Measuring Union and Nonunion Wage Growth: Puzzles in Search of Solutions

Barry T. Hirsch
Department of Economics
Trinity University
715 Stadium Drive
San Antonio, Texas 78212-7200
Voice: (210)999-8112, Fax: (210)999-7255
e-mail: bhirsch@trinity.edu

David A. Macpherson
Department of Economics
Florida State University
Tallahassee, Florida 32306-2180
Voice: (850)644-3586, Fax: (850)644-4535
e-mail: dmacpher@mailer.fsu.edu

Edward J. Schumacher
Department of Health Care Administration
Trinity University
715 Stadium Drive
San Antonio, Texas 78212-7200
Voice: (210)999-8137, Fax: (210)999-8108
e-mail: eschumac@trinity.edu

Revised, July 2002

Abstract

This paper presents conflicting evidence on trends in private sector union and nonunion wages. The BLS quarterly Employment Cost Index (ECI), constructed from establishment surveys, uses fixed weights applied to wage changes among matched job quotes. The ECI shows a substantial decrease in wage growth for union relative to nonunion workers. The annual Employer Costs for Employee Compensation (ECEC), drawn from the same survey data as the ECI, provides wage level estimates constructed from the full sample of job quotes using current sector weights. Surprisingly, the ECEC shows no trend in relative union-nonunion wages. Household evidence from the Current Population Survey (CPS) can potentially reconcile the conflicting ECI/ECEC evidence, but it is first necessary to account for Census earnings imputation procedures that bias the level and trend in the CPS union gap. CPS wage data absent controls, which should provide results similar to that from the ECEC, instead displays a steep decline in relative union wages, similar to that seen in the ECI. Regression estimates using the CPS, similar in spirit to the ECI, indicate a union premium that declines modestly over time. Union and nonunion wage growth is next calculated from the CPS using methods roughly consistent with the ECI and ECEC. These results shed rather dim light on the sources of ECI/ECEC differences. The contribution of the paper is its unearthing of puzzling and apparently contradictory evidence on union and nonunion wage trends (as well as on economy-wide wage growth). Although our analysis helps account for specific elements of this puzzle, a comprehensive solution remains elusive. We conclude that there has been closing in the union-nonunion wage gap since the mid-1980s, but the magnitude of the closing is anything but clear.

This paper was prepared for and presented at "The Changing Role of Unions," Middlebury College Economics Conference, April 13-14, 2002, Middlebury, Vermont. We particularly appreciate the detailed comments received from Mark Loewenstein of BLS, as well as remarks from our discussant, Darren Grant, and other conference participants.

I. *Introduction*

Few subjects in labor economics have received more attention than the estimation of union-nonunion wage differentials (Lewis 1986, Jarrell and Stanley 1990, Andrews et al. 1998, Blanchflower 1999). Although there is a consensus that union density and organizing strength in the U.S. have declined over time, there is no agreement as to how union wage premiums have changed. The theoretical relationship between union density and the union wage gap is ambiguous. For any given level of union labor demand, there exists an inverse relationship between union density and the wage premium, while declining union premiums are more likely if demand curves for union labor are shifting inward.[1]

There is general agreement that union wage premiums increased during the late 1970s, but there is no consensus as to whether the premium has been stable or falling since the early 1980s. Blanchflower (1999) estimates union wage gaps from the CPS for 1983-1995. He finds little evidence of a trend and concludes that the economy-wide union gap has remained constant. Bratsberg and Ragan (forthcoming) also examine this issue using the CPS, concluding that dispersion in the union premium across industries has substantially declined as the U.S. economy has become more competitive, but that there has been only a modest decline in the average premium.[2] An annual data book from Hirsch and Macpherson (2002) provides estimates of CPS union wage premiums for all years since 1973 using a time-consistent specification. They obtain an economy-wide premium estimate of .172 log points in 1983 and .136 in 2001, suggesting modest decline. For the private sector, however, they obtain estimates of .218 in 1983 and .143 in 2001, a large -.075 log point drop in the union premium. Some of the decline evident in the CPS, however, results from an increase in the number of workers with earnings allocated by the Census.[3]

Although academic studies typically use the CPS or other household microdata, the BLS provides published wage indices for union and nonunion wages (and benefits) based on establishment data. The BLS provides a quarterly index of employer wage cost changes using fixed sector weights (the

[1] For a more complete discussion, see Hirsch and Schumacher (2002b). These conclusions follow strictly if bargaining settlements are on labor demand curves. Similar conclusions are likely to follow when outcomes are off the demand curve. To the extent that union-nonunion wage gaps differ across labor markets, sectoral employment shifts can affect the *average* union premium.

[2] Bratsberg and Ragan provide an update and extension of the industry analysis in Linneman, Wachter, and Carter (1990).

[3] Hirsch and Schumacher (2002a) show that the Census match procedure used to impute missing earnings causes a large downward bias in union wage gap estimates. The increase in recent years in numbers of allocated earners implies that standard CPS estimates overstate the decline in union wage gaps.

Employment Cost Index or ECI) and annual data providing dollar figures on employer costs using current employment weights (the Employer Costs for Employee Compensation or ECEC). The ECI and ECEC measures are derived from the same underlying survey data, the ECI/ECEC program being one of three that form the comprehensive National Compensation Survey statistical program (the other two are the Occupational Compensation Survey and the Employee Benefits Survey).

Despite their common source, union-nonunion wage trends seen in published ECI and ECEC statistics are consistent neither with each other nor with the CPS. Depending on the data series examined, one can conclude that there has been a steep decline, a modest decline, or no decline in relative union-nonunion wages. Conflicts arise primarily owing to different rates of *nonunion* wage growth in the surveys. Hence, the puzzles highlighted in this paper have important implications not only for union wage gaps, but for economy-wide wage and productivity growth. In this paper, we first examine the seemingly conflicting evidence, identifying which pieces can be readily reconciled and which present real puzzles. We then examine more carefully the puzzles, attempting to identify solutions. In the process we examine changes over time in the industry/occupational structure and demographic characteristics of union and nonunion workers. In a concluding section, we provide an assessment of what can be reliably inferred about changes in union wage gaps.

II. *An Overview of the Evidence: Uncovering the Puzzles?*

In this section, we provide evidence on changes over time in the union-nonunion wage gap. We examine four types of data: quarterly ECI wage (and compensation) indices, annual ECEC wage (and compensation) levels, the CPS unadjusted for worker, job, and location controls, and CPS union wage gap estimates using a variety of approaches. To provide an overview of the puzzles present in the data, we first present changes in the union wage gap over the period 1986 to 2001 based on these four approaches, using data either published by BLS or results calculated by us from the CPS.[4] Although we subsequently examine union-nonunion wage patterns in the ECI, ECEC, and CPS in depth, this quick overview nicely illustrates the issues at hand.

In Figure 1, changes in the union log wage gap for the U.S. private sector are shown, based on calculations from published ECI and ECEC figures, and from the CPS based on mean wages (i.e., no

controls) and standard regression models. Details are provided in the Figure note and in analysis discussed later in the paper. Based on the quarterly fixed-weight ECI wage indices for union and nonunion work units, nonunion wages have grown substantially faster than union wages, with the log wage gap closing by -.102 log points between 1986:2 and 2001:2 (the end of the 2nd quarter corresponds most closely to annual averages from the ECEC and CPS). The ECEC is based on the same survey data as the ECI, but provides average annual dollar figures on pay using current weights. In contrast to the ECI evidence, the ECEC shows union wage levels growing slightly faster than nonunion, with the union-nonunion wage gap *increasing* by approximately .014.[5]

Evidence from the CPS monthly earnings files introduces even more puzzles. CPS mean wage rates for union and nonunion workers should produce a result comparable to that seen using the ECEC, with the use of current employment weights and no controls for worker or job characteristics. Yet the unadjusted CPS union log wage gap closes by -.122 log points between 1986 and 2001, far different from the ECEC result showing no closing. Ironically, the pattern shown using the unadjusted CPS is highly similar to that obtained with the ECI, even though the latter has fixed employment weights and uses a very different methodology. The puzzles accumulate when we turn to regression estimates of the union premium, which include control for industry, occupation, and worker characteristics. The regression premium falls by -.056 log points between 1986 and 2001, a bit less than half of the decline evident in the raw CPS wage data.[6]

In short, evidence indicates that between 1986 and 2001, changes in the union wage gap ranged between a closing of as much as -.12 log points and a widening of .01 points. Moreover, methods that are seemingly similar (the ECEC and unadjusted CPS) provide very different answers. "Control" for

---

[4] The period 1986-2001 is chosen since 1986 is the first year for which ECEC figures are available.

[5] Changes in the log wage gap cannot be calculated precisely based on the ECI index values or ECEC mean dollar wages for union and nonunion workers. We approximate the log wage changes for union and nonunion workers by calculating $\ln(I_1/I_0)_u - \ln(I_1/I_0)_n$, where I is the ECI index value, u and n index union and nonunion, and 0 and 1 represent years 1986 and 2001. Letting W represent the mean wage, $\ln(W_1/W_0)_u - \ln(W_1/W_0)_n$ is used to approximate the log change in the union-nonunion wage gap based on mean wage figures by year. Using the CPS, we subsequently show that this approximation is close to the actual log wage change (Table 1).

[6] Hirsch and Macpherson (2002) provide annual computations from the CPS monthly earnings files. For years from 1973-2001 they include both mean hourly earnings for union members and nonmembers, and a logarithmic union wage gap based on a wage regression with standard controls. They report a ratio of unadjusted mean union to nonunion wages that falls from 1.26 in 1986 to 1.12 in 2001. Regression estimates of the union premium fall by -.076 log points between 1986 and 2001. Because allocated earners are included in their samples

employment, albeit in a noncomparable fashion (fixed weights in the ECI and sector dummies in the CPS regression), has seemingly opposite effects (seen by the direction of the arrows in Figure 1), with a large narrowing of the gap moving from the ECEC to ECI and exactly the opposite pattern moving from the unadjusted CPS to CPS regressions with controls. Below, we provide more comprehensive discussion and evidence in an attempt to find solutions to the puzzles so clearly demonstrated in Figure 1.

A. The Employment Cost Index

The quarterly Employment Cost Index (ECI) is part of the BLS's comprehensive National Compensation Survey of employers. The ECI is a Laspeyres-type index intended to measure average increases in employer wage (or compensation) costs for a fixed composition of jobs. It is constructed from average pay increases for "linked" jobs (i.e., jobs that have remained in the sample in consecutive quarters). Quarterly pay ratios among "job quotes" are first averaged within 700 occupation-industry cells (70 industries by 10 broad occupations) using *compensation* shares as weights. Average wage or compensation changes across industry/occupation cells are then averaged using cost shares employing fixed employment weights from a base period. In short, the ECI is intended to represent average pay increases for existing jobs, being invariant to changes in employment shifts.[7]

The ECI is available for union and nonunion workers beginning in 1975:3.[8] Figure 2a provides the published private sector union and nonunion ECI for wages for the period 1975:3 through 2001:4 (with 1989:2=100). Figure 2b provides the same information in different form, showing each quarter's (approximate) difference in union-nonunion log wage *growth* from the previous 12 months. The pattern is clear. Union workers displayed substantially faster wage growth than did nonunion workers during the late 1970s and early 1980s. Converting the ECI to changes in log points, there was a .073 widening of the union log wage gap between 1975:3 and 1983:2. The quarter 1983:2 approximates the time period when union wage growth fell below nonunion wage growth, and corresponds most closely to the January-December 1983 CPS average.

---

and the proportion of these workers has increased over time, the decline in the wage gap is overstated (Hirsch and Schumacher, 2001).

[7] For details on construction of the ECI, see Wood (1982) and Lettau et al. (1997).

[8] The union and nonunion subindices are not pure Laspeyres indices, as is the overall ECI. Rather, relative union-nonunion employment is updated each period. Rates of wage change for longer periods are calculated by

Beginning in the early 1980s, union wages increased more slowly than nonunion wages, with the exception of the early 1990s and the latter half of 2001.[9] During the period 1983:2 and 2001:2 (the midpoint of the 2001 CPS), the ECI indicates that the union log wage gap closed by a remarkable -.139 log points! To put this into perspective, note that the consensus opinion among labor economists is that the union wage premium is approximately 15 percent.[10] If both the profession's consensus and the ECI wage patterns were correct, then there would no longer exist a union wage premium. We will argue subsequently that neither assumption is correct. By the early 1980s, the union wage premium (measured by standard cross-sectional wage equations) was substantially larger than 15 percent. Moreover, the relative wage changes evident in the ECI are likely to overstate the decline in the union premium.

Beginning in 1979:4, the ECI provides evidence on union and nonunion *compensation* as well as wages. The ECI-Compensation indices for union and nonunion workers are shown in Figure 3. As compared to the -.139 closing in the ECI *wage* gap between 1983:2 and 2001:2, the compensation gap closed by -.111. This difference reflects a faster rate of growth in union than in nonunion benefits, partially offsetting the slower union growth in wages.

Articles by BLS economists appearing in *Compensation and Working Conditions* have reported the slower growth of union than nonunion wages evident in the ECI (Schwenk 1996, Foster 2000). But they have neither noted nor addressed in print the substantial discrepancies between the ECI and ECEC in relative union-nonunion wage growth.

BLS economists have recognized that the ECI displays faster economy-wide wage growth than does the ECEC and have attempted to reconcile these series (Schwenk 1997, Lettau et al. 1997).[11] The

---

chaining together subperiod wage growth. By construction, the weighted sum of the union and nonunion indices equal the change in the overall index. See Wood (1982) for details.

[9] Although not the focus of this paper, it is worth noting that union wage growth exceeded nonunion growth during the recessions of the early 1980s and early 1990s. A similar pattern is evident for the early 2000s slowdown, with faster union than nonunion wage growth during 2001:3 and 2001:4. Grant (2001) provides a comprehensive analysis of union-nonunion wage cyclicality using CPS panels. He concludes that beginning in the early 1980s, reduced bargaining power of unions was associated with union wages becoming less procyclical than in the past and as compared to nonunion wages. This conclusion is consistent with patterns seen in the ECI. Likewise, evidence from the PSID indicates greater nonunion than union procyclicality during the 1980s (Wunnava and Okunade 1996). For a summary of relevant literature, see Grant (2001).

[10] A survey by Fuchs, Krueger, and Poterba (1998) measured the views of labor economists at top universities. In response to the question: "What is your best estimate of the percentage impact of unions on the earnings of their average member?" the median response was 15 percent and mean response 13.1 percent.

[11] More broadly, Bosworth and Perry (1994) examine differences in wage growth seen in different data series, including the ECI and CPS.

analysis by Lettau et al. (1997) accounts for much but not all of the difference. They show that faster ECI growth results from both calculation of wage change within cells and aggregation of average growth across cells. First, "job quote" wage growth between quarters is based on linked jobs that remain in the survey. Average wages among jobs entering the survey, however, are lower than among those continuing in the survey. Were composition allowed to vary (as in the ECEC) job cells would show slower wage growth. Secondly, the ECI's use of fixed rather than current employment to construct the cost share weights that aggregate industry/occupation cells into an average leads to faster wage growth. Although Lettau et al. cannot provide an exact decomposition, they conclude that both sources are important. The implications of their analysis are that within ECI/ECEC industry/occupation cells employment has been moving toward lower paying jobs, and that over time employment has been shifting toward lower-paying industry/occupation cells. It is important to note that the ECI and ECEC have no measures of worker characteristics such as schooling, age, and gender, a point we return to in our analysis using the CPS.

Following the logic of Lettau et al., one can speculate on potential explanations for divergence between the ECI and ECEC in relative union and nonunion wage growth. One possible explanation would be that union employment has become more concentrated over time across industry/occupation cells displaying rapid wage growth. Whereas the ECI (where relative union wage growth has been slow) holds sectoral employment fixed, the ECEC (where union and nonunion wage growth are similar) reflects these shifts in employment. A second possibility is that union employment has grown (or declined least) among those jobs *within* industry/occupation cells displaying rapid wage growth. A third possibility, following the logic of Lettau et al. (1997), is that entering job quotes, which the ECI fails to account for, not only are lower paying on average, but also likely to be nonunion since there are lower rates of attrition and creation in union job quotes. Hence, as compared to the ECEC, the ECI may overstate wage growth most substantially for nonunion jobs where there is rapid entry, but far less so for union jobs where entry is limited.[12] This explanation is also consistent with the countercyclical pattern of the union wage gap, since creation of new jobs and quits are likely to fall during recessions relatively most in the nonunion sector. A final possibility is that the ECI/ECEC sample (or at least its nonunion component) has

[12] Lettau et al. (1997), however, conclude that nonrandom rates of attrition can explain little of the discrepancy in overall rates of ECI and ECEC wage growth.

unintentionally shifted toward lower wage jobs. That is, low wage jobs were either previously underrepresented or are now overrepresented. This would result in artificially slow growth in ECEC mean (nonunion) wages over time, but have little systematic effect on rates of ECI wage growth among continuing job quotes.[13] Although we cannot literally replicate the ECI and ECEC using the CPS, the plausibility and importance of alternative explanations can be investigated.[14]

B. Employer Costs for Employee Compensation (ECEC)

Employer Costs for Employee Compensation (ECEC) is an annual series that provides dollar costs for employee wages and benefits as of March of each year. The series is available for years beginning in 1986. The ECEC is part of the National Compensation Survey and based on the same survey data that forms the basis for the quarterly ECI. The ECEC is intended to measure average wages and compensation at a point in time for a representative cross-section of workers (jobs). Unlike the ECI, the ECEC utilizes current employment weights and accounts for the wages of new workers (those not employed in the job the previous quarter). Changes in the ECEC across years thus reflect changes in the average wage across all workers (jobs), following employment shifts within and across industry/occupation job cells.

In contrast to the ECI, trends from the ECEC indicate that union and nonunion wages have grown at *similar* rates. As seen previously in Figure 1, between 1986 and 2001, ECEC union wages increased by .014 more than did nonunion wages, in contrast to the -.10 slower union growth indicated by the ECI. If we focus instead on total compensation, average pay and benefits increased by .026 more than did nonunion compensation, as compared to -.07 slower union compensation growth suggested by the ECI. Figure 4a shows the union and nonunion (approximate) year-to-year change in log wages (using the log of the ratio of year t to year t-1 wages) between 1986-87 and 2000-01. Figure 4b provides the identical information for union and nonunion total compensation. Consistent with the full-period trends, union wage growth during the overall period is not systematically higher or lower than for nonunion workers.

[13] The appeal of this final explanation is that it can simultaneously help resolve differences between the ECEC/ECI and the ECEC/CPS. Unfortunately, we cannot follow-up on such speculation, absent a comparison of ECEC microdata with other data sets believed to have maintained representativeness over time.

[14] The ECI can be thought of as an average of percentage changes (payroll weighted across cells) whereas wage changes calculated from the ECEC measure percentage changes in average wages (employment weighted

In line with discussion in the previous section, explanations that could help reconcile the ECEC and ECI evidence include a finding that union employment has become less concentrated over time in industry/occupation cells displaying slow wage growth, that union employment has declined most sharply among those jobs within industry/occupation cells displaying slow wage growth, that the ECI failure to give weight to entering job quotes causes the ECI to overstate wage growth for nonunion jobs relative to union jobs, or that the composition of the ECEC (and ECI) has shifted over time toward greater representation of low-wage nonunion jobs. It is important to note that circumstances that internally reconcile the ECI and ECEC need not be consistent with external evidence from the CPS.

C. Current Population Survey (CPS)

Much of the published research on levels of and changes in union premiums has come from the CPS. The CPS reports worker union membership status in the May 1973-81 earnings supplements and, beginning in 1983, during all months (for a quarter sample) in the CPS-ORG (outgoing rotation group) earnings files.[15] CPS regression estimates of the union premium show little decline through the mid-1990s (but decline thereafter), leading some authors to conclude that there has been stability in the overall union premium (Blanchflower, 1999). Hirsch and Schumacher (2002) point out that *private sector* regression-based premiums decline, particularly in the late 1990s. They also show that the "raw" or unadjusted CPS union wage gap changes over time in a fashion roughly similar to the ECI, with substantial decline since the early 1980s. The oddity of this result is that the unadjusted CPS should closely mimic the ECEC and not the ECI.

Meaningful comparison of CPS wage trends with those in the ECI and ECEC requires that we construct consistent time-series of CPS union wage gap estimates. This cannot be done without taking into account the substantial effect of "allocated earnings" on relative union-nonunion wages. In the CPS, individuals who either refuse or are unable to report weekly earnings have earnings imputed (i.e., allocated) using a "cell hot deck" method. The cell hot deck method matches each nonrespondent to an earnings "donor" with an identical mix of match characteristics (this differs from the method used in the

---

across cells within years). The average of percentage changes, weighted by payroll shares in the initial year, is equivalent to the percentage change across years in employment weighted mean wages.

[15] In May 1973-80 all rotation groups were asked union questions, but in May 1981 only a quarter of the sample was administered the questions. There were no union questions in the 1982 CPS.

March CPS). There are just under 15,000 "cells" or combinations of match variables. The match criteria include schooling, age, gender, occupational category, hours, and gender, but *not* sectoral variables such as industry or union status.

As shown in Hirsch and Schumacher (2002a), even if the Census matching provides an unbiased measure of average earnings, wage differential estimates are systematically understated when the attribute being studied is *not* a criterion used by the Census to match donors to nonrespondents. These include, among others, union-nonunion, industry, and public-private wage gap estimates. Hirsch and Schumacher refer to this as "match bias" and derive a general expression for the bias. They show that in the case of union wage gap estimates, the bias is closely approximated by $\Omega\Gamma$, where Ω is the proportion of workers with imputed earnings and Γ is a log wage gap estimate free of match bias. Standard wage gap estimates from CPS samples including allocated earners must be multiplied by $1/(1-\Omega)$ to approximate a wage gap free of match bias. For example, if a quarter of the estimation sample has allocated earnings, the union wage gap estimate is attenuated by roughly 25 percent (i.e., a quarter of the sample displays no gap); thus, gap estimates should be adjusted upward by 1.33.[16]

Prior to the 1994 revision in the CPS, approximately 20 percent of the earnings sample had their earnings allocated. Since 1994, in excess of 25 percent have allocated earnings, with particularly high rates (about 30 percent) in the most recent years. Hirsch and Schumacher (2002a) show that union gap estimates understate actual wage gaps by about 5 percentage points owing to a large downward bias in imputed earnings for union nonrespondents, matched primarily to nonunion donors, and a small upward bias for nonunion nonrespondents. Moreover, changes over time in the number and identification of allocated earners makes it difficult to estimate time-consistent union wage gap estimates. For example, the 1973-78 May CPS files do not provide allocated earnings for nonrespondents (earnings are recorded as missing), but beginning in May 1979 allocated earnings are included. The apparent sharp decline in CPS union wage premium estimates between 1978 and 1979, long a puzzle in the literature (Freeman 1984; Lewis 1986) is found to result in large part from the inclusion of imputed earnings in CPS earnings

[16] Hirsch and Schumacher (2002a) provide the general expressions for bias (attenuation), with and without covariates. A similar (albeit more complex) match bias exists for longitudinal estimates of wage gaps. Longitudinal analyses of union wage gaps based on CPS panels include Card (1996) and Hirsch and Schumacher (1998). Both studies omit workers with allocated earnings.

records beginning in 1979 following their exclusion in 1973-78. There are additional problems. During the period from 1989-93, only about a quarter of those with allocated earnings are identified in the CPS-ORG files. There are no valid allocated earnings flags in the CPS-ORG during 1994 and most of 1995. The proportion of the sample with allocated earnings increased with the 1994 CPS redesign (valid allocation flags begin in late 1995), and has been particularly large since 1999. Thus, standard estimates of CPS union wage differentials substantially understate the size of the gaps (due to inclusion of allocated earners), while overstating recent declines in the gap (due to the increasing number of allocated earners).

In Figure 5, we reproduce the time-consistent estimates of the regression-adjusted private nonagricultural sector union wage gap from 1973-2001, as shown in Hirsch and Schumacher (2002a).[17] Presented are regression union wage gaps, with control for worker characteristics, job sector, and location. The solid line corrects for match bias. The dotted line shows what a researcher would obtain using the full CPS sample, with downward bias beginning in 1979 following inclusion of allocated earners. Their regression estimates of the union premium (corrected for match bias) indicate a decline of -.051 log points from the 1984 peak through 2001. Their unadjusted (non-regression) figures measuring the union-nonunion wage gap (not shown here) shows a -.122 log point closing between 1984 and 2001.[18]

Having examined evidence on union wage gaps from the CPS, ECI, and ECEC, puzzles abound. The pattern since the mid-1980s ranges from evidence of no closing in the union-nonunion wage gap (the ECEC) to evidence of a substantial narrowing of the wage gap (the ECI and raw CPS). CPS regression estimates indicate a moderate closing of the gap. The ECEC and CPS results are based on the use of current industry/occupation employment weights, whereas the ECI uses fixed weights. CPS regression estimates provide controls for worker characteristics (e.g., schooling, age, gender) and sector of

[17] The estimates correct for match bias by omitting all allocated earners in those years possible (1973-88 and 1996-2001) and making adjustments in other years based on the expected difference in the wage gap with and without allocated earners. This is done by adjusting 1989-93 estimates based on differences observed in 1983-88 (.031 log points) and adjusting 1994-95 estimates (following revisions in the CPS that increased the number of allocated earners) based on differences observed in 1996-98 (.046 log points). Hirsch and Schumacher also conduct their own earnings imputation in which union status is used as a match criterion (i.e., union nonreporters are assigned the reported earnings of matched union donors and nonunion nonreporters earnings of nonunion donors). Estimates obtained omitting allocated earners are similar to those obtained retaining all workers and relying on their own imputation method.

[18] Hirsch and Schumacher (2002a) estimate union *membership* gaps for the *nonagricultural* private sector. CPS results calculated for this paper are union *coverage* gaps for the entire private sector. Union premium decline economy-wide is less pronounced than in the private sector. The conclusion reached in some studies of no change

employment (industry/occupation). The raw CPS and ECEC provide no worker or sectoral controls, whereas the ECI provides fixed sectoral weights but no worker controls. Given the common method used by the ECEC and the raw CPS one expects to see a similar pattern, yet the ECEC and raw CPS results are at opposite ends of the spectrum.

One also expects to see the use of fixed sectoral weights (as in the ECI) or regression controls (in the CPS) drive results in the same direction. Just the opposite occurs. Use of fixed weights in the ECI (compared to the ECEC) produces slower union than nonunion wage growth; use of sectoral controls in CPS regressions (compared to the raw CPS) results in a far less marked pattern of union wage decline. There is no shortage of puzzles.

III. *Are there Solutions to the Puzzles? Reconciling the Evidence*

In this section, we attempt to reconcile conflicting evidence on the trends in union and nonunion wages. We focus on three areas. First, we tackle what is inherently the most difficult puzzle – why there exist completely different patterns in the ECEC and the raw CPS. Because both use similar methods, with current employment weights and no statistical controls, there is little that we can do to reconcile the surveys, absent access to microdata from the ECI/ECEC as well as the CPS. We do discuss possible differences in the surveys that might account for the different pattern. The second area of focus is the discrepancy in wage patterns between the ECEC and ECI. In principle, we can simulate changes that occur as one moves from the ECEC to ECI through the adoption of similar adjustments within the CPS. Specifically, using the CPS one can switch from current year weights to fixed employment weights and switch from measurement of changes in mean wages across years to the measurement of the mean change in year-to-year wages among individual union and nonunion job stayers. This analysis has the potential to shed light not only on union wage gap patterns in the CPS, but also on differences in behavior of the ECEC and ECI. Finally, we analyze the CPS using standard decomposition techniques. Starting with the total (raw) change in the union-nonunion wage gap over time, we examine how much of the change is accounted for by changes in worker and sectoral characteristics (and their payoff in the labor market) and how much by a changing union wage premium. An important byproduct of this analysis will be our

---

in the union premium is not surprising, especially if analysis begins after the early 1980s peak and ends prior to the late-1990s decline.

examination of how the private-sector union workforce has changed over time.

A. The CPS versus the ECEC

Were the CPS and ECEC to have identical wage measures and an identical sample frame, they would likely display the same pattern of change in the union-nonunion wage gap. Of course, neither is the case. The CPS samples households, with wage figures based on the reported earnings of employed wage and salary workers who report that they are and are not union members (or covered by a collective bargaining agreement). The wage measure represents usual weekly earnings (including overtime, tips, commissions, and shift pay) divided by usual hours worked per week. The ECEC and ECI, however, are based on establishment surveys. Sampled are "jobs" or "job quotes" within establishments classified by occupation and work level ("leveling factors" include knowledge required, supervision received, complexity, physical demands, work environment, etc.). Based on current employment weights, job quotes are averaged into 700 cells (70 industries by 10 occupations), which in turn are averaged based on current weights. The wage measure represents the straight time wage, inclusive of tips, commissions, and other productivity-related incentive pay but, in contrast to the CPS, excludes overtime and shift supplements (these are included in the benefits measure). Thus, one avenue to explore is whether restricting the CPS analysis to straight-time pay has a substantial effect on union-nonunion wage trends

A second issue is the classification of jobs as union or nonunion. In the CPS, this is based on individual workers' reported union status. In the ECEC and ECI it is based on whether the job within an establishment is reported as primarily covered by a union contract. Although union density in the ECEC is not reported, the one piece of evidence that we located suggests that differences in the union measure may not be important. Foster (2000) reports that in 1997, 23 percent of her total NCS/ECEC sample was unionized, as compared to a coverage rate of 15.6 percent in the 1997 CPS. In the private sector NCS/ECEC sample, there was a 16 percent unionization rate, as compared to 10.6 coverage density in the CPS. Most of this difference can be explained by the fact that unlike the full ECEC or ECI, her NCS/ECEC sample excluded establishments with fewer than 50 employees. In the private sector, establishments with over 50 employees account for only 58 percent of total employment in March 1998 (based on ES-202 state UI reports, published in *Employment and Wages, Annual Averages 1998*). Using the extreme assumption that *no* employees in small establishments were unionized, this would increase

the CPS private sector figure from 10.6 to 18.3 percent (10.6/.58), a bit higher than the ECEC union density of 16 percent. In short, the very limited evidence that we found does not lead us to worry about the representativeness of the ECEC (and ECI) samples with respect to union density.

We can also assess the plausibility of mean wage estimates from the ECEC and CPS. On the one hand, CPS wages including overtime and shift pay should be higher than ECEC straight-time wages. On the other hand, ECEC hours for salaried workers are effectively truncated at 40 based on a standard work week, which should cause ECEC wages to exceed CPS implicit hourly earnings for those with greater than 40 usual hours worked per week. Table 1 presents mean union and nonunion wages from the ECEC and CPS for 1986 and 2001, with CPS wages calculated for all workers based on earnings inclusive of overtime and shift pay, and for workers for whom straight-time pay can be isolated.[19] Mean union wages reported in the ECEC are $18.36 in 2001, nearly identical to the $18.39 we calculate from the CPS. Nonunion wages, on the other hand, are lower in the ECEC than in the CPS, $14.81 versus $15.87. Equally disturbing is that 1986 wages are not similar, with ECEC union wages being a bit higher than in the CPS (11.32 versus 11.09), and nonunion wages now being substantially higher in the ECEC than in the CPS (9.26 versus 8.51), the opposite of what's observed in 2001. These are puzzling patterns. As compared to the CPS (and the ECI), the ECEC substantially understates *nonunion* (but not union) wage growth between 1986 and 2001. We do not know why.[20]

For many workers, hourly earnings in the CPS are implicit, being calculated as the ratio of usual weekly earnings on the principal job divided by usual hours worked per week on that job. Some have argued that many workers overreport hours worked, reporting scheduled rather than actual hours, and that this overreporting has increased over time (see Abraham, Spletzer, and Stewart 1999, Hamermesh 1990, Robinson and Bostrum 1994), causing CPS growth in hourly earnings (and productivity) to be understated. For the moment, assume that this is correct for the overall labor force. In order to explain a

[19] Union and nonunion workers in the CPS are identified based on union coverage rather than membership, since this corresponds more closely to the union measure in the ECI and ECEC. Covered workers include all union members plus nonmembers stating they are covered by a collective bargaining agreement. Union wage premiums using coverage as the union measure are about .01 log points lower than using membership. For an analysis of the "membership premium" see Schumacher (1999) and Budd and Na (2000).

[20] As previously mentioned, a possible explanation (for which we have no evidence) would be that over time the ECEC/ECI nonunion (but not union) sample has increased the proportion of low-wage jobs (or decreased high-pay jobs). This would account for ECEC/CPS differences and different growth rates for the ECEC and ECI, since change in sample representativeness need not affect the ECI measures of wage growth among matched jobs.

declining union wage gap in the CPS as compared to the ECEC, it must be the case that there has been an increase in the overreporting of hours for union relative to nonunion workers, thus understating union wage growth. This seems unlikely. Typically, union jobs have less flexibility in hours than do nonunion jobs and, if anything, we would think there has been less variation in hours reporting over time in the union than in the nonunion sector.

Evidence reported in Table 1 addresses some of these issues. By examining wage changes among hourly union and nonunion workers reporting their straight-time wage, wage trends should be largely purged of bias resulting from misreporting of hours worked. Comparing 1986 and 2001, we find that there has been a closing in the union wage gap for hourly workers of -.121 in the CPS, similar to the -.118 for the more comprehensive wage measure for all wage and salaried workers combined. We also use our standard wage measure (including tips, commissions, and overtime) for the full sample, but for workers with greater than 40 usual hours worked per week, we calculate the wage by dividing weekly earnings by 40. This mimics the ECEC/ECI assumption of 40 hours for full-time workers (but unlike the ECEC/ECI, this mixes in overtime wages for hourly workers). As seen in line 3, wages are higher (by construction) using this measure and, owing to an increase in hours over time among high wage workers, we also see more rapid wage growth. Closing in the union gap, however, is affected little, being nearly identical to that seen in line 1 (a closing of -.12). In short, differences in the wage measure between the ECEC and CPS fails to explain even a modest portion of the large divergence in wage growth (particularly for nonunion workers) between the ECEC and CPS. Even if it could, this would tell us nothing about differences between the ECEC and ECI.

Finally, the bottom panel of Table 1 provides the CPS calculations in log wages as well as dollars, thus allowing us to assess how closely our approximation to log wage changes comes to actual log wage changes. They are reasonably close, with the log approximation calculated from mean dollar wages slightly understating the actual closing in union-nonunion log wages (e.g., for all private workers, a -.118 approximation versus the -.122 actual change in the log wage).

B) Emulating ECEC and ECI Wage Growth Methods With the CPS

Wage growth in the ECI differs in several fundamental ways from that calculated in the ECEC and CPS. First, ECI wage growth within jobs is based on a *continuing* sample of matched job quotes,

ignoring jobs that have exited or entered the sample. Second, wage growth in the ECI is averaged across cells using fixed industry/occupation weights (*wage bill* shares). A third difference – use of alternative wage growth metrics – is more apparent than real. For the ECEC and CPS wage growth is measured by the change between periods in average wages. In the ECI, growth is measured by the average of wage growth rates over time. However, because the latter is payroll weighted, these wage growth metrics are equivalent (see footnote 14).

Although we cannot precisely replicate ECI methods using the CPS, we can use methods in the spirit of the ECI. First, we can utilize the panel nature of the CPS and measure wage growth based on wage changes of matched workers in adjacent years (i.e., workers who are union job cell stayers or nonunion stayers in adjacent years). Second, average wage growth across cells can be calculated using payroll shares based on fixed industry/occupation employment weights. And third, long-term wage change can be calculated from linked year-to-year wage growth ratios rather than relying on just beginning and end point wages. By making changes one step at a time, we may identify the impact of specific methodological differences.

We report the outcome of this investigation in Table 2. Recall that previously we found a closing of the union gap of -.118 using CPS means absent disaggregation (see Table 1). Using the 1986 and 2001 CPS, we disaggregate union and nonunion private sector workers into 85 job cells based on a division into 5 broad occupational categories cross-classified with 17 broad industry groupings. We measure union and nonunion wage growth separately in all calculations. In lines 1 and 2 we examine the effect of using 1986 versus 2001 fixed employment weights. We measure wage growth for each group within the 85 industry/occupation cells by taking the mean wage for 1986 and mean wage for 2001 (each calculated using CPS employment weights) and then taking the ratio of the 2001 to 1986 mean wages. We then average across the 85 job cells using current (2001) employment weights. Letting 1986=100, the union wage index in 2001 is 163.2 (i.e., a 2001/1986 wage ratio of 1.632); the nonunion wage index is 179.1. Taking the log difference of the index values, we approximate closing of the union-nonunion log differential to be -.093. In line 2, we switch from using current year to base year employment weights to aggregate across cells, which increases (in magnitude) the union wage gap closing to -.097.

We next switch to aggregation across cells using *payroll* rather than employment weights (payroll

weights account for employment times wages times hours worked), since payroll weighted wage ratios across cells are equivalent to the change in means. The use of 1986 payroll weights across cells (Line 3) indicates a closing in the wage gap of -.097. We next modify the calculation by compiling *within-cell* wage growth based on individual shares in cell payroll rather than employment (Line 4). This leads to faster union and nonunion wage growth, suggesting that wage growth within cells has been highest among those with larger earnings (wages times hours), and shows more rapid closing of the union wage gap, to -.114. The pattern found so far is consistent with differences in the ECEC and ECI, with the use of base year and cell payroll weights leading to a finding of a shrinking union wage gap (slower union than nonunion wage growth). The differences found so far are rather trivial, however, an order of magnitude different than the huge disparity between the ECEC and ECI.

The final set of calculations (Line 5) is potentially important, but statistically problematic. We focus exclusively on wage changes among job cell *stayers*. We form worker-year pairs based on CPS panels and then restrict our analysis to the subset of the panel comprising workers who do not change industry, occupation, or union status across the year. These calculations are intended to approximate the effect that use of matched job quotes (and omission of new quotes) and linked wage indices have on the ECI measure of wage change, as compared to the ECEC. We first measure wage changes (the ratio of the year 2 to year 1 wage) for each individual stayer in the CPS panel. We then calculate the mean of the wage growth ratio within each industry-occupation-union-year job cell (based on year 1 worker payroll weights). Because some cells, particularly union cells, are empty or very small, and individual wage changes vary enormously (in part due to measurement error), small cells (N<6) are assigned the mean wage growth for their industry and union status during that year (i.e., occupations are collapsed). Next we form a linked 1986-2001 index for each cell, in the spirit of the ECI, by multiplying for each of the industry/occupation/union cells the wage ratio for 1987-86 times the ratio for 1988-87, and so forth, continuing through 2001-2000. Having calculated wage growth over 1986-2001 for each of the 85 union cells and 85 nonunion cells, we next calculate the average across these cells using 1986 payroll weights calculated from the full CPS file, as used previously in Line 4 (this insures adequate cell sample sizes).[21]

[21] Absent data quality restrictions, the magnitude of these rates of wage growth blow up, being highly sensitive to individuals with extreme ratios of wage growth (a very low first year wage followed by a large second

The results of our calculations are shown in Line 5 of Table 2. Rates of implied wage growth are implausibly high, with a 1986-2001 index of 308.5 for union growth and of 412.9 for nonunion growth. These index numbers imply an unrealistic -.291 log point closing in the union premium. The extremely high rates of wage growth for both union and nonunion wages in Line 5, however, are consistent with the higher growth rates in ECI than in ECEC wages. But our methods do not identify the extent to which this outcome is the result of using a sample of job cell stayers or from measurement error producing extreme values whose errors are compounded as they are multiplied across years. Lettau et al. (1997) have shown the first explanation (i.e., a matched sample) to be important using ECI/ECEC data. We suspect that the second explanation also matters, although we do not know the extent of error in ECI job quotes. In contrast to BLS calculations using matched job quotes, our CPS analysis is overwhelmed by individual variability in wage changes resulting in part from measurement error and compounded by small cell sizes. The most that we can say is that our panel analysis imitating ECI methods is at least suggestive of an explanation for ECI/ECEC differences in the pattern of union and nonunion wages.

In short, the large difference in relative union-nonunion wage growth in the ECEC and ECI remains a mystery. Given that both rely on the same survey data, the different outcomes are obviously a result of different methodologies. But neither economic intuition nor methodological differences appear readily consistent with such large differences. Our suspicion, based in part on the results in Line 5, is that multiplication of wage ratios across years tends to produce larger rates of wage growth than taking the change in average wages. Any tendency toward higher measures of wage growth using ECI than ECEC methods must be strongest for nonunion workers, thus leading to a substantial closing in the union gap using the ECI but not ECEC. Again, such an explanation is largely conjecture. Even if this were to account for differences between the ECEC and ECI, it does not explain the large discrepancy in union-nonunion results between the ECEC and CPS. As discussed previously, a change in the representativeness of the ECEC/ECI nonunion sample (but not union sample) toward more low-pay jobs and fewer high pay jobs would simultaneously help account for ECEC/ECI differences and ECEC/CPS differences. But, again, we have no evidence that such a shift has occurred.

---

year wage). There is no easy way to identify whether extreme values are real or result from reporting error. We arbitrarily truncate wage growth at 100 percent and -50 percent in the calculations reported.

C. Decomposing Union and Nonunion Wage Changes in the CPS

Our third general approach involves decomposition of CPS union and nonunion total wage changes into those resulting from employment shifts, changes in worker characteristics, and in the residual union wage premium. We provide this analysis for the 1986-2001 period in order to shed light on the puzzles created by the contradictory evidence from the ECEC, ECI, and CPS.

Simple annual wage regressions provide measures of the union wage gap based on a union intercept shift, with a common set of parameters attaching to worker and sectoral variables.

$$(1) \qquad w_{it} = \sum\beta_t x_{it} + \sum\theta_t z_{it} + \Gamma_t u_{it} + \xi_{it}$$

Here, w is the log wage for individual i in year t, x is a set of individual characteristics (those not measured or fixed within the ECI) with β the corresponding parameter set, z is a set of sectoral dummies measuring occupation, industry, location, and part-time status variables (those fixed within the ECI) with θ their coefficients, u is union membership, Γ_t represents the logarithmic union-nonunion wage gap in year t, and ξ is an error term assumed to have zero mean and constant variance.

Letting W, X, Z, and U represent the *mean* values in year t, the total change in the log union-nonunion wage gap between any two years 0 and 1 is equal to:

$$(2) \qquad (W_{u1}-W_{n1}) - (W_{u0}-W_{n0}) = \sum\beta_1(X_{u1} -X_{n1}) - \sum\beta_0(X_{u0} -X_{n0}) + \sum\theta_1(Z_{u1} - Z_{n1}) - \sum\theta_0(Z_{u0} -Z_{n0}) + \Gamma_1 - \Gamma_0$$

Designating Δ as the change operator between years 0 and 1, the equation simplifies to:

$$(3) \qquad \Delta(W_u-W_n) = \Delta\sum\beta(X_u -X_n) + \Delta\sum\theta(Z_u - Z_n) + \Delta\Gamma$$

The total change in the union-nonunion wage gap is decomposed into the change in the regression gap Γ, the change in relative union-nonunion worker characteristics over time, and the change in relative union-nonunion sectoral employment. Note that the "explained" effects of changes in worker characteristics and employment sector are "priced" based on their current prices (coefficients) in years 0 and 1 rather than using fixed prices. Thus, the explained changes in the union-nonunion wage gap reflect not only changes in relative characteristics and sector of employment, but also changes over time in how these are rewarded in the labor market.

Table 3 shows the results of this decomposition for the period 1986-2001. The total change in the

union-nonunion mean log wage gap between 1986-2001 is -.122. The change in the regression wage premium Γ is -.056, from -.238 in 1986 to -.182 in 2001, with the remaining -.066 of the total decline "explained" by measurable control variables and their coefficients. Changes in individual characteristics (and their coefficients) account for -.020 of the decline in the union wage gap, reflecting factors not measured or held constant in the ECI or ECEC. The decomposition indicates that -.046 of the decline is accounted for by a change in employment sector (industry, occupation, large metro, region, and part-time), factors held constant within the ECI owing to fixed sector weights with matched job quotes to calculate percentage changes. Employment sector is allowed to vary within the ECEC because it uses current weights and its sample of job quotes changes (slowly) over time.

The decomposition is informative in that it helps us understand why the unadjusted CPS union gap decline exceeds the estimated decline in the regression wage gap. Table 4 shows means of the regression controls for 1986 and 2001 (plus 1973-74). Among individual characteristics, part of the decline in the unadjusted union gap between 1986 and 2001 is due to an increase in the union relative to nonunion percentage of private sector female workers and slower growth in mean experience for union compared to nonunion workers. Working in the opposite direction is higher growth in mean schooling for union than for nonunion workers. Among the sectoral changes, two stand out as important – first, a substantial decline in union relative to nonunion employment in durable manufacturing and second, a decline in relative pay (i.e., the coefficient) in transportation, communications, and utilities (TCU), a sector with a large share of total union employment (18.0 percent in 1986 and 18.7 percent in 2001).[22]

Although enhancing our understanding of union premiums and the CPS, the decomposition analysis does little to solve the puzzling discrepancies among the data sets. The -.02 difference that results from control of individual characteristics accounts for a modest share of the large difference between the unadjusted CPS and the ECEC. More fundamentally, sectoral controls clearly move CPS outcomes toward the result of *less* closing over time in the union wage gap, just the opposite of the result seen as one moves from the ECEC toward the fixed-weight ECI.

As discussed earlier, in order to reconcile differences in the ECI and ECEC union wage gap

[22] Bratsberg and Ragan (forthcoming) provide an analysis of union wage gaps across industries, finding that the dispersion in gaps has decreased over time due, in part, to declines in high premium sectors such as TCU.

trends, it should be the case that union employment became less concentrated (relative to nonunion employment) in sectors with slow wage growth. An implication from the CPS decomposition, however, is that relative sectoral shifts (at a very aggregate level) have been mildly unfavorable for union workers. This should lead to a slower relative union wage growth in the ECEC (where employment weights vary) than in the ECI (with fixed employment weights), the opposite of what is seen in these series.[23] In work not shown, we examined this issue further. Recall from Table 2, line 2, that the ratio of 2001 to 1986 union wages averaged across cells using 1986 union employment weights is 1.613, or an index of 161.3. Substituting 1986 nonunion weights we obtain an index of 164.9, indicating that union employment in 1986 was disproportionately concentrated in those industry/occupation cells exhibiting slow union wage growth. Likewise, we find little correlation (-.012) between the proportion unionized in a sector in 1986 and that cell's overall wage growth between 1986 and 2001 (weighted by 1986 total employment).

We do find some evidence consistent with greater union employment decline (growth) where union wage growth is small (large). We find a positive correlation across the 85 sectors between union employment change during 1986-2001 and union wage change (.351), stronger than the correlation between nonunion employment growth and union wage change (.174) over the same period. Likewise, union employment change is more highly correlated with nonunion wage change (.437) than is nonunion employment and nonunion wage change (.312).[24]

We have found evidence from the CPS that is both supportive and not supportive of the qualitative discrepancies between the ECEC and ECI regarding union and nonunion wage trends. But at best, these findings might account for a tiny share of the vast difference between the ECI and ECEC in union-nonunion wage growth. In short, we have identified many puzzles, but few solutions. Despite our lack of progress, the questions being asked are important and clearly warrant a more detailed and systematic analysis than we can provide in this paper.

IV. *Changes Over Time in Union and Nonunion Workforces*

One element of our investigation has been the importance of changes in relative union-nonunion

[23] Recall that use of fixed sectoral employment weights in the ECI wage index is not equivalent to use of regression controls for sector of employment. Moreover, sectoral changes in the CPS decomposition are the product of relative employment and union wage gap changes.

[24] All correlations weight cells by 1986 total employment.

employment weights and worker characteristics. This section summarizes these changes. As seen in the previous section, over half of the total -.122 log wage gap change in the CPS is accounted for by changes in relative union-nonunion attributes and their valuation. That is, shifts in sectoral employment and wages adversely affected relative union-nonunion wages during the 1986-2001 period. In Table 4, we provide a demographic and sectoral profile of union and nonunion wage and salary workers over the past 28 years, with descriptive statistics for 1973-74, 1986, and 2001.

Notable are changes in gender composition. Whereas the percentage of women in private nonunion employment was effectively constant between 1986 and 2001, after rising between 1973 and 1986, the percentage of women in unionized employment rose from 20.6 percent in 1973, to 28.4 percent in 1986, and to 31.8 percent by 2001. Although the unionized private sector remains disproportionately male, this has become less true over time. Growth in the proportion of women is most readily evident when we include private and public sector employment, the latter being heavily female. Among public and private union wage and salary workers, the proportion female increased from 23.8 percent in 1973 to 42.4 percent by 2001 (versus 45.2 to 49.0 percent among nonunion workers). Union workers have also increased relative schooling over time. Whereas union workers averaged nearly 1.0 year less schooling in 1973, the gap narrowed to 0.3 years by 2001.

Also worthy of mention are trends in part-time work. Part-time employment decreased among nonunion workers, from 25.5 percent in 1973, to 21.5 percent in 1986, and to 19.6 percent in 2001, yet remained close to 10 percent among private sector union workers, despite the increase in female workers who comprise roughly two-thirds of all part-time workers.

When we turn to industry and occupational composition, several changes are notable. Nearly half (49.4 percent) of all union workers were in operative or laborer occupations in 1973, but by 2001 the share had fallen to 31.9 percent (for nonunion workers, shares fell from 18.1 percent to 14.1 percent). Whereas only 4.4 percent of union workers in the private sector were in managerial and professional occupations in 1973, the share rose to 14.4 percent in 2001 (for nonunion workers, shares rose from 18.9 percent to 27.8 percent). Focusing on broad industry, the share of union workers in manufacturing (durable plus nondurable) fell from 52.0 percent in 1973 to 28.4 percent in 2001, as compared to a decrease among nonunion workers from 25.7 percent to 16.8 percent. The share of union employment

rose most markedly in professional services, from 3.1 percent to 16.5 percent between 1973 and 2001, and to a far lesser extent in construction and transportation, communications, and utilities.

V. *What Can We Conclude About Changes in the Union Wage Gap?*

Knowledge of wage growth in an economy is fundamental to our understanding of economic performance and the operation of labor markets. This paper has emphasized the large and puzzling differences found in relative union-nonunion private sector wage growth using different data sets and methods. Focusing primarily on the period from 1986 to 2001, we find that the evidence on the wage gap between union and nonunion workers varies enormously. BLS's widely-used Employment Cost Index (ECI) indicates a substantial narrowing of the union wage gap, by roughly 10 percentage points (-.10 log points). Yet published annual wages from the Employer Costs for Employee Compensation (ECEC), based on the same underlying survey as the ECI, indicates that private sector union wages have grown slightly *faster* than nonunion wages. The ECEC and ECI are based on employer surveys among establishments. Evidence on mean hourly earnings across individual workers in the Current Population Survey (CPS) shows that mean wages for union relative to nonunion workers have fallen by about -.12 log points between 1986 and 2001. This is highly similar to evidence from the ECI. Yet the computational methods used to compile the CPS mean figures differ substantially from ECI methods and closely match ECEC methods. CPS regression analysis, which controls for worker characteristics and sector of employment, suggests that the union wage premium has declined by less than -.06. Just over half of the decline in the mean union wage gap can be accounted for by measured changes (and the payoffs) in worker characteristics and employment sector.

Although the puzzles presented in the paper are clear-cut, solutions are not. We have presented evidence that accounts for bits and pieces of the differences across surveys, but cannot provide a comprehensive reconciliation of CPS, ECI, and ECEC evidence. Differences between the CPS and ECEC are the result of substantially slower wage growth among *nonunion* workers in the ECEC than in the CPS (and ECI). Thus, these differences present a troubling puzzle for *economy-wide* wage (and productivity) growth. Analysis with the CPS using ECEC and ECI-type methods provides results both consistent and inconsistent with the *pattern* of differences reported in the ECEC and ECI. Little in our CPS analysis helps us in understanding the *magnitude* of the difference between the ECEC and ECI.

In the end, we find ourselves relying most heavily on results from the CPS. First, the CPS data are publicly available so that researchers may use the data in a way suited for the specific question at hand and disaggregate economy-wide union and nonunion wage trends into their component parts. Second, CPS results conform most closely to our priors and economic intuition. Relative union wages have declined substantially during a period of shrinking unionization, but the decline reflects in part the slow wage growth occurring in those occupations and industries in which private sector union employment is concentrated. Decreases in the union wage *premium* are far more modest. Third, ECI methods are complex, making it difficult to understand the large and puzzling differences between the ECEC and ECI. The closing union wage gap seen in the ECI simply appears too large to represent changes in the union wage *premium*. ECEC methods are more straightforward, but the ECEC results of slow growth in nonunion wages and a slight increase in the relative union-nonunion wage are counterintuitive and the clear outlier among the various pieces of evidence.

The weight of the evidence indicates that the union-nonunion wage gap in the private sector has declined, perhaps substantially, since the early-to-mid-1980s.[25] The magnitude of the decline is anything but certain, although the six percentage point decline in the CPS regression estimate of the union premium (since 1986) appears plausible, certainly more so than evidence from the ECEC of no decline or from the ECI of a huge decline. Of course, a -.06 log point decline since 1986 is quite sizable if one believes the conventional wisdom among labor economists that the union premium (as typically measured in wage level equations) is close to 15 percent, a figure long associated with the work of Gregg Lewis. By the early 1980s, however, the private sector union premium had risen to a level around 25 percent, a finding hidden in part by the large downward "match bias" (due to inclusion of allocated earners) present in most CPS union gap estimates. By 2001, however, private sector union wage gaps in the CPS had fallen below 20 percent. Such a level is not so far from 15 percent, making Lewis and the conventional wisdom reasonable once again. In a paper that has been long on puzzles and short on solutions, it is perhaps appropriate to conclude on this comforting note.

[25] Recall that this conclusion applies to the private sector. Public sector union wage gaps, if anything, have increased, while the share of unionized (covered) workers employed in the public sector rose to 45 percent by 2001 (Hirsch and Macpherson, 2002, Tables 1a, 1f, 2a). Moreover, both the ECEC and ECI indicate faster growth in private sector nonwage benefits among union than nonunion workers.

REFERENCES

Abraham, Katharine G., James R. Spletzer, and Jay C. Stewart. "Why Do Different Wage Series Tell Different Stories?" *American Economic Review Papers and Proceedings* 89 (May 1999): 34-39.

Andrews, Martyn J., Mark B. Stewart, Joanna K. Swaffield, and Richard Upward. "The Estimation of Union Wage Differentials and the Impact of Methodological Choices." *Labour Economics* 5 (December 1998): 449-474.

Blanchflower, David G. "Changes Over Time in Union Relative Wage Effects in Great Britain and the United States." In *The History and Practice of Economics. Essays in Honor of Bernard Corry and Maurice Peston, Vol. 2*. Sami Daniel, Philip Arestis and John Grahl, eds. Northampton, Mass.: Edward Elgar, 1999, pp. 3-32.

Bosworth, Barry and George L. Perry. "Productivity and Real Wages: Is There a Puzzle?" *Brookings Papers on Economic Activity* (1:1994): 317-44.

Bratsberg, Bernt and James F. Ragan Jr. "Changes in the Union Wage Premium by Industry – Data and Analysis." *Industrial and Labor Relations Review* (forthcoming).

Budd, John W. and In-Gang Na. "The Union Membership Wage Premium for Employees Covered by Collective Bargaining Agreements." *Journal of Labor Economics* 18 (October 2000): 783-807.

Card, David. "The Effect of Unions on the Structure of Wages: A Longitudinal Analysis." *Econometrica* 64 (July 1996): 957-79.

Foster, Ann C. "Union-nonunion Wage Differences, 1997." *Compensation and Working Conditions* 5 (Spring 2000): 43-46.

Freeman, Richard B. "In Search of Union Wage Concessions in Standard Data Sets." *Industrial Relations* 25 (Spring 1986): 131-45.

Fuchs, Victor R., Alan B. Krueger, and James M. Poterba. "Economists' Views about Parameters, Values, and Policies: Survey Results in Labor and Public Economics." *Journal of Economic Literature* 36 (September 1998): 1387-425.

Grant, Darren. "A Comparison of the Cyclical Behavior of Union and Nonunion Wages in the United States." *Journal of Human Resources* 36 (Winter 2001): 31-57.

Hamermesh, Daniel S. "Shirking or Productive Schmoozing: Wages and the Allocation of Time at Work." *Industrial and Labor Relations Review* 43 (February 1990, Special Issue): S121-S133.

Hirsch, Barry T. and David A. Macpherson. *Union Membership and Earnings Data Book: Compilations from the Current Population Survey (2002 Edition)*. Washington: Bureau of National Affairs, 2002.

Hirsch, Barry T. and Edward J. Schumacher. "Unions, Wages, and Skills." *Journal of Human Resources* 33 (Winter 1998): 201-19.

_____. "Match Bias in Wage Gap Estimates Due to Earnings Imputation." Trinity University, June 2002a, available at www.trinity.edu/bhirsch/ or www.ssrn.com.

_____. "Private Sector Union Density and the Wage Premium: Past, Present, and Future," In The Future of Private Sector Unionism in the United States, James T. Bennett and Bruce E. Kaufman, eds. Armonk, NY: M.E. Sharpe, 2002b, pp. 92-128.

Jarrell, Stephen B. and T.D. Stanley. "A Meta-Analysis of the Union-Nonunion Wage Gap." *Industrial and Labor Relations Review* 44 (October 1990): 54-67.

Lettau, Michael K., Mark A. Loewenstein, and Aaron T. Cushner. "Explaining the Differential Growth Rates of the ECI and the ECEC." *Compensation and Working Conditions* 2 (Summer 1997): 15-23.

Lewis, H. Gregg. *Union Relative Wage Effects: A Survey*. Chicago: University of Chicago Press, 1986.

Linneman, Peter D., Michael L. Wachter, and William H. Carter. "Evaluating the Evidence on Union Employment and Wages." *Industrial and Labor Relations Review* 44 (October 1990): 34-53.

Robinson, John P. and Ann Bostrom. **"**The Overestimated Workweek? What Time Diary Measures Suggest." *Monthly Labor Review* 117 (August 1994): 11-23.

Schumacher, Edward J. "What Explains Wage Differences Between Union Members and Covered Nonmembers?" *Southern Economic Journal* 65 (January 1999): 493-512.

Schwenk, Albert E. "Trends in the Differences Between Union and Nonunion Workers in Pay Using the Employment Cost Index." *Compensation and Working Conditions* 1 (September 1996): 27-33.

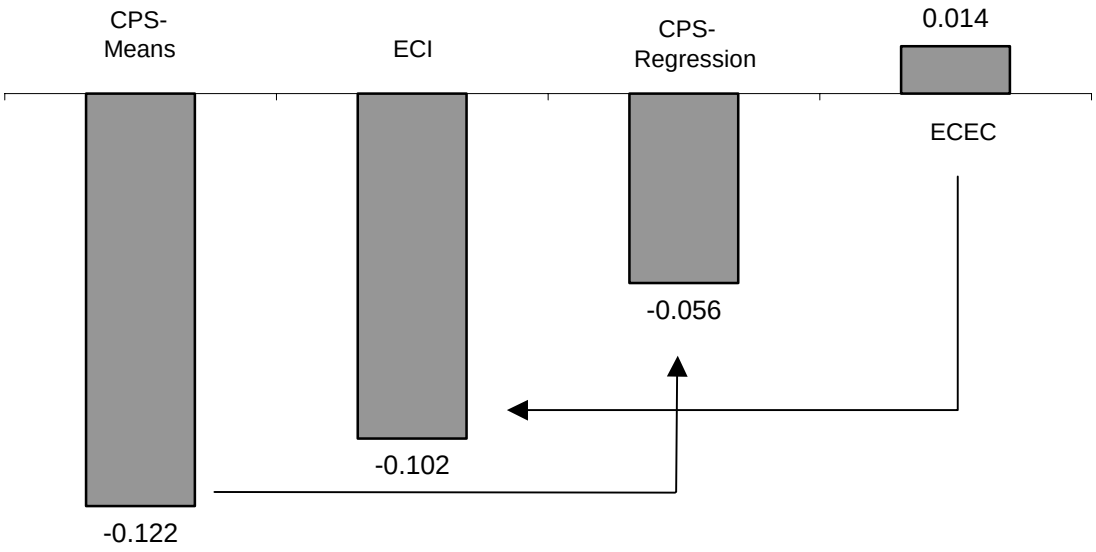
Schwenk, Albert E. "Measuring Trends in the Structure and Levels of Employer Costs for Employee Compensation." *Compensation and Working Conditions* 2 (Summer 1997): 3-14.

Wood, G. Donald. "Estimation Procedures for the Employment Cost Index." *Monthly Labor Review* (May 1982): 40-42.

Wunnava, Phanindra V. and Albert Ade. Okunade. "Countercyclical Union Wage Premium? Evidence for the 1980s." *Journal of Labor Research* 17 (Spring 1996): 289-96.

`

Figure 1: CPS, ECI, and ECEC Changes in the Union-Nonunion Wage Gap, 1986-2001



Notes: Figures taken from Tables 1 and 3. See the text and table notes for details. For the Employer Costs for Employee Compensation (ECEC), mean dollar values are converted to a wage index by taking the ratio of 2001 to 1986 wages, and the change in the log wage gap is approximated by the difference in the logs of the union and nonunion indexes. The change in the wage gap from the Employer Cost Index (ECI) is approximated by difference in the logs of the relative 2001/1986 index values for union and nonunion jobs. Current Population Survey (CPS) log wage calculations are based on CPS union-nonunion mean wage differences in 2001 minus 1986, and on the change between 1986 and 2001 in regression-based union wage gap estimates. The arrows represent movement from the current employment weighted ECEC means to the ECI using fixed-sector weights, and movement from current weighted CPS means to CPS regression estimates with sectoral (and other) controls.

Figure 2a: Union and Nonunion Private ECI Wage Index Values, 1975:3-2001:4 (1989:2=100)

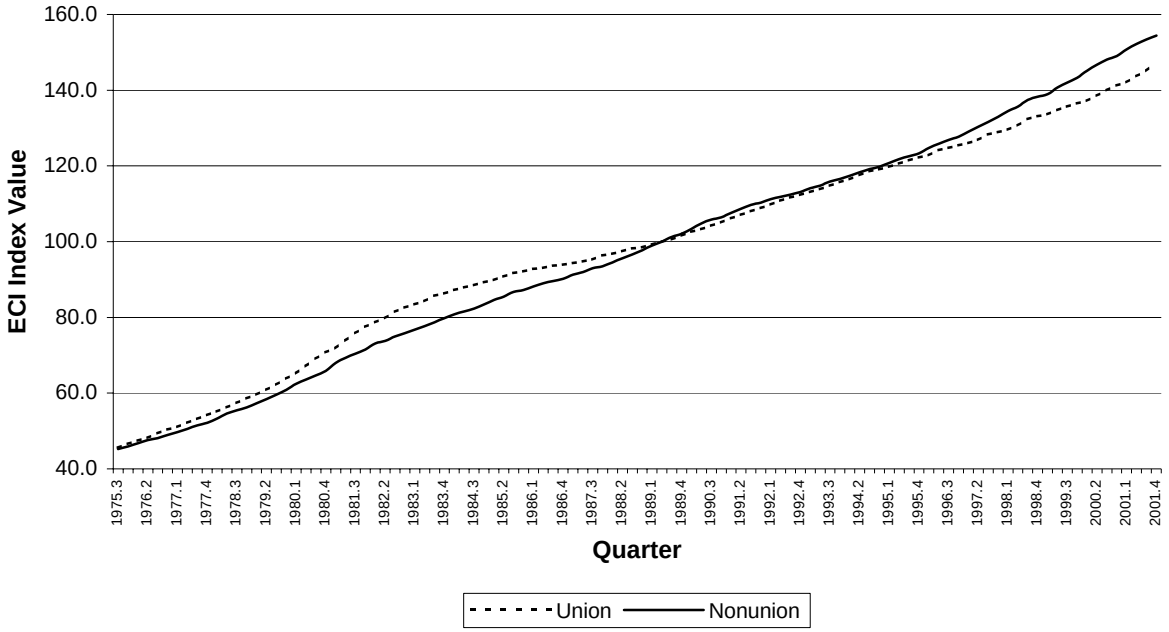
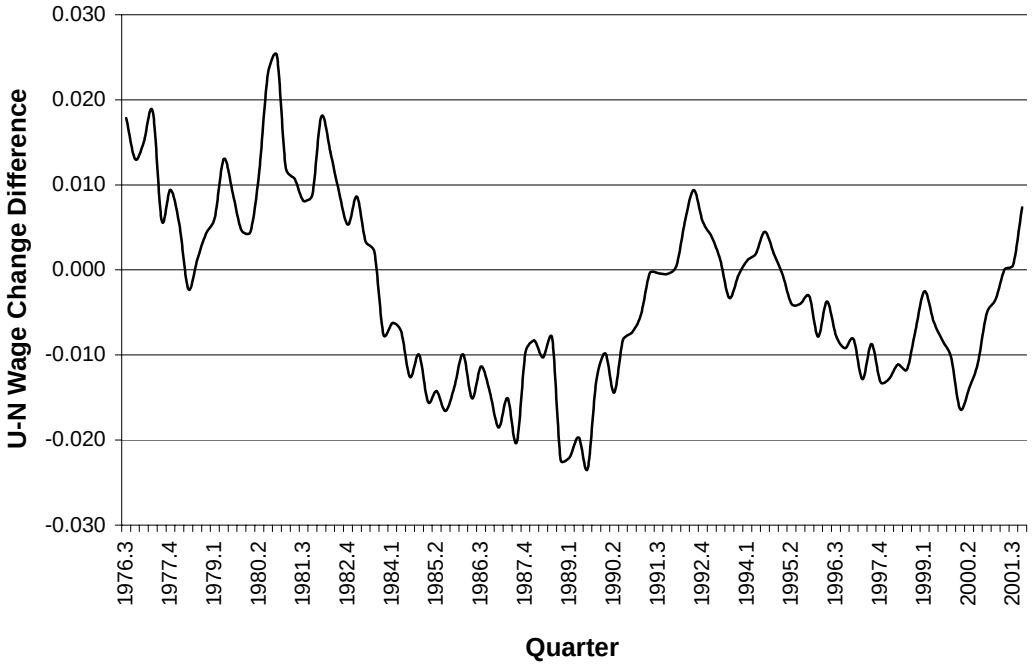
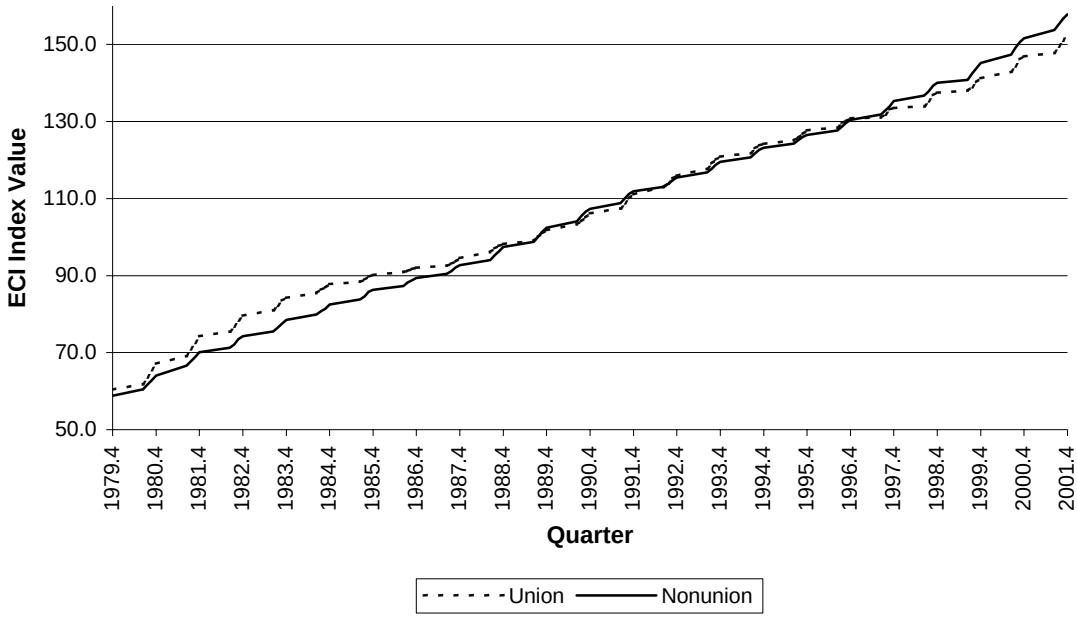


Figure 2b: Union minus Nonunion Private Sector ECI 4-Quarter Wage Changes, 1976:3-2001:4



Notes: ECI Wage index values in Figure 2a are from U.S. Bureau of Labor Statistics, Office of Compensation Levels and Trends, *Employment Cost Index: Historical Listing*, January 31, 2002, Table 7. U-N Wage Change Differences in Figure 2b represent the 4-quarter change in log values for the union ECI index minus the nonunion change. A positive (negative) value represents an increase (decrease) in the union-nonunion wage gap.

Figure 3: Union and Nonunion Private ECI Compensation Index Values, 1979:4-2001:4



Notes: ECI total compensation index values from U.S. Bureau of Labor Statistics, Office of Compensation Levels and Trends, *Employment Cost Index: Historical Listing*, January 31, 2002, Table 4.

Figure 4a: Union and Nonunion ECEC Annual Wage Changes, 1986-2001

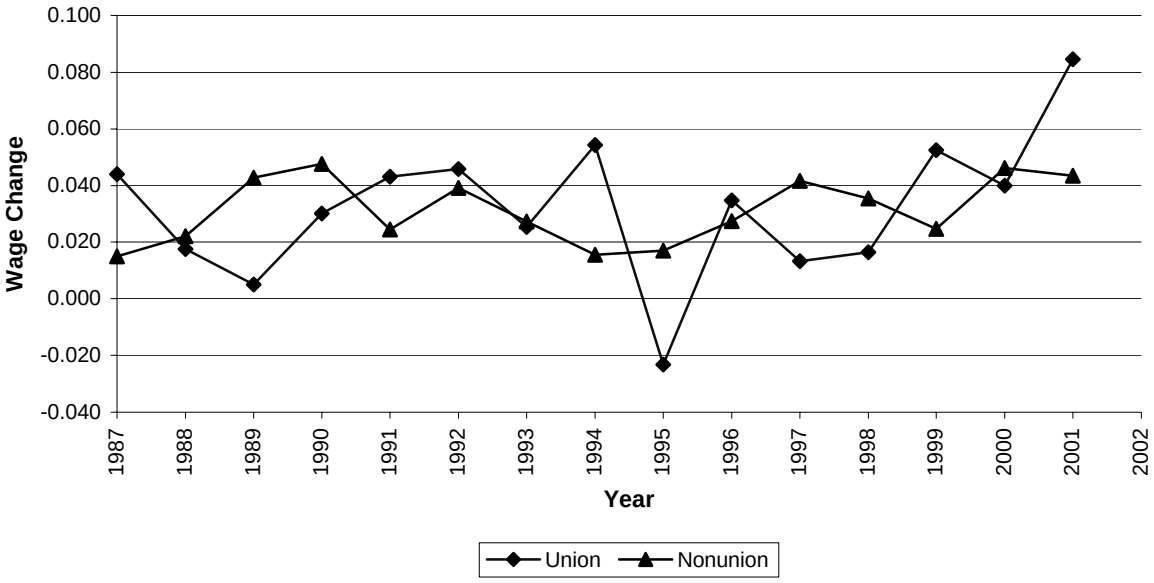
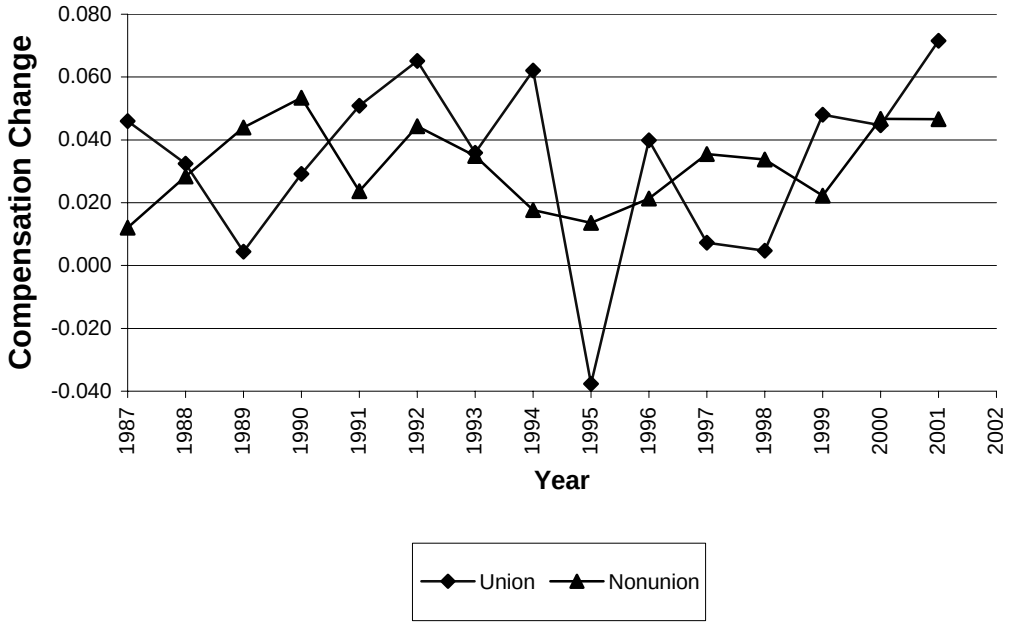
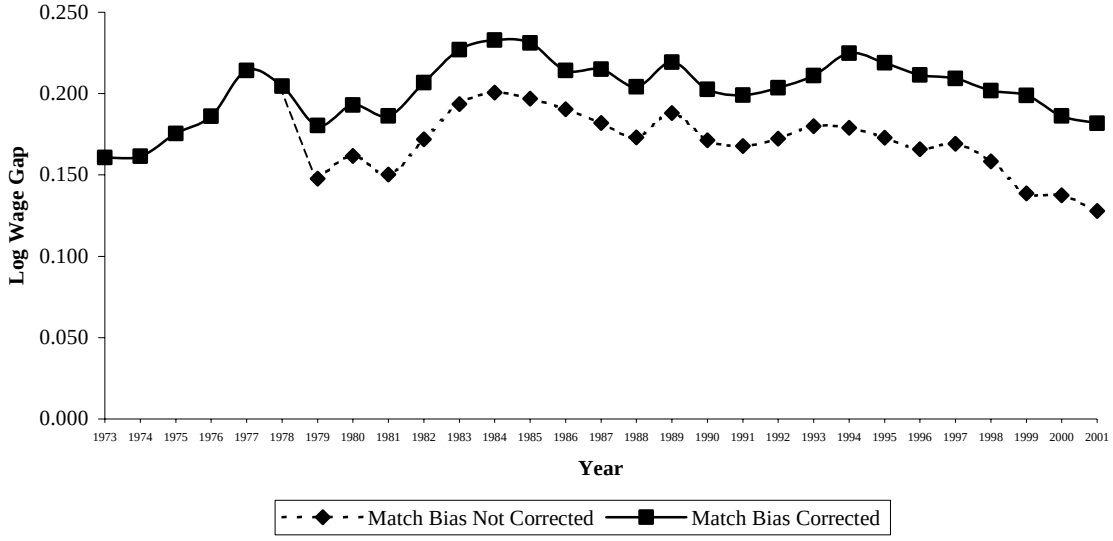


Figure 4b: Union and Nonunion ECEC Annual Compensation Change, 1986-2001



Notes: ECEC mean dollar wage (compensation) values are from U.S. Bureau of Labor Statistics, Office of Compensation Levels and Trends, *Employer Costs for Employee Compensation Historical Listing*, August 29, 2001, Table 5. Wage (compensation) change is an approximate log change, measured by union status as the log of the ratio of year t to year t-1 wages (compensation).

Figure 5: Union-Nonunion Private Sector Wage Premiums: With and Without Match Bias from Earnings Allocation



Notes: Estimated taken from Hirsch and Schumacher (2002a), measuring regression log wage gaps for the private nonagricultural sector, based on 1973-2001 CPS earnings files. See section II-C and footnote 14 for estimation details. The "squared" line corrects for imputation match bias by removing allocated earners in years possible and approximating unbiased gaps in years where allocated earners cannot be reliably identified (1989-95). The "diamonds" represent estimates attenuated by match bias. Researchers who use all valid earnings records in publicly available CPS files would obtain wage gap estimates similar to the "squares" for 1973-78, when CPS files do not include imputed earnings, and the "diamonds" beginning in 1979, when CPS files include imputed earnings values.

Table 1: Private Sector Mean Wages and Union-Nonunion Wage Gap Change, 1986-2001

	Union		Wage Growth	Nonunion		Wage Growth	Union-Nonunion Change in Log
	1986	2001	Index	1986	2001	Index	Wage Gap
Employment Cost Index (ECI)							
Index values (1989:2=100)	93.1	143.7	154.4	89.0	152.2	171.0	-0.102
Employer Costs for Employee Compensation (ECEC)							
Current dollar mean wages, private sector	11.32	18.36	162.2	9.26	14.81	159.9	0.014
Current Population Survey (CPS)							
Current dollar mean wages:							
Full hourly earnings, all private sector	11.09	18.39	165.8	8.51	15.87	186.5	-0.118
Straight-time wage, hourly workers only	10.60	16.72	157.7	6.23	11.09	178.0	-0.121
Full hourly earnings, assuming maximum 40 hours	11.53	19.48	169.0	9.07	17.28	190.5	-0.120
Current dollar mean log wages:			ΔlnW			ΔlnW	
Full hourly earnings, all private sector	2.307	2.787	0.480	1.950	2.552	0.602	-0.122
Straight-time wage, hourly workers only	2.276	2.717	0.442	1.724	2.294	0.570	-0.129
Full hourly earnings, assuming maximum 40 hours	2.339	2.831	0.492	1.995	2.606	0.611	-0.119

Notes: Mean dollar wages are converted to a wage index by taking the ratio of 2001 to 1986 wages times 100. The change in the union-nonunion log wage gap is approximated by the difference in the logs of the indexes. For the CPS log wage calculations, the change in the wage gap is measured by the difference in log wage growth for union and nonunion workers. For the ECI, we report the index values of union and nonunion wages for 1986:2 and 2001:2 (with 1989:2=100). The ECI wage growth index represents the ratio of 2001 to 1986 index values times 100, with the change in the log wage gap approximated by the difference in the log of the index values.

Table 2: Emulating ECI Methods Using the CPS: Union and Nonunion Wage Growth, 1986-2001

Calculation Method	Union Wage Index	Nonunion Wage Index	U-N Log Gap Change
1. Average across I/O cells using 2001 employment weights	163.2	179.1	-0.093
2. Average across I/O cells using 1986 employment weights	161.3	177.7	-0.097
3. Average across I/O cells using 1986 payroll share weights (employment x wages x hours).	161.0	177.4	-0.097
4. Average within I/O cells calculated with worker payroll shares; average across cells with 1986 payroll share weights	166.4	186.4	-0.114
5. Average within I/O cells from CPS panel cell stayers. Wage ratios by year averaged across individuals using worker payroll weights. The ratios are multiplied across years to measure 1986-2001 cell growth. The average growth ratio across cells is calculated using 1986 payroll share weights, as in Line 4.	308.5	412.9	-0.291

Notes: Data sources for Lines 1-4 are the 1986 and 2001 CPS-ORG files. Union and nonunion workers are grouped into 85 broad occupation (5) by industry (17) cells. In Lines 1-3, within-cell means are calculated by the ratio (times 100) of 2001 to 1986 mean wages, where means are calculated using individual employment weights. In Line 4, within-cell means are calculated using individual payroll shares (employment weight times wage time hours worked). Aggregation across the 85 I/O cells is based on 2001 employment in Line 1, 1986 employment in Line 2, and 1986 payroll in Lines 3-4. In Line 5, within-cell wage growth is measured separately among union and nonunion workers who remain in the job cell during adjacent years. Individual workers' wage ratios are calculated for the year pairs 1987-86, 1988-87, …, 2001-00. Cell-specific wage growth for each year pair is averaged using worker payroll weights from the initial year. Each cell's wage growth for 1986-2001 is calculated by multiplying the 15 year-pair ratios. The average across cells, reported in Line 5 for union and nonunion workers, is calculated using 1986 cell payroll share weights from the full sample (as in Line 4) and multiplying by 100. The union-nonunion log gap change is approximated by the difference in the logs of union and nonunion wage growth. Union workers include those who are union members and non-members covered by a collective bargaining agreement.

Table 3: Decomposition of Private Sector Union-Nonunion CPS Wage Change, 1986-2001

Change in total union-nonunion log wage gap	-0.1220
Change due to worker characteristics and payoffs	-0.0198
Change due to sectoral shifts and payoffs	-0.0458
Change in union log wage premium	-0.0564
Estimated union log wage premium: 1986	0.2383
Estimated union log wage premium: 2001	0.1818

Notes: Private sector wage and salary workers, 1986 and 2001 CPS-ORG. Worker characteristics include schooling, experience and its square, gender, race, and marital status. Sectoral variables are part-time, metropolitan area, region (8), occupation (5), and industry (12). Calculation of the decomposition is shown in equations (2) and (3) in the text. Changes attributed to worker characteristics and sector reflect changes over time in relative union-nonunion values times their payoffs (coefficients).

Table 4: Private Sector Union and Nonunion Worker Characteristics, 1973-74, 1986, and 2001

	Union			Nonunion		
	1973-74	1986	2001	1973-74	1986	2001
Wage (current dollars)	5.01	11.09	18.39	4.02	8.51	15.87
Log Wage (current dollars)	1.5205	2.3068	2.7865	1.1824	1.9499	2.5515
Schooling (years completed)	10.99	12.05	12.87	11.94	12.74	13.16
Age	39.38	39.12	41.15	36.35	35.04	37.78
Experience (Age-Schooling-6)	22.39	21.07	22.29	18.42	16.32	18.63
Female	0.206	0.284	0.318	0.439	0.483	0.480
White	0.877	0.833	0.807	0.900	0.881	0.840
African-American	0.110	0.136	0.149	0.086	0.091	0.110
Other Race	0.013	0.031	0.044	0.014	0.028	0.050
Married Spouse Present	0.765	0.674	0.600	0.631	0.556	0.527
Separated, Divorced, Widowed	0.093	0.145	0.173	0.116	0.141	0.156
Never Married	0.143	0.181	0.227	0.252	0.304	0.317
Part-time	0.108	0.082	0.101	0.255	0.215	0.196
Occupations:						
Managers/Professionals	0.044	0.081	0.144	0.189	0.212	0.277
Technicians/Sales/Admin Support	0.136	0.184	0.179	0.345	0.355	0.322
Service	0.059	0.075	0.100	0.146	0.145	0.140
Farming/Forestry/Fishing	0.006	0.005	0.005	0.031	0.022	0.018
Precision Production/Craft and Repair	0.261	0.255	0.253	0.109	0.110	0.102
Operators/Laborers	0.494	0.400	0.319	0.181	0.157	0.141
Industry:						
Agriculture	0.003	0.003	0.003	0.027	0.021	0.018
Mining	0.016	0.013	0.007	0.009	0.010	0.005
Construction	0.103	0.095	0.133	0.050	0.056	0.060
Durable Manufacturing	0.335	0.272	0.179	0.146	0.130	0.102
Nondurable Manufacturing	0.185	0.156	0.105	0.112	0.091	0.066
Transportation, Communication, Utilities	0.160	0.180	0.187	0.047	0.052	0.061
Wholesale Trade	0.027	0.025	0.027	0.056	0.051	0.047
Retail Trade	0.092	0.102	0.103	0.222	0.217	0.213
Finance, Insurance, Real Estate	0.010	0.019	0.021	0.082	0.091	0.081
Business and Repair Services	0.015	0.024	0.033	0.039	0.063	0.097
Personal Services	0.015	0.018	0.020	0.059	0.047	0.037
Entertainment and Recreation	0.007	0.008	0.016	0.010	0.012	0.019
Professional Services	0.031	0.084	0.165	0.141	0.162	0.194
Large Metropolitan Area	0.462	0.393	0.407	0.399	0.336	0.348
Region:						
New England	0.055	0.051	0.046	0.070	0.064	0.053
Middle Atlantic	0.232	0.214	0.207	0.161	0.146	0.129
East North Central	0.283	0.250	0.250	0.184	0.166	0.163
West North Central	0.068	0.074	0.080	0.074	0.073	0.072
South Atlantic	0.086	0.100	0.098	0.172	0.184	0.191
East South Central	0.053	0.050	0.045	0.065	0.058	0.059
West South Central	0.051	0.056	0.052	0.104	0.112	0.112
Mountain	0.029	0.034	0.041	0.044	0.053	0.064
Pacific	0.143	0.172	0.180	0.125	0.142	0.156
Sample Size (Wages, w/o allocated earners)	22,009	19,507	9,441	72,641	112,100	87,981
Sample Size (Total)	26,826	21,710	13,802	90,106	125,967	128,387

Notes: Data are from the 1973-74 May CPS and 1986 and 2001 CPS-ORG files. Employment weights are used to calculate means. The full sample includes all employed private sector wage and salary workers. The wage sample excludes workers with earnings allocated by the Census. Union workers in 1973 include members only; in 1986 and 2001 union includes members plus covered non-members.