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2 **Metropolitan Wage Differentials: Can Cleveland Still Compete?** How high are Cleveland's wages, relative to those in other cities, when differences in worker skills are held constant? Skill-adjusted wage differentials for 44 cities show that Cleveland's wages are higher than the national average, but lower than in some "fast-growth" cities. In addition, wage differentials for Cleveland and other cities have narrowed substantially in the last decade.

9 **The Effects of Supplemental Income and Labor Productivity on Metropolitan Labor Cost Differentials.** Author Thomas F. Luce examines the effects that a combination of supplemental income and labor productivity have on the measurement of metropolitan labor-cost differentials in manufacturing. Using data for the 20 largest Standard Metropolitan Statistical Areas (SMSAs), he finds that controlling for these factors increases the measured labor-cost differentials among these SMSAs. He also finds that the data do not support the proposition that higher-than-average wage rates are associated with greater-than-average labor productivity.

17 **Reducing Risk in Wire Transfer Systems.** Wire transfer provides an efficient electronic method for moving huge sums of money—sometimes as much as $500 billion per day—in the nation's payment system. Some users have come to rely on daylight credit generated by wire transfer systems. This practice creates risk for those extending credit as well as a systemic risk of disrupting worldwide financial markets. Author E.J. Stevens discusses wire transfer systems, a new Federal Reserve Board of Governors' risk control policy, and some institutional changes that might be expected to reduce risk in this policy environment.

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Metropolitan Wage Differentials: Can Cleveland Still Compete?

by Randall W. Eberts and Joe A. Stone

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Introduction

Labor costs are often cited as one of the primary reasons for the economic hardships plaguing many older industrial cities, such as Cleveland. Of course, other factors, such as local taxes, proximity to markets, product cycles, and energy costs may also contribute to the area's diminished ability to compete with other regions in attracting and retaining businesses. Nonetheless, since labor costs represent an important part of total production costs, the initial presence of significant wage differentials among metropolitan areas may have been a major factor in the economic expansion of Sunbelt cities and the relative decline of Snowbelt cities. In turn, divergent patterns of growth resulting partly from firms relocating in low-wage areas may have caused wage levels to converge.

With respect to the effect of differential labor costs on firm location and on regional employment growth, two aspects of labor costs must be considered. First, there is more to examining labor cost differentials across regions than simply looking at regional differences in wage rates. Firms consider not only the amount they pay workers, but also the productivity of their workers. Stated simply, an employer is willing to pay a worker in Cleveland a higher hourly wage than a worker in Atlanta, for example, if the Cleveland worker is more productive than the Atlanta worker. Therefore, a comparison of regional wage differentials is much more meaningful when these wages are adjusted for differences in worker skills.

Second, the advantage to a firm in searching for a low-wage area is directly proportional to the degree of regional dispersion in labor costs. A large regional variation in labor costs would make it advantageous for firms to search for low-wage areas, since the relative cost savings would be sizable. On the other hand, if wage differentials, adjusted for worker skills, are observed to converge over time, then the competitive disadvantage of relatively high-wage areas, such as Cleveland, would diminish over time.

The purpose of this paper is threefold: to provide estimates of variations across metropolitan areas in the wage employers pay a worker of given skills and training, to compare these "skill-adjusted wage differentials with observed differentials, and to examine how these differentials may have changed over the past decade. The Cleveland metropolitan labor market is used as a point of comparison to highlight how labor costs in a major industrial city in the Fourth Federal Reserve District fare with respect to other U. S. cities.

I. Theoretical Framework

Metropolitan areas in the United States are characterized by many firms that act as price-takers when they sell to national markets and that consider the rental prices of capital to be fixed by external conditions (see Borts and Stein [1964]; and Muth [1968 and 1983]). This demand-side interpretation of regional labor markets fixes local nominal wages by the horizontal labor demand curve of firms competing in national or interna-

tional product markets. Long-run equilibrium levels of local wages are determined by the demand for labor, under the technical condition that the level of output changes in constant proportion to changes in labor and capital. Shifts in labor supply have no long-run effect on local nominal wages in this model, but supply changes do cause changes in total employment and eventually in total population. Of course, other influences on local wages are possible in short-run disequilibrium and even in long-run equilibrium, if local products are relatively unique or sold in geographically limited markets, if local natural resources are a significant input into the production of exportable goods, or if any of the other conditions of the demand-side model above are violated. Johnson (1983) provides an extensive theoretical and empirical analysis of many of these factors, including local costs of living, environmental amenities important to workers, taxes, income transfers, moving costs, unionization, transportation costs, discrimination, and various human capital and skill variables. Most of the previous studies of geographical wage differentials have allowed a dominant role for labor supply in determining local wages (see Coelho and Ghali [1971]; Bellante [1979]; Sahling and Smith [1983]; Scully [1969]; and Johnson [1983]).

Estimates **of Wage Equations for** 1974 and 1983 ***(Current*** Population ***Survey*** data)

Variable	1974	1983
Intercept	1.26 (39.08)	1.58 (115.27)
Schooling	0.12 (9.15)	0.13 (30.70)
Schooling squared	0.007 (2.17)	0.004 (3.18)
Potential experience	0.024 (31.39)	0.026 (114.22)
Potential experience squared	-0.0004 (-25.05)	-0.0004 (-86.03)
Employment status (full-time = 1)	0.14 (14.25)	0.16 (58.34)
Gender (female = 1)	-0.31 (-35.15)	-0.23 (-96.52)
Race (nonwhite = 1)	-0.05 (-3.90)	-0.02 (-6.82)
Occupation dummy variables (omitted for brevity)	————	————
R-square	0.49	0.49
Number of observations	13,733	175,268

NOTES: Coefficients are followed by t-statistics in parentheses. The 1983 regression also contains quarterly dummy variables to control for variations during 1983. See text for definition of variables and further explanation of data. All coefficients are statistically significant at the 0.01 percent level, except for schooling squared in 1974, which is statistically significant at the 0.05 percent level.

TABLE 1

Without necessarily denying a role for nondemand factors, the purpose of our study is to obtain estimates of metropolitan wage differentials relevant for identifying demand-side effects and to explore the possible significance of such effects over the past decade. To do this, we first estimate the demand-side differentials for 1974 and 1983, and then examine the trends in the differentials between the two periods. Under the demand-side model, the change in skill-adjusted wage differentials during this period is expected (all else the same) to be inversely related to subsequent rates of economic growth via firm locations, expansions, and contractions. We have found in Eberts and Stone (1985), for example, a significant inverse relationship between metropolitan wage differentials in the 1970s and subsequent firm locations. Therefore, one would expect wage differentials measured in 1974 to narrow by 1983.

II. Data and **Empirical** Results

The **data** used to estimate the metropolitan wage differentials are obtained from 1974 and 1983 ***Current Population Surveys*** (CPS) compiled by the Bureau of Labor Statistics. The 1974 data come from the May survey, which contains supplementary questions regarding employment. The 1983 information is derived from questions asked of one-quarter of the individuals in each of the 12 monthly surveys. Because of this difference (and also because of other changes in the CPS between 1974 and 1983), the total number of workers with sufficiently complete records for analysis is much smaller in 1974 than in 1983 (13,733 workers in 1974 versus 175,268 in 1983). The sample allows us to identify 43 of the largest metropolitan areas—Standard Metropolitan Statistical Areas (SMSAs)—for both years of data.

Our first step in obtaining skill-adjusted wage differentials is to specify estimable wage equations that reflect appropriate demand determinants of the wages of individual workers. This approach follows the human capital specification of individual wages set forth by Hanoch (1967) and Mincer (1974). Thus, we specify individual wages (expressed in logarithms) as a function of observed determinants of individual productivity—education level (entered as a quadratic), potential experience (age, minus years of education, minus six, also entered as a quad-

ratic), a binary dummy variable indicating full-time employment status, and *46* binary occupation dummy variables (with one of these omitted as a constant). Binary dummy variables are also entered to control for race and gender differences in wages. Under the assumptions of the demand model, the separate wage regressions for *1974* and *1983* yield coefficients that reflect national average marginal productivities in specific occupations and for particular human capital components. Industry dummy variables and union membership status are not included, because these variables are not viewed as productive attributes. Detailed information on other components of labor compensation (pensions, health insurance, and the like) is not available in the data.

The predicted wage level for each worker in the sample is obtained by multiplying the estimated coefficients by each worker's characteristics. The predicted wage can be interpreted as the compensation a worker could expect to receive, given his or her characteristics, regardless of geographic location. Subtracting the predicted wage from the actual wage, then, nets out the portion of the actual wage that is related to the worker's skills. The skill-adjusted metropolitan wage differentials are then obtained by averaging the wage residuals (actual, minus predicted wage) in each year for all workers in a particular metropolitan area. Average wage differentials are calculated for each of the *43* SMSAs for each year. The national average wage differential is, of course, equal to zero by the property of least-squares regression. For purposes of comparison, an additional average is calculated jointly for nonSMSAs and other excluded SMSAs.

Wage regressions. The estimated (log) wage equations for both *1974* and *1983* are presented in ***table* I,** except that the *45* estimated coefficients for the occupation dummy variables are omitted for brevity. These equations are presented only to document the results of our demand-oriented wage regressions. Except for the absence of nondemand factors (for example, controls for union membership), these are familiar regressions (with minor variations) in the labor literature.

The estimated coefficients in ***table*** *1* are as expected in both years. Schooling (with a value equal to 1 for eight to *11* years, a value of *2* for *12* to *15* years, a value of *3* for *16* to *17* years, and a value of *4* for more than *18* years) enters with a significantly positive coefficient.[1] Schooling squared also enters with a significantly positive coefficient; years of potential experience

1974 Metropolitan Wage Differentials (percentage difference from national average)

Rank	SMSA	Skill-adjusted	Actual
1	New York	18.6	21.6
2	Paterson	17.9	18.6
3	San Francisco	17.5	19.8
4	Detroit	17.1	23.6
5	Chicago	15.7	16.1
6	Nassau-Suffolk	15.5	24.8
7	Rochester	14.5	19.9
8	San Jose	13.4	23.7
9	Portland	13.3	16.8
10	Gary	12.9	10.5
11	San Diego	12.9	21.2
12	Anaheim	12.2	27.3
13	Seattle	9.1	24.4
14	Los Angeles	8.4	10.8
15	Albany	8.3	18.7
16	Akron	7.9	3.8
17	Cleveland	7.5	14.4
18	Atlanta	6.5	2.8
19	Denver	5.9	11.4
20	New Orleans	5.9	-0.8
21	Baltimore	5.8	5.4
22	Sacramento	5.7	9.0
23	Indianapolis	5.5	8.9
24	Minneapolis-St. Paul	5.1	9.8
25	Milwaukee	4.9	8.0
26	Columbus	4.3	3.9
27	Boston	4.1	9.4
28	San Bemardino	3.9	5.0
29	Houston	3.8	10.4
30	Newark	3.7	3.6
31	Philadelphia	3.1	6.3
32	St. Louis	1.4	1.7
33	Pittsburgh	0.6	-1.6
34	Cincinnati	0.5	-0.3
35	Miami	-0.6	0.2
36	Kansas City	-1.8	3.6
37	Dallas	-2.9	-0.9
38	Ft. Worth	-4.4	-0.5
39	Birmingham	-4.7	0.1
40	NonSMSAs and other SMSAs	-5.8	-8.7
41	Buffalo	-6.9	-4.9
42	Norfolk	-7.1	-7.6
43	Greensboro	-8.1	-8.6
44	Tampa	-15.9	-17.9

NOTE: **Wage differentials are derived from *Current Population Survey* files, using the technique descdhed in the text.**

TABLE 2

1 This specification of education permits greater nonlinearity in the effects of different education levels than the use of individual years of education, although the difference is trivial for our estimated wage differentials.

enters with a positive coefficient; experience squared enters with a negative coefficient; a dummy variable for full-time employment enters with a positive coefficient; and dummy variables for race (with nonwhite equal to 1) and gender (with female equal to 1) enter with negative coefficients. All listed coefficients are significant at the 5 percent level.

With the exception of the decline in absolute value for the race and gender coefficients in 1983, the 1974 and 1983 regressions are basically the same. The similarity extends, by and large, to the 45 occupation dummy variables as well, although a few of these coefficients do change. Intercepts in the two equations, of course, differ significantly, due to both nominal and real wage growth between 1974 and 1983 for the United States as a whole. Both regressions explain 49 percent of the variation in actual wages.

1983 Metropolitan **Wage** Differentials
(percentage difference from national **average)**

Rank	SMSA	Skill-adjusted	Actual
1	San Francisco	18.1	25.4
2	San Jose	18.1	28.4
3	Anaheim	15.5	23.0
4	Seattle	14.9	22.1
5	Minneapolis-St. Paul	12.0	12.6
6	Nassau-Suffolk	11.3	16.0
7	Houston	10.8	14.5
8	Los Angeles	10.7	13.0
9	Chicago	10.4	14.5
10	San Bemardino	10.0	7.1
11	Detroit	9.3	9.1
12	Gary	8.4	3.6
13	Dallas	8.0	12.2
14	Portland	7.9	9.7
15	Paterson	7.8	13.5
16	Sacramento	7.8	7.0
17	Denver	7.6	12.7
18	Newark	7.3	12.7
19	Milwaukee	7.1	7.9
20	New York	7.1	11.4
21	San Diego	5.7	4.5
22	Cleveland	5.1	7.0
23	Rochester	5.1	11.0
24	New Orleans	4.8	8.8
25	St. Louis	3.9	4.0
26	Ft. Worth	3.4	3.0
27	Pittsburgh	2.7	5.4
28	Atlanta	2.7	6.2
29	Boston	2.2	5.7
30	Kansas City	2.1	4.5
31	Baltimore	1.6	4.8
32	Philadelphia	1.5	4.7
33	Cincinnati	1.3	1.4
34	Akron	-1.3	1.4
35	Greensboro	-1.6	-3.5
36	Columbus	-2.2	-2.1
37	Indianapolis	-2.5	-2.6
38	Buffalo	-2.6	-4.5
39	NonSMSAs and other SMSAs	-4.8	-7.1
40	Albany	-6.0	-5.4
41	Birmingham	-6.9	-5.1
42	Miami	-6.9	-11.4
43	Norfolk	-7.3	-7.3
44	Tampa	-10.7	-11.7

NOTE: Wage differentials are derived from *Current Population Survey* **files, using the technique described in the text.**

TABLE 3

Metropolitan wage differentials. Skill-adjusted and actual metropolitan wage differentials (expressed as the percentage deviation from the national average) are presented in *table* 2 for 1974 and in *table* 3 for 1983. The SMSAs are ranked according to the size of the skill-adjusted differential. Because of the semilogarithmic specification of the wage equation, residuals are exponentiated to obtain percentage differentials.

The rankings offer a perspective on how Cleveland's wages compare with regions against which the area might compete for economic development. In 1974, Cleveland's skill-adjusted wage was 7.5 percent above the national average, which put Cleveland in seventeenth place among the cities considered. A number of cities usually associated with rapid growth, such as San Jose, San Diego, and Anaheim, had wage differentials that were higher than Cleveland's. On the other hand, Cleveland's skill-adjusted wages are consistently higher than they are in southeastern cities. About one-quarter of the cities with wage rates below Cleveland's level were in the Southeast, and no southeastern city had a skill-adjusted wage differential higher than Cleveland's. Moreover, small SMSAs and nonSMSA regions showed much lower skill-adjusted wage differentials than Cleveland's—over 12 percent lower.

In 1983, Cleveland's skill-adjusted wage fell to only slightly above 5 percent of the national average, which brought its ranking down to twenty-second place. All the southern cities in the sample still had wage differentials below Cleveland's. A few additional cities, such as San Bemardino and Sacramento, were added to the 1974 list of west coast cities that surpassed Cleveland in the skill-adjusted wage differential.

Wage differences between metropolitan areas can be broken down into two components: differences in the skill-adjusted wages and differences in the value of skills (measured in dollars). Consider the difference in actual wages between two SMSAs (w_1 and w_o). Recall that:

$$(1) \quad \log(w_o) = bS_o + e_o,$$
$$\log(w_1) = bS_1 + e_1,$$

where b is the regression coefficient associated with the skill-related variables (S), and e denotes the residual or skill-adjusted wages (actual wage, minus predicted wage). We assume that the appropriate aggregation has been done, so that each equation represents wages in a specific metropolitan area.

The difference in the actual (log) wages between the two metropolitan areas is:

$$(2) \quad \log(w_1) - \log(w_o) = b(S_1 - S_o) + (e_1 - e_o)$$

The first component on the right-hand side is the difference in levels of skills normalized in wage units between the two areas. The second is the difference in skill-adjusted wages between the two metropolitan areas. If, for example, the actual wage differential is greater than the skill-adjusted differential, then the skill level is necessarily greater in area *1* than in area o. Consider the wage differentials displayed for San Francisco in *1983*. The actual wage in San Francisco is *17.2* percent higher than the actual wage in Cleveland, but the skill-adjusted wage is only *12.4* percent higher.[2] The difference of *4.8* percentage points is due to the higher skill levels of San Francisco workers relative to Cleveland workers. Since employers are willing to pay workers the value of their contribution to the production of each unit of output, the higher wages associated with higher productivity do not affect the relative competitiveness of the two areas. Rather, it is the difference in wages over and above the differential associated with higher labor productivity that affects competitiveness among regions. In the case of San Francisco, a *12.4* percent wage differential exists, which is not accounted for by skill differentials. On the other hand, Rochester's *3.2* percent wage differential relative to Cleveland is due entirely to higher skill levels in Rochester.

Although the results for *1974* show a rough correspondence between skill-adjusted and observed (actual) wage differentials, substantial differences are also clearly evident. Detroit, Anaheim, Birmingham, San Diego, Cleveland, Houston, and Boston, for example, all have observed wage differentials that exceed the skill-adjusted differential by at least *8* percentage points, which is the approximate differential required for statistical significance at the 5 percent level. Only Akron exhibits the opposite phenomenon — a skill-adjusted differential that is at least *8* percentage points higher than the observed differential. The five SMSAs with the highest skill-adjusted wages are New York, Paterson, San Francisco, Detroit, and Chicago. The five lowest SMSAs are Tampa, Ft. Worth, Greensboro, Norfolk, and Buffalo.

The results for *1983* show a stronger correspondence between skill-adjusted and observed wage differentials. By this year, no SMSA except San Jose has an observed wage differential that differs from the skill-adjusted differential by at least 8 percentage points. Only one of the five highest-wage SMSAs in *1974* (San Francisco) remains in the top five in *1983*. The remaining four in *1983* are San Jose, Anaheim, Seattle, and Minneapolis-St. Paul. Two of the lowest-wage SMSAs in *1974* (Tampa and Norfolk) remain among the five lowest SMSAs in *1983*. The remaining three in *1983* are Albany, Birmingham, and Miami.

The changes in the differentials between *1974* and *1983* are presented in table 4. SMSAs with the largest increases are Dallas, Ft. Worth, Houston, Minneapolis-St. Paul, and Greensboro. SMSAs with the largest decreases are Albany, New York, Paterson, Rochester, and Akron. Most of the cities associated with rapid growth during the last decade exhibit increases in both skill-adjusted and observed wage differentials. In some instances, the skill-adjusted and actual changes in wage differentials differ substantially. SMSAs that show increases in the skill-adjusted differential, but a decline in the actual wage differentials, are Houston, Anaheim, and Sacramento. For these SMSAs, the skill-adjusted increase is presumably offset by a decline in average skill level.

Cleveland's skill-adjusted and observed wage differentials fell between *1974* and *1983;* the actual wage declined more rapidly than the skill-adjusted wage. Since the relative decline in the actual wage differential, with respect to the skill-adjusted wage differential, has to be offset by a decline in average skill level of the area's work force, this indicates that Cleveland suffered a decline in the average skill of the area's labor force.

New Orleans, Philadelphia (trivially), Atlanta, and Akron show decreases in the skill-adjusted wage differential, but an increase in

2 The percentage difference in wages between any two metropolitan areas can be easily calculated from *tables 1* and *2*, by using the following formula:

$$\frac{w_1 - w_o}{w_o} = \left(\frac{w_1 - w_{us}}{w_{us}} - \frac{w_o - w_{us}}{w_{us}}\right) \quad (1/(1+(w_o - w_{us})/w_{us}))$$

where $(w_1 - w_o)/w_o$ is the percentage difference in wages between area *1* and area o and $(w_1 - w_{us})/w_{us}$ is the percentage deviation in wages in area *i* from the nation's (the differential displayed in tables 2 and 3).

the actual wage differential. For these SMSAs, the skill-adjusted decrease is presumably offset by an increase in the average skill level. Large divergences between the skill-adjusted and actual changes (even if the changes are in the same direction) have similar interpretation. Other SMSAs with large differences between the two measures are San Jose, Birmingham, Gary, San Diego, Detroit, and Albany.

Change in Wage Differentials from 1974 to 1983 (percentage point change)

Rank	SMSA	Skill-adjusted	Actual
1	Dallas	10.9	13.1
2	Ft. Worth	7.8	3.5
3	Houston	7.0	4.1
4	Minneapolis-St. Paul	6.9	6.9
5	Greensboro	6.5	5.1
6	San Bernardino	6.1	2.1
7	Seattle	5.8	-2.3
8	Tampa	5.2	6.2
9	San Jose	4.7	6.2
10	Buffalo	4.3	0.4
11	Kansas City	3.9	0.9
12	Newark	3.6	-9.1
13	Anaheim	3.3	-4.3
14	St. Louis	2.5	2.3
15	Los Angeles	2.3	2.2
16	Milwaukee	2.2	-0.1
17	Pittsburgh	2.1	7.0
18	Sacramento	2.1	-2.0
19	Denver	1.7	0.7
20	NonSMSAs and other SMSAs	1.0	1.6
21	Cincinnati	0.8	1.7
22	San Francisco	0.6	5.6
23	Norfolk	-0.2	0.3
24	New Orleans	-1.1	9.6
25	Philadelphia	-1.6	-1.6
26	Boston	-1.9	-3.7
27	Birmingham	-2.2	-5.2
28	Cleveland	-2.4	-7.4
29	Atlanta	-3.8	3.4
30	Nassau-Suffolk	-4.2	-8.8
31	Baltimore	-4.2	-0.6
32	Gary	-4.5	-6.9
33	Chicago	-5.3	-1.6
34	Portland	-5.4	-7.1
35	Miami	-6.3	-11.6
36	Columbus	-6.5	-6.0
37	San Diego	-7.2	-16.7
38	Detroit	-7.8	-14.5
39	Indianapolis	-8.0	-11.5
40	Akron	-9.2	-2.4
41	Rochester	-9.4	-8.9
42	Paterson	10.1	-5.1
43	New York	-11.5	-10.2
44	Albany	-14.3	-24.1

NOTE: Wage differentials are derived from *Current Population Survey* files, using the technique described in the text.

TABLE 4

Based on the estimates above, have skill-adjusted metropolitan wage differentials converged since 1974? This question can be answered by calculating the change in the coeffcient of variation from *1974* to *1983*. The coeffcient of variation is the standard deviation (computed from the sample of SMSA-level wage differentials) divided by the mean; thus, it is an index of the degree of dispersion in the sample. This measure indicates substantial convergence for both sets of differentials, declining by *22* percent for the skill-adjusted differentials and by *46* percent for the actual wage differentials. Because the observed wage differential is composed of the skill-adjusted wage differentia! and a differential related to differences in actual skills, the fact that observed wages converged more than twice as much as skill-adjusted wages suggests that variations across metropolitan areas in actual skill levels also declined during the period.3

Why do we observe relatively strong wage convergence during the 1974-1983 period? Following our demand-side approach, one could attribute convergence to the expanding scope of most product markets (both domestically and internationally), increased competition faced by geographically concentrated firms that may have had some power to influence price, the relative decline of industries that make products using relatively large amounts of local natural resources, and the emergence of manufacturing industries that require smaller-scale plants.

III. Conclusion

The objective of this paper was to provide estimates of variations across metropolitan areas in the wage employers pay a worker of given skills and training, and then to compare how these differentials have changed over the past decade. Based upon *1974* and *1983* data from the ***Current Population Survey,*** we find substantial variations in skill-adjusted wages in both *1974* and *1983,* as well as significant deviations between skill-adjusted and observed wage levels. We also find that the wage differentials and skill differentials converged significantly during this same period. Cleveland's skill-adjusted and actual wage levels

3 The change in average skill level could be the result of changes in actual skills or of changes in the market compensation of the skills between 1974 and 1983. The oeneral similaritv of the 1974 and 1983 wage regressions, however, suggests that most ot ihe change in skill level reflects actual changes in skills.

also converged toward the national averages. Over the last decade, Cleveland closed the gap by 2.4 percentage points for skill-adjusted wages and by nearly 9 percentage points for actual wages.

The reduction in Cleveland's wage differentials and the general convergence in wages and skills could influence Cleveland's economic future in at least two ways. First, the incentive for firms to move out of Cleveland might diminish, since convergence in wages reduces the potential cost savings of a move. Second, the wage differential might not be as critical a factor in economic growth as it once was. In fact, labor supply-side factors, such as labor climate and local amenities and public services, might become more important influences on economic development.

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Introduction

Regional variations in labor costs attract a great deal of attention because of their potential to affect the regional distribution of economic activity. Because of the major role that labor costs play in total production costs, regional differences in labor costs may translate into dramatic regional differences in profitability. Profitability, in turn, is a major determinant of whether or not existing firms will expand and of whether or not new firms are likely to locate in a given region.

Most studies of regional variations in labor costs are based solely on data for payroll per employee or wages. However, the measure of labor costs that is most relevant to the profitability of a firm is the total cost of the labor needed to produce its output. There are at least two steps involved in getting from simple wage data to estimates of labor costs per unit of output.

First, nonwage income to workers ("supplemental income") must be added to wages to get total labor costs per hour. In 1977, the value of measurable supplemental income paid to manufacturing workers was, on average, about 20 percent of the value of wages paid to those workers. This percentage showed considerable variation, however, among regions and states. (See Garofalo and Fogarty [1984].) By 1982, supplemental income had increased to nearly 25 percent of wages.

Second, labor costs per hour must be scaled by the amount of output per hour that is attributable to labor inputs, as opposed to other inputs, if the objective is to measure labor costs per unit of output. The amount of output generated by a unit of labor input varies for different workers and for different production processes. Labor productivity will be different among workers possessing different skills or other personal characteristics. Similarly, productivity will vary for a single worker according to the amount of other factors of production (machinery, energy, or raw materials) used in a particular production process.

The research described here has been directed toward incorporating these two corrections to the raw wage rates to obtain a more accurate measure of labor costs per unit of output. The supplemental income estimates are a direct extension of work done at the state level by Garofalo and Fogarty.

The strategy employed to control for labor productivity differs significantly from that used in most other studies. Researchers interested in analyzing regional labor productivity patterns face hard decisions regarding the techniques and data available to them One option is to use indirect indicators of productivity that can be measured reliably, but which may or may not be reliable proxies for labor productivity. This option uses the personal characteristics of workers to measure productivity. The strength of the technique is that it uses data that are relatively accessible and reliable. It has two major weaknesses. (1) Strong assumptions are required about the relationship between the indirect measures (personal characteristics) and labor productivity. (2) The method does not control for differences across industries or regions in capital intensity.

The other choice—the one used in this analysis—is to attempt to estimate labor productivity directly from data that measure output ancl input levels. The strength of this approach is that the effects of differences in the quality of labor *and* of differences in the mix of inputs (capital intensity) are both captured by the measure. This approach also has two major weaknesses: (1) Reliable data are not easily available at the regional level for some of the measures, especially capital inputs. Some variables must, therefore, be estimated (with some error) from the data that are available. (2) The option requires one to make fairly strong assumptions about the nature of production processes across industries and regions.

Neither approach is entirely satisfactory since each requires strong assumptions. It could be argued that the first approach (based on characteristics of the labor force) provides the more relevant measure for new firms seeking a location, because these kinds of firms are not tied to an existing technology or physical plant. On the other hand, the seconcl approach, because it controls for the effects on labor productivity of existing capital intensities, may be the better measure for capturing the potential of existing firms to expand in their current location.

Indexes for wage rates, supplemental income, and labor productivity have been generated for each of the 20 commonly reported Manufacturing subsectors (two-digit SIC industries) in the 20 largest (based on 1980 employment) Standard Metropolitan Statistical Areas (SMSAs).

I. Wages

The wage data collected for this research support the finding by other researchers that wage rates vary significantly among metropolitan areas and regions in the United States. The first column of *table* I shows 1982 Manufacturing wage indexes for the 20 largest SMSAs. The indexes represent production worker hourly wages in the SMSA as a percent of the national average. In order to control for the fact that different SMSAs have different industrial structures, each SMSA's index compares the cost of that SMSA's employment mix computed from the SMSA's wage structure to the cost of the same mix at national average wages. This means that an artificially high index number will not be produced simply because an SMSA has greater-than-average concentrations of employment in industries that have wages that are higher than the average for Manufacturing as a whole.

The first thing that is clear from the wage indexes is that, in 1982, there was a great deal of variation in Manufacturing wages among these large SMSAs. Wages in the lowest-wage SMSA (Nassau) were only 75 percent of those in the highest-wage SMSA (Pittsburgh). Eight of the SMSAs showed wages less than the national average, but the weighted average wage for the 20 was 2 percent greater than the national average.

The most striking feature of the regional averages is that all of the SMSAs in the North Central region showed Manufacturing wages in 1982 that exceeded the national average. Wages in Cleveland approximately matched the regional average at about 8 percent above the national average and were greater than in all but six of the 20 largest SMSAs. Wages in the Northeast, South, and West were close to the national average, but the indexes are far from being uniformly distributed within these regions. The Northeast, for instance, shows the lowest regional average despite the fact that it contains the highest-wage SMSA in the sample (Pittsburgh). Similarly, wages in the South and West range from a low of 91 percent of the average (Dallas) to a maximum of 115 percent (San Francisco).

These regional patterns, particularly the finding that the Northeastern SMSAs showed lower wages on average than those in the South and West, are somewhat surprising. In light of the often-citecl difference between wages in the "Sunbelt" and the "Frostbelt," one might have expected greater regional differences than those revealed by the data. One possible explanation for the patterns is that wages have converged over time as the result of equilibrating forces at work in the national economy. In regions where Manufacturing employment is in decline, one would expect downward pressure on relative wages. Examination of column (7) of *table* I provides some support for this view. Wages in the slower-growing Northeast and North Central regions have indeed declined relative to those in the South and West. However, the decline was significantly greater in the Northeast than the North Central and there are some clear exceptions at the SMSA level—for example, relative wages in Pittsburgh increased between 1777 and 1982 despite significant declines in Manufacturing employment during the period.

II. Supplemental Income

Estimates of supplemental income for the 20 largest SMSAs showed even more variation than the wage indexes, ranging from about 75 percent of the national average to more than 130 percent of the average. The supplemental income data available in the *Census of Manufactures* include both mandatory supplements to wages like social security and worker's compensation, and voluntary supplements like health and life insurance. Other, less easily measured fringe benefits, such as free parking or subsidized cafeterias, are not included.

Unfortunately, the regional data are reported at the state level only, with no detail

across industries. Industry detail is available only in the national data. Estimates of supplemental income for each of the 20 Manufacturing sectors in the SMSAs have been generated by combining wage data from the SMSAs with the information about regional variations in fringe benefits rates contained in the state level data and with the information about variations among industrial sectors contained in the more detailed national data. The procedure assumes supplementary income in a given industry and SMSA to be the product of (1) the level of wages in that industry and SMSA, (2) the average supplemental income rate (supplemental income divided by wages) for the industry in the nation, and (3) the average supplemental income rate in total Manufacturing in the SMSA's home state (controlling for the Manufacturing employment mix in the state). The supplemental income estimates for each industry in an SMSA are then combined in the same way as the wage estimates to get the mix-controlled index for total Manufacturing in the SMSA.

The supplemental income indexes in *table* I, column (2), compare the supplemental income cost of the SMSA's employment mix to the cost of the same mix at the national average supplemental income rates. The estimates for 1982 show the differences among the SMSAs' fringe benefits rates to be much more substantial than for wages. The supplemental income rate in

Manufacturing Wage, Supplemental Income and Labor Productivity Indexes: 20 Largest SMSAs, 1982

United States = 100

	(1) Simple wage index	(2) Supplemental income index	(3) Total labor cost index	(4) Labor productivity index	(5) Corrected labor cost index	(6) Column (5) minus column (1)	(7) Column (1) change from 1977	(8) Column (5) change from 1977
Twenty largest SMSAs[a]	102.2	98.1	101.5	99.1	102.4	0.2	-0.8	-0.7
Northeast[a]	98.6	93.3	97.7	98.7	99.0	0.4	-2.6	-3.2
Boston	96.5	85.4	94.5	104.3	90.5	-6.0	-0.8	-3.3
Nassau	89.1	74.1	86.4	95.2	90.7	1.6	-2.2	-5.5
Newark	96.5	85.4	94.4	94.6	99.9	3.4	-2.0	-1.8
New York	95.5	83.8	93.5	105.0	89.1	-6.4	-3.6	-5.9
Philadelphia	101.6	110.2	103.3	98.0	105.4	3.8	-2.8	-4.9
Pittsburgh	118.9	131.4	121.6	85.3	142.4	23.5	5.5	20.6
North Central[a]	108.0	109.9	108.5	95.9	113.0	5.0	-0.9	3.4
Chicago	103.2	106.5	103.9	94.8	109.5	6.3	-0.1	7.4
Cleveland	107.7	114.9	109.2	94.1	116.0	8.3	-1.7	2.2
Detroit	118.4	129.0	120.6	92.0	131.1	12.7	-1.3	5.3
Minneapolis	109.0	93.2	106.1	103.4	102.6	-6.4	3.9	1.8
St. Louis	104.8	97.2	103.2	104.8	98.5	-6.3	0.1	-0.4
South[a]	100.4	87.8	98.0	101.6	96.4	-4.0	1.7	-0.1
Atlanta	93.8	77.9	90.7	102.6	88.4	-5.4	-2.4	0.2
Baltimore	111.3	119.2	112.9	99.3	113.7	2.4	4.5	0.7
Dallas	91.3	74.3	88.0	103.9	84.7	-6.6	1.0	-3.2
Houston	109.1	88.8	105.1	100.1	105.0	-4.1	4.9	6.6
Washington, DC[b]	101.4	137.5	107.6	99.2	108.5	7.1	-4.5	-4.0
West[a]	101.1	96.7	100.3	102.5	97.9	-3.2	2.5	0.2
Anaheim	99.1	94.8	98.3	98.4	99.9	0.8	4.0	4.2
Denver	105.7	92.0	103.1	101.0	102.1	-3.6	4.8	2.2
Los Angeles	98.3	95.0	97.7	103.9	94.0	-4.3	2.4	-1.2
San Francisco	114.8	111.0	114.1	101.7	112.2	-2.6	1.5	2.5

SOURCE: Computed from *Census of Manufactures*, 1977 and 1982, Bureau of the Census, U.S. Department of Commerce.

a. Aggregate indexes are weighted averages of the SMSA estimates with weights based on manufacturing employment in the 20 largest SMSAs.

b. Supplemental income index for Washington, DC based on 1977 supplemental income data.

TABLE 1

Nassau (the SMSA showing the lowest index number) was only 54 percent of that in Washington, DC (the SMSA with the highest rate).

The overall pattern of supplemental labor costs reflects the wage pattern. Higher-than-average wage rates tend to be associated with higher-than-average supplemental income rates. Eight of the 12 SMSAs with higher-than-average wages had higher-than-average supplemental income rates. Similarly, all eight of the lower-than-average wage SMSAs also showed lower-than-average supplemental income. Cleveland's standing in supplemental income rates mirrored its position in wages—only three of the 20 SMSAs showed supplemental income rates higher than Cleveland's.

Total labor costs in a specific industry and SMSA are calculated as the sum of wages and supplemental income. The industry-specific estimates are then combined in the same way as the wage and supplemental income measures to get a mix-corrected estimate of the labor-cost index for total Manufacturing. Because of the rough correspondence between the wage indexes and the supplemental income indexes, and because supplemental income represents a much lower percentage of total compensation than wages, the total labor-cost indexes (column [3]) do not differ dramatically from the wage indexes. In only four of the 20 SMSAs is the difference greater than three percentage points (Atlanta, Dallas, Houston, and Washington, DC). In general, adding supplemental income to the labor-cost indexes increases the spread among the SMSAs, but not by a substantial amount.

III. Labor Productivity

Factoring labor productivity into the labor-cost estimates is also very important. If higher-than-average wages in an SMSA reflect higher-than-average labor productivity, then the index for the SMSA from column (3) of *table 1* will overstate any relative disadvantage that the SMSA might have in competing with other regions for jobs.

The potential for labor productivity to significantly alter the competitive position of an SMSA is greater than it is for supplemental income. Supplemental income represented only about 24 percent of total compensation in 1982. Any adjustment made for labor productivity, however, affects 100 percent of total compensation. Consequently, equivalent percentage differences in the two factors in an SMSA will have different effects on the overall measure of labor costs in the SMSA, with the productivity adjustment being the greater of the two.

Differences among SMSAs in labor productivity can arise from two different sources. First, differences in labor quality due to skill levels, education, or experience are likely to be reflected in differences in productivity. Many analysts, therefore, use various labor-force characteristics as proxy measures for productivity. However, there is another important source of productivity differences. The amounts of other factors of production that are used in combination with labor will affect labor productivity independently of the quality of labor. The productivity of otherwise identical workers will be different depending on the amount of capital (such as machinery and equipment) used in combination with them in the production process.

Ideally, controlling for labor productivity differences arising from both sources would require that the researcher have industry- and SMSA-specific data for output, capital inputs, labor inputs, and all other inputs. In addition, knowledge about the production process, itself—how capital and labor are combined at different levels of output—is required. With this kind of data, it would be possible to separate the portion of output directly attributable to labor from the part attributable to the other inputs.

These kinds of data are not readily available, particularly at the SMSA level. However, the *Census of Manufactures* reports value-added data by industry and SMSA. From these data, it is possible to estimate the amount of output that is directly attributable to a unit (one hour) of labor input, after controlling for the amount of capital used in the production process. The labor cost per unit of output can then be estimated by dividing the cost per unit of labor input by output per unit of labor input.

The procedure used in this research to make this calculation involved two steps. First, capital inputs were estimated by subtracting total labor costs (including the costs for nonproduction workers) from value added and dividing this difference by an estimate of the rate of return to capital. Second, the value of output attributable to a unit of labor input was estimated by assuming that capital and labor are combined in a specific way in the production process.[1] The

1 In theory, value added represents only the contribution to the total value of output that is made at the stage of production in question. Any contributions to value that are made at prior stages in the total production process (such as by the refining of raw materials, or pre-assembly of components) are not included in the "value added" at the stage of production under analysis. In reality, the value-added data reported by the Bureau of the Census includes some value that cannot be directly attributed to the labor or capital brought to bear at the stage of production in question. The capital estimates used here thus overstate capital stock. How this overstatement affects the relative measures used in this analysis depends on the extent to which the magnitude of noise in the data varies from SMSA to SMSA, a piece of information which is not available. The production process assumed for the analysis is a constant returns-to-scale Cobb-Douglas production function with a capital exponent of 0.282 (taken from Hulten and Schwab [1984]).

result is a measure of how effectively the SMSA's labor force is combined with the existing capital plant. By estimating productivity directly from output data (albeit with some strong assumptions), it is not necessary to make any assumptions about how labor force characteristics, such as education or age, affect productivity. If an SMSA's labor force possesses productivity-enhancing characteristics, the impact should be captured in the estimate of output that is directly attributable to labor inputs.

Labor productivity estimates derived by using this procedure show much less variation across the 20 largest SMSAs than either the wage or supplemental income indexes Column (4) of *table 1* reports the labor productivity indexes for the 20 SMSAs. The index represents labor productivity in Manufacturing in the SMSA as a percentage of national average labor productivity in Manufacturing. Productivity in the lowest-productivity SMSA (Pittsburgh) is about 85 percent of the national average and about 81 percent of the value for the highest-productivity SMSA in the group (New York).[2]

A primary reason for investigating labor productivity is to test whether higher-than-average labor costs in an SMSA reflect higher-than-average labor productivity. Comparisons of the third and fourth columns of *table* I suggest that this is not the case in the 20 largest SMSAs. Indeed, the simple correlation coefficient—a measure of how closely two variables move together—between the labor productivity indexes and the wage indexes is negative, indicating that, in these SMSAs, higher-than-average wage indexes are associated with lower-than-average labor productivity.[3]

The result of this negative relationship is that, when labor productivity is factored into the labor-cost indexes, the spread among the SMSAs increases Column (5) shows the labor cost per unit of output indexes. The lowest-cost SMSA (Dallas) showed labor costs in 1982 that were just uncier 60 percent of those in the highest-cost SMSA (Pittsburgh).

IV. Combined Effects of Supplemental Income and Labor Productivity

The supplemental income and labor productivity adjustments to the simple wage index tend to operate in the same direction. This was true for 17 of the 20 largest SMSAs. In each of the seven SMSAs where the supplemental income adjustment increased the labor-cost index, the productivity adjustment also increased it. Similarly, in 10 of the 13 SMSAs where the supplemental income correction decreased the labor-cost index, the productivity correction also resulted in a decrease.

The net change in the labor-cost measure resulting from the two adjustments is shown in column (6) of *table* I. In 11 of the 20 SMSAs, the net effect of the two adjustments was to decrease the labor-cost index. In these SMSAs, the simple wage index overstates relative labor costs. In the other nine SMSAs (including Cleveland), the simple index understates costs relative to the national average. The magnitude of the under- or overstatement varied substantially from SMSA to SMSA, with the understatement being the greatest for Pittsburgh, and the overstatement being the greatest for Dallas.

Overall, these results suggest that simple wage measurements will tend to distort regional labor-cost differentials. On average, the wage indexes understate relative labor costs in the higher-cost, North Central SMSAs, and overstate them in the lower-cost SMSAs in the South and West.

In addition, the productivity correction has a very significant effect on the measured change in labor costs between 1977 and 1982. The increases in costs in the South and West reflected in the simple wage indexes are largely offset by improving relative labor productivity during the period (column [8], *table 1*). On the other hand, the decline in relative wages in the North Central region is overwhelmed by the decline in the relative productivity measure. Only in the Northeast does the productivity correction have little effect on the measured change in labor costs. The net effect is that the competitive position (as measured by the productivity-corrected labor-cost indexes) of the Northeastern SMSAs improved on average between 1977 ancl 1982, while the North Central's position deteriorated, and those of the South and West remained unchanged.

What are the implications of labor-cost differentials of the magnitude found in *table 1*? Statistical analysis, relating employment growth between 1977 and 1982 to relative labor costs in 1977 in the 20 largest SMSAs, suggests that they have been significant in the past. (See Summers ancl Luce [1985].)

The finding was that, after controlling for the effects of national employment trends, unionization rates, right-to-work legisla-

2 The very low index for Pitlsburgh is largely due lo lhe index for the SMSA's dominant sector — Primary Metals. Reported value added in this sector for 1982 was less than total labor costs for the seclor, a relationship which is conceptually troublesome and which is inconsistent with the labor productivity calculation. The difference between reported value of shipmenis and cost of materials was therefore substituted for reported value added in the productivity eslimation procedure. Consequently, the productivity measure for Pittsburgh should be viewed with caution, since it is likely that the problems resulting from the use of available value-added data (see fn. 1) are particularly acute in Pittsburgh's case.

3 The correlation coefficient is 0.52

tion, energy costs, vulnerability to international competition, state and local taxes, cost of living, and local amenities, a labor-cost differential of 50 percent in 1977, like the one that existed between Dallas and Detroit, was associated with a subsequent employment growth differential of almost 3 percent per year. The actual differential for these two SMSAs for the period from 1977 to 1982 was about 10 percent per year, implying that the labor-cost differential explained almost 30 percent of the total difference in growth rates.

case. Manufacturing employment declined much more quickly in these six SMSAs between 1977 and 1982 than in the other 14, or in the nation as a whole. In the six, total Manufacturing employment declined by more than 5 percent per year over this time period, compared to a decline of less than 1 percent per year in the other 14.

V. Relative Labor Costs in Cleveland

In Manufacturing as a whole, Cleveland fell into

Manufacturing Wage, Supplemental Income and Labor Productivity Indexes: Cleveland SMSA, 1982

United States = 100

	(1) Simple wage index	(2) Supplemental income index	(3) Total labor cost index	(4) Labor productivity index	(5) Corrected labor cost index	(6) Column (5) minus column (1)	(7) Column (5) change from 1977
Total manufacturing[a]	107.7	114.9	109.2	94.1	116.0	8.3	2.2
Durables[a]	109.0	116.5	110.6	94.6	116.9	7.9	2.4
Lumber products	108.2	115.5	109.4	102.3	107.0	-1.2	-2.7
Furniture and fixtures	110.8	118.3	112.0	107.8	103.9	-6.9	-20.1
Stone, clay and glass	100.2	106.9	101.5	97.3	104.3	4.1	-0.5
Primary metals	111.3	118.7	113.2	93.0	121.7	10.4	23.5
Fabricated metals	111.7	119.2	113.2	95.2	118.9	7.2	2.8
Non-elec. machinery	106.2	113.3	107.5	86.9	123.8	17.6	11.9
Elec. machinery	117.0	124.9	118.5	114.9	103.1	-13.9	-2.1
Trans. equipment	105.6	112.7	107.2	98.4	109.0	3.4	-29.3
Instruments	94.5	100.8	95.5	90.5	105.6	11.1	-2.8
Other durables	99.4	106.0	100.5	87.0	115.5	16.1	-4.1
Nondurables[a]	102.7	107.5	103.5	92.7	111.7	9.0	1.8
Food and kindred	102.0	108.9	103.3	93.7	110.3	8.3	-22.1
Textiles	85.1	90.8	86.0	112.0	76.8	-8.3	-6.0
Apparel	161.6	172.4	163.1	125.8	129.7	-31.9	13.5
Paper and allied	89.1	95.1	90.2	81.1	111.3	22.2	14.9
Printing and publishing	110.3	117.7	111.4	87.1	128.0	17.7	11.9
Chemicals	95.7	102.1	97.0	92.5	104.9	9.2	2.1
Petroleum products	74.2	79.2	75.2	94.0	80.0	5.8	-18.7
Rubber and plastics	91.6	97.7	92.8	91.9	101.0	9.4	-3.8

SOURCE: Computed from ***Census of Manufactures, 1977*** and ***1982,*** Bureau of the Census, U.S. Department of Commerce.
a. Aggregate indexes control for industrial structure.

TABLE 2

For the SMSAs showing higher-than-average labor costs and lower-than-average productivity in 1982 (Philadelphia, Pittsburgh, Chicago, Cleveland, Detroit, and Baltimore) the implications of this finding are particularly sobering. The statistical analysis implies that those SMSAs would have had to possess very significant cost advantages from other sources, such as greater-than-average access to input or output markets, to have been competitive with other areas in the United States. This does not appear to have been the

the group of SMSAs in 1982 (composed primarily of the older SMSAs in the Noah and East) with higher-than-average wages, higher-than-average supplemental income, and lower-than-average labor productivity. It is of interest to examine whether this pattern carries over into the specific industrial sectors that are of greatest importance to the region. ***Table*** 2 shows the 1982 labor-cost measures, described above, broken out by the 18 sectors for which data are available for Cleveland.

Some caution should be exercised in evaluating the results presented in *table* 2. The primary reason for this is the level of industrial disaggregation used in the analysis. In the same way that total Manufacturing measures that do not control for different industrial structures across SMSAs may over- or understate labor-cost differences, the two-digit SIC breakdowns in *table* 2 may reflect differences between Cleveland and the nation in industrial structure at a finer level of disaggregation. This problem, in fact, appears to be a factor in at least two of the sectors shown in *table* 2. It is likely that the very low wage index for Petroleum Products and the very high index for Apparel are largely the result of this issue. However, since these two sectors, together, accounted for less than 5 percent of Manufacturing employment in the region, they have very little impact on the overall indexes.

Nearly 70 percent of 1982 production worker employment in Manufacturing in the Cleveland SMSA was contained in the five sectors beginning with Primary Metals in *table* 2. Each of these sectors showed higher wages and supplemental income in Cleveland than in the nation as a whole. In addition, only one of the five (Electric Machinery) showed labor productivity significantly above the national average. Two others (Fabricated Metals and Transportation Equipment) showed labor productivity within five percent of the average. However, productivity advantages in none of these sectors were large enough to offset the significantly higher-than-average wage and supplemental income rates.

Overall, productivity-correctedlabor costs exceeded the national average in all but two of the reported 18 sectors. In addition, the region's competitive position deteriorated between 1977 and 1982 in eight of the 18 sectors and in three of the region's five largest sectors (Primary and Fabricated Metals, and Nonelectric Machinery). Iabor costs clearly cannot be viewed as a factor enhancing the region's desirability to firms competing in national and international markets.

What impact are differences of the magnitude found in Cleveland likely to have on future employment growth or decline in the region?The research cited in previous sections suggests that the impact was very significant between 1977 and 1982. The findings implied that a labor-cost differential like the one found for Cleveland in 1977 (14 percent) was associated with subsequent employment growth in Manufacturing, which was about 0.8 percent per year less than it would have been if labor costs had been equal to the national average. This represents more than one-fifth of the total difference between the growth rate in the Cleveland SMSA and that in the nation between 1977 and 1982 (when the average difference was about 3.6 percent per year). Although other factors working to Cleveland's disadvantage explain the majority of the region's slower-than-average employment growth in the period, the effect of higher-than-average labor costs cannot be ignored. A 0.8 percent per year shortfall in growth represents about 7,000 Manufacturing jobs in the SMSA over the five-year period from 1977 to 1982.

VI. Conclusions

Manufacturing labor costs varied significantly among large SMSAs in 1982. Most of the variation was attributable to differences in wage rates. When supplemental income was added to wages to get total labor costs per hour, the spread among SMSAs increased, but not by a substantial amount. Correcting for differences among SMSAs in labor productivity tended to increase the differentials by more than the supplemental income adjustment but by a magnitude that was less than the original wage differentials. The data for the 20 largest SMSAs do not support the proposition that higher-than-average wage rates are associated with greater-than-average labor productivity.

Labor costs in 1982 for the Cleveland SMSA were significantly greater than the national average. Of the overall 16 percentage point differential, about 50 percent (or eight percentage points) was due to greater-than-averagewage rates. Another 40 percent of the total difference was attributable to lower-than-average labor productivity, with the remaining 10 percent being due to greater-than-averagesupplemental income rates.

The higher-than-averagelabor costs in Cleveland are likely to have had a dampening effect on employment growth in Manufacturing in the region. In the group of the 20 largest SMSAs, labor-cost differentials of the magnitude evident in Cleveland in 1977 were associated with employment growth about 0.8 percent per, year less than if labor costs had equaled the national average. This represents about one-fifth of the total difference in Manufacturing employment growth rates between Cleveland and the nation between 1977 and 1982.

The overall implication of this research for the Cleveland area is that, in order to compete effectively with other areas of the country for Manufacturing jobs, other characteristics of the region must be sufficiently advantageous to overcome the region's relatively high labor costs. Many of the same market forces that operated in the past to create the higher-than-averagewages in the region are likely to lead in the future to some moderation, but this is a slow and painful process. Wages in Cleveland as a percent of national average wages declined by only 2 percent between 1977 and 1982 — a period when Manufacturing employment in the region

decreased by 25 percent. In addition, the marginal improvement in the region's competitive position embodied in the relative wage decline was more than offset by a decrease in relative labor productivity in the region.

Perhaps the most important message from the analysis is that there is room for improvement in the SMSA in one component of labor costs—labor productivity—that can be enhanced over a shorter time horizon by actors within the region. Any improvements in this direction will require both a commitment by labor to productivity-enhancing changes in work rules and incentive structures, and by management to invest in the region to maintain and improve the physical plant. Neither group, working alone, can significantly improve the region's ability to compete in national and international markets.

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Reducing Risk in Wire Transfer Systems

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The author would like to acknowledge useful conversations with David B. Humphrey.

Introduction

Hundreds of billions of dollars in payments are made each day in the United States. The system that enables this enormous sum to change hands includes several different mechanisms. Probably the largest number of payments, but with the smallest total dollar value, are made by using coins and paper money. Another very large number of payments, with a daily total value in the neighborhood of $75 billion, are made by using checks, credit cards, and direct transfers through automated clearinghouses. The smallest number of payments, but representing by far the largest total dollar value — frequently $500 billion a day — are made using so-called wire transfers of funds.

Wire transfers move balances electronically at Federal Reserve Banks from one bank's deposit account to another's on the same day. Transfers can be carried out over any of several wire networks (large-dollar transfer systems) connecting banks to one another and to the Federal Reserve Banks.[1] In this way, banks make payments that handle their own short-term financing transactions as well as payments on behalf of themselves and their customers. These payments, in turn, reflect much of the dollar-denominated securities and foreign exchange market trading of the world.

March 27, 1986 was the effective date of a Federal Reserve Board of Governors' policy to control risks in large-dollar transfer systems. Adjustment to that policy has been smooth, as expected, for two reasons.[2] First, consultation and public comment on the need for and nature of the program have been ongoing for a number of years. The actual policy was announced in May of last year. Since then, both the Federal Reserve Banks and private consultants have been conducting informational meetings for banks across the nation. Second, the risk-control mechanism that became effective on March 27 embodies only a modest initial effort at risk reduction. With the mechanism in place, however, future steps to reduce risk become more feasible. How smoothly future risk reduction can be assimilated will depend on the ease with which financing practices of banks and institutional arrangements for making certain kinds of payments can adapt to the rising cost of risk implied by the risk-control policy.

This article briefly describes sources of risk in large-dollar transfer systems and discusses major features of the new mechanism for risk control.[3] Then, examples of potential changes

1 The word "bank will be used here in a generic sense, and includes commercial banks, thrift institutions, Edge Act and Agreement Corporations, U. S. Branches and Agencies of Foreign Banks, and New York Article XII Investment Companies.

2 This expectation was supported by a survey done just before March. See "Findings: Survey on Implementation Status of Reduction of Payment System Risk," Bank Administration Institute, January 23, 1986.

3 A full description of the policy may be found in "Policy Statement Regarding Risks on Large-Dollar Wire Transfer Systems" (Docket No. R-0515), Board of Governors of the Federal Reserve System. Discussion of the risk problem is in: E. J. Stevens, "Risk in Large Dollar Transfer Systems," FRB of Cleveland Economic *Review,* Fall 1984, pp. 2-16.

in financing and payments practices that might facilitate future risk reduction are examined.

I. Risk Exposure

The risk being controlled is the threat that payments made over one of the large-dollar transfer systems can't be settled. None of these systems operates on a real time, cash-in-advance basis that would continuously settle by deducting each payment, minute by minute, as it occurs, from the balance in an account. Instead, they are "batched" settlement systems that update accounts only at the end of the day by the net of payments and receipts during the day. It is possible, therefore, for a depository institution to transfer large sums during the day before it has received all the funds needed to settle its account at a Federal Reserve Bank. If the needed funds can't be acquired, a settlement failure occurs.

A settlement failure is a rare event in the United States. Many banks have failed to open in the morning, but few in modem history have failed to settle their accounts at a Federal Reserve Bank the previous evening. Ultimately, who stands to lose in the event of a settlement failure depends in part on whether the large-dollar transfer system involved is a net settlement system, or Fedwire. The leading example of a net settlement system is CHIPS (Clearing House Interbank Payments System), a private telecommunications clearinghouse payments network operated by the New York Clearing House. Participants exchange provisional payments messages during the day, but payments become final only at the end of each day when the net position (receipts, minus payments) of each participant is settled through accounts at Federal Reserve Banks.[4] Inability of a participant to settle in this type of system suggests that one or more other participants or their customers are at risk because the Federal Reserve will not effect a net settlement order at day's end if one or more participants have insufficient balances. On the other hand, Fedwire, a wire transfer system operated by the Federal Reserve, makes payments by transferring funds directly from one depository's account at a Federal Reserve Bank to that of another.[5] Inability of a Fedwire user to cover its payments at the end of a day means that a Reserve Bank takes the loss, because funds received by a bank over Fedwire during the day are irrevocable once notification of a payment is received.

In both cases, risk arises because a bank can send more funds before the end of a day than are covered by its initial balance, plus its receipts, to that point during the day. Such a practice results in a "daylight overdraft." For example, consider a bank continuously borrowing overnight in the federal funds market: each morning it returns the previous day's borrowing over Fedwire, but can't actually cover that return of funds until later in the day when new borrowing has been arranged and received. The risk is that a bank might be unable to arrange sufficient new borrowing and therefore fail to repay its daylight overdraft.

Daylight overdrafts reflect daylight credit provided to the overdrafting bank either by the Federal Reserve on Fedwire, or by other banks on a net settlement system. The practice of relying on daylight credit creates credit risk for banks vis-a-vis their customers, for Federal Reserve Banks vis-a-vis Fedwire users, and for participants in net settlement systems vis-a-vis one another. Systemic risk is also created in the last case because the unexpected failure of one bank to settle might have a ripple effect as that failure makes it impossible for other banks to settle. In such a case, there is the potential for causing a classic banking crisis that could disrupt financial markets worldwide.[6] Rapid growth of large-dollar transfers relative to reserve deposit balances suggests that banks commonly resort to daylight credit to finance payments during the day.[7]

The Federal Reserve does not condone daylight overdrafts and, until relatively recently, they were probably rare. It was not until 1979 that the first measurement of daylight overdrafts was taken. Therefore, aggregate values of transfers relative to banks' deposit balances at Federal Reserve Banks is only suggestive of the likely growth of daylight overdrafts. Transfers were only about 20 percent of balances in 1950, 150 percent in 1970, but approaching 3000 percent in the past few years. Now, with use of powerful computerized accounting systems, it is possible for a bank to maintain an on-line monitor of its own and customers' daylight overdrafts. The Federal Reserve is able to monitor the daylight overdrafts of a bank across all large-dollar networks, at least after the fact. In the future, large-dollar trans-

4 This brief description simplifies a more complex settlement process. Only 22 banks' accounts actually receive a debit or credit at Federal Reserve Banks. Ten of these banks settle for the remaining 112 participants. A failure might reflect the inability of one of the 22 to settle its own position, or of one of the associate banks to meet its settlement obligation with a settling participant.

5 It is immaterial that the depositories may hold accounts at different Reserve Banks because the Federal Reserve Banks "settle-up" among themselves at the end of each day.

6 A thorough analysis of systemic risk is in David B. Humphrey, "Payments Finality and Risk of Settlement Failure: Implications for Financial Markets." Paper prepared for Conference on Technology and the Regulation of Financial Markets, New York University, May 1985.

7 Marcia L. Stigum cites the example of a large money center bank with daily payments 2½ times its *total assets. The Money Market,* Homewood, Illinois, Dow Jones, I-win, 1983. p. 585-6.

fer systems conceivably could operate on-line real time monitors that would prevent the use of daylight credit completely, thus requiring that cash be available in advance of each payment.

Daylight credit exposure is not a unique indicator of risk. Risk depends on the probability that institutions will not cover their daylight overdrafts by the end of a day, as well as, in the event of an actual failure to settle, the probability that claimants won't recover some or all of their loss in the liquidation of a failed institution. Payment system risk then depends jointly on the amount of daylight credit, on the soundness of institutions in daylight overdraft positions, and on the ability of depository institutions to control the amount of payments-related credit extended to other depository institutions during a day. Systemic risk—the risk that otherwise sound institutions will be swept up in a cascade of settlement failures—depends as well on the interrelatedness of institutions in the payments system. This is influenced heavily by the ability of the central bank, in its role as lender-of-last-resort, to prevent or isolate a settlement failure by providing overnight credit at the end of a day.

Reliance on daylight credit is not troubling in itself. Rather, it is the uncontrolled and unrationed provision of daylight credit that is troubling. As long as daylight credit is unrationed, risk creation is subsidized and daylight credit becomes overused. Fedwire has no explicit price for providing daylight credit and, because there is no well-developed private market for daylight credit, has little basis for setting such a price. Until the current risk-control policy began to be developed, Fedwire also did not have an effective limit on daylight overdrafts for any but visible problem banks.

It can be argued that there is implicit pricing of daylight credit in net settlement systems.[8] Receivers of funds transfers (suppliers of daylight credit) face a cost in the form of some probability of loss. They therefore have an incentive to limit the amount of daylight credit they extend to each other participant. However, this argument is weak, unless the computerized net settlement system provides a feature that both allows participants to set such limits, and enforces them by preventing transfers that would breach a limit. Moreover, the whole argument breaks down when, as appears to have been the case, there is a widespread presumption among banks that the Federal Reserve, as the lender-of-last-resort, would lend to a participant that is otherwise unable to settle rather than let a settlement failure take place and risk a systemic wave of failures.

II. The Mechanism for Risk Control

The risk-control policy establishes three requirements for every net settlement system: 1) each participant should be able to set a bilateral limit on the net amount of daylight overdraft credit it is willing to extend to each other participant; 2) each participant should be subject to a limit on the amount of daylight overdraft credit it uses; 3) the net settlement system should include an on-line monitor to reject or hold payments that would breach either limit.[9]

In the case of Fedwire, banks will be subject to a daylight overdraft limit in the form of a dual "cap." One part of the cap limits a bank's average daylight overdraft position during a two-week required reserve maintenance period. The other part limits a bank's overdraft during any single day of that two-week period.

A potential problem with independent daylight overdraft caps for each large-dollar system is that they would not distinguish institutions using only one system from those using two or more systems. Consequently, each net settlement system must provide data to the Federal Reserve so that it can monitor the risk exposure each bank creates simultaneously over all systems relative to that bank's daylight overdraft cap on Fedwire. If a bank's overdrafts across all systems exceed this limit, the Federal Reserve Bank could counsel the bank and/or advise the appropriate examiner about the situation, or the Federal Reserve could reject a bank's Fedwire transfers that exceed its overdraft limit.

A bank seeking permission to run daylight overdrafts must undertake a self-evaluation of its creditworthiness, credit policies, and operational controls and procedures. This self-evaluation must include a review by its own board of directors, and the bank must maintain records as a basis for examiner inspection and comment to the directors. The bank thereby will establish its own overdraft limitations, but these must lie within Federal Reserve guidelines. The guidelines are expressed in terms of a multiple of the institution's capital. (See box.) Should this volunatry process not be taken seriously, "...the Board (of Governors) will reconsider its options, including the adoption of regulations designed to impose explicit limits on daylight credit exposure."[10]

In summary, each depository institution, including each Federal Reserve Bank, can now manage the net amount of daylight credit it extends to each other institution; each institution must undergo self-evaluation necessary to obtain

8 For discussion of risk and pricing, see David L. Mengle, "Daylight Overdrafts and Payment System Risks," *Economic Review* Federal Reserve Bank of Richmond, May/June 1985 pp. 14-27.

9 This was a feature of the Board's interim risk-reduction policy adopted in 1982.

10 Policy Statement Regarding Risks on Large-Dollar Wire Transfer Systems, p. 10.

The Cross-System Net Debit 'Cap'

At the heart of the new risk-control policy is a cross-system sender net debit cap. The sender is a bank, making payments over Fedwire. A net debit cap is a dollar limit on the amount of daylight credit a bank may draw by sending payments in excess of the sum of its opening balance and payments received up to any point during the day on Fedwire. The limit is "cross-system" in that, for banks that participate in net settlement systems such as CHIPS, the amount of daylight credit allowed under the limit set on Fedwire will be reduced by the net amount of daylight credit the bank has drawn on those net settlement systems.[a]

Clearly, a bank's cross-system daylight credit use, or net debit position, must vary over a day, beginning and ending at zero, but rising above zero whenever the opening balance, plus payments received, fall short of payments made. The cross-system net debit cap has two forms. One is a limit on the two-week average of a bank's maximum daily net debit position, with the average taken over each two-week required reserve maintenance period. Averaging provides flexibility for banks to operate within the unpredictable ebb and flow of payments traffic, while abiding by the intent of the risk-control policy. The other form of the cap is a limit on a bank's maximum net debit during each day of the two-week period. This cap is higher than the two-week average cap, but effectively puts a limit on the flexibility built into the averaging process. If a bank is at the one-day limit for one or more days of the period, then it must be below the two-week average for one or more days in order to stay within the average.

Dual Cap

Multiple of Adjusted Primary Capital

Cap Class	Two-Week Average	Plus	Single Day
High	2.0		3.0
Above Average	1.5		2.5
Average	1.0		1.5
No Cap	0		0

The Board's Policy Statement includes a discussion of the cap-setting procedure banks should employ and how self-judgements of creditworthiness, credit policies, and operational controls and procedures might be combined into the single summary self-classification required to obtain a cap higher than zero.[b]

a. The Fedwire limit will not be raised if a bank has been a net supplier of credit on a net settlement system.

b. Other details of the procedure also are included in the Statement, including a definition of adjusted primary capital; treatment of Edge Act and Agreement Corporations, U. S. Branches and Agencies of Foreign Banks, and New York Article XII Investment Companies; and implications for Book-entry Securities Transfers, Automated Clearinghouses, Net Settlement Services, and additional matters.

BOX 1

a nonzero limit on the aggregate net amount of daylight credit it draws from all systems during an interval; the Federal Reserve Banks will monitor the daylight overdraft positions of institutions on Fedwire relative to their self-imposed caps, normally after the fact, but net of any daylight credit obtained on other funds transfer networks.

III. Institutional Adjustments for Risk Reduction

Incredulity was a common reaction to early discussions of reducing risk on large-dollar transfer systems.[11] How could half-a-trillion dollars or more of daily payments possibly be resequenced so that, with only $20-30 billion of cash deposits, those payments could still be made, but with less reliance on daylight overdrafts? Each sender might wait until enough payments were received before payments were sent, but every delayed send would, of course, mean a delayed receipt for someone else. Given the small cash base and limited time during which transfer networks are open (the working day sometimes extended into the evening), the result seemed more likely to be "gridlock" than smoothly functioning transfers of funds. The emphasis on creating a risk-control mechanism first, with high overdraft limits based on self-evaluation, seems to have submerged this kind of reaction. But when future steps are taken to use the mechanism to reduce risk, how will smoothly operating payments be maintained consistent with reduced daylight overdrafts and reduced risk?

Two kinds of changes, induced by market incentives, should take place that could achieve the desired result. One kind would purchase reduced risk directly, as individual banks reallocate their operating and portfolio resources to live within overdraft limits. The other kind would result from innovations in standard arrangements for interbank payments and financing.

Direct *Risk* Reduction: Banks may reduce the amount of daylight credit they extend as well as reduce their own use of daylight credit simply because nationwide attention has focused on the problem. Heightened awareness and better information may bring more prudent behavior. While many banks have monitored and managed their own and their customers' daylight overdraft positions for many years, others apparently have not. As a result of the educational program and preparation accompanying implementation of the Board of Governors' risk policy, banks now may be less generous in accommodating other banks' and customers' use of daylight credit, thereby reducing their own need for daylight credit. Setting more prudent limits, or col-

11 See, for example, Stigum.

lecting fees for scheduled extensions of daylight credit to customers, would have this effect. Similarly, with the ability to specify binding bilateral net credit limits in net settlement networks, banks may be less generous in accommodating other banks' use of daylight credit. Risk reduction will then result both from reduced daylight overdrafts and from improved credit quality resulting from continuous, explicit risk management.

Banks also might delay making some payments until later in the day in order to reduce their reliance on daylight credit. Of course, the resulting delayed receipts might increase reliance on daylight credit at other banks. However, many depositories and customers never use daylight credit and, in fact, maintain positive balances throughout the day. Thus, some overall reduction in daylight credit is possible through more careful management of the timing of payments.

Banks could elect to hold larger overnight balances at Federal Reserve Banks from which to make payments during the day. This might seem to be an expensive adjustment costing a bank the foregone earnings on those extra reserves. However, a bank can elect to hold additional sums as a clearing balance on which earnings credits can be used to pay for priced services. In either case, banks might make this a part of a least-costly method of reducing daylight overdrafts.

Risk declines as bank capital grows, providing more room for institutions to operate within caps set on a "times capital" basis. Maintaining a higher capital position might also seem to be an expensive adjustment, but may be worth the price. Moreover, many banks are already adding, or planning to add, to capital as they adjust to potential loan quality problems and comply with regulatory guidelines for safety and soundness. Even without any change in daylight overdraft practices, more highly capitalized institutions might present lower risk.

Another fertile field for reducing daylight overdrafts lies in the liability management of depository institutions. About two-thirds of Fedwire transfers reflect federal funds transactions, as borrowing banks repay the previous day's borrowing and then, typically, replace that with fresh borrowing for the current day. Extending the maturity of bank financing could yield substantial dividends in reduced Fedwire traffic and reduced daylight overdrafts of Federal Reserve Bank accounts. Risk exposure of the Federal Reserve Banks certainly would decline, but risk exposure of others might grow. Longer-term financing would add to lenders' risk of illiquidity (that is, of using costly methods to meet unexpected needs for cash) and, all else unchanged, add to lenders' and borrowers' interest rate risk (that is, of unexpected changes in maturity rate spreads). Uninsured lenders, replacing overnight with longer maturity loans, would also face a slightly different credit risk. No longer could they rely on Federal Reserve Banks to assume credit risk each morning, as they had when overnight loans had been returned. The "musical chairs" of repayment thus would be spaced further apart.

Moving the bearer of risk from Federal Reserve Banks to private market lenders does not represent evasion of risk-reduction policy. Widening the scope of market scrutiny and the opportunity for risk pricing should be expected to encourage more conservative behavior by borrowing banks.

Innovations: Substantial reductions in daylight overdrafts at individual banks could emerge from innovations in some long-standing market practices. Some of these innovations might only evade the risk-control mechanism by shifting risks outside the monitor, and will not be acceptable.[12] Others would, in fact, reduce risk and are to be encouraged. Distinguishing between the innovations will require careful investigation. The three examples of suggested changes discussed here might be acceptable if carefully structured and are offered to indicate the range of ideas being developed in the market in response to the risk-control policy.

An alternative to replacing overnight financing with longer-term borrowing would be to develop a "rollover" practice in overnight credit markets. Borrower and lender might agree that, unless either wished to terminate the entire credit, all or part would be rolled over at the relevant daily rate each day. A single daily transfer could cover interest, plus any agreed change in the outstanding amount of the loan. This would eliminate the need to transfer the full amount of borrowing both back and forth each day. Credit risk from overnight lending would remain, but would not become a daily daylight payment risk either for the Federal Reserve or for participants in net settlement systems.

Access to a rollover loan, as well as its price, presumably would depend on the creditworthiness of the borrower as viewed with more intense lender scrutiny than for a typical overnight loan today. In this way, the transfer of risk from Federal Reserve Banks and participants in net settlement systems should generate incentives for more conservative behavior by borrowers.

Another substantial portion of the traffic on large-dollar transfer systems flows among banks that, for themselves or for dealer customers, are settling securities or foreign

12 The Policy Statement (pp. 30-31) specifically, "reaffirms its (earlier) policy that institutions may not use Fedwire or other payments networks as a method of avoiding risk-reduction measures."

exchange transactions. Current practice typically involves gross next-day settlement of securities transactions, meaning that banks send one another payments for each transaction. Each day, two banks active in handling security market operations typically will send each other multi-million dollar payments that are more or less offsetting. These payments are initiated and received in automated systems on the basis of trades known in advance because they were done on the previous day.

The alternative would be for two banks to offset the payments due to one another, replacing those two payments with a single transfer of the net difference due to one or the other institution. Daylight credit risk would be reduced if the banks adopted new legal agreements defining obligations to be for this net position rather than for gross positions.[13] Heretofore, the incentive for this kind of economizing on payments traffic was primarily the cost of a funds transfer—at most a few dollars per transfer. The additional incentive of avoiding more costly means of daylight overdraft reduction might provide the impetus for devising offset arrangements. As in the case of federal funds rollover, offset payments would not eliminate all risk. Banks would be exposed to risk of a failure to settle the net amount due, but the amount at risk would be much smaller than the gross amounts now exposed.

Development of a day-loan market is another institutional change frequently cited as promising daylight overdraft relief. The Federal Funds market is the source of one-day maturity loans of cash in the form of deposit balances at a Federal Reserve Bank. Similarly, a day-loan market would be the source of loans of cash, but with same-day maturity. Just as banks may charge a fee to customers who daylight overdraft their accounts, so too, for a fee, banks might be able to borrow and lend cash for repayment later in the day. Such a procedure seems technologically feasible, especially if it were encouraged by provision for priority-funds transfer messages that would bypass a queue of payment orders on large-dollar transfer systems. Some banks will always have positive balances that might be loaned to others who want to make payments but who are at their daylight overdraft limits.

A day-loan market is not an institutional development that would directly reduce risk. Rather, it would transfer risk from the Federal Reserve Banks and the whole set of participants in net settlement networks to the institutions making day loans. However, it may indirectly reduce risk by making exposures more visible so that market discipline would ration credit to risky institutions with increased certainty.

These three examples of institutional changes—rollover, offset, and day loans—have not happened yet, but they, and others like them, suggest promising ways in which market practices might be expected to adjust to future efforts to use the new risk-control mechanism to reduce risk in large-dollar transfer systems.

IV. Concluding Remarks

An important result of the risk-control policy now in place is that each depository institution's cross-system use of daylight credit can be monitored relative to caps that are themselves related to the institution's self-evaluated creditworthiness. Initial caps are not expected to result in any significant disruption in large-dollar funds transfer service. Nonetheless, some depository institutions are having to adjust their operations to meet the policy limitations. This, plus the adjustments of other institutions recently sensitized to the risks, should at least dampen the growth of daylight overdraft risk exposures. However, conclusions must await experience under the new limitations because payments patterns may change in response to these initial adjustments, perhaps creating daylight overdraft problems for institutions that had not previously experienced them.

Once the situation settles down, the Federal Reserve Board of Governors fully expects to move further toward reducing risk, perhaps, for example, by ratcheting down "times-capital" cross-system daylight overdraft limits. In the meantime, banks can develop operational and institutional changes that will reduce and redirect risk without disrupting the payments system. In return, Federal Reserve Banks' risk exposure on Fedwire should diminish and market discipline should play a larger role in controlling risk.

13 Such an arrangement, said to be the first of its kind, is expected to start operating soon in London, involving settlement of foreign exchange transactions among major international banks. See "International Financing Review," Issue 622, May 17, 1986, pp. 1496-7.