# The female-male unemployment differential: effects of changes in industry employment

*In 1982, the civilian jobless rate of men exceeded that of women for the first time since 1947, and industry employment trends suggest that the female unemployment rate may be lower in the future*

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Over time, a significant change in the relationship between male and female unemployment rates has occurred. Between 1970 and 1981, the female unemployment rate averaged 1.5 percentage points higher than the male rate. However, in 1982, the male unemployment rate (9.9 percent) exceeded the female rate (9.4 percent) for the first time since such data were recorded beginning in 1947. This reversal in unemployment rates is the apparent culmination of a narrowing of the differential that began in 1978.[1] (See chart 1.)

Although male unemployment rates generally increase more than female rates during recessions (see the shaded areas in chart 1), the relative worsening experienced by men during the 1981–82 recession was greater than in previous downturns.[2] (And, as noted, the female-male unemployment rate differential began to narrow prior to the recession, which is inconsistent with historical patterns.) Are we witnessing a long-term improvement in the unemployment situation of women relative to men? To what extent are the observed changes due to trends in interindustry growth rates in employment which may favor one sex over the other? This article addresses these questions using a modified version of shift-share analysis (see appendix A) to estimate the effect that change in employment patterns among industries has had on the female-male unemployment rate differential since 1964, and to project likely future effects through 1995.[3] Shift-share analysis is commonly used to disagregate regional employment change in an industry in order to identify the components of that change. The application of shift-share analysis in this article, however, is to disaggregate annual changes in the male-female unemployment differential into three components.

Many researchers have observed the procyclical nature of the female-male unemployment rate differential. Because men tend to be concentrated in those industries which are most sensitive to the business cycle (particularly manufacturing, construction, and mining), it is not surprising that male unemployment rates rise relative to female rates during recessions and fall during recoveries.[4] But industries also change their employment requirements in response to forces other than the business cycle. For example, in recent years, automobile and steel manufacturing employment has experienced a secular decline because of increased foreign competition and laborsaving technological changes. Such longer term trends have an impact on unemployment differentials between men and women.

The effect that the growth (or decline) of a given industry has on the female-male unemployment rate differential depends on several factors, including:

- The rate of growth (or decline) of the industry;
- the percentage of total employment in the industry which is female (or male);

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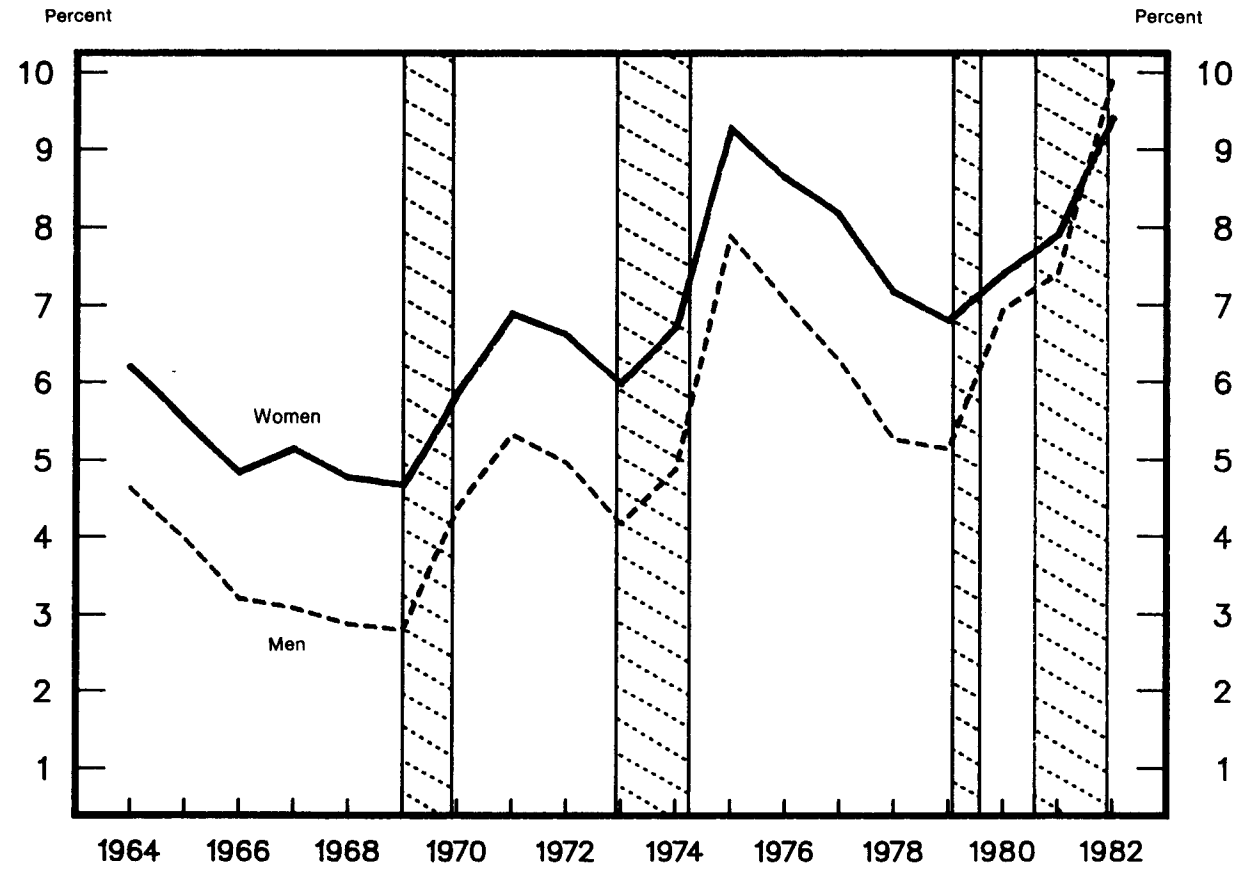
**Chart 1. Unemployment rates for men and women, 1964-82**




NOTE: Shaded areas denote recessions.

- the interindustry mobility of men and women in response to changes in employment opportunities in the industry; and
- the labor force mobility of men and women in response to changes in employment opportunities in the industry.

Information on the first two factors is presented in table 1. It shows the average annual rate of growth of employment in nine broadly defined industries during 1964–82. Clearly, employment grew most rapidly in those industries which employ the highest proportions of women, particularly services, and finance, insurance, and real estate. This trend in industry growth rates has contributed to the narrowing of the female-male unemployment rate differential. However, it is important to note that the mobility of men and women between industries and into and out of the labor force must be "less than perfect" for changes in the industrial composition of employment to have an effect on the unemployment differential. Otherwise, an increase in unemployment in an industry would quickly be offset by the movement of unemployed workers to other industries (interindustry mobility) or by an exit of unemployed workers from the labor force (labor force mobility). Industry growth differentials would then have no direct effect on male and female unemployment rates. With perfect mobility, men who lose their manufacturing jobs would quickly join the growing service industries or drop out of the labor force. Research has shown, however, that unemployed men and women do not exhibit perfect interindustry and labor force mobility.[5]

In sum, it appears that the four factors previously cited would tend to decrease the female-male unemployment rate differential. First, female-dominated service-producing employment is growing faster than male-dominated goods-producing employment. Second, because interindustry and labor force mobility is less than perfect, variations in employment demand will influence unemployment rates. The trend towards slower goods-producing growth rates relative to services implies, then, that the recent reversal in the

**Table 1. Employment and average annual growth rates of employment, by selected industries**

| Industry | 1982 | | Average annual growth rate | | |
|---|---|---|---|---|---|
| | Total employment (in thousands) | Percent female | 1964–82 | 1964–73 | 1973–82 |
| Total | 89,596 | 42.1 | 2.42 | 3.11 | 1.73 |
| Mining | 1,143 | 12.0 | 3.32 | .14 | 6.62 |
| Construction | 3,911 | 8.9 | 1.30 | 3.16 | −.51 |
| Manufacturing | 18,853 | 31.8 | .49 | 1.73 | −.74 |
| Transportation and public utilities | 5,081 | 24.8 | 1.41 | 1.84 | .97 |
| Wholesale and retail trade | 20,401 | 44.3 | 2.92 | 3.52 | 2.31 |
| Finance, insurance, and real estate | 5,340 | 57.1 | 3.43 | 3.73 | 3.13 |
| Services | 19,064 | 62.9 | 4.48 | 4.49 | 4.47 |
| Government | 15,803 | 43.7 | 2.81 | 4.06 | 1.57 |

female-male unemployment rate differential could be the result of secular growth differentials among industries as well as the severe recession.

The following section presents a shift-share technique which is used to measure the effects of relative changes in industry employment on the female-male unemployment rate differential from 1964 to 1982. In a subsequent section, this technique is applied to BLS employment projections to predict how expected future trends in industry employment growth would affect female-male unemployment rate differentials. The appendices develop the methodology in greater detail.

## Components of change in differentials

Shift-share analysis has frequently been used to analyze the sources of regional employment growth, but seldom to disaggregate the components of change in unemployment differentials.[6] (See table 2.) The purpose of the shift-share analysis is to dissect the year-to-year change in the female-male differential into three components: national share effect, industry mix effect, and employment shift effect. The sum of these effects equals the total change in the unemployment differential. The analysis starts with very restrictive assumptions regarding labor force and interindustry employment trends and proceeds to relax these assumptions one at a time.

*National share effect.* This effect is computed by assuming that male and female employment in each industry changes at the same rate as total national employment. The male and female labor forces are each assumed to grow at the same rate as the total labor force. The national share effect shows how the female-male unemployment rate differential would have changed from year to year if: (1) the proportion of men and women in each industry remained unchanged, (2) the proportion of men and women in the labor force remained unchanged, (3) the share of each industry's employment in total employment was constant, and (4) total employment and the labor force grew at their actual rates.

Under these assumptions, male and female employment and labor forces change at the same rate. Because the unemployment rate is defined as:

$$1 - \frac{\text{number employed}}{\text{number in labor force}},$$

this results in proportionate changes in male and female unemployment rates. The national share effect on the female-male differential is thus procyclical but trivial in magnitude.

*Industry mix effect.* To calculate the industry mix effect, the assumption that each industry grows at the national rate is dropped. Employment in each industry is postulated to grow at its actual rate, but it is assumed that the proportion of men and women employed in each industry remains the same as in the *previous* period. If employment in female-dominated industries is growing faster than employment in male-dominated industries, as appears indicated in table 1, the industry mix effect will reduce the unemployment rate of women relative to that of men.

When employment increases in an industry, the additional workers will be drawn into employment from the ranks of the unemployed and from outside the labor force. Therefore, an assumption is needed about how this effect changes the labor force. It is assumed that men and women who "enter" employment as a result of the industry mix effect come from the unemployment pool and from outside the labor force in the same proportions as they actually did during the previous year. Similarly, when the industry mix effect causes a decrease in employment, it is assumed that men and women who exit employment leave the labor force or become unemployed in the same proportions as they actually did during the previous year. (This procedure is discussed in detail in

**Table 2. Shift-share analysis of female-male unemployment differentials, 1964–82**

| Year | Female rate | Male rate | Female-male differential | Change in differential | Shift-share effects | | |
|---|---|---|---|---|---|---|---|
| | | | | | National share effect | Industry mix effect | Employment shift effect |
| 1964 | 6.22 | 4.62 | 1.60 | — | — | — | — |
| 1965 | 5.54 | 3.97 | 1.57 | −.03 | .017 | .046 | −.086 |
| 1966 | 4.85 | 3.20 | 1.64 | .07 | .012 | .106 | −.043 |
| 1967 | 5.17 | 3.08 | 2.09 | .45 | −.009 | −.153 | .603 |
| 1968 | 4.78 | 2.87 | 1.92 | −.17 | .006 | −.061 | −.123 |
| 1969 | 4.68 | 2.79 | 1.89 | −.03 | −.004 | −.001 | −.022 |
| 1970 | 5.88 | 4.37 | 1.51 | −.38 | −.033 | −.296 | −.049 |
| 1971 | 6.91 | 5.34 | 1.56 | .05 | −.011 | −.256 | .322 |
| 1972 | 6.64 | 4.96 | 1.67 | .11 | .001 | −.039 | .142 |
| 1973 | 6.00 | 4.17 | 1.84 | .17 | .015 | .075 | .074 |
| 1974 | 6.74 | 4.87 | 1.88 | .04 | −.017 | −.242 | .300 |
| 1975 | 9.30 | 7.89 | 1.41 | −.47 | −.061 | −.849 | .444 |
| 1976 | 8.64 | 7.06 | 1.58 | .17 | .012 | −.092 | .246 |
| 1977 | 8.18 | 6.28 | 1.90 | .32 | .007 | .023 | .297 |
| 1978 | 7.18 | 5.27 | 1.91 | .01 | .018 | .035 | −.042 |
| 1979 | 6.82 | 5.14 | 1.68 | −.23 | .006 | .030 | −.265 |
| 1980 | 7.41 | 6.94 | 0.47 | −1.21 | −.027 | −.412 | −.780 |
| 1981 | 7.92 | 7.39 | 0.53 | .06 | −.008 | −.259 | .332 |
| 1982 | 9.42 | 9.89 | −0.47 | −1.00 | −.014 | −.558 | −.521 |

appendix A.) It is also assumed, in the computation of the interindustry effect, that there is no net interindustry mobility of labor.

The industry mix effect shows how differing industry growth rates affect the female-male unemployment rate differential when there are different percentages of men and women in each industry. (See table 2.) When the effect is negative, female-dominated industries are growing faster (or declining less) than male-dominated industries, reducing the female-male unemployment rate differential. When the effect is positive, male-dominated industries are growing faster (or declining less) than female-dominated industries, thereby increasing the differential.

The industry mix effect appears to have both a cyclical component and a secular trend.[7] The cyclical component is suggested by the industry mix effect always being negative during recessions (for example, 1970–71, 1974–75, and 1981–82) and positive only during expansions. This is because employment is more cyclically variable in male-dominated industries than in those which are female-dominated. For example, the three industries that are most sensitive to the business cycle (mining, construction, and manufacturing) are very much male-dominated. (See table 1.)

The industry mix effect shows smaller positive changes in each successive expansion and generally larger negative changes in each successive recession, which suggests that there may be a long-term trend which lowers female unemployment rates relative to male rates. (See table 2.) To determine whether there is a significant trend in the industry mix effect which is independent of the business cycle, a regression equation was estimated for the 1964–82 period which predicts the impact of the business cycle (as measured by the help-wanted advertising index) and trend variables on changes in the industry mix effect over time.[8] The regression results presented in appendix B, show that the trend and the business cycle were both highly significant predictors of change. After controlling for cyclical effects, the female-male differential declined on average by about 0.2 percentage points per year. These results indicate that the differential employment growth rates of industries have tended to favor female-dominated industries and that this has caused a narrowing in the female-male unemployment rate differential, even after accounting for the short-term effects of the business cycle.

*Employment shift effect.* This effect is the change in the male-female unemployment differential that remains after accounting for the national share and industry mix effects. Two factors determine the sign and the magnitude of this effect. The first is the difference in the rates of growth in the male and female labor force. The fact that the female labor force has been expanding more rapidly than the male labor force tends to cause unemployment rates of women to be greater than those of men. The second factor which determines the employment shift effect is the change in the male-female employment composition within industries. If an industry increases the proportion of women it employs, the unemployment rate of women will decrease relative to that of men. The following tabulation presents the proportion of women employed in each industry during 1964 and 1982 and the average annual percentage change in that proportion. These data show significant differences among industries in the rates at which the proportions of female employment have increased.

| *Industry* | *Percent female* | | *Average annual percent change* |
|---|---|---|---|
| | *1964* | *1982* | |
| Total | 33.7 | 42.1 | 1.24 |
| Mining | 9.3 | 12.0 | 1.43 |
| Construction | 4.9 | 8.9 | 3.37 |
| Manufacturing | 26.3 | 31.8 | 1.06 |
| Transportation and public utilities | 18.3 | 24.8 | 1.70 |
| Wholesale and retail trade | 38.0 | 44.3 | .86 |
| Finance, insurance, and real estate | 50.3 | 57.1 | .71 |
| Services | 51.0 | 62.9 | 1.17 |
| Government | 38.7 | 43.7 | .68 |

The employment shift effect can be thought of as representing the ability of industries to respond to changes in labor force participation rates of men and women by altering the distribution of their employment between sexes. Perfect accommodation to changes in labor force participation would result in an employment shift effect which equals zero. However, if the share of female employment within industries does not rise by enough to accommodate the increase in female labor force participation, the employment shift effect would be positive. This would tend to increase female unemployment rates relative to the male rate. And finally, where the share of female employment in the industry advances by more than enough to accommodate the increase in female labor force participation, the employment shift effect would be negative. This would tend to decrease the female unemployment rate relative to the male rate.

We note that the employment shift does not exhibit the same kind of cyclical behavior as the industry mix effect. For example, during the 1970–71 and 1974–75 recessions, the employment shift effect favored men, but during the 1980 and 1981–82 recessionary period it favored women. (See table 2.) This is a potentially important development because it may represent a change in the ability and willingness of individual industries to absorb women into employment. Regression results show, however, that on average, during the 1964–82 period, the employment shift effect shows no significant trend or cyclical response. (See appendix B.)

In recent years (1979–82), all three effects—the national share effect, industry mix effect, and employment shift effect—contributed to reducing the female-male unemployment rate differential. The industry mix effect

**Table 3. Projected average annual rates of change in employment by selected industry, 1982–90 and 1982–95**

| Industry | 1982 | 1982–90 | | | 1982–95 | | |
|---|---|---|---|---|---|---|---|
| | Percent female | Low | Moderate | High | Low | Moderate | High |
| Total | 42.1 | 1.7 | 1.8 | 1.9 | 1.6 | 1.7 | 1.9 |
| Farm | 19.5 | −.8 | −.7 | −.6 | −.9 | −.9 | −.6 |
| Mining | 12.0 | .6 | .7 | .3 | 1.0 | 1.2 | 1.0 |
| Construction | 8.9 | 3.1 | 3.0 | 3.2 | 2.7 | 2.9 | 2.9 |
| Manufacturing | 31.8 | 1.5 | 1.8 | 2.1 | 1.4 | 1.5 | 1.8 |
| Transportation and public utilities | 24.8 | 1.3 | 1.4 | 1.6 | 1.2 | 1.4 | 1.5 |
| Wholesale and retail trade | 44.3 | 1.7 | 2.0 | 2.1 | 1.6 | 1.8 | 1.9 |
| Finance, insurance, and real estate | 57.1 | 2.2 | 2.4 | 1.5 | 2.0 | 2.1 | 2.2 |
| Services | 62.9 | 2.5 | 2.6 | 2.8 | 2.4 | 2.5 | 2.8 |
| Government | 43.7 | .8 | .7 | 1.0 | .6 | .7 | .9 |

indicates that, as in previous recessions, the 1980 and 1981–82 downturns affected male-dominated industries more severely than female-dominated ones. But there is also a trend in the industry mix effect independent of the business cycle. This means that long-term industry-specific employment trends have favored women's employment because of their greater concentration in those industries with the highest long-term growth rates. Finally, an examination of the employment shift effect shows that since 1979 many industries more readily employed women entering the work force, but that there has been no such long-term trend.

## Employment projections

Will employment trends continue to improve the unemployment situation of women relative to men? The preceding analysis suggests that this will depend to a large extent on the future growth rates of female- versus male-dominated industries. The Bureau of Labor Statistics projections of employment by industry make it possible to analyze the probable impact of the industry mix effect on the future of the female-male unemployment differential.[9] Table 3 presents the average annual rates of change in projected employment between 1982 and 1990 and between 1990 and 1995. The BLS made three sets of projections for each time frame: the first assumes low rates of economic growth; the second, moderate growth rates; and the third, high growth rates. Valerie A. Personick describes the moderate growth scenario as follows:

> This case is marked by a period of recovery from the 1982 recession, followed by stable economic growth through the mid-1990's. The civilian unemployment rate, which was 9.7 percent in 1982, is projected to fall to 6.3 percent by 1995. Total employment is expected to rise from 102.3 million in 1982 to 127.6 million by 1995, a gain of more than 25 million new jobs. Growth is projected to be faster in the earlier years, as industries rebound from the recent economic downturn. Employment, which expanded by 3.6 percent a year between 1975 and 1979, showed very few gains during the business slump of 1980 or the brief recovery period thereafter. The more severe recession of 1981–82 brought an additional 1.3-percent decline in total jobs. Employment is projected to rebound, averaging growth of 1.8 percent a year from 1982 to 1990, then slow to 1.5 percent annually through 1995.[10]

Table 3 shows significant differences in projected employment growth rates among industries under each of the three growth scenarios. It also indicates that, except for the construction industry, women are currently overrepresented in the high-growth-rate industries (for example, services and finance, insurance, and real estate). Women represent only 25.5 percent of total employment in the five industries which are projected in the moderate scenario to grow by 13.2 percent between 1982 and 1990. However, women constitute 51.6 percent of employment in the four service-oriented industries projected to increase by 18.9 percent. It appears that future trends in employment will continue to favor a reduction of the unemployment rates of women relative to men's.

What are the implications of these trends for the female-male unemployment rate differential? The following tabulation presents the results of a partial shift-share analysis of changes in female-male unemployment rate differentials which would occur between 1982 and 1990 and between 1982 and 1995 under each of the three economic growth scenarios:

| *Period* | *Growth scenario* | *National growth effect* | *Industry mix effect* |
|---|---|---|---|
| 1982–90 | Low | −0.017 | −2.077 |
| | Moderate | −0.018 | −2.103 |
| | High | −0.022 | −1.986 |
| 1982–95 | Low | −0.015 | −2.419 |
| | Moderate | −0.109 | −2.369 |
| | High | −0.023 | −2.456 |

Because BLS does not project male and female employment by industry, it is possible to calculate only the industry mix effect. Its computation assumes that employment in each industry grows at its projected rate and that the proportions of men and women in each industry remain at the 1982 levels.[11] Also, male and female labor force entry and exit patterns are assumed identical to those of 1982. Under these assumptions, the female unemployment rate would decrease by about 2 percentage points relative to the male rate between 1982 and 1990 and would decrease by approximately 2.4 percentage points between 1982 and 1995. The industry mix effect would continue its 1964–82 trend, exerting downward pressure on the female-male unemployment rate differential by about 0.2 percentage points per year.

It should be noted that the impact of the changing industry mix on the differential is likely to be modified by several factors which are not measured in the partial shift-share analysis. First, the BLS projections of employment growth between 1982 and 1995 do not allow for cyclical variation, apart from the current recovery. The results for 1964–82 imply that the industry mix effect is strongly affected by the business cycle, and thus the results reported in the tabulation represent only the *trend* component of this effect. There will undoubtedly be substantial year-to-year cyclical variation in the female-male unemployment differential during 1982–95. Second, male interindustry mobility may increase over past rates as the relative secular decline in goods-producing

industries continues. Men may increase their employment share in the rapidly growing industries, decreasing their projected unemployment rate. Third, female labor force participation rates will continue to rise during the next decade, and women's attachment to the labor force has also been increasing.[12] These factors would tend to boost female unemployment rates over their industry mix levels. Both of these trends—the possible rise in the male share of rapidly growing industries, and the continuing increase in the female participation rate—would be reflected in a positive employment shift effect over the 1982–95 period.

Still, the projected relative secular decline in goods producing industries will tend to increase the male unemployment rate relative to the female rate at least in the near term. There is no recent evidence that the employment shift effect will offset this negative industry mix effect. On the contrary, in 4 of the 5 years since 1978, the employment shift has been negative. The most plausible scenario for the female-male unemployment rate differential is for the male rate to drop below the female rate during the current cyclical recovery, and for the female rate to again be lower than the male rate in the next recession. Beyond that, it seems likely that the female rate will remain below the male rate well into the 1990's. □

*FOOTNOTES*

[1] The female unemployment rate continued to be less than the male rate in 1983. The rate for men was 9.9 percent; for women, 9.2 percent.

[2] See, for example, Nancy S. Barrett and Richard D. Morgenstern, "Why Do Blacks and Women Have High Unemployment Rates?" *Journal of Human Resources*, Fall 1974, pp. 452–64; Janet L. Johnson, "Sex Differentials in Unemployment Rates: A Case for No Concern," *Journal of Political Economy*, pp. 293–303; Deborah P. Klein, "Trends in employment and unemployment in families," *Monthly Labor Review*, December 1983, pp. 21–25; Joyanna Moy, "Recent labor market developments in the U.S. and nine other countries," *Monthly Labor Review*, January 1984, pp. 44–51; "The Female-Male Differential in Unemployment Rates," *Industrial and Labor Relations Review*, April 1974, pp. 331–50; Beth Niemi, "Geographic Immobility and Labor Force Mobility: A Study of Female Unemployment," in Cynthia B. Lloyd, ed., *Sex, Discrimination and the Division of Labor* (New York, Columbia University Press, 1975), pp. 61–89; Beth Niemi, "Recent Changes in Differential Unemployment," *Growth and Change*, July 1977, pp. 22–30; and Sigurd R. Nilsen, "Recessionary impacts on the unemployment of men and women," *Monthly Labor Review*, May 1984, pp. 21–25.

[3] The year 1964 was chosen as the starting point because it was the first year that male and female unemployment rates were reported for several of the industries included in the analysis.

[4] Nilsen found that the increase in the male unemployment rate relative to the female rate was especially pronounced during the 1980–82 downturn largely because male-dominated industries were particularly hard hit. See Sigurd R. Nilsen, "Recessionary impacts."

[5] See, for example, Niemi, "Geographic Immobility," pp. 72–79.

[6] A technique similar to shift-share analysis was recently employed in this journal by Sigurd R. Nilsen (see footnote 2) to explain changes in male and female unemployment differentials between 1975 and 1982. One difference between his methods and those applied in this article is that we focus on trends in the distribution of employment between industries to explain trends in male and female unemployment rates, while Nilsen focuses on the effects that changes in the labor force and in industry-specific unemployment rates have on male and female unemployment rates.

For a detailed description of shift-share analysis and a discussion of its strengths and weaknesses, see Benjamin H. Stevens and Craig L. Moore, "A Critical Review of the Literature on Shift-Share as a Forecasting Technique," *Journal of Regional Science*, November 1980, pp. 419–37.

[7] The Bureau of Labor Statistics' establishment survey data is used to measure employment by industry. Total employment and labor force data come from the Current Population Survey (households), so there is a problem of data compatibility. The household employment total is larger than the establishment total, as the former includes self-employed persons and agricultural workers, among others. These additional employees were treated as an "industry" in the shift-share analysis. For a detailed discussion of the household-establishment employment difference, see Alexander Korns, "Cyclical Fluctuations in the Difference Between the Payroll and Household Measures of Employment," *Survey of Current Business*, May 1979, pp. 14–44.

[8] The regression equation estimated is: $\Delta$ Effect $= a + b_1(\Delta \text{Help} - \text{Wanted}) + b_2(\text{Trend})$, where "$\Delta$ Effect" is the change in the industry mix effect from one year to the next; "Help – Wanted" is the change in the help-wanted advertising index; and "Trend" is the linear trend.

[9] For a discussion of the Bureau of Labor Statistics' industry employment projections for 1990 and 1995, see Valerie A. Personick, "The job outlook through 1995: industry output and employment projections," *Monthly Labor Review*, November 1983, pp. 24–35. For a methodological discussion of the projections, see Howard N Fullerton, Jr. and John Tschetter, "The 1995 labor force: a second look," *Monthly Labor Review*, November 1983, pp. 3–10. Male and female employment for 1982 was determined from the household and establishment surveys.

[10] "The job outlook," p. 25.

[11] Male and female employment was calculated using the Bureau of Labor Statistics' Current Establishment Survey and Current Population Survey data by sex for wage and salary and nonwage and salary employees. The female-male proportions from the Current Population Survey were used for private household employment.

[12] For example, Ronald G. Ehrenberg has shown that increasing adult female unemployment rates over the 1967–77 period were due, in part, to the decreasing likelihood of leaving unemployment by exiting the labor force. See Ronald G. Ehrenberg, "The Demographic Structure of Unemployment Rates and Labor Market Transition Probabilities," in Ronald G. Ehrenberg, ed., *Research in Labor Economics: Volume 3* (Greenwich, Conn., JAI Press, Inc., 1980), p. 258.

## APPENDIX A: Shift-share equations

This appendix develops the equations used to compute the national share, industry mix, and employment shift effects.

The total female-male unemployment rate differential in time $t$ is:

$$d_t = u_t^f - u_t^m$$

where $u_t^f$ = the female ($f$) unemployment rate at time $t$; and

$u_t^m$ = the male ($m$) unemployment rate at time $t$.

The purpose of the shift-share analysis is to explain the change in this differential from one period to the next (that is, $d_t - d_{t-1}$). The shift-share analysis decomposes this

change into three parts: the national share effect, the industry mix effect, and the employment shift effect.

*National share effect.* This effect assumes that employment for men and women in each industry changes at the national rate for total employment. Similarly, the male and female labor force is assumed to change at the national rate for the total labor force. Let:

$$(1) \qquad u^s_{tN} = 1 - \frac{E^s_{t-1}\left(\frac{E_t}{E_{t-1}}\right)}{L^s_{t-1}\left(\frac{L_t}{L_{t-1}}\right)}$$

where $u^s_{tN}$ = the national share ($N$) unemployment rate for females ($s=f$) or males ($s=m$) for time $t$;

$E^s_{t-1}$ = employment for females ($s=f$) or males ($s=m$) for time $t-1$;

$L^s_{t-1}$ = female ($s=f$) or male ($s=m$) labor force for time $t-1$.

The terms in parentheses represent the rate of change in total employment and the labor force from the preceding year. The national share female-male unemployment rate differential is:

$$d_{tN} = u^f_{tN} - u^m_{tN}$$

The national share effect is the change in the female-male unemployment rate differential from the previous year that results from national labor force and employment changes:

$$\text{national share effect} = d_tN - d_{t-1}.$$

*Industry mix effect.* This is the effect on the female-male unemployment rate differential of allowing employment in each industry to grow at its actual rate while assuming that the proportions of men and women in each industry remain constant. This can be stated in equation form as:

$$E^s_{tI} = \sum_{j=1}^{n} E^s_{jt-1}\ \frac{E_{jt}}{E_{jt-1}}$$

where $E^s_{tI}$ = industry mix employment for females ($s=f$) or males ($s=m$) at time $t$; and

$E^s_{jt-1}$ = female or male employment in industry $j$ ($j=1$ to $n$) at time $t-1$.

When the industry mix assumption is introduced, the measure of employment by sex changes by:

$$\Delta E^s_t = E^s_{tI} - E^s_{tN}$$

where $E^s_{tN}$ is the national share employment by sex, which is the numerator of equation 1.

The next step in developing the industry mix effect is to establish an assumption governing how this employment change will affect the labor force. When $\Delta E^s_t$ is positive, it is assumed that some of these "new" employees come from outside of the labor force and that the remainder come from the pool of the unemployed. The proportion of new employees that come from outside the labor force is assumed to be the proportion of the actual gross employment increase for each year, by sex, which came from outside the labor force. These proportions are calculated from the Annual Employment Status Gross Change tables available from the Bureau of Labor Statistics. The industrial mix labor force is:

$$L^s_{tI} = L^s_{tN} + \pi\Delta E^s_t$$

where $L^s_{tN}$ = the national share labor force by sex, which is the denominator of equation 1; and

$\pi$ = the appropriate labor force proportion.

When $\Delta E^s_t$ is negative, the labor force proportion $\pi$ is the probability of moving from unemployment to out of the labor force.

The industry mix unemployment rate is:

$$u^s_{tI} = 1 - \frac{E^s_{tI}}{L^s_{tI}}$$

where $u^s_{tI}$ is the industrial mix unemployment rate for women or men in time $t$. The industry mix differential is:

$$d_{tI} = u^f_{tI} - u^m_{tI}$$

and the industry mix effect is $d_{tI} - d_{tN}$.

The industry mix effect is thus the change in the female-male unemployment rate differential caused by the introduction of the actual industry growth rate assumption.

*Employment shift effect.* The employment shift effect is that part of the year-to-year change in the female-male unemployment rate differential which is not explained by either the national share or industry mix effects. The actual differential in year $t$ is:

$$d_t = u^f_t - u^m_t$$

so the employment shift effect is $d_t - d_{tI}$.

Note that the sum of the three effects equals the total annual change in the actual female-male unemployment rate differential, that is:

$$d_t - d_{t-1} = (d_t - d_{tI}) + (d_{tI} - d_{tN}) + (d_{tN} - d_{t-1}).$$

## APPENDIX B: Regression results

Table A–1 presents the results of a regression analysis in which each of the three shift-share effects is regressed on a linear trend variable and a variable representing cyclical change. The variable chosen to represent cyclical change is

**Table A–1. Time series regressions for the three shift-share effects[1]**

| Variable | National share effect | Industry mix effect | Employment shift effect |
|---|---|---|---|
| Intercept | −0.0055 | −0.1718 | 0.0498 |
| | (−2.14) | (−6.09) | (0.62) |
| Help-wanted | 0.0839 | 0.9947 | 0.1055 |
| | (6.45) | (7.00) | (0.26) |
| Trend | 0.0002 | −0.0061 | −0.0160 |
| | (0.36) | (−1.08) | (−0.99) |
| $\bar{R}^2$ | .713 | .774 | .042 |
| F test[2] | 22.15 | 30.02 | 0.66 |
| DW | 1.89 | 2.01 | 2.00 |

[1]The t ratios are in parentheses. Critical t value with 15 degrees of freedom at the 95-percent confidence level = 2.13.

[2]Critical F with 15 degrees of freedom at the 95-percent confidence level = 3.68.

the index of the help-wanted advertising in newspapers in first difference form. Because the dependent variables are also first differences, the intercept may be interpreted as the coefficient on a linear trend and the coefficient of the trend variable can be interpreted in the same way as the coefficient of a trend-squared variable in a regular time series regression. If there is a long-term trend in the female-male unemployment rate differential caused by any of the three shift-share effects, its intercept coefficient will be statistically significant. Therefore, in table A–1, the intercept represents the average annual change in the shift-share effect, while the trend coefficient measures the presence of acceleration or deceleration in this annual change.

The national share effect shows both a significant negative annual change (that is, intercept) and a significant positive response to the business cycle, but the magnitude of this effect is trivial. The industry mix effect is of greater interest. The intercept indicates a significant negative trend in the female-male unemployment rate differential. Apart from any cyclical effect, this differential narrows by about 0.2 percentage points per year. Because this trend appears in the industry mix regression and because there are no quantitatively important trends in either of the other effects, the cause of the narrowing unemployment differential is the relatively rapid growth of employment in female-dominated industries. This is the most important result of our study. As expected, the industry mix differential varies procyclically. This is indicated by the positive and significant coefficient on the help-wanted variable. In all of the regressions, the trend coefficient indicates no significant acceleration or deceleration in the year-to-year change of the differential. Finally, the employment shift regression shows that there is no significant trend or cyclical response in the employment shift effect.