Structural Demand Shifts and Potential Labor Supply Responses in the New Century

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I. Introduction

It is widely recognized that inequality of labor market earnings in the United States grew dramatically in recent decades. This may be seen in Figure 1, which plots the growth of real hourly wages of US workers (both male and female) by earnings percentile for the years 1973 through 2005. Over the course of more than three decades, wage growth was weak to nonexistent at the bottom of the distribution, strong at the top of the distribution, and modest at the middle. While real hourly earnings of workers within the bottom 30 percent of the earnings distribution rose by no more than 10 percentage points, earnings of workers at the 90th percentile rose by more than 40 percentage points.

What is much less widely known, however, is that this smooth, monotone growth of wage inequality is a feature of a specific time period—and that this time period has passed.\(^1\) Figure 2 shows that, consistent with common perceptions, the growth of wage inequality between 1973 and 1989 was strikingly linear in wage percentiles, with sharp falls in real wages at the bottom of the distribution and modest increases at the top.\(^2\) Yet, starting in the late 1980s, the growth of wages ‘polarized,’ with strong, ongoing wage growth in the top of the earnings distribution (at or above the 70th percentile) and modest growth in the lower tail of the distribution (at or below the 30th percentile). Notably, the portion of the wage distribution that saw the least real earnings growth between 1989 and 2005 was the ‘middle,’ roughly the group of earners between the 30th and 70th percentiles of the distribution.\(^3\) Thus, the periods of 1973 to 1989 and 1989 to 2005 present two distinct periods of rising inequality: one of diverging wages throughout the distribution; a second of polarizing wage growth.

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1. This observation was, to my knowledge, first offered by Mishel, Bernstein and Boushey (2002).
2. The public use Current Population Survey and Census of Populations data analyzed here do not cover the top several percentiles of the earnings distribution where the most dramatic increases in real earnings have occurred during these decades (see Piketty and Saez 2002). Including these top percentiles would, consistent with our discussion, reveal even greater growth at the top throughout the years studied but would not qualitatively change our conclusions.
3. It bears note, however, that all percentiles of the distribution fared better in the second half of the time period (1989 through 2005) than in the first (1973 through 1989), reflecting the considerable acceleration of US productivity growth from the mid-1990s forward.
These two epochs are contrasted in Figure 3, which plots the evolution of the ratio of 90\textsuperscript{th} to 50\textsuperscript{th} percentile hourly earnings alongside the evolution of the ratio of 50\textsuperscript{th} to 10\textsuperscript{th} percentile hourly earnings.\textsuperscript{4} The 90/50 ratio rises smoothly and secularly from 1979 to 2004. By contrast, the 50/10 ratio rises sharply from 1979 to 1987, plateaus in 1988, and then reverses course for the remainder of the time period. The divergent growth of upper- and lower-tail wage inequality in the 1980s and 1990s is also corroborated by micro data on wages and total compensation from the establishment-based Employment Cost Index (Pierce 2001). The steady growth of upper tier earnings inequality is seen in rising shares of wages paid to the top 10 and top 1 percent of US earners since the late 1970s in tax data (Piketty and Saez 2003).

This article evaluates the sources of the growth and then ‘polarization’ of earnings inequality and considers implications for future growth of labor demand, by which we mean the demand for workers at various skill levels.\textsuperscript{5} We begin by reviewing basic trends in earnings levels by education groups over several decades, and show how the pattern of polarization visible in Figure 2 is also reflected in trends in earnings by education level. We next consider whether these patterns of changing earnings by educational level can be adequately explained by canonical labor demand models of the type used by Katz and Murphy (1992), Autor, Katz and Krueger (1998), Card and Lemieux (2001) and Acemoglu (2002) among many others. Though these models do an excellent job of explaining the evolution of US inequality to 1992, they fare poorly thereafter, suggesting a substantial change (or ‘structural break’) in the character of labor demand over the last one and a half decades.

We briefly consider whether widely discussed institutional explanations for rising US wage inequality—most particularly, fluctuations in the US minimum wage and the tight labor market of the 1990s—provide a sufficient alternative explanation for these same patterns. While these factors are

\textsuperscript{4} These series are smoothed using three year moving averages. Thus, the data point labeled 2004 is the average of the values for 2003, 2004 and 2005.

\textsuperscript{5} I use the term “we” throughout the article because the material in this article draws heavily on work performed jointly with David Dorn, Frank Levy, Lawrence Katz, Melissa Kearney, Alan Krueger and Richard Murnane.
likely to have contributed to rising inequality, particularly in the 1980s, neither provides a viable explanation for the long-term secular growth of high incomes seen in the 1970s through 1990s, nor for the plateau and slight rebound of low-incomes during the 1990s.

We next discuss how technological change and, more recently, international outsourcing, provide a plausible, albeit still preliminary, explanation for the polarization of earnings growth. Following the conceptual model offered by Autor, Levy and Murnane (2003), we argue that technological change (recently abetted by outsourcing) that has been complementary to high-education occupations, particularly deleterious to middle-education occupations, and neither strongly complementary to nor strongly deleterious to (i.e., substitutable for) low-education service occupations. A key implication of this conceptual framework is that computerization may foster a demand-driven ‘polarization’ of labor market activities. Corroborating this implication, we present initial evidence that the observed polarization of earnings inequality is demand driven. We use this model to speculate on the changing shape of labor demand in the US, which we argue will be characterized by rapid growth of managerial and professional occupations and rapid growth of comparatively low-education service employment.

The final section of the paper focuses on three sets of research and policy issues that impinge on how the changing shape of labor demand will affect employment opportunities and inequality. A first considers potential supply responses in the form of human capital investment and immigration policy. A second considers the role of labor standards and social welfare policy in shaping the ‘quality’ of future jobs, particularly service jobs. The final section considers areas of theory and measurement needing urgent attention for improving understanding of how changes in technology and trade will affect labor demand in ensuing decades.

II. Measuring Inequality of Earnings

To summarize the basic changes in the US wage structure over the last four decades, we draw on two large and representative household data sources: the March Current Population Survey (CPS) and
the combined CPS May and Outgoing Rotation Group samples. The March CPS data provide reasonably comparable data on prior year’s annual earnings, weeks worked, and hours worked per week for four decades. We use the March files from 1964 to 2006 (covering earnings from 1963 to 2005) to form a sample of real weekly earnings for workers ages 16 to 64 who participate in the labor force on a full-time, full-year (FTFY) basis, defined as working 35-plus hours per week and 40-plus weeks per year. We complement the March FTFY series data with data on hourly wages of all current labor force participants using May CPS samples for 1973 through 1978 and CPS Outgoing Rotation Group samples for 1979 through 2003 (CPS May/ORG). From these sources, we construct hourly wage data for all wage and salary workers employed during the CPS sample survey reference week.6

We focus on two measures of relative earnings. The first is inequality in the upper and lower halves of the wage distribution, summarized by 90-50 and 50-10 log wage gaps (which we refer to as upper- and lower-tail inequality). These trends are depicted above in Figure 3. The second is ‘between-group’ inequality, which we measure using the earnings levels and earnings differentials among workers of different educational attainments.7 Figure 4 displays these earnings trends for full-time, full-year workers by educational attainment for the years 1963 to 2005.8 In this figure, the average earnings for each education group in 1963 is normalized to zero, and subsequent data points represent the logarithmic change in earnings (approximately equal to the percentage point change) since 1963. Wage levels are indexed using the Personal Consumption Expenditure deflator and are composition-adjusted to hold constant the gender and labor market experience of workers within each education group at their average levels over 1963 to 2005.

6 Details of the samples and data processing methods used for these data series are provided Autor, Katz and Kearney (2008).
7 We do not discuss inequality of earnings residuals (that is, the unexplained component of wage variance). For recent work on this topic, see Lemieux (2006b) and Autor, Katz and Kearney (2005 and 2008).
8 For this figure, we use the full time period of 1963 to 2005 (in contrast to Figures 1 through 3) because reliable measures of average earnings levels extending back to 1963 are available from the March CPS. By contrast, trends in earnings distribution (such as the 90/50 and 50/10) are more precisely measured using the CPS May/ORG data (Lemieux 2006b), which only extend back to 1973.
Figure 4 reveals the four major epics in the evolution of between-group inequality in the United States. From 1963 to 1973, real wages grew strongly for all education groups. Since growth rates were relatively comparable across educational levels (with the exception of workers with a post-college education), these sharp gains were not accompanied by a significant rise in between-group inequality. Following the 1973 oil shock, earnings levels stagnated for all groups, while inequality remained largely steady. Commencing in 1979, inequality rose rapidly even as average earnings remained stagnant. Real wages of workers with a college or post-college education increased significantly, while real wages of those with a high-school or lower education plummeted. Most recently, from the early 1990s forward, overall earnings levels have risen again, but this growth was bimodal: earnings of less educated workers (those with a high-school degree or lower) rose modestly, earnings of the most highly educated (those with post-college education) rose extremely rapidly, and earnings growth of those with some college education was comparatively weak. Thus, the polarization of overall earnings growth in the 1990s depicted in Figures 2 and 3 is reflected in a contemporaneous polarization of earnings across education groups.

III. Rising Inequality: The Role of Demand Shifts for College Relative v. Non-College Workers

To interpret the forces shaping the rise and subsequent ‘polarization’ of wage inequality—and to forecast its future trajectory—it is critical to assess the degree to which shifts in labor demand are responsible for the observed patterns. In this section, we ask whether the rising wages of high relative to low education workers can be explained by a combination of demand and supply shifts that favor more educated workers. A particularly simple and attractive formulation of this supply-demand framework posits that there are two major skill groups in the labor market, college and high school equivalents. Both skill groups are demanded by firms and, critically, these groups are imperfect
substitutes in production. Thus, an increase in the relative supply of one group reduces its earnings relative to the other.9

Figure 5 illustrates the intuitive appeal of this conceptual framework. In the Figure, the series labeled “Log Wage Differential” plots the composition-adjusted log college/high-school earnings gap for 1963 through 2005. Consistent with the more disaggregated earnings series summarized in Figure 4, the college/high-school gap rises in the 1960s, contracts modestly in the 1970s, and then expands rapidly from 1981 forward. By 2005, the college/high-school gap has attained its highest level—94 percent or 66 log points—since 1915 (Goldin and Katz 2007). This gap is nearly double the 1963 level of 49 percent (40 log points). The second series in Figure 5, labeled “Log Relative Supply,” depicts the evolution of the composition-adjusted supply of college relative to high school workers in the same time period. This series reveals an acceleration of the growth in the relative supply of college workers in the 1970s relative to the 1960s, followed by a dramatic slowdown starting in 1982. Notably, this deceleration, caused by slowing college attainment among cohorts of youth born after 1950 (see Card and Lemieux 2000), corresponds closely with the sharp jump in the college/high-school premium after 1981. Thus, the juxtaposition of these series suggests that fluctuations in the rate of supply growth of college educated workers, overlaid on secularly rising demand for college workers, may provide a reasonable summary explanation for the growth of college premium. Indeed, this hypothesis was famously exposited by Katz and Murphy in 1992, who found that it provided an excellent fit for trends in the college premium for the years 1963 to 1987 (the end of their data set).

To explore the power of this framework for more recent trends in inequality, we re-estimate the Katz-Murphy model using earnings data extended to 2005 (an additional 18 years beyond their original work). Our illustrative conceptual framework starts with a CES production function for aggregate output $Q$ with two factors, college equivalents ($c$) and high school equivalents ($h$):

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\[ Q_t = \left[ \alpha_t(a_t N_{ct})^{\rho} + (1 - \alpha_t)(b_t N_{ht})^{\rho} \right]^{1/\rho} \]

where \( N_{ct} \) and \( N_{ht} \) are the quantities employed of college equivalents (skilled labor) and high-school equivalents (unskilled labor) in period \( t \). \( a_t \) and \( b_t \) represent skilled and unskilled labor augmenting technological change, \( \alpha_t \) is a time-varying technology parameter that can be interpreted as indexing the share of work activities allocated to skilled labor, and \( \rho \) is a time invariant production parameter. Skill-neutral technological improvements raise \( a_t \) and \( b_t \) by the same proportion. Skill-biased technological changes involve increases in \( a_t / b_t \) or \( \alpha_t \). The aggregate elasticity of substitution between college and high-school equivalents is given by \( \sigma = 1/(1 - \rho) \).

Under the assumption that college and high-school equivalents are paid their marginal products, we can use equation (1) to solve for the ratio of marginal products of the two labor types yielding a relationship between relative wages in year \( t \), \( w_{ct} / w_{ht} \), and relative supplies in year \( t \), \( N_{ct} / N_{ht} \) given by

\[ \ln( w_{ct} / w_{ht} ) = \ln[ \alpha_t / (1 - \alpha_t) ] + \rho \ln(a_t / b_t) - (1/\sigma) \ln(N_{ct} / N_{ht}), \]

which can be rewritten as

\[ \ln( w_{ct} / w_{ht} ) = (1/\sigma) [ D_t - \ln(N_{ct} / N_{ht}) ], \]

where \( D_t \) indexes relative demand shifts favoring college equivalents and is measured in log quantity units. The impact of changes in relative skill supplies on relative wages depends inversely on the magnitude of aggregate elasticity of substitution between the two skill groups. The greater is \( \sigma \), the smaller the impact of shifts in relative supplies on relative wages and the greater must be fluctuations in demand shifts (\( D_t \)) to explain any given time series of relative wages for a given time series of relative quantities. Changes in \( D_t \) can arise from (disembodied) skill-biased technological change, non-neutral changes in the relative prices or quantities of non-labor inputs, and shifts in product demand.

Following the approach of Katz and Murphy (1992), we directly estimate a version of equation (3) to explain the evolution from 1963 to 2005 of the overall log college/high school wage differential series.
for FTFY workers from the March CPS shown in Figure 5. We substitute for the unobserved demand shifts $D_t$ with a simple linear time trend. We also include an index of the log relative supply of college/high school equivalents: \(^{10}\)

\[
\ln \left( \frac{w_{c_t}}{w_{n_t}} \right) = \gamma_0 + \gamma_1 t + \gamma_2 \ln \left( \frac{N_c}{N_n} \right) + \epsilon_t,
\]

where $\gamma_2$ provides an estimate of $1/\sigma$.

Figure 6 plots the observed college/high-school premium for years 1963 to 2005 alongside the fitted values of equation (4) generated by estimating the Katz-Murphy model for calendar years 1963 through 1987 and then extrapolating the estimates through the year 2005 based on the observed evolution of college/high-school relative supply. The model implies a strong, secular growth of college/high school relative demand at the rate of about 2.6 log points annually over 1963 to 1987. Though the Katz-Murphy model is only fit to data through 1987, it does an excellent job of forecasting the growth of the college wage premium through 1992, suggesting that demand shifts favoring college-educated workers continued apace in these years. This demand growth is typically interpreted as evidence of Skill-Biased Technical Change, i.e., changes in the organization of production that have favored the skills possessed by college relative to non-college workers. Indeed, comprehensive analyses of longer time series by Autor, Katz and Krueger (1998) and Goldin and Katz (2007) suggest that such skill-biased demand shifts have been underway for many decades—and that they accelerated in the second half of the twentieth century.

What drives these secular demand shifts? A large literature reviewed in Katz and Autor (1999) and Katz (2000) yields two consistent findings suggesting that skill-biased technological change has played an

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\(^{10}\) We use a standard measure of college/non-college relative supply calculated in “efficiency units” to adjust for changes in labor force composition by gender and experience groups.
integral role. The first is that the relative employment of more-educated workers and non-production workers has increased rapidly within detailed industries and within establishments in the United States during the 1980s and 1990s, despite the sharp rise in the relative wages of these groups (Dunne, Haltiwanger and Troske 1997; Autor, Katz and Krueger 1998). Similar patterns of within-industry increases in the proportion of skilled workers are apparent in other advanced nations (Berman, Bound and Machin 1998; Machin and Van Reenen 1998). These findings suggest strong within-industry demand shifts favoring the more skilled. Second, a wealth of quantitative and case-study evidence documents a striking correlation between the adoption of computer-based technologies (and associated organizational innovations) and the increased use of college-educated labor within detailed industries, within firms, and across plants within industries (Doms, Dunne and Troske 1997; Autor, Levy and Murnane 2002; Levy and Murnane 2004; Bartel, Ichniowski and Shaw 2007).

While appealing, this story is not entirely confirmed by the data. Though the Katz-Murphy model accurately predicts the ongoing growth of the college wage premium from 1992, the model substantially over-predicts the growth of the college wage premium from 1992 forward. This suggests, unexpectedly, that demand shifts favoring college-educated workers have slowed since 1992. This implied slowdown in trend demand growth in the 1990s is potentially inconsistent with a simple skill biased technical change story looking at the growth of computer investments since these continued rapidly in the 1990s (particularly with the rapid diffusion of the Internet). Why has this occurred?

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11 Skill-biased technological change refers to any introduction of a new technology, change in production methods, or change in the organization of work that increases the demand for more-skilled labor relative to less-skilled labor at fixed relative wages.

12 Foreign outsourcing of less-skilled jobs is another possible explanation for this pattern (Feenstra and Hanson 1999). But large within-industry shifts towards more skilled workers are pervasive even in sectors with little or no observed foreign outsourcing activity. Foreign outsourcing appears likely to become increasingly important, however.

One potential explanation for this implied slowdown is the strong cyclical labor market of the expansion of the 1990s, leading to a tight labor market which may particularly boost the earnings of low-education workers. The impacts of labor market institutions such as the erosion of the real value of the minimum wage since the early 1980s might also have played a role. These explanations are evaluated by Autor, Katz and Kearney (2008), however, and found wanting. After accounting for the role of supply shifts, the real minimum wage and prime age male unemployment rates have modest additional explanatory power for the evolution of inequality and thereby reduce the extent of the estimated slowdown in trend demand growth over the last decade. But these cyclical and institutional factors are insufficient to resolve the puzzle posed by slowing trend relative demand for college workers in the 1990s.

A closer look at the data suggests why the simple CES model with two factors—college and high-school equivalents—fails to provide an adequate explanation of the evolution of between-group wage inequality starting in the early 1990s. As shown in Figure 4, the real, composition-adjusted earnings of full-time, full-year workers at different levels of educational attainment ‘polarized’ after 1987 in a manner consistent with the divergent trends in 90-50 and 50-10 inequality documented in Figure 3. In particular, the wage gap between males with a post-college education and those with a high school education rose rapidly and monotonically from 1979 through 2005, increasing by 43.1 log points overall and 15.4, 15.7 and 12.0 points respectively between 1979–1988, 1988–1997, and 1997–2005. By contrast, after increasing by 13.3 log points between 1979 and 1987, the wage gap between males with

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14 In contrast to the findings of Autor, Katz and Kearney (2008), analyses by Bartik (2001) and Bernstein and Baker (2003) find that a low unemployment rate differentially raises earnings in low relative to high wage deciles, thus compressing wage inequality. While a resolution of these conflicting conclusions is beyond the scope of this paper, this issue merits further study.

15 The direct effects of union decline on US wage inequality growth also appear to be modest. Card, Lemieux and Riddell (2003) find that falling unionization explains about 14 percent of the growth of male wage variance from 1973 to 2001 (in models allowing for skill group differences in the impact of unions) with an even smaller union effect for the growth of female wage variance.

16 For females, earnings growth between 1988 and 2005 among post-college educated workers was substantially greater than for college-only workers but the pattern was reversed for 1979 to 1988.
exactly a college degree and those with a high school education rose comparatively slowly thereafter, by 4.5 and 9.0 log points respectively between 1988–1997 and 1997–2005. By implication, between 1988 and 2005, the earnings of post-college males rose by 14.2 log points more than the earnings of college-only males. Conversely, at the bottom of the wage distribution, the wage gap between high school graduates and high school dropouts increased steadily from 1979 and 1997, then flattened or reversed.

This pattern, in which wage gaps within college-educated and non-college-educated workers groups diverge, is inconsistent with the basic, two-factor CES model. In this model, the labor input of all college-educated worker subgroups is assumed to be perfectly substitutable up to a scalar multiple, and similarly for non-college worker subgroups. Accordingly, the wage ratio of college-educated to post-college educated worker should be roughly constant, as should the wage ratio of high school dropouts to high school graduates. This two-factor assumption fits the data rather well from 1963 to 1987. However, the drastic rise in earnings of post-secondary relative to college-only workers after 1987 and the slightly increasing earnings of dropouts relative to high school graduates after 1997 represent significant departures from the assumptions of the model. Fundamentally, the two-factor model does not accommodate a setting in which the wages of very-high and very low-skilled workers rise relative to those of middle-educated workers—that is, a setting where wage growth polarizes. We consider the sources of this polarization next, after briefly considering the role of the minimum wage in more detail.

IV. The Elusive Role of the Minimum Wage

In contrast to our conclusions above, several studies, including Lee (1999), Card and DiNardo (2002) and Lemieux (2006b), find that fluctuations in the US minimum wage plays a primary role in the rise of wage inequality since 1980. The minimum wage explanation for rising wage inequality has obvious appeal. As shown by Card and DiNardo (2002), there is a striking time series relationship between the

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17 Lemieux (2006a) documents the rapid, ongoing rise in the wage return to college and post-college education. He estimates that more than two-thirds of the rise in wage inequality between 1973 and 2005 is explained by the growing return to post-secondary education.
real value of the federal minimum wage and hourly wage inequality, as measured by the 90-10 log earnings ratio. This relationship is depicted in Figure 7. A simple regression of the 90-10 log hourly wage gap from the May/ORG CPS for the years 1973 to 2005 on the real minimum wage yields a coefficient of -0.74 and an R-squared of 0.71. Based in part on this tight correspondence, Card and DiNardo (2002) and Lemieux (2006b) argue that much of the rise in overall and residual inequality over the last two decades may be attributed to the minimum wage.18 In a cross state analysis of the minimum wage and wage inequality for the period 1979 to 1991, Lee (1999) reaches a similar conclusion.

A potential problem for this argument is that the majority of the rise in earnings inequality over the last two decades occurred in the upper half of the earnings distribution. Since it is not plausible that a declining minimum wage could cause large increases in upper-tail earnings inequality, this observation suggests that the minimum wage is unlikely to provide a satisfying explanation for the bulk of inequality growth. Not surprisingly, as shown in the upper panel of Figure 7, the real minimum wage is highly correlated with lower-tail earnings inequality between 1973 and 2005; a 1 log point rise in the minimum is associated with 0.26 log point compression in lower-tail inequality. Somewhat surprisingly, the minimum wage is also highly correlated with upper-tail inequality: a 1 log point rise in the minimum is associated with a 0.48 log point compression in upper-tail inequality (Figure 7, lower panel).

Autor, Katz and Kearney (2008) explore these relationships in greater detail by estimating a set of descriptive regressions for 90-10, 90-50 and 50-10 hourly earnings inequality over 1973 to 2005. In addition to the minimum wage measure used in Figure 7, Autor, Katz and Kearney (2008) augment these models with a linear time trend, a measure of college/high-school relative supply (calculated from the May/ORG CPS), the male prime-age unemployment rate (as a measure of labor market tightness), and in

18 Lemieux (2006b) focuses on the tight fit between the real minimum wage and residual wage variance for men and women from 1973 to 2003. We also find greater time series explanatory power of the real minimum wage for residual wage inequality measures than for actual wage inequality measures. This is puzzling for minimum wage hypothesis since the minimum wage should “bite” more for actual low wage workers than for residual low wage workers.
some specifications a post-1992 time trend, reflecting the estimated trend reduction in skill demand in the 1990s. The main finding from these models is that the strong relationship between the minimum wage and both upper and lower-tail inequality is highly robust.

These patterns suggest that the time series correlation between minimum wages and inequality is unlikely to provide causal estimates of minimum wage impacts. Indeed, the relationship between the minimum wage and upper-tail inequality is potential evidence of spurious causation. Although the decline in the real minimum wage during the 1980s likely contributed to the expansion of lower-tail inequality—particularly for women—the robust correlation of the minimum wage with upper-tail inequality suggests other factors are at work.\(^{19}\) One possibility is that federal minimum wage changes (or inaction) during these decades were partially a response to political pressures associated with changing labor market conditions and costs to employers of a minimum wage increase. This political economy story could help explain the coincidence of falling minimum wages and rising upper-tail inequality.\(^{20}\)

V. Why is Labor Demand Polarizing? The Possible Role of Technology and Outsourcing

Why, following the monotonic surge of inequality from 1979 to 1987, did US wage growth ‘polarize,’ with a strong, persistent rise in inequality in the upper half of the distribution and a slowing and then slight reversal of inequality in the lower-half of the distribution? Based on the above, along with further

\(^{19}\) Lee (1999) also noted a puzzling relationship between the ‘effective’ state minimum wage (the log difference between the state median and the state minimum) and upper-tail inequality. Opposite to the simple time-series regressions above, Lee finds in a cross-state analysis that increases in the effective state minimum wage appear to reduce upper-tail inequality, both for males and for the pooled-gender distribution, leading him to advise caution in causally attributing trends in male and pooled-gender earnings inequality to the minimum wage.

\(^{20}\) In a similar vein, Acemoglu, Aghion and Violante (2001) argue that the decline in union penetration in the United States and the United Kingdom is partly explained by changing skill demands that reduced the viability of rent sharing bargains between high and low skill workers. Furthermore, the direct effects of union decline on US wage inequality growth appear to be modest. Card, Lemieux and Riddell (2003) find that falling unionization explains about 14 percent of the growth of male wage variance from 1973 to 2001 (in models allowing for skill group differences in the impact of unions) with an even smaller union effect for the growth of female wage variance.
evidence presented in Autor, Katz and Kearney (2008), we conclude that neither standard supply-demand models nor conventional institutional explanations are sufficient to explain the evolution of US inequality since the late 1980s.

In this section, we focus on one potentially viable hypothesis for the polarization of inequality, which focuses on changing demand for job tasks and their link to computerization and, over the longer term, outsourcing. As argued by Autor, Levy and Murnane (2003, ‘ALM’ hereafter) and amplified by Goos and Manning (2003), Spitz-Oener (2006), Autor, Katz and Kearney (2006) and Dustmann, Ludsteck and Schönberg (2007), the term “Skill Biased Technical Change” presents an inadequate description of the shifts in skill demands that were induced or abetted by the rapid price declines in computer technology over the last three decades. In the task framework proposed by ALM, computerization has non-monotone impacts on the demand for skill throughout the earnings distribution: sharply raising demand for the cognitive and interpersonal skills used by educated professionals and managers (‘abstract tasks’); reducing demand for clerical and routine analytical and mechanical skills that comprised many middle-educated white collar and manufacturing production jobs (‘routine tasks’). Somewhat paradoxically, computerization has probably had little direct impact on the demand for the non-routine manual skills (‘manual tasks’) used in many ‘low-skilled’ service jobs such as health aides, security guards, orderlies, cleaners, and servers. Because the interpersonal and environmental adaptability demanded by these manual tasks has proven extraordinarily difficult to computerize (to date), these manual activities may in fact grow in importance as a share of labor input.

The ALM framework suggests that computerization (along with complementary forces such as international outsourcing) may have raised demand for skill among higher-educated workers, depressed skill demands for ‘middle-educated’ workers, and left the lower echelons of the wage distribution

\[21\] A related earlier model along these lines is developed in Juhn (1994).

\[22\] See Levy and Murnane (2004) for numerous paradigmatic examples. The fact that computerization causes manual tasks to grow as a share of labor input may be understood as a form of Baumol’s disease.
comparatively unscathed.\textsuperscript{23} Goos and Manning (2007) label this process a “polarization of work,” and argue that it may have contributed to a hollowing out of the wage distribution in the United Kingdom from 1975 to 2000. Spitz-Oener (2005) and Dustmann, Ludsteck and Schönberg (2007) report a similar polarization of employment for the former West Germany for 1979 to 1999.\textsuperscript{24}

To illustrate the relevance of shifts in task demands for changes in skill demands, we link data on task intensity by occupation from the Dictionary of Occupational Titles to data on skill level by occupation in the 1980 Census. In this analysis, occupational skill level is measured by the mean years of education of an occupation’s workforce (weighting workers by their annual hours worked). Figure 8 uses a locally weighted smoothing regression to plot task intensity by occupational skill for each of the three broad task categories above: abstract, routine and manual tasks.\textsuperscript{25} Task intensities are measured as percentiles of the baseline distribution of job tasks in 1960. Thus, an occupation with the median intensity of ‘routine’ task input in 1960 would receive a score of 50. This figure shows that the intensity of abstract skill input is monotonically rising in occupational skill (i.e., education) and, conversely, the intensity of manual task input is falling in occupational skill. Most significantly, there is a distinctly non-monotone relationship between occupational skill and routine task input. Routine task use is highest between the 20\textsuperscript{th} and 60\textsuperscript{th} percentiles of the skill distribution, and falls off sharply on either side of this range. This non-monotonic relationship is highly relevant because, as documented by ALM, routine task input saw the sharpest decline of all task categories over the last two decades (relative to its initial 1960

\textsuperscript{23} Welch (2000) and Weinberg (2000) argue that these technical changes are particularly likely to have been favorable to demand for female labor.

\textsuperscript{24} Acemoglu (1999) offers an alternative theory of job polarization based on endogenous changes in production techniques as a response to a rise in the availability of skilled labor.

\textsuperscript{25} The task intensity data are constructed by matching Census 1980 data by occupation and gender with task measures from the Dictionary of Occupational Titles (DOT). Task intensities by occupational skill percentile are plotted using a locally weighted smoothing regression with bandwidth 0.5 (i.e., one-half of one percentile). Details on the processing and matching of DOT task measures to occupations are given in Autor, Levy and Murnane (2003). The abstract task category we use in Figure 10 is the arithmetic average of ALM’s ‘non-routine cognitive/analytic’ and ‘non-routine cognitive/interactive’ category and, similarly, our routine task category is the average of ALM’s ‘routine manual’ and ‘routine cognitive’ categories. Our manual category is equivalent to ALM’s ‘non-routine manual’ category.
level). The substitution of information technology for routine tasks might be expected to contribute to polarization by reducing demand for ‘middle-skill’ occupations relative to either high or low skill occupations.

An implication of the polarization hypothesis is that the twisting of the wage structure observed in recent years is, at least in part, a demand-side phenomenon, induced by rising relative demands for both high and low-skill tasks. This implication is testable, and we provide a simple evaluation here. Following Goos and Manning’s (2007) analysis for the U.K., we use US Census data to explore how employment growth by occupation over the last two decades is related to occupational skill as proxied by educational levels. Our hypothesis is that, if the wage structure changes observed in the 1980s and 1990s are driven in substantial part by demand shifts, wages changes by earnings level and employment changes by skill level should positively covary in both decades.

To test this implication, we plot in the upper panel of Figure 9 the change in the share of total hours worked in the economy from 1980-1990 and 1990-2000 by occupation skill percentile, using the education-based occupational skill measure developed above. For the decade of the 1980s, we see substantial declines in employment shares at the bottom end of the skill distribution with strongly monotone increases in employment shares as we move up the skill distribution. In contrast, employment growth in the 1990s appears to have polarized. There is rapid employment growth in highest-skill jobs (at or above the 75th percentile), a decline in the employment shares of middle-skill jobs (those at percentiles 30 to 75) and flat or rising employment shares in the lowest-skill jobs, those in deciles one through three.

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26 Autor, Katz and Kearney (2006) present a similar analysis using Census data for changes in occupational employment and CPS May/ORG data for changes in wage levels by earnings percentile. In the present analysis, we use exclusively Census data covering the same time periods.

27 We employ a consistent set of occupation codes for Census years 1980, 1990 and 2000 developed by Meyers and Osborne (2005). We use a locally weighted smoothing regression (bandwidth 0.8 with 100 observations) to fit the relationship between decadal growth in occupational employment share and occupations’ initial skill percentile in the 1980 skill distribution.
This pattern of job growth corresponds closely with the observed pattern of wage structure changes in each decade, as is shown in the lower panel of Figure 9. Real wage growth was essentially monotone in wage percentile in the 1980s, with especially sharp wage growth above the 75th percentile and especially sharp declines below the 30th percentile. In the decade of the 1990s, however, wage growth was more U-shaped. Wage growth was stronger below the 30th percentile and especially above the 80th percentile of the distribution than throughout the remainder of the distribution. Thus, despite substantial differences in the evolution of inequality between the 1980s and 1990s, labor market prices and quantities (as measured by wage and skill percentiles) appear to positively covary in each decade.

To provide a slightly more rigorous assessment of this observation, we estimate a set of OLS models of the form,
\[
\Delta E_{p\tau} = \alpha + \beta \Delta \ln W_{p\tau} + e_{p\tau},
\]
where changes in log employment share by skill percentile are regressed on changes in log wages by wage percentile in each decade. Here, \(\Delta E_{p\tau}\) represents the change in occupational log employment share at skill percentile \(p\) in decade \(\tau\) and \(\Delta \ln W_{p\tau}\) is the change in real log hourly earnings at the corresponding wage percentile in the same decade.\(^{28}\) Using data for the 4th through 97th percentiles of the earnings and skill distributions (thus trimming outliers at the tails), we estimate that \(\beta = 3.00\) \((t=3.75)\) for the 1980s and that \(\beta = 2.96\) \((t=1.90)\) for the 1990s. Thus, both the monotone rise of wage inequality in the 1980s and the ‘polarized’ growth of wage inequality in the 1990s are mirrored by

\(^{28}\) In contrast to the upper panel of Figure 9, we use raw changes in employment shares by occupational wage percentile as the dependent variable rather than smoothed changes. If we were to instead use smoothed changes, this would not affect the point estimates by much but would substantially increase the precision of the estimates.
conformal changes in employment by skill. This is consistent with a demand-side explanation for observed wage changes.\textsuperscript{29}

We have further experimented with these simple models by including linear terms in wage percentiles in addition to (or instead) of estimated wage changes by percentile. For the decade of the 1980s, we find that a linear function of wage percentiles fits the observed pattern of skilled employment growth better than does the observed change in earnings by percentile. In the 1990s, by contrast, the linear term is insignificant and the estimate of $\beta_{90-00}$ is hardly affected by its inclusion (either in magnitude or precision). These simple models do not, of course, take into account the substitutability and complementarity among various skill groups (as measured by skill percentiles) and so lack a well-grounded production function interpretation. We nevertheless view them as suggestive evidence that labor demand shifts have favored low- and high-wage workers relative to middle-wage workers over the last fifteen years—a pattern that stands in contrast to the shifts in labor demand during the 1980s, which appear to have been monotonically rising in skill.

VI. The Jobs of the Future: Both ‘Lousy and Lovely’ Jobs

The contention that highly-educated professional and managerial jobs (i.e., those using abstract skills) will continue growing rapidly is uncontroversial. Perhaps less familiar is the implication that low-education jobs using ‘non-routine manual’ skills (i.e., those not readily automated) are likely to expand as well.\textsuperscript{30} To provide some direct evidence on the relevance of this hypothesis, we look at the changing occupational structure of employment in the United States.

Table 1 shows the educational level and employment shares in six major occupational groups covering all US employment: managerial and professional specialties; technicians, sales and

\textsuperscript{29} Notably, this pattern appears inconsistent with the hypothesis that a declining minimum wage played a leading role in the expansion of lower-tail inequality in the 1980s. A decline in a binding wage floor should have lead to a (modest) rise in low-wage employment rather than a sharp contraction.

\textsuperscript{30} The phrase ‘Lousy and Lovely jobs’ reiterates the title of Goos and Manning’s 2007 study of the polarization of employment in the United Kingdom.
administrative support; precision production, craft and repair; service occupations; operators, fabricators and laborers; and farming, fishing and forestry occupations. The highest skilled of these occupational categories is managerial and professional specialty occupations, followed (by some distance) by technicians, sales and administrative support. The four remaining categories—each averaging half the size of the first two—are demonstrably less human capital intensive. Whereas in the year 2000, high school dropouts made up 2.2 percent of employment in professional/managerial jobs and 6.7 of employment in technical, sales and administrative support jobs, they comprised 20-plus percent of employment in the four remaining categories.

As discussed by Autor and Dorn (2007), growth has not been uniform across these six categories. Figure 10 shows that managerial and professional specialty occupations—the highest skilled category—experienced consistent, rapid growth between 1980 and 2005, gaining 7.1 percentage points as a share of overall employment between 1980 and 2005, a 30 percent increase. By contrast, employment in the ‘middle skill’ group of technical, sales and administrative support occupations showed an inverse u-shape pattern over this period, expanding in the 1980s and then contracting to below its initial 1980 level over the next 15 years (consistent with the growing substitution of technology for routine tasks). Most strikingly, employment shares in three of the four low-skill occupations fell sharply in each decade. Between 1980 and 2005, farming, forestry and fishery occupations contracted by more than 50 percent as a share of employment, operators, fabricators and laborers contracted by 33 percent and precision production, craft and repair occupations contracted by 19 percent.

Standing in sharp contrast to these patterns of declining employment, however, is the experience of service occupations. Despite being among the least educated and lowest paid occupations in the US economy, employment in service occupations expanded in each decade between 1980 and 2005, rising from 11.0 percent of employment in 1980 to 11.8 percent in 1990, to 13.7 percent in 2000 and to 14.9
percent in 2005. This 35 percent increase is six percentage points larger than the gain in employment shares of managerial and professional employment during the same period.

What is special about service jobs? Table 2 lists the major service occupations, the largest of which are: food preparation and service; health service support (a group that excludes registered nurses and other skilled medical personnel); and buildings and grounds cleaning and maintenance. These are low-paying jobs; in the year 2000, 73 percent had hourly wages below the overall hourly median. From the perspective of our conceptual framework, what distinguishes these occupations is that each is highly intensive in ‘non-routine manual’ tasks—activities requiring interpersonal and environmental adaptability yet little in the way of formal education. These are precisely the job tasks that are difficult to automate with current technology because they are ‘non-routine’ and difficult to outsource because, in large part, they must be produced and performed in-person (at present).

Employment projections from the Bureau of Labor Statistics Employment Outlook confirm the view that low-skilled services are likely to be a major contributor to US employment growth going forward. BLS forecasts that employment in service occupations will increase by 5.3 million, or 19 percent, between 2004 and 2014. The only major occupation with greater projected growth is professional

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31 It is critical to distinguish service occupations, a relatively narrow group of low-education occupations comprising 13.4 percent of employment in 2000 (author’s calculation from Census IPUMS), from the service sector, is a very broad category of industries ranging from health care to communications to real estate and comprising 81 percent of non-farm employment in 2000 (source: www.bls.gov).

32 The service employment measure used by the Bureau of Labor Statistics Occupational Outlook indicates a service employment share that is several percentage points higher that our calculations above (17.7 percent versus 13.4 percent). The discrepancy stems from three factors: unlike our calculations based on household data from the Census, the BLS numbers use Current Employment Statistics (CES) which, as an establishment survey, double-counts workers who hold multiple jobs; our Census-based numbers are weighted by hours of labor supply, and so part time jobs (common in service occupations) are weighted down whereas the CES data count all jobs equally; and our Census calculations exclude workers younger than 18 whereas the CES data include workers ages 16 and above. The service occupation in which the Census and CES data are most discrepant is in Food Preparation and Service, where our data show a 3.5 percent employment share and the CES data show a 7.4 percent employment share. Despite these discrepancies in levels, we have no reason to believe that the qualitative employment trends in the Census and CES data differ.
occupations, which are predicted to add 6 million jobs, a 21.2 percent increase. Like all forecasts, these should be treated as tentative. Historically, BLS has under-predicted the growing demand for professional and managerial occupations (Bishop and Carter 1991; Freeman 2006).

It is likely that the rapid growth of service employment has multiple causes. One is the direct substitution of computerization for ‘routine’ tasks, which causes the share of labor input devoted to non-routine activities to increase. A second force, though of highly uncertain magnitude, is international outsourcing, which complements computerization in permitting routine tasks previously performed by domestic workers to be sourced to other locations.

But these technological forces are not the only drivers. The aging of the US population contributes to the growth of health services support occupations—and this contribution will become more important going forward. Supply side factors may also be important. Recent work by Cortes (2006) demonstrates that influxes of low-skilled immigrants into major US cities cause the market prices of non-traded, low-skill intensive services to fall and consumption of these services to rise. Thus, the rapid growth of service employment is also partly attributable to US immigration policy.

A final, relatively unstudied, factor potentially contributing to the growth of service employment is the rise of income inequality itself. Household consumption of services appears to be highly income elastic (Mazzolari and Ragusa 2007). This makes it plausible that the strong, secular rise in the earnings share of high income households over close to three decades has increased final demand for services

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33 The BLS category of professional occupations excludes managerial occupations and so is more disaggregated than the Census category of professional and managerial occupations. Combined growth in professional and managerial jobs is projected at 8.2 million jobs, or 18.8 percent.

34 Though computerization appears far more complementary to abstract tasks than non-routine manual tasks, our framework implies that computerization is a relative complement to all non-routine tasks (i.e., relative to routine tasks).

35 Though in many respects computerization and outsourcing appear to have similar implications for the domestic organization of work (Levy and Murnane 2006), one important difference is that there are an important subset of non-routine manual tasks that are not readily computerized but can be easily outsourced, for example, call center operations or back office manual tasks including data entry and hand-processing of bill and check images (see Autor, Levy and Murnane 2002). Neither outsourcing nor computerization appears a close substitute for the in-persons tasks performed by service occupations, however (Blinder 2007).
(Piketty and Saez 2002; Autor, Katz and Kearney 2008). Preliminary evidence supporting this hypothesis is offered by Autor and Dorn (2007) and Mazzolari and Ragusa (2007), who find that service employment growth in the United States has been greatest in metropolitan areas where income inequality has increased most. Given that the rise of high incomes shows no signs of abating, this force may stimulate additional demand for low-education, in-person services.

VII. Possible Labor Supply Responses: Human Capital Policy and Immigration

Proceeding on the view that US employment growth will be concentrated at the tails—i.e., in high and low-education occupations—how might labor supply respond? Because other papers in this volume treat this question in great detail, I offer only brief remarks, focusing on topics where policy is likely to have particular leverage.36

A first point of paramount economic importance is that the returns to human capital investments are currently extremely high. While some research has highlighted the fact that the college wage differential plateaued in the early 1990s, this observation needs appropriate context. Even in the late 1990s, the college wage differential stood at a near-historic level (Goldin and Katz 2007). And, as indicated by Figure 4, there was a further pickup in the pure college/high-school premium after 1999. Moreover, the wage differential associated with post-college education has risen rapidly and near-continuously from 1980 to the present. Thus, post-secondary education appears an excellent investment.

Responding to this price signal, college enrollment of US youth has risen considerably since the premium to education began its historic rise in the early 1980s. After falling slightly between 1970 and 1980, the fraction of 20 to 24 years olds enrolled in post-secondary education rose from 35.9 percent in 1980 to 42.7 percent in 1990 to 44.7 percent in 2000 and 49.3 in 2005 (US Department of Education

College completion rates have not risen commensurately, however. Bound, Lovenheim and Turner (2007) report that the share of youth obtaining the equivalent of a college degree by age 23 rose only slightly for cohorts completing high school from 1970 forward. Simultaneously, the college completion rate among those attending college fell by 10 percent and the share completing a degree within four years (among degree completers) fell by 20 percent. Although some increase in the college non-completion rate is to be expected as the fraction of students enrolling in college rises, these statistics suggest that there may be room to improve the outcomes of these initial college investments. Indeed, despite having lead the world in high school and college completion for most of the twentieth century, U.S. young adults are now in the middle of the pack in the OECD in terms of educational attainment (OECD 2006; Goldin and Katz 2007).

There is ongoing debate about the degree to which financial constraints hinder college-going among US youth. There is little doubt, however, that the gap in college attendance rates by parental income, race and ethnicity remain large and may have potentially widened over the last 25 years (Ellwood and Kane 2000; Heckman and Carneiro 2002). Considerable evidence shows that reductions in college costs (due to tuition reductions or financial aid) greatly increase college-going for youths from moderate income families (Dynarski 2002; Kane 1999) and even affect the post-college occupational choices of graduates of elite universities (Rothstein and Rouse 2007). Moreover, the economic returns to college attendance for youth from moderate income families appear to be at least as large as those for more advantaged attendees (Card 2001). Thus, there appears a solid case for reducing the financial barriers to college attendance for low and moderate income US families.

As has been stressed by many researchers, generous college financing is not sufficient for college success. Students who do not receive adequate human capital investments early in life may gain less

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37 This reflects both a high non-completion rate and an increased time to degree. Thus, the share of youth obtaining the equivalent of a four year college degree by age 28 has risen significantly more than the share of obtaining the degree by 23.
38 See Krueger and Heckman (2004) for a comprehensive debate.
from later educational investments (Heckman and Lochner 2000). Most evidence suggests large returns from early childhood educational interventions (Currie 2001; Anderson 2007). Thus, efforts to improve college attainment among US students need to commence well before students approach college-going age.  

In addition to fostering college-going by US residents, a critical policy lever for increasing the supply of highly educated workers is attracting skilled students of all nationalities to US colleges and universities. In 2003, 573 thousand foreign students were enrolled in US institutions of higher education, an 84 percent increase from the 1980 level (US Department of Education 2005, Table 408). While these numbers appear sizable, the share of foreign students in US higher education is small: 2.6 percent in 1980 and 3.4 percent in 2003.  

Foreign student enrollment brings many of the world’s most talented individuals to the United States. A substantial fraction of these students will ultimately remain in the United States and contribute to US invention and economic growth. To the extent that foreign students return to their home countries following their studies, one suspects that many will maintain positive economic—as well as political and cultural—interactions with the US. Thus, the US maximizes the return on its leadership role in higher education by producing talent and by attracting it.

Foreign students are heavily concentrated in graduate and doctoral level study, particularly in Science, Technology, Engineering and Mathematics (‘STEM’). In the year 2000, foreign students received between 25 and 55 percent of all doctorates awarded in fields including electrical engineering, physics, chemistry and biology. The growth of foreign enrollment in US post-college degree programs has raised concerns that wages of natives are adversely impacted by the influx of foreign students (Borjas 2006). Though economically sound, this concern strikes me as somewhat misplaced given the high and rising earnings of highly educated workers in the US—particularly those with graduate degrees. If the

39 See also Heckman and Krueger (2002).

40 Denominators for these calculations come from US Department of Education (2005, Table 170).
relatively abundant supply of foreign students to STEM fields serves to buffer the ongoing growth of wage inequality in the upper half of the United States earnings distribution, this may arguably be viewed as an additional benefit.

Closely related to the enrollment of foreign students into US universities is the entry of skilled migrants into the US labor force. Though the US has many of the world’s leading universities, the majority of highly educated workers are produced elsewhere. Freeman (2006) estimates that the US fraction of Ph.D.’s trained relative to total world output will have fallen from about 50 percent in the early 1970s to a projected level of 15 percent in 2010. The growing cadre of highly educated workers outside the US provides one mechanism for addressing potential skill shortages. As Freeman (2006, p. 10) observes:

During the 1990s rapid growth of the US economy, the country greatly increased its employment of scientists and engineers. It did so despite fairly constant numbers of graduates in these fields among citizens or permanent residents and without markedly raising the salaries of these workers... The US was able to meet increased demands for scientists and engineers without huge increases in salaries by “importing” foreign born specialists in these areas. Some of the foreign born obtained their education in the US and remained to work in the country. But most of those with BS degrees and roughly half of those with higher degrees graduated overseas and came to fill jobs. If the US economy demands more highly skilled workers in the period of projected slow labor force growth, it should be able to increase supplies by admitting more immigrants in areas with rising labor demand, as it did in the 1990s.

This example underscores that, should the US ultimately face a ‘skill shortage’ as the baby boom retires, this shortage will reflect as much a political choice as a consequence of demographics. So long as the US is perceived as a land of abundant opportunity by educated citizens worldwide, it will have the ability to attract foreign talent to meet domestic labor demand.

In recent years, immigration policy has been responsive to these demands. The H1-B program allows US employers to temporarily hire skilled foreigners who have the equivalent of US Bachelor's Degree education. Prior to the mid-1990s, the H1-B quota stood at 65,000 visas per year. During the ‘dot-com’ boom, Congress increased the quota to 115,000 in 1998 and then again to 195,000 in the year 2000. The
quota dropped back to 90,000 in 2004, however, and is currently coming under economic pressure. The entire quota of H1-B visa for fiscal year 2007 was exhausted within a span of less than 2 months. It remains to be seen whether the cap will be lifted again soon.

Over the longer term, it appears possible (though highly uncertain) that the US will move to a skills-based immigration system. The Secure Borders, Economic Opportunity and Immigration Reform Act of 2007, currently before Congress, would prioritize access to US visa applicants according to education levels, family ties, age, English language proficiency and applicants’ occupations. Priority would be given to workers in “in-demand” occupations. While the virtues and drawbacks of such a system are too complex to flesh out here, two points deserve note. First, the notion of weighting applicants’ skills in visa allocation decisions appears meritorious. Second, accurately forecasting what skills and occupations will be “in demand” is generally not something at which government statistical agencies are highly reliable (Freeman 2006). In the existing H1B program, by contrast, employers identify and sponsor individual visa candidates. While this process is time and resource intensive, it does give employers a strong incentive to sponsor workers who possess particularly valuable skills. Thus, there may be efficiencies in this highly particularistic determination process. Commenting on the immigration reform act current before Congress, Lowell Sachs of Sun Microsystems opines (quoted in Broache 2007):

“The best the government can hope to do is select a pool of generically potentially qualified candidates, whereas a company knowing exactly what it needs, exactly what skills and exactly what kind of individual can best deliver is going to be far better able to make the right match... What happens if I’m interested in finding a brain surgeon and I’ve got a bunch of people to pick from, a pediatrician over here, a podiatrist over here, but no brain surgeon?”

VIII. The Quality of Jobs in Services Occupations

There is, in my view, a solid case for meeting rising demand for professional and technical occupations (in part) by importing post-secondary students and highly trained foreign workers. The same arguments are less persuasive when applied to the demand for low-education, in-person service workers. Unlike the earnings of college graduates, wages of high school graduates and dropouts—those
most likely to perform service jobs—have fared poorly over the last three decades. Autor, Katz and Kearney (2008) estimate that real wage growth for workers with high school and lower education was negative between 1979 and 1995, and only modestly positive from 1995 to 2005. Facilitating increased immigration of competing worker groups appears unlikely to improve this situation.\footnote{There is heated debate about the extent to which low-skilled immigration depresses native wages (Borjas 2003; Card 2005; Goldin and Katz 2007). Recent evidence suggests that because many low-skilled immigrants are heavily specialized in ‘manual’ tasks such as cleaning, cooking, and building, they do not directly compete with most natives, including low-skilled natives who typically have a comparative advantage in English language communication tasks (Cortes 2007; Peri and Sparber 2007).} Moreover, while a case can be made that high-skilled workers generate positive human capital externalities—thus making high-skilled immigration a “public good” (Moretti 2004a and 2004b)—this argument does not apply to low-skilled immigrants.\footnote{Acemoglu and Angrist (2001) provide a strong test of human capital externalities and find only limited support.} Finally, it is often argued that if the US does not import high-skilled labor, high-skilled jobs will follow the workers to where they reside. This argument clearly is not relevant for low-skill, in-person services since these services are primarily non-traded. In sum, rising demand for low-skilled services does not represent an economic problem that demands a policy solution. Indeed, a significant benefit of such a demand shift is that it is likely to increase the earnings of less-educated workers.\footnote{Freeman (2006, p. 20) states this case compellingly, “If firms demand more labor than workers supply due to a reduced growth of supply, should not a country that relies extensively on unfettered markets allow those markets to raise the price of labor, just as it allowed them to reduce the pay of many in recent decades?”}

Even given rising demand, labor supply to services may be sufficiently elastic that wages stay low, however. Median real hourly wages in service jobs were $8.99 in 1980, $8.76 in 1990 and $9.40 in 2000. These hourly wage rates imply annual, full-time earnings of under $20 thousand per year (of course, many service jobs do not provide full-time, full-year earnings).\footnote{Autor and Dorn (2007) report that the median hourly wage in service jobs was between 63 and 65 percent of the median hourly wage in non-service jobs in 1970, 1980 and 1990. Accounting for differences in full-compensation among high and low-wage workers (as in Pierce 2001) would enlarge this gap.} This income level readily exceeds the poverty threshold for the year 2000 of $17,500 for a family of two adults and two dependent children. Yet, it is probably inadequate income for families to make optimal investments in child-rearing and
education. Echoing the concerns above regarding college attainment and early life preparedness, it appears a legitimate worry that the ongoing polarization of earnings levels among US households will ultimately serve to thwart economic mobility among subsequent generations. Unfortunately, the impact of current economic inequality on future mobility cannot be judged until decades after the die is cast.\textsuperscript{45} Thus, investments in insuring the economic mobility of the next generation are necessarily precautionary.

There are two primary means to improve the economic conditions of workers in low-education service jobs. One is through transfers and other social supports. For example, the Earned Income Tax Credit has substantially raised labor force participation and earnings of single mothers (Meyer and Rosenbaum 2001). Programs such as Medicare, Head Start and the federal Pell grant program provide health insurance, support early childhood educational investments and reduce the cost of post-secondary education for low-income households. Such programs could be expanded (and improved) to provide additional assistance to child-rearing families. A significant downside to such policies, however, is that they are vulnerable to the vicissitudes of budgetary pressures and political sentiments.\textsuperscript{46} Transfer programs that do not create a broad constituency of middle and upper income beneficiaries are, over the long run, probably less likely to survive.

An alternative means to improve economic conditions of workers in low-education service jobs is to ‘professionalize’ these occupations so that they provide better services and command higher wages. Occupational standards and licensing are one means to accomplish this objective. Labor unions are

\textsuperscript{45} Recent research by Wojciech, Saez and Song (2007) finds little change in mobility over the course of a career among US cohorts born between 1920 and 1950. However, these data do not speak to economic mobility across generations, in particular, how likely children of low income households are to reach higher echelons of the earnings distribution during their careers.

\textsuperscript{46} For example, the State Children’s Health Insurance Program, enacted in 1997, has significantly increased the health insurance coverage rate of children from low-income households (Lo Sasso and Buchmueller 2004). SCHIP is a block grant program with fixed annual funding levels, however, and SCHIP outlays have not kept pace with population increase or the rising cost of health care. Absent a significant policy change, the number of program beneficiaries will have to decline. The US minimum wage provides another example of a politically vulnerable policy instrument for raising earnings of low-skill workers.
another. The evidence on the efficiency of such steps is decidedly mixed. Kleiner’s thorough 2005 study of occupational licensing in the US concludes that licensing has primarily served to restrict competition without improving quality. DiNardo and Lee (2004) find that new private sector labor unions certified in the 1980s and 1990s had little economic impact—positive or negative—on employees or employers. Thus, despite the intellectual appeal of improving wages and quality in service occupations, the specific steps to accomplish this objective are not immediately evident (to me).

IX. International outsourcing: The vast unknown

More than any area discussed above, there is vast uncertainty about the degree to which international outsourcing will ultimately affect domestic labor demand. At present, most quantitative assessments of the potential impacts of outsourcing are highly preliminary or impressionistic (Kletzer 2006; Blinder 2007).\(^{47}\) Theoretical work has also produced somewhat mixed projections on possible labor demand impacts (Antràs, Garicano and Rossi-Hansberg 2006a and 2006b; Grossman and Rossi-Hansberg 2006). In my assessment, a safe conclusion is that outsourcing will increase the returns to ‘knowledge work,’ both by raising demand for scarce managerial and problem-solving talent and by increasing the returns on intellectual property developed in advanced economies. Outsourcing will not directly substitute for in-person services. Moreover, the income gains accruing to the highly skilled might stimulate additional demand for such services. Beyond this, there is little certainty. The possibility appears remote that outsourcing will ultimately displace as large a share of domestic white collar work as international trade and technological change did blue collar manufacturing work. But then again, the possibility that manufacturing would ultimately employ less than 15 percent of the US workforce in 2000, even while 42 percent of US consumer spending was devoted to goods, must also have seemed remote several decades earlier (US Congressional Budget Office 2004).

\(^{47}\) See Hsieh and Woo (2005) for a rigorous assessment of the impact of outsourcing to China on the Hong Kong labor market.
The profound uncertainty about the potential for outsourcing to affect domestic labor demand should stimulate much additional research on this topic. A key factor hindering research has been lack of measurement. Unlike trade in goods, trade in labor services is at an extremely primitive stage of measurement. A first priority for US statistical agencies should be extensive data collection to assess the extent of international outsourcing and to document the nature of tasks currently being outsourced. Trade in services will always be more difficult to capture and quantify than trade in goods, however. Just as productivity measurement has become more uncertain as economic activity has moved from manufacturing to services, tracking trade flows will become increasingly challenging as trade in services takes its place alongside trade in goods as an increasingly important source of US economic activity.

X. Conclusion

Past is not prologue. Viewed from the perspective of the 1980s, the rapid, monotone rise of wage inequality appeared to presage an era of ever-increasing demand for skills, with rising incomes for the highly educated and falling incomes for everyone else. Fortunately, this vision has not come to pass. The secular demand increases favoring more educated workers appear to have been less rapid in the 1990s and early 2000s than from the 1960s to the 1980s. Overall wage inequality continued growing from 1990 to 2005, but at a slower pace than in the 1980s. Rather than spreading continuously, wage growth ‘polarized’ after 1987, with persistent increases in inequality in the upper half of the distribution and slow or reversing inequality trends in the lower-half of the distribution.

Demand forces have played a key role in shaping wages structure changes during the inequality surge of the 1980s and the polarization that followed. In the 1980s, during which wage growth was essentially monotone in skill, employment shares in the highest educated and highest paid occupations expanded substantially while employment shares in the lowest skill occupations contracted. During the subsequent decade—in which earnings growth polarized—employment shares in very low and very high skill occupations increased while employment shares in moderately skilled occupations contracted. The
roughly parallel movement of earnings and employment growth in each decade suggests that demand forces have been central to these patterns of wage changes.

Following Autor, Levy and Murnane (2003) and Goos and Manning (2007), we argue that these patterns may in part be explained by a richer version of the skill-biased technical change hypothesis in which information technology complements highly educated workers engaged in abstract tasks, substitutes for moderately educated workers performing routine tasks, and has less impact on low-skilled workers performing manual tasks. Extrapolating from these trends, we forecast (perhaps unwisely) an ongoing growth of demand for both highly educated professional and managerial jobs and for low-education, in-person service jobs—tasks that are difficult to either automate or outsource.

Given slowing US population growth and decelerating rates of educational attainment, it is natural for the US to look to developing and developed countries as a source of supply for future employment growth. In the case of highly-educated workers, we view such efforts as sound. Attracting skilled residents to the US, either as students or workers, is likely to raise wealth and improve the quality of life for a large number of US residents. As a secondary benefit, increased skilled migration to the US may temper the ongoing rise of upper-tail earnings inequality. These same arguments appear less compelling when applied to the immigration of low-skilled workers. Wages of low-skilled US workers have been stagnant for most of the past thirty years. If labor demand is indeed rising for low-skilled, in-person service occupations, this may give a long overdue boost to earnings for these groups—a welcome development for economic mobility and social cohesion.

Though it seems banal to end a research summary on a call for further research, this bromide seems less self-serving than usual in the current context. Due to rapid economic development in Asia and improvements in computer and communications technology, international trade and outsourcing appear poised to become important determinants of domestic labor demand. Yet, we have little knowledge of the scope, magnitude, speed or even direction with which these forces will impact skill
demands and earnings distributions in the US and other advanced economies. Devising innovative and rigorous means to measure and evaluate the impacts of these evolving forces of globalization on inequality and economic well-being constitutes a significant agenda item for further research in this field.
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Table 1. Descriptive Statistics for Main Census Occupation Groups in 2000

<table>
<thead>
<tr>
<th>Employment Share</th>
<th>Median Hourly Wage</th>
<th>% High School Dropout</th>
<th>% No College</th>
<th>% Female</th>
<th>% Non-White</th>
<th>% Foreign Born</th>
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<td>Precision Production, Craft, and Repair Occupations</td>
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<td>19.9</td>
<td>60.4</td>
<td>8.6</td>
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<td>$11.49</td>
<td>27.3</td>
<td>71.9</td>
<td>22.2</td>
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Source: Autor and Dorn (2007) calculated from Census IPUMS 2000 5 percent sample. All calculations are weighted by hours of annual labor supply and exclude those under age 18 or over age 65.
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Source: Autor and Dorn (2007), calculated from Census IPUMS 1980, 1990 and 2000 5 percent samples. All calculations are weighted by hours of annual labor supply and exclude those under age 18 or over age 65.
Figure 1. Change in Real Hourly Earnings 1973 through 2005 by Percentile of the Male and Female Hourly Earnings Distribution
Figure 2. Percent Change in Real Hourly Earnings of Male and Female Workers by Hourly Earnings Percentile, 1973-1989 and 1989-2005.
Figure 3. Real Wage Ratios of 90th, 50th and 10th Percentile Hourly Earnings, 1974-2004 (Three Year Moving Averages)
Figure 4. Changes in Composition-Adjusted Male FT Log Weekly Wages, 1963-2005

Changes in Composition-Adjusted Male FT Log Weekly Wages, 1963-2005

Figure 4. Changes in Composition-Adjusted Real Log Weekly Full-Time
Figure 5. College/High School Relative Supply and Wage Differential, 1963-2005 (March CPS)
Figure 7. Log Real Federal Minimum Wage and Log 90/10, 90/50 and 50/10 Hourly Wage Differentials, 1973-2005 (May/ORG CPS).

Note: Nominal minimum wages are deflated to real log values using the PCE deflator. In the first panel, the real log minimum wage measure is normalized to zero in 1973. Subsequent panels depict the observed wage gap (90/10, 90/50, and 50/10) for all hourly workers from the May/ORG CPS samples in each year plotted alongside the predicted values from separate OLS regressions of the relevant wage gap on a constant and the contemporaneous real log minimum wage.
Figure 8. Task Intensity by Occupational Skill Percentile, Defined as Occupations' Rank (in Percentiles) in Mean Years of Schooling.
Figure 9.


Figure 10.
Source: Autor and Dorn (2007), Figure 1a.