants. As many immigrants are educated overseas under different educational systems and in different languages than in the United States, however, their years of schooling may have a different value in the U.S. labor market than years of schooling in the United States. For simplicity, we ignore this problem and treat years of schooling of immigrants as equivalent to the schooling of natives.

For illegal aliens who were not enumerated in the Census or CPS, we estimate educational attainment from the educational distributions of 1975-1980 immigrants reported in the 1980 Census for two national origin groups: Mexican immigrants and all other immigrants. We distinguish between these groups for two reasons. First, the educational distribution of immigrants differs markedly between Mexican and non-Mexican immigrants. As figure 3 shows, Mexican immigrants are disproportionately high school dropouts while non-Mexican immigrants have a more even distribution among education categories. Hence the proportion of uncounted immigrants who are Mexican will affect the estimated educational distribution of uncounted illegal workers. Second, a large proportion of counted illegals are in fact Mexicans (one-half according to Warren and Passel (1987)), suggesting that many

Figure 3: Education Distributions of Mexican and Non-Mexican
Labor Force Participants Who Entered the U.S. in 1975-80

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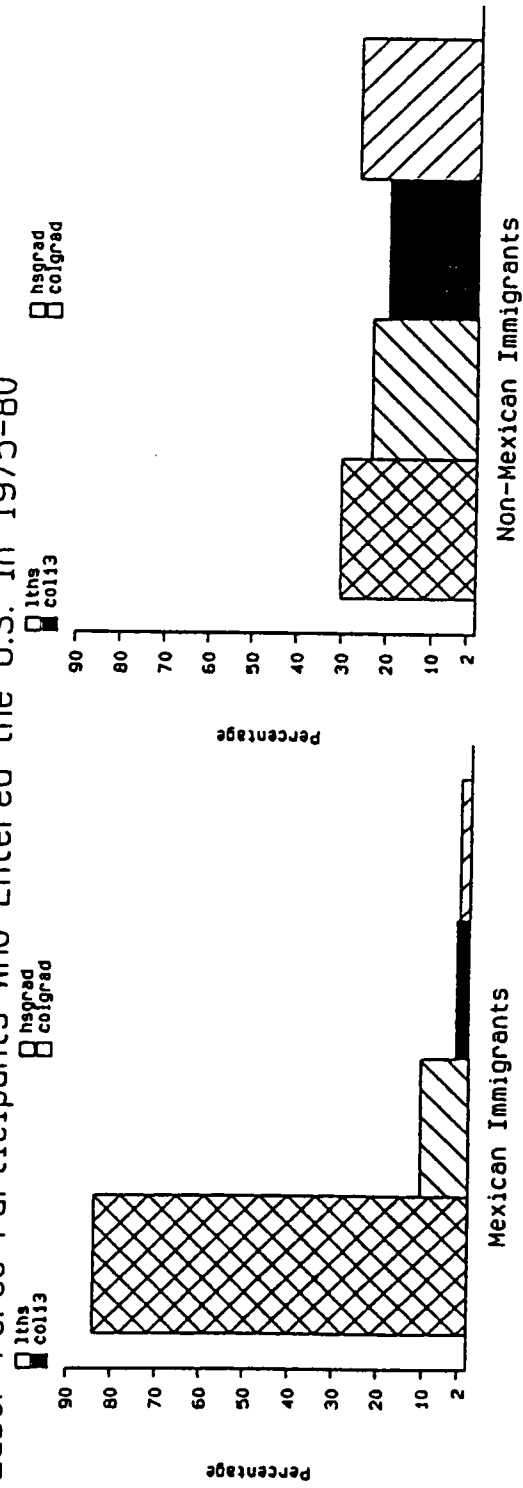
uncounted illegals are Mexican, or are similar to illegal Mexican immigrants.

On the basis of evidence that about three-quarters of the persons who applied for legalization of their immigration status as a result of the 1986 Immigration Reform and Contract Act were of Mexican origin (U.S. Immigration and Naturalization Service, 1990), we assume that 75 percent of uncounted illegal immigrants were Mexican while 25 percent were of non-Mexican origin. We take a weighted average of the educational distribution of Mexican immigrants (0.75) and of the educational distribution reported by all other immigrants (0.25) to obtain an estimated educational distribution of uncounted illegal immigrants.[10] Finally, we estimate the educational distribution of all immigrants by summing relevant numbers of counted and uncounted immigrants in each of our four educational categories.

The resulting educational distributions are reported in Table 3. This table gives our estimated distribution for the entire immigrant population, including uncounted immigrants, the distribution for the enumerated population (so that the reader can see the effect on the results of our assumptions about the uncounted population), and the comparable distribution for native workers. The distribution for native workers is obtained by enumerating the number of native born workers in each education category from the relevant Census or CPS file. Consider first the column giving the educational distribution of the 1980 male immigrant work force. It indicates that 39.6 percent of the male immigrant labor force was composed of persons with less than a high school education. This statistic is notable because only 22.7 percent of native male workers lacked a high school diploma in 1980. By contrast, the proportion of immigrants with college degrees is similar to the proportion of native American workers with college degrees. The data for 1988 tell an even more striking story of disparity among dropouts: 36.0% of immigrant men compared to 15.3% of native men in the labor

Table 3: Education Distributions of Immigrant and Native Workers, 1980-1988

	Percentage Shares							
	Males				Females			
Completed Years of Schooling	1980	1983	1986	1988	1980	1983	1986	1988
A. Counted Plus Uncounted Immigrants								
Less than 12	39.6	34.1	36.9	36.0	35.7	29.7	27.0	28.3
12	22.4	22.5	23.7	22.6	30.3	30.3	30.8	27.6
13-15	16.3	18.1	16.3	16.2	17.9	18.1	20.5	21.8
16 or more	21.7	25.3	23.1	25.1	16.0	22.1	21.7	22.3
B. Natives								
Less than 12	22.7	19.0	16.5	15.3	18.2	14.2	12.1	11.0
12	37.9	35.8	36.5	36.0	44.9	42.8	41.6	40.6
13-15	19.2	22.6	23.6	24.6	20.9	24.8	26.6	27.6
16 or more	20.2	22.7	23.3	24.0	16.0	18.2	19.6	20.7
C. Counted Immigrants								
Less than 12	37.5	31.6	34.7	33.7	34.0	27.7	24.8	26.2
12	23.0	23.1	24.4	23.2	31.2	30.9	31.7	28.3
13-15	16.9	18.8	16.9	16.8	18.4	18.6	21.1	22.5
16 or more	22.6	26.5	24.0	26.2	16.4	22.8	22.4	23.0

Sources: Education distributions for natives and for counted immigrants are based on the number of immigrant and native workers with the specified education levels counted in the 1980 Census of Population, April 1983 CPS, and June 1986 and 1988 CPSs. The education distribution for uncounted immigrants is based on a weighted average of the education distributions of counted Mexican immigrant workers (75%) and all other counted immigrant workers (25%) who entered the United States from 1975-80; these education distributions were tabulated from the 1980 Census and are displayed in figure 3. The total number of uncounted immigrants by sex and year are from Table 1.

force lacked a high school diploma. The figures for female immigrant workers follow the same pattern: a disproportionate number were high school dropouts compared to native female workers.

Turning to changes over time, table 3 shows that the share of native workers with less than a high school degree fell sharply in the 1980s. Indeed, the underlying statistics reveal a massive 5.6 million drop in the number of U.S.-born workers with less than a high school degree from 1980 (19.2 million) to 1988 (13.6 million)! This is the result of the retirement of older less-educated workers and increased rates of high school graduation among younger cohorts. For immigrants, by contrast, the high school dropout share of workers fell modestly, and there was an actual growth in the number of dropout immigrant workers by some 0.8 million persons. The implication is that during the 1980s immigration became **a major source of the supply of high school dropout workers** whereas it was only a much smaller source of the supply of more educated workers.

Lines 1 and 2 of table 4 pursues this implication by reorganizing the data on the numbers of immigrant and native workers by education to show the relative increment in the labor supply of workers with differing amounts of education due to immigration year by year. A relative increment is the ratio of the number of immigrant workers to the number of native workers in a given category. The table records figures on an index basis, with the estimated native labor supply set at 1.00 for each group in each year. Thus, the first line in each year for the native labor supply is 1.00. The second line in each year gives the relative increment of immigrants (counted and uncounted) to the labor supply. In all the years covered immigrants increase the number of workers with less than high school education by the largest amount and the number with college education by the second largest percentage amount. Over time, however, the relative increment in the supply of high school dropouts due to

Table 4: Estimated Increments to the Supply of Labor by Education and
Sex Arising from Immigration and Trade, 1980-1988[a]

	Males				Females			
	<HS	HS Grad	Some Col.	Col. Grad	<HS	HS Grad	Some Col.	Col. Grad
1980								
Native Labor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Immigrants	.13	.04	.06	.08	.14	.05	.06	.07
Trade I	.00	-.01	-.01	-.01	.01	.00	.00	.00
Trade II	.02	.00	-.01	-.02	.04	.00	-.01	.00
Dom+Imm+Tr I	1.13	1.03	1.05	1.07	1.15	1.05	1.06	1.07
Dom+Imm+Tr II	1.15	1.04	1.05	1.06	1.18	1.05	1.06	1.07
1985/6[b]								
Native Labor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Immigrants	.23	.07	.07	.10	.19	.06	.07	.10
Trade I	.05	.02	.01	.00	.09	.02	.01	.00
Trade II	.09	.03	.00	-.02	.14	.02	.00	.00
Dom+Imm+Tr I	1.27	1.08	1.08	1.10	1.28	1.08	1.07	1.10
D.+I.+Tr.II	1.32	1.10	1.07	1.08	1.34	1.09	1.07	1.10
1988[c]								
Native Labor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Immigrants	.26	.07	.07	.11	.24	.06	.07	.10
Trade I	.03	.01	.00	.00	.07	.01	.00	.00
Trade II	.07	.02	-.01	-.02	.12	.02	.00	.00
Dom+Imm+Tr I	1.28	1.08	1.07	1.11	1.31	1.08	1.07	1.10
Dom+Imm+Tr II	1.33	1.09	1.07	1.09	1.36	1.08	1.07	1.10

[a] Trade I — imports and exports assumed to affect production and nonproduction workers in same manner as domestic production (Method I);
   Trade II — imports assumed to affect production workers only and exports treated same as in method I (Method II).

[b] Trade numbers are for 1985 and immigration numbers are for 1986.

[c] Increments to labor supply from trade for 1988 are predicted from regressions of the actual increments to labor supply from trade on real net exports of durable goods as a fraction of GNP and a time trend by education and sex for the 1967-1985 period. Separate regressions are run for each group using the Method I and Method II estimates of the increment to labor supply from trade.

Sources: See Table 1 for trade numbers and Table 3 for immigration numbers.

immigration doubles while the relative increment in the supply of more educated workers due to immigration changes only modestly. In 1988, immigrant workers increased the work force of high school dropouts by approximately 25% whereas immigrant workers increased the work force of high school graduates by 6-7% and of college graduates by 10-11%.

IV. The Effect of Trade and Immigration on Relative Labor Supplies

Taken together, trade and immigration substantially altered the nation's labor skill endowments during the 1980s. Table 4 examines the dimensions of this change in terms of the increment in the labor supplies of different educational groups of workers due to these two components of the open economy. The third and fourth lines of each panel in the table show the ratio of the implicit labor supply due to trade to the native supply under assumptions I and II. Since our estimates of the implicit labor supply in net trade flows by education and sex only cover the 1967-1985 period, we need to approximate the effect of trade in 1988. To do so, we regress the measures of implicit labor supply in trade by education and sex plotted in figures 1A and 1B on net exports in durable goods as a fraction of GNP (both measured in 1982 dollars) and on a linear time trend for the 1967-1985 period.[11] The entries for Trade I and Trade II for 1988 in table 4 are the predicted values from these regressions for 1988 (i.e. with real net exports in durable goods as a fraction of real GNP set at its 1988 value and with the time trend variable set to 1988). Finally, the fifth and six line in each panel give the summation of the relevant supplies; they are our bottom-line estimates of the effect of immigration and trade on the nation's factor endowments.

The table shows that because immigration and trade have been skewed toward increasing the work force with less than high school education, whose native labor supply has been decreasing rapidly, they substantially altered the nation's labor skill endowments in

the 1980s. In 1985-6, at the height of the trade deficit and after a decade of substantial legal and illegal immigration, the nation's effective supply of high school dropout men was 27 to 32 percent higher than it would otherwise have been, while the supply of high school dropout women was 28 to 34 percent higher. By contrast, the nation's effective supply of college graduates was just 8 to 10 percent higher, exclusively because of immigration. Between 1980 and 1988 the contribution of trade and immigration to the effective supply of high school dropout workers rose from 13 to 15 percent to 28 to 33 percent of native labor supply for men and from 15 to 18 percent to 31 to 36 percent for women, while over the same period the contribution of trade and immigration to the effective supply of other groups increased much more modestly.

The finding that trade and immigration worked in the same direction to augment the relative supply of less-educated workers in the U.S. economy when that supply was falling rapidly in the 1980s is consistent with Heckscher-Ohlin models of trade and factor endowments (Mundell, 1957; Samuelson, 1944). The similar pattern of change in labor skills due to the two flows is inconsistent with the notion that immigrant flows alter factor supplies in an opposite manner than trade that is possible when trade is generated by technology or scale factors (Markusen, 1983).[12] On the other hand, one must be cautious in using the skill content of actual immigration flows to infer the economic incentives for immigration of different skill groups because immigration flows are highly restricted by legal and institutional barriers.[13] Similarly formal and informal trade barriers suggest similar caveats apply to drawing strong conclusions about trade models from realized trade flows.

V. The Effect of Changes in Labor Skill Endowments on Relative Earnings

Were the trade and immigration induced changes in relative labor supplies large enough

to have contributed to the huge increase in skill differentials in the U.S. labor market in the 1980s?

To answer this question in a simple and direct manner, we take two approaches. First, we amalgamate our four education groups into two categories -- college-equivalent and high school-equivalent workers -- and calculate the effect of immigration and trade induced changes in implicit labor supply on the earnings of these two groups using a single economy-wide estimated elasticity of substitution for them. Second, we perform a similar analysis breaking the labor force into high school dropouts and all other workers. By amalgamating labor skill groups into two groups in both of these approaches, we are able to avoid analyzing substitution among many groups of workers that would put great strains on our data. Treating the effects of changes in implicit labor supplies in the economy as a whole sidesteps the potentially complex relationship between immigration and trade flows and the relative prices and outputs of different industries.[14]

The Effects of Trade and Immigration on the College/High School Wage Differential

We follow the procedure of Katz and Murphy (1990) in amalgamating education-gender categories into: (1) less-skilled high school equivalent workers and (2) more-skilled college equivalent workers. We treat high school graduates (workers with exactly twelve years of schooling) as pure high school equivalents and college graduates (workers with sixteen or more years of schooling) as pure college equivalents. We allocate high school dropouts (those with less than twelve years of schooling) and workers with some college (those with thirteen to fifteen years of schooling) to these two categories on the basis of regressions of their wages on the wages of high school graduates and college graduates for the 1963-87 period. This implicitly assumes that there are two skill groups in the economy and that

workers in each education group represent a linear combination of the two groups.

Specifically, we sorted our individual-level March CPS data for each year into 320 gender-education-experience cells based on 2 gender, 4 education, and 40 experience splits. We then computed average weekly wages for full-time workers in each of these 320 cells and used the cell averages to compute fixed-weight average weekly wages for our 4 education groups.[15] We used these fixed-weight average wages by education group to convert high school dropouts and workers with some college into high school and college equivalents on the basis of the following annual time-series regressions for the 1963-87 period:

$$w_{<12} = 0.932\ w_{12} - 0.048\ w_{16+}\ ,\ n=25,$$
$$\phantom{w_{<12} = }(0.072)\phantom{\ w_{12}}\ (0.045)$$

$$w_{13-15} = 0.686\ w_{12} + 0.293\ w_{16+}\ ,\ n=25,$$
$$\phantom{w_{13-15} = }(0.069)\phantom{\ w_{12}}\ (0.043)$$

where w_j is the fixed-weight average weekly wage of workers with j years of schooling.

The regression coefficients indicate that high school dropouts are comparable to high school graduates, with a discount factor of 0.932, and that those with some college are also closer to high school graduates than to college graduates. On the basis of these regressions we define the number of high school equivalents (N_{HS}) and college equivalents (N_{CG}) in the labor force as:

$$N_{HS} = 0.932\ n_{<12} + n_{12} + 0.686\ n_{13-15}\ ,$$

$$N_{CG} = -0.048\ n_{<12} + 0.293\ n_{13-15} + n_{16+}\ ,$$

where n_j is the fixed-weight total supply to the U.S. labor market of workers with j years of schooling. These equations indicate that this aggregation scheme essentially breaks the labor force into college graduates (college equivalents) and all other workers (high school equivalents).

Using the above equivalence formulae, we translated our estimates of the implicit labor supply by education due to trade and immigration into high school and college equivalents and compare them to the number of high school and college equivalents absent trade or immigration. Table 5 gives the results of these calculations. The first two lines record the number of high school or college equivalent workers in the native work force -- the work force we would have observed if there had been no immigration -- relative to the total native labor input in equivalent efficiency units (this is a normalization for ease of presentation). Line 3 gives the ratio of these units. The next three lines treat the total supply of high school and college equivalents in the work force inclusive of the implicit supply embodied in trade and of immigrants. Lines 7 to 10 document the separate proportional contributions of trade and immigration to the supplies of high school and college equivalents. Trade clearly has shifted the nation's skill endowments towards high school equivalent workers. In contrast, immigration had only quite minor effects on the relative supplies of high school and college equivalents during the 1980s. The reason for this small effect of immigration on relative labor supplies when the labor force is aggregated into college equivalents (essentially college graduates) and high school equivalents (essentially all others) is that while immigration is most important for high school dropouts, it was much less important for those with 12 to 15 years of schooling than it was for college graduates.

Lines 11 to 13 summarize the combined effects of trade and immigration on the supplies of high school and college equivalents. Line 11 records the ln difference between

Table 5: The Effects of Trade and Immigration on Labor Supplies
of High-School and College Equivalents, 1980-1988[a]

	1980	1985/86[b]	1987/88[c]
Supplies of the Native-Born			
1. Native HS Equivalents	.728	.685	.679
2. Native College Equivalents	.272	.315	.321
3. Ratio of (1) to (2)	2.676	2.175	2.115
Total Supplies, including Immigrants **and Implicit Supply from Trade[d]**			
4. Total HS Equivalents	.780	.771	.762
5. Total College Equivalents	.288	.340	.348
6. Ratio of (4) to (5)	2.708	2.268	2.115
Separate Effects of Trade and Immigration **on Skill Endowments[d]**			
7. Trade HS Eqs/Native HS eqs	.004	.035	.025
8. Trade Col Eqs/Native Col eqs	−.017	−.012	−.015
9. Immig HS Eqs/Native HS eqs	.068	.090	.097
10. Immig Col Eqs/Native Col eqs	.073	.090	.100
Combined Effect of Trade and Immigration **on Skill Endowments (ln units)**			
11. HS Equivalents: $\ln[(4)/(1)]$	.069	.118	.115
12. College Equivalents $\ln[(5)/(2)]$	.055	.075	.082
13. HS Relative to College (11)−(12)	.014	.043	.033

[a]All supplies have been normalized so that the sum of high school and college equivalents of the native labor force equals 1.00 in each year.

[b]The native supplies and implicit supplies from trade are for 1985; immigrant labor force shares are from 1986.

[c]The native supplies are for 1987; implicit supplies from trade and immigrant labor force shares are for 1988.

[d]We allocated imports to production workers only and exports to all workers in estimating the effect of trade on labor supplies (i.e. we used Method II).

Sources: See Table 1 for trade numbers and Table 3 for immigration numbers. Native supplies are calculated using the immigration shares from Tables 2 and 3 and data on total supplies of natives plus counted immigrants from the 1981, 1986, and 1988 March CPSs.

the relative supply of high school equivalent supply inclusive of trade and immigration and the relative native supply, while line 12 records the analogous ln difference for college equivalent supplies. These are our estimates of the proportional increase in the supply of high school and college equivalents in the United States that can be attributed to trade and immigration. Finally, line 13 shows the effect of trade and immigration on the ratio of the supply of high school to college equivalents. Line 13 indicates that the ratio of high school to college equivalent labor supply was 0.043 ln points or about 4.4 percent higher in 1985 as a result of trade and immigration than it would otherwise have been. Lines 7 to 10 indicate that the entirety of this 4.4 percent effect on relative supplies arise from trade since immigration had equivalent effects (9 percent of the native labor force) on the supplies of both high school and college equivalents. The difference between the 0.033 in line 13 for and the 0.014 in the 1980 column is our estimate of how the increased flow of trade and immigration between those years raised the ratio of high school to college equivalents. The entire 2 percent change in the ratio of high school to college equivalents from 1980 to 1988 can be attributed to changes in labor skill endowments induced by trade flows.

Table 6 turns from relative supplies to relative earnings. Line 1 records estimates from Katz and Murphy (1990) of the ln ratio of the earnings of college to high school equivalent workers from 1980 to 1988, and gives changes in this measure of the ln college/high school wage differential.[16] These figures show that the college wage premium rose sharply in the 1980s -- the phenomenon to be explained. Line 2 gives three estimates of the effect on relative earnings of the impact of trade and immigration on labor endowments. We obtain the estimate in line 2(a) by multiplying our estimated impact of trade and immigration on relative skill endowments from line 13 of table 5 by -0.709, the Katz-Murphy estimate of the effect of relative labor supply on the earnings of college graduates relative to the earnings of

Table 6: Estimated Contribution of Trade and Immigration to the Change in the College/High School Log Wage Differential, 1980–88

	Levels			Changes	
	1980	1985/6	1987/8	1980–85	1980–88
1. Actual College/High School Log Wage Differential[a]	.391	.498	.515	.107	.124
2. Predicted Change in Differential from Change in Relative Skill Endowments Induced by Trade and Immigration[b]					
(a) elasticity – 0.709	.010	.030	.023	.020	.013
(b) elasticity – 1.0	.014	.043	.033	.029	.019
(c) elasticity – 0.5	.007	.022	.017	.015	.010
3. Percentage Contribution of Change in Relative Skill Endowments Induced by Trade and Immigration to the Actual Change in the Earnings Differential[c]					
(a) elasticity – 0.709	—	—	—	19%	10%
(b) elasticity – 1.0	—	—	—	27%	15%
(c) elasticity – 0.5	—	—	—	14%	8%

[a]The actual differential is from Katz and Murphy (1990) and is the fixed-weighted average college/high school log weekly wage differential for full-time workers in 16 sex-potential experience groups computed from the March CPSs. The fixed-weights are the average shares of each of the 16 sex-experience groups in total employment for the entire 1963–1987 period. The differentials in the levels columns are for 1980, 1985, and 1987.

[b]Elasticity refers to the absolute value of the elasticity of the college/high school relative wage with respect to the relative supply of college and high school equivalents. The entries in line 2 are the combined trade and immigration induced changes in skill endowments from line 13 of Table 5 times the assumed elasticities.

[c]100 x (Line 2/Line 1).

high school graduates from 1963 to 1987.[17] The (b) and (c) estimates impose different elasticities: 0.5 and 1.0.

With an elasticity of relative wages with respect to relative supplies of -0.709, the effect of trade and immigration is to reduce the relative wage of high-school equivalents by 0.030 ln points in 1985. This indicates that the relative earnings of high school equivalent workers would have been that much higher absent trade and immigration. For 1980 the estimated effect of trade and immigration is 0.014 ln points. The difference between these estimates is the effect of the 1980-85 change in trade and immigration on relative earnings: 0.029. The ratio of 0.020 to the 0.107 increase in the relative earnings of college graduates from 1980 to 1985 gives the bottom line of our calculation: the fraction of the increase in the earnings differential due to the impact of immigration and trade on the nation's effective labor skill endowments of the two groups. Turning to the 1980 to 1988 period, we find that the trade/immigration induced changes in relative labor supplies explains a smaller 8 to 15 percent change of the rise in the college/high school wage differential. The smaller effect for the 1980-88 period than for the 1980-85 period arises from the improvement in the trade balance from 1985 to 1988.

In summary, changes in labor skill endowments induced by trade flows can explain a substantial fraction (15 to 25 percent) of the 1980-85 increase in the college/high school differential and a smaller proportion of the 1980-88 increase. Immigration flows did not significantly alter the nation's relative supplies of high school and college equivalents during the 1980s and are unlikely to have had much impact on the college/high school earnings ratio.

The Effects of Trade and Immigration on the Relative Earnings of High School Dropouts

Our second approach to assessing the effects of trade and immigration on relative

wages is to break the labor force into high school dropouts and all other workers (those with 12 or more years of schooling). This approach allows us to focus on the potential effects of trade and immigration on the less-skilled workers who appear most likely to be significantly affected by trade and immigration flows.

Table 7 present our estimates of the effects of trade and immigration on the labor supplies of high school dropouts and of all other workers. The format of the table follows that of table 5, and labor supplies are measured in efficiency units.[18] Lines 5 to 8 of table 7 present the separate effects of trade and immigration on the supplies of dropouts and of workers with 12 or more years of schooling. Table 7 reinforces the message of table 4 and indicates that both trade and immigration have greatly expanded the supply of dropouts relative to the aggregate of all other workers. Lines 9 through 11 summarize the combined effects of trade and immigration on the relative supply of dropouts. Line 9 indicates that the contribution of trade and immigration to the supply of dropouts increased from approximately 15 percent in 1980 (0.144 ln points) to over 30 percent (0.292 ln points) in 1988. The effect of trade and immigration on the relative supply of dropouts increased from 10 percent (0.094 ln points) in 1980 to 23 percent (0.21 ln points) in 1988.

Table 8 translates the changes in relative supplies into changes in the relative earnings of dropouts. Line 1 presents a fixed-weighted average for 16 sex-experience groups of the ln ratio of the earnings of workers with 12 or more years of schooling to those of high school dropouts. The relative earnings of dropouts declined by 0.091 ln points from 1980 to 1988. Line 2 presents the predicted change in the differential from the changes in relative supply induced by trade and immigration. Predicted changes are presented for three different assumptions about the elasticity of the relative wage of dropouts with respect to the relative supply of dropouts. The (a) estimate of 0.322 comes from a time-series regression over the

Table 7: The Effects of Trade and Immigration on Labor Supplies
of High School Dropouts and All Other Workers, 1980–1988[a]

	1980	1985/86[b]	1987/88[c]
Supplies of the Native-Born			
1. Native HS Dropouts (Dropouts)	.123	.087	.082
2. Natives with 12 or more years of schooling (HS or more)	.877	.913	.918
Total Supplies, including Immigrants and Implicit Supply from Trade[d]			
3. Total Dropouts	.142	.115	.109
4. Total HS or more	.924	.990	.997
Separate Effects of Trade and Immigration on Skill Endowments[d]			
5. Trade Dropouts/Native Dropouts	.021	.107	.085
6. Trade HS or more/Native HS or more	−.009	.006	−.000
7. Immig Drop Outs/Native Drop Outs	.133	.217	.253
8. Immig HS or more/Native HS or more	.061	.079	.085
Combined Effect of Trade and Immigration on Skill Endowments (ln units)			
9. Dropouts: $\ln[(3)/(1)]$	.144	.281	.292
10. HS or more: $\ln[(4)/(2)]$	.051	.081	.082
11. Dropouts relative to HS or more: (9)−(10)	.092	.200	.210

[a]All labor supplies are measured in efficiency units. All supplies have been normalized so that the sum of supplies of native high school dropouts and all other native workers in the labor force equals 1.00 in each year.

[b]The native supplies and implicit supplies from trade are for 1985; immigrant labor force shares are from 1986.

[c]The native supplies are for 1987; implicit supplies from trade and immigrant labor force shares are for 1988.

[d]We allocated imports to production workers only and exports to all workers in estimating the effect of trade on labor supplies (i.e. we used Method II).

Sources: Same as Table 5.

Table 8: Estimated Contribution of Trade and Immigration to the Change in the Relative Earnings of High School Dropouts, 1980-88

	Levels			Changes	
	1980	1985/6	1987/8	1980-85	1980-88
1. Actual HS or more/Dropout Log Wage Differential[a]	.390	.470	.481	.080	.091
2. Predicted Change in Differential from Change in Relative Skill Endowments Induced by Trade and Immigration[b]					
(a) elasticity — 0.322	.030	.064	.068	.034	.038
(b) elasticity — 0.5	.046	.100	.105	.054	.061
(c) elasticity — 0.20	.018	.040	.042	.022	.024
3. Percentage Contribution of Change in Relative Skill Endowments Induced by Trade and Immigration to the Actual Change in the Earnings Differential[c]					
(a) elasticity — 0.322	—	—	—	43%	42%
(b) elasticity — 0.5	—	—	—	68%	67%
(c) elasticity — 0.2	—	—	—	28%	26%

[a]The actual differential is the fixed-weighted average for full-time workers in 16 sex-potential experience groups of the log weekly wage differential between workers with 12 or more years of schooling and high school dropouts. The fixed-weights are the average shares of each of the 16 sex-experience groups in total employment for the entire 1963-1987 period. The differentials in the levels columns are for 1980, 1985, and 1987 and were computed from the March CPSs.

[b]Elasticity refers to the absolute value of the elasticity of the high school or more/dropout relative wage with respect to the relative supply of workers with 12 or more years of schooling and dropouts. The entries in line 2 are the combined trade and immigration induced changes in skill endowments from line 11 of Table 7 times the assumed elasticities.

[c]100 x (Line 2/Line 1).

1963 to 1987 period of the ln relative wage measure presented in line 1 on the ln relative supply of dropouts measured in efficiency units and on a linear time trend.[19] This estimate of the elasticity implies that trade and immigration induced changes in relative skill endowments can explain over 40 percent of the 9 ln point decline in the relative earnings of high school dropouts during the 1980s. These are substantial effects compared to the effects of changes in labor rents arising from industrial shifts or the decline in unionization stressed by Blackburn, Bloom, and Freeman (1990), Bound and Johnson (1989), and Katz and Revenga (1989) in their attempts to account for the deterioration in the relative earnings of less-educated men. Both trade and immigration played large roles in affecting the relative supply of dropouts and thus both contribute substantially to the predicted change in relative earnings from changes in skill endowments. The alternative elasticity assumptions also imply large effects.

In summary, the basic fact uncovered in our calculations -- that trade and immigration have greatly increased the effective labor supply of high school dropouts -- implies that trade and immigration flows may have contributed substantially to the poor labor market performance of the least educated American workers during the 1980s.

VI. Summary and Conclusions

Our assessment that trade adversely affects the relative earnings of workers with the skills intensively used in import-intensive sectors is, as noted at the outset, consistent with previous work examining how imports and exports influence industry wages and employment. Admittedly, we have not developed a full-scale analysis of how the trade-induced changes in relative labor skill endowments play themselves out across sectors or how they interact with changes in productivity across sectors [see Bhagwati (1991) for a discussion of these issues].

Nevertheless, the fact that the trade deficit increased the implicit relative supply of less-educated labor implies that almost any plausible model of wage determination will yield ceteris paribus effects of trade on relative earnings that are qualitatively similar to those implied by our calculations.

Our assessment that immigration also adversely affected the relative earnings of American high school dropouts, however, diverges from the results of the empirical literature which attempts to determine the impact of immigration on economic conditions in local labor markets. These studies find modest and imprecisely estimated differences in the earnings and employment opportunities of native workers residing in cities with sizable immigrant flows and those residing in cities with limited numbers of immigrants.

There are several potential ways of reconciling the two sets of findings. Perhaps the factors that drive labor markets towards equilibrium operate with sufficient speed so that the effects of immigration on a given region are quickly diffused throughout the country. If so, there would be little reason to expect any correlation between the presence of immigrants in a particular locality and economic conditions in that locality. For instance, it may be that native workers adjust their migration behavior to take account of (competing) immigrant flows, so that immigration ultimately has only modest effects on area labor supplies. Card (1990) finds that Miami's actual population after the Mariel boatlift was similar to the population projections made prior to the (unexpected) migration of 125,000 Cubans in 1980. Alternatively, the gateway cities that attracted immigrants may have just happened to be those that were experiencing reduced net native migration [as Filer's (1992) analysis of the 1980 Census indicates]. This explanation, however, is not consistent with the more recent evidence reported by Butcher and Card (1991) who show that during the 1980s, natives and immigrants tended to move to the same cities. Finally, perhaps an influx of immigrants raises the demand

for goods and services in an area by enough to offset the potential adverse effects of the increased labor supply on earnings and employment opportunities.

Under any of these conditions, our economy-wide analysis would correctly answer the question "how has the increase in immigration affected relative labor supplies and ultimately relative earnings?" In contrast, the local labor market analyses would correctly answer the question "how does an increase in immigration in a particular area affect relative earnings in that locality?" We believe that the "macro" implications of immigration provided by our study are as relevant to the debate over immigration policy as the "micro" insights provided by the existing literature.

It is also possible, however, that the difference in results from the two different analytical approaches reflects the inadequacy of existing economic theory and empirical models. In other words, the labor market impacts of immigration and trade work through channels that are not easily incorporated into our conceptual framework or that are imperfectly measured by the available data. Nevertheless, whatever the ultimate explanation for the different results obtained from the two modes of analysis, our empirical evidence suggests that both the immigration flows and trade deficits of the 1980s adversely affected the economic position of less-skilled Americans. At a minimum, our analysis reveals that immigration and trade significantly altered the nation's labor skills endowments by enough to have contributed substantially to the decline in the relative earnings of less-skilled workers during the 1980s.

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Endnotes

1. Studies documenting changes in the U.S. wage structure during the 1980s include Blackburn, Bloom, and Freeman (1990), Bound and Johnson (1989), Juhn, Murphy and Pierce (1991), Katz and Revenga (1989), Katz and Murphy (1990), and Murphy and Welch (1988).

2. It is irrelevant whether we treat trade as shifts in labor supply or in labor demand. This is obviously the case in terms of the likely effects of trade on wages since in a market clearing model $W' = (D'-S')/(e+h)$, where W' is the change in ln wages, D' and S' are shifts in demand and supply, and e and h are the elasticities of supply and demand respectively. Whether we treat imports as increasing labor supply (an increase in S') or reducing labor demand (a decrease in D') is a matter of taste.

3. The net labor supply contained in imports for skill group j in year t using the production worker only allocation scheme is given by:

$$LP_{jt} = \Sigma_i \, p_{ij} \, L_{it} \, (T_{it}/O_{it}),$$

where p_{ij} is the average proportion of production workers in industry i from the jth skill group for the 1967-85 period. We classify as production workers those workers in the manufacturing sector in the following broad occupational categories: craft workers, handlers and laborers, operatives, transport operatives, and service workers.

4. This normalization focuses on the mix of labor in a sector relative to the economy. Alternatively, we could have normalized on efficiency units in a given year. This would have added a trend factor to the overall number of efficiency units without affecting industry differences in efficiency units.

5. The CPS data set utilized is described in detail in Juhn, Murphy, and Pierce (1991) and Katz and Murphy (1990).

6. Abowd (1991) provides detailed discussions of this data set and the construction of trade data on a four-digit SIC industry basis. The data on output and employment in each industry given by the NBER data set are from the Annual Survey of Manufactures.

7. The figures for 1984 and 1985 are likely to be fairly representative of the rest of the decade, as the trade deficit was at comparable levels on average in the 1986-89 and 1984-85 periods.

8. We report a range of estimates for the effect of trade on implicit labor supplies. In each case the smaller number in absolute value is obtained by our method I, in which we treat production and nonproduction workers the same. The larger number in absolute value is obtained by our method II, in which we assume that imports do not displace nonproduction workers.

9. Woodrow, Passel and Warren (1987) provide a detailed discussion of the quality of the immigration data from the June 1986 CPS, and Woodrow and Passel (1990) provide an analysis of the immigration data from the June 1988 CPS.

10. We also made estimates assuming that 50 percent of the uncounted illegal workers were Mexican, on the basis of the Warren and Passel estimate that approximately 50 percent of the counted illegals in the 1980 Census are of Mexican origin. The results differed only modestly from those reported here.

11. In other words, we run 16 regressions are of the form:

$$LT_{it} = \beta_0 + \beta_1 NX_t + B_2 Time_t + \epsilon_{it},$$

where LT_{it} is the implicit labor supply in net exports in manufactures expressed as a fraction of the total domestic labor force for group i in year t and NX_t is real net exports in durable goods divided by real GNP in year t, and Time is a linear time trend. Two regressions of this form (one using Method I and one using Method II to measure the labor supply in trade flows) were run for eight demographic groups (two sexes by four education groups). The data on real GNP and real net exports in durable goods (both in 1982 dollars) are from U.S. Council of Economic Advisors (1990, pages 296 and 317). The results are quite similar when the real merchandise trade balance (including durable and nondurable goods) or overall real net exports are used in the prediction equations as the measure of NX rather than real net exports of durable goods. The equations using net exports of durable goods tend to fit better) than those using alternative measures of NX.

12. In these models if export industries use skilled labor and technology/scale economies generate exports, expansion of those industries will increase demand for skilled workers, inducing immigration of skilled labor. Thus, it is possible that a country will import "less skilled" labor through trade and skilled labor through immigration.

13.See Borjas (1990) for a detailed analysis of the determinants of the skill content of U.S. immigration and of the institutions governing immigration flows.

14. As Bhagwati (1991) has pointed out, the changes in relative wages implied by this procedure have implications for import and export prices (lower wages for the less skilled should reduce the price of import-substitutes and of low-skill service sector activities) and thus for the sectoral composition of output.

15. The fixed-weights used for computing the average wage for each education group were the average share of the gender-education-experience cell in employment for the education group over the entire 1963-87 period.

16. The relative earnings measure is a fixed-weighted average of the ln college/high school weekly wage differential for full-time workers in 16 sex-experience groups (both sexes by 8 five-year potential experience brackets). The fixed-weights are the average shares of each of the 16 sex-experience groups in total employment for the entire 1963-1987 period. These estimates are based on all full-time workers with 1 to 40 years of potential

experience who participated in the labor force for at least 39 weeks in the calendar year prior to each March CPS survey, including immigrants. While we would have preferred to record earnings differentials for native workers only, to get a better fix on the effect of trade and immigration on the labor market for natives, the March CPSs do not provide information that allows us to distinguish between native and foreign-born workers.

17. More precisely, the regression of ln relative earnings (RE) on ln relative supplies (RSUP) and a time trend for the 25 year period, 1963-1987 yielded the following:

$$RE = \text{constant} - 0.709 \text{ RSUP} + 0.033 \text{ Time}$$
$$(0.150) \qquad (0.007)$$

where standard errors are in parenthesis. The R^2 in this equation is 0.52. The relative earnings measure is the ln college/high school weekly wage differential described in footnote 15, and the relative supply measure is the ln ratio of college to high school equivalents for workers counted in the March CPSs (native workers and counted immigrants).

18. The results are quite similar when labor supplies are measured in personhours.

19. More precisely, the regression of ln relative earnings (RE) on ln relative supplies (RSUP) and a time trend for the 25 year period, 1963-1987 yielded the following:

$$RE = \text{constant} - 0.322 \text{ RSUP} + 0.023 \text{ Time}$$
$$(0.138) \qquad (0.010)$$

where standard errors are in parenthesis. The R^2 in this equation is 0.48.