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A policymakers' guide to economic forecasts

Steven Strongin and Paula S. Binkley

Economic forecasts have always had an uneasy relationship with monetary policy. Policy clearly must focus on the future; however, just as clearly, policymakers need a firmer foundation for current actions than projections about tomorrow's economic performance. The reluctance of policymakers to rely on economic forecasts is understandable. There is a large body of research evaluating the accuracy of economic forecasts and demonstrating that, while forecasts do contain useful information, they can also be seriously misleading.

To offset these well-known limitations of economic forecasts, policymakers have used historically robust long-run relationships to supplement economic forecasts. The targeting of the money supply from 1979 to 1982 is a good example of a case where the long-run relationships were dominant over short-run forecasts in the formation of policy.

In the 1980s we have seen many of these long-run relationships falter, for a variety of reasons, including financial deregulation and industrial restructuring. Many economic relationships of great historical persistence have simply vanished. For example, velocity, the key summary measure of the usefulness of monetary targeting, has been extremely unstable during this decade. As a result of the failures of these long-run guides to policy, forecasts have become increasingly important in the process of policy formation.

If policy is going to be forced to rely more heavily on economic forecasts, it is useful not only to analyze the general accuracy of those forecasts, as previous studies have done, but also to assess the accuracy of revisions to those forecasts. The making of policy is a continuous process. New information arrives, that information is incorporated into the policymaker's understanding of the economy, and then policy is revised in accordance with that revised understanding.

Unfortunately, economic information is not always accurate. Often new information that seems very important turns out to be either a short-run anomaly or just plain wrong, later revised to show an entirely different course of events. As a result, forecasts are sometimes revised in the wrong direction and actually become less accurate as new information is applied.

The frequency with which new information is misleading has strong implications for the day-to-day management of policy. If incoming information is highly reliable then policy should respond quickly and forthrightly to that information. On the other hand, if the reliability of incoming information is in serious question then the policymaker should wait for confirming evidence. In general, the lower the reliability of the new information, the more evidence the policymaker should require before changing policy.

This study analyzes the accuracy of forecast revisions in order to determine the amount of evidence that should, in general, be required to significantly improve the policymaker's information about the current economic outlook. The results of the analysis are dramatic. Forecast revisions, *during the year being forecast,* are as likely to worsen as to improve the accuracy of the forecast with as much as six months' additional economic information. These results make a strong case for policymakers or any other users of economic forecasts to be extremely cautious when responding to current economic statistics. We found that forecasts were often revised significantly in the *wrong* direction in response to supposedly clear economic signals. Early forecasts were often more accurate than their mid-term forecast revisions. In such an environment, it is important for policymakers to wait for full verification of economic trends before acting. Early signals simply are not reliable.

Methodology

This study uses a straightforward approach to analyzing revisions to economic forecasts. The Conference Board publishes, in its monthly *Statistical Bulletin,* a set of current, publicly available, economic forecasts. These

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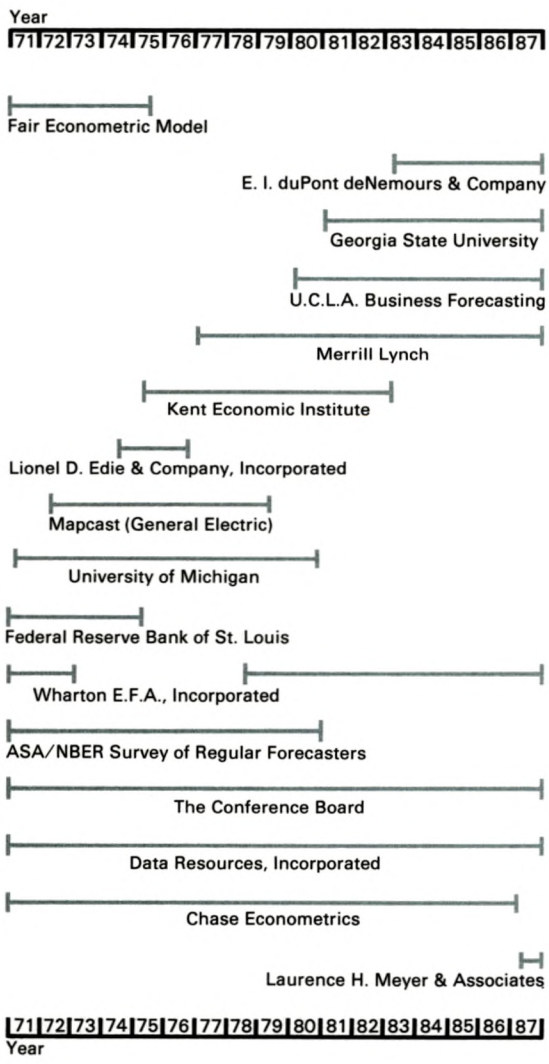
Figure 1
Forecasters and periods of publication



forecasts were used to construct a small database of revisions to macroeconomic forecasts, specifically forecasts of real GNP growth and inflation. Figure 1 shows the forecasters whose forecasts were published and over what time periods those forecasts were available. There was a wide range of participants from academics, such as UCLA Business Forecasting, to commercial forecasting firms, such as DRI and Chase Econometrics.

While some other broader surveys, such as the Blue Chip, could have been used, the Conference Board survey offered a number of advantages. All of the forecasts it contains are normally publicly available and the methods of the participants well known. The relatively limited number of participants allowed us to examine the numbers closely to make sure that no peculiarity of some individual forecast or small group was generating the results. Further, the sample is monthly back to 1971 which produced a good balance between frequency of forecasts and years of availability.

The forecasts for any given month were averaged to create a single forecast. The averaging was used to represent the overall evolution of a consensus view of the economy. From a purely statistical viewpoint, other methods may be preferable, but a simple average probably captures the essence of how forecasts enter the policy process. The study does not attempt to model or examine whether or not forecasters are using information correctly; it restricts its attention to the overall flow of information which the policymaker receives. Specifics of the forecasting process are ignored in favor of analyzing the final output of the forecasting process.

It might be argued that it would have been more informative to examine the actual data streams of incoming information. This approach suffers from two significant flaws. The first is that different information sets are given different weights at different times. Economic series are often contaminated by widely known events. For instance, capacity utilization numbers are often discounted because of ongoing structural adjustments in the economy. Financial flow variables are often discounted around April 15 because of the well-known but nevertheless random effects of tax day. The use of forecasts, rather than actual data streams, abstracts from the difficulties of having to adjust for known, but statistically unstable, flaws in the data.

The second problem in examining the specific data flows is also the more fundamental. From a policy perspective, the question is not why forecast revisions have a given behavior pattern, it is what information can be derived from those revisions. Whether the poor performance of forecast revisions that we will examine later in this paper is due to the quality of information, the way that information is used, or some other peculiarity of the process, is secondary to an understanding of exactly how bad that performance is. As we attempt

to address the problems that the current study raises it will be necessary to examine the why's, but that is beyond the scope of this paper.

Revisions were studied over the year being forecast. For instance, when we discuss the forecasts for 1987, the January forecast of 1987 would be the forecast of growth from fourth quarter of 1986 through the fourth quarter of 1987 made in January of 1987. And similarly, the December forecast would be the forecast of growth from the fourth quarter of 1986 to the fourth quarter of 1987 made in December of 1987. In a very real sense, the December forecast would be a forecast of the previous year. Thus, as the year progresses the information being built up is not only about trends, but about actual economic performance of the period being forecast. In such a case, it might seem reasonable to assume that a rather steady and rapid improvement in forecasts would be evident. As we shall see, this is not the case.

Forecasts of real GNP growth

The time paths of each year's forecast errors for real GNP growth and inflation are shown in the graphs in Figure 2. The graphs show the error in each forecast as measured against the first Bureau of Economic Analysis benchmark estimates of actual economic performance. As can be seen, there is a tremendous diversity of experience. Only 1982 exhibits what might be naively thought of as a typical pattern of learning—a year either stronger or weaker than expected, with forecasters steadily updating their forecasts in the appropriate direction. More typical of actual experience, though clearly the word typical overstates the case, is 1987, where the initial forecasts were fairly accurate. As the first few revisions were made the forecast drifted off, and then about mid-year the forecast began to steadily improve.

It is evident from an examination of the patterns of revisions in the graphs contained in Figure 2 that it is very common for forecasts to drift away from, rather than toward, truth. There is a very good reason for this. As the forecasts originally had all previous information built into them, revisions to forecasts are totally at the mercy of the very latest economic statistics and thus likely to reflect all of the limitations and false signals contained in those statistics. So the fact that forecasts often track off-course does not come as any particular surprise. It just demonstrates what policymakers and forecasters have known for a long time—that great caution should be exercised when forecasting economic trends from one month of data.

The key question is how much data is necessary to give the policymaker some confidence that the latest numbers are actual evidence of a trend rather than statistical noise. The magnitude of the difficulties in interpreting incoming data comes out quite strikingly in Table 1. For the sake of simplicity the number of forecasts examined is reduced to January and the end of each of the four quarters of the year. Table 1 compares the accuracy of forecasts at the end of each quarter to the accuracy of the forecasts made in January. This is useful because in January no actual data for the year being forecast is available, but as time goes on every quarter's forecast contains an additional quarter's worth of economic information about the year being forecast.

In only 7 of the 17 years covered by the database was there any improvement in the forecast of real GNP by the end of the first quarter and in only 8 of the 17 years was there any improvement by the end of the second quarter. This is less than an even money result, indicating that through the first half of the year current economic information is at least as likely to mislead the economic forecaster or policymaker as it is to help. By the end of the third quarter, in 11 of the 17 years the forecast has moved in the right direction. This is at least indicative of some improvement; though on purely statistical grounds, it is still insufficient to flatly reject the hypothesis that incoming information is not providing any useful input to the forecaster.[1] By the end of the fourth quarter, forecast accuracy has improved substantially.

Table 1
Real GNP forecast improvement record

Periods compared	Number of years in which improvements occurred
Q1 to January	7 out of 17
Q2 to January	8 out of 17
Q3 to January	11 out of 17
Q4 to January	15 out of 17

Figure 2
Forecast error time paths

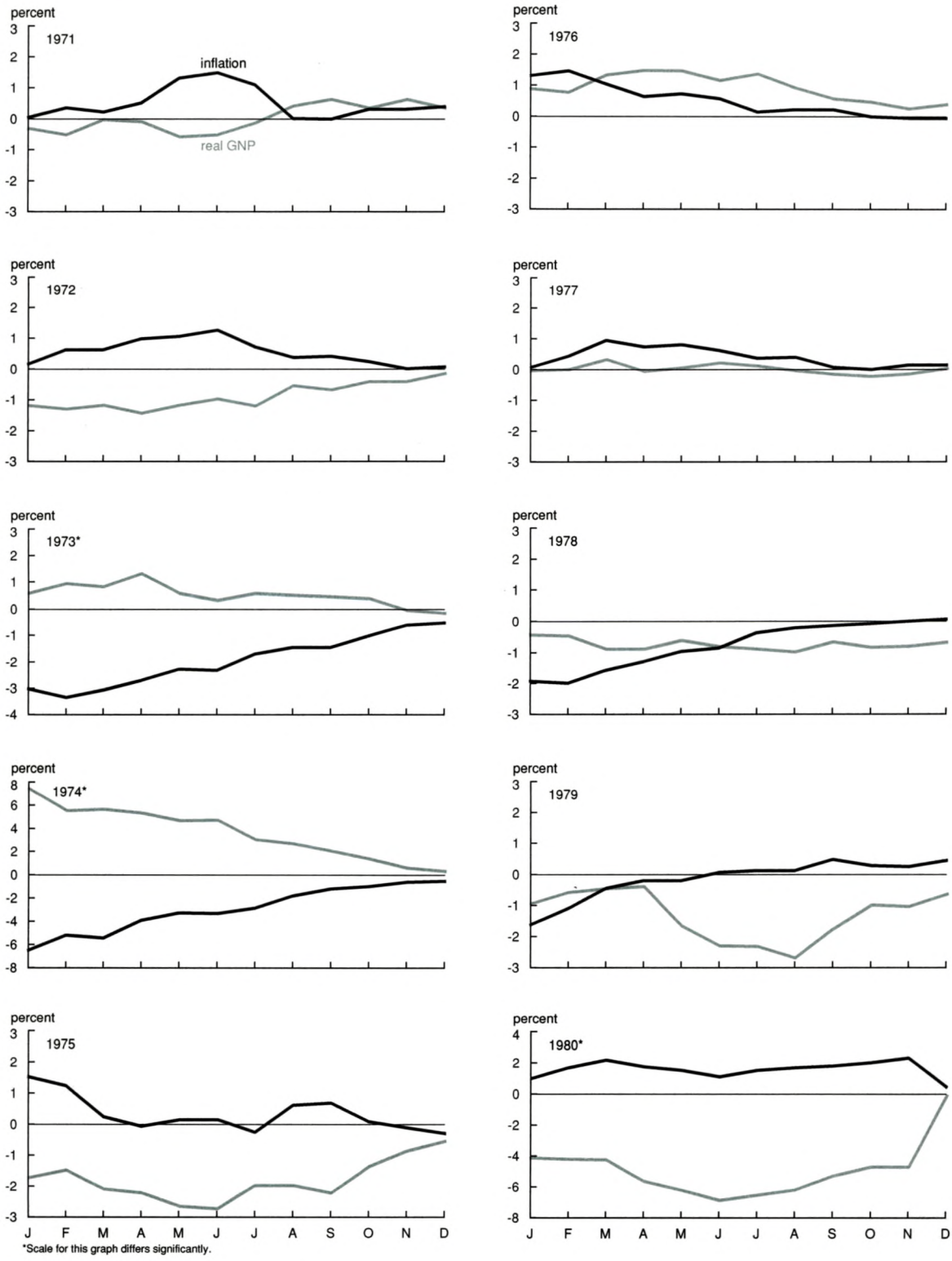
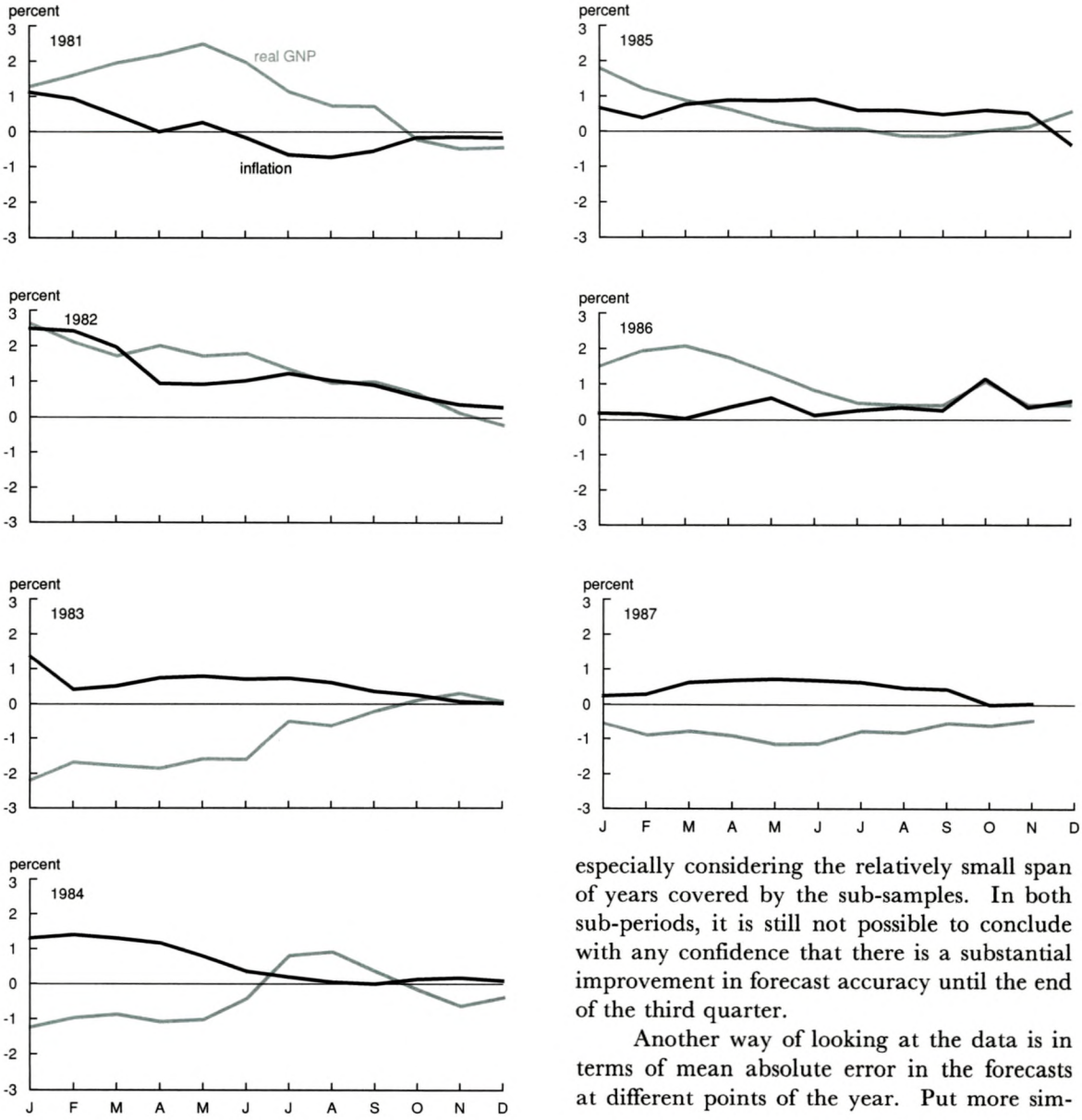


Figure 2
Forecast error time paths (cont'd)



One immediate question that the very poor improvement record of real GNP forecasts raises is whether this a peculiarity of some particular set of years. Table 2 shows the percentages of improvement in forecasts for the first and second half of the time period investigated. While the 1971-1979 period is worse than the 1980-1987 period, neither period shows substantially different qualitative results, especially considering the relatively small span of years covered by the sub-samples. In both sub-periods, it is still not possible to conclude with any confidence that there is a substantial improvement in forecast accuracy until the end of the third quarter.

Another way of looking at the data is in terms of mean absolute error in the forecasts at different points of the year. Put more sim-

Table 2
Real GNP forecast improvement record*

Periods compared	1971-1986	1971-1979	1980-1987
01 to January	41%	33%	50%
Q2 to January	47%	33%	63%
Q3 to January	65%	44%	88%
Q4 to January	88%	78%	100%

*Percent of forecast revisions which improve forecast

Table 3
Magnitude of difference between forecasted and actual real GNP growth rates

Forecast as of	Average absolute error
January	1.70
End of Q1	1.59
End of Q2	1.67
End of Q3	1.05
End of Q4	.35

ply, what is the average size of forecast error across the year being forecast? This is subject to some objections because, unlike statistics based on the percentage of years in which forecasts improve, statistics about size of error can easily be dominated by a few especially bad years. Nevertheless, Table 3 shows the mean absolute error of forecasts at the same point of time during the years investigated in previous tables. Here the picture looks somewhat better, with some moderate improvement over the year, though even here the forecasts actually get worse from the end of the first quarter to the end of the second quarter.

However, the graphs in Figure 2 indicate that much of the observed improvement in forecast accuracy could be due to rather massive improvements in forecast accuracy in 1974 and 1980 when the January forecasts were very wrong (so much so, in fact, that those years required special scaling in Figure 2). Table 4 shows the results of Table 3 when 1974 and then 1974 and 1980 are removed from the data sample. With the exclusion of these years no

Table 4
Magnitude of difference between forecasted and actual real GNP growth rates

Forecast as of	Average absolute error
(Excluding 1974)	
January	1.34
End of Q1	1.34
End of Q2	1.48
End of Q3	.99
End of Q4	.35
(Excluding 1974 and 1980)	
January	1.15
End of Q1	1.14
End of Q2	1.12
End of Q3	.70
End of Q4	.37

improvement in forecast accuracy is noticeable until the end of the third quarter. So, at least for real GNP forecasts, the data would indicate that six to nine months of data would normally be required to provide a good case for revising policy based on economic forecasts. Even a very sympathetic reading of the data could not push that number much lower than six months. This is not to imply that large-scale events should not cause policymakers to act, but it does suggest that policy actions should be based on a fundamental understanding of the events themselves and not merely derived from incoming, and often preliminary, economic statistics or economic forecasts.

One important thing to remember in this regard is that an event that might cause a recession in the absence of a policy change may not do so if policy does, in fact, react. In such a case economic forecasts might go wrong not because they fail to understand the economic events, but because they underestimate the policymaker's ability or willingness to respond to those events. Thus, the statistics presented above cannot be used to argue against policy action, but only provide a cautionary note about the amount and type of information required to justify policy action.

Forecasts of inflation

Here, the news is a little better. Forecasts of inflation show a marked tendency to improve with additional information. As Table 5 shows, at the end of the first quarter there is an improvement in 9 of 17 years, and by the end of the second quarter there is improvement in 11 of 17 quarters, indicating that within 6 months there is some reason to think that inflation forecasts have improved. Table 6 shows the time sub-sample breakdown of this result. The sub-sample results appear to indicate that much of the observed improvement in the accuracy of inflation forecasts was due to the

Table 5
Inflation forecast improvement record

Periods compared	Number of years in which improvements occurred
Q1 to January	9 out of 17
Q2 to January	11 out of 17
Q3 to January	12 out of 17
Q4 to January	14 out of 17

Table 6
Inflation forecast improvement record*

Periods compared	1971-1986	1971-1979	1980-1987
01 to January	53%	56%	50%
Q2 to January	65%	67%	63%
Q3 to January	71%	78%	63%
Q4 to January	82%	78%	88%

*Percent of forecast revisions which improve forecast

1971-1979 period, with the more recent period again showing no real evidence of improvement until the end of the third quarter. However, an examination of the graphs in Figure 2 shows that many of the mistaken revisions to inflation forecasts in the 1980-1987 time period occurred in years in which the inflation forecast started out very accurate and varied little throughout the year, though veering slightly off. In fact, careful analysis of the graphs of the 1980s indicates that on the whole inflation forecasts do improve throughout the year.

In support of this visual evidence, Table 7 shows the average absolute error of inflation forecasts throughout the year and Table 8 shows the time sub-sample results. These numbers do indeed show a consistent improvement in the overall accuracy of inflation forecasts throughout the year. It should also be noted, in comparing Tables 7 and 8 to Tables 4 and 5 for real GNP growth, that inflation forecasts are on the whole more accurate and improve faster and with more consistency than the real GNP growth forecasts.

Table 7
Magnitude of difference between forecasted and actual inflation growth rates

Forecast as of	Average absolute error
January	1.45
End of Q1	1.27
End of Q2	.93
End of Q3	.56
End of Q4	.26

A digression

A side note is in order at this point. The view of forecasting and policy presented here is not universal. The criticism has often been made of both policymakers and forecasters that they are not sufficiently sensitive to turning points in the economy and that as a result the economy has, all too often, been allowed to slip into recession. In this view, it is all right if we occasionally respond to weakness in the economy that is not there, so long as we respond to weakness when it is there.

Table 8
Comparisons of inflation forecasts over different periods

Period	Average absolute error				
	January	End of Q1	End of Q2	End of Q3	End of Q4
1971-1987	1.45	1.27	.93	.56	.26
1971-1979	1.80	1.51	1.18	.52	.28
1980-1987	1.05	1.00	.64	.60	.25

The problem with this view is that it substantially underestimates the practical limitations of economic statistics implied by the previous analysis. While the specifics of forecasting turning points were not studied, it seems unlikely that economic data that cannot reliably be used to revise a forecast would nevertheless be sufficient to sniff out a sudden unexpected recession. Rather, it seems likely that if policy strongly reacted to downward revisions in the outlook it would be in a constant fight against imaginary recessions, inevitably leading to major inflationary excesses.

The economy generates too many false signals to allow reliable forecasting of events that evolve quickly, such as economic turning points. Thus, at least within the context of normal forecasting methods and our current ability to interpret economic information, turning points are unlikely to provide a reasonable focus for policy.

Conclusions

From the point of view of the day-to-day management of policy, it is clear that changes in the economic outlook provide only minimal guidance to policymakers. Further, even over the span of six to nine months more attention should be paid to revisions in inflation forecasts than to revisions in real GNP growth forecasts. This is not to say that economic analysis provides little benefit to policymakers. It simply points out the fact that it is the analysis of real events and fundamental factors in the economy that must guide policy and not the last round of forecasts based on the very latest economic statistics.

These results might be considered a guide to what we can reasonably expect economic analysis to provide to the policy process. It can provide a baseline understanding of how the economy is operating and how the overall thrust of policy fits into that operation. What we cannot expect from economic analysis and should not expect from policy is real time management of the economy. The data and our ways of filtering that data are simply not up to the task.

[1] Technically, if the direction of forecasts to or away from truth is modeled as a binomial process in 17 trials, 12 correct revisions would be required to reject the null hypothesis of incoming economic information containing no useful information at the 95% confidence level.

Appendix

Difference between forecasted and actual fourth quarter to fourth quarter growth rates

Forecast year	Difference (percentage points) January	End of Q1	End of Q2	End of Q3	End of Q4
			Real GNP		
1971	−0.30	−0.01	−0.50	0.64	0.36
1972	−1.18	−1.18	−0.98	−0.68	−0.15
*1973	0.58	0.83	0.33	0.46	−0.16
1974	7.42	5.64	4.75	2.03	0.32
*1975	−1.73	−2.10	−2.73	−2.23	−0.55
1976	0.90	1.34	1.17	0.59	0.40
1977	−0.03	0.33	0.22	0.16	0.02
1978	−0.43	−0.87	−0.80	−0.66	−0.67
1979	−0.96	−0.46	−2.30	−1.75	−0.64
*1980	−4.14	−4.26	−6.89	−5.28	−0.09
*1981	1.30	1.97	1.98	0.73	−0.42
*1982	2.64	1.73	1.80	0.99	−0.21
1983	−2.18	−1.75	−1.58	−0.19	0.08
1984	−1.23	−0.86	−0.41	0.35	−0.39
1985	1.79	0.89	0.07	−0.13	0.57
1986	1.51	2.07	0.82	0.41	0.41
1987	−0.56	−0.78	−1.13	−0.55	−0.47**

Forecast year	Difference (percentage points) January	End of Q1	End of Q2	End of Q3	End of Q4
			Inflation		
1971	0.06	0.23	1.50	0.00	0.41
1972	0.17	0.64	1.28	0.42	0.08
1973	−3.01	−3.05	−2.31	−1.43	−0.51
1974	−6.49	−5.41	−3.28	−1.18	−0.51
1975	1.53	0.25	0.16	0.69	−0.29
1976	1.32	1.04	0.58	0.23	−0.04
1977	0.07	0.96	0.63	0.07	0.15
1978	−1.92	−1.57	−0.84	−0.14	0.07
1979	−1.62	−0.44	0.07	0.48	0.45
*1980	0.99	2.20	1.11	1.82	0.47
*1981	1.13	0.49	−0.16	−0.54	−0.16
*1982	2.50	1.98	1.03	0.92	0.30
1983	1.36	0.52	0.71	0.36	0.02
1984	1.32	1.32	0.36	0	0.09
1985	0.68	0.77	0.92	0.48	−0.37
1986	0.20	0.04	0.13	0.27	0.53
1987	0.25	0.64	0.69	0.44	0.04**

*Years in which NBER turning points occurred.
**Figure for November 1987, last available forecast.

Government spending and the "falling rate of profit"

David Alan Aschauer

Over the last decade, various authors have noted the apparent "productivity slowdown" in the United States. Specific reference has been made to a "falling rate of profit" or a "profits squeeze" as an indicator of a reduction in the productivity of capital. This paper looks at the recent behavior of the rate of return to private capital and then considers the extent to which its movements can be explained by public sector capital accumulation as well as the overall level of government expenditures on goods and services.

Discussion of fiscal policy issues usually centers on the public sector deficit, its relation to financial market rates of return, and thereby its impact on private investment and economic growth. Little or no importance is placed on the precise way in which the deficit is created, whether by tax or expenditure changes, nor on the possible distinctive impacts which the two types of deficits may have on economic variables of interest.

Public investment policy, for example, may affect the level of private investment by altering the marginal product of private capital. New highways, airports, and modern power plants—components of a general economic infrastructure—are likely to heighten the productivity of private capital and spur expenditure on new plant and equipment. This paper examines whether such effects are large enough to explain the widely discussed fall in the return on capital in the U.S. economy and thus whether the size of the decline in public investment can potentially be linked to the slowdown in U.S. productivity growth.

Recent behavior of the return to private capital

We begin by examining the behavior of the rate of return to private capital held by nonfinancial corporations in the United States during the period 1953 to 1985. Two specific average rates of return, gross and net of physical depreciation, are employed. These rates of return are calculated as the ratio of corporate profits (with inventory valuation adjustment and capital consumption adjustment) plus net interest to the net stock of fixed capital, land, and inventories. The net stock of fixed capital is computed along "perpetual inventory" lines by subtracting from the gross capital stock (cumulative investment minus discards) an estimate of cumulative depreciation. For private capital, the depreciation methodology is straight-line over 85 percent of the service lives as published in Bulletin F of the Treasury Department. The gross rate of return exceeds the net rate of return by the ratio of the capital consumption allowance to the net capital stock.

Note three aspects of these average rates of return. First, the rates of return are limited to the nonfinancial corporate sector since published data on capital consumption allowances are confined to this category. Second, both the gross and net rates of return are pre-tax, with the exception that state and local property taxes are treated by the Commerce Department as a cost of production. Third, capital losses on the net financial assets held by corporations arising from inflation are ignored. The basic rationale for the second and third characteristics of these profit rates is that the attempt is to capture underlying technological relationships between the government spending variables and capital's marginal product.

The behavior of these rates of return during the period 1953 to 1985 is shown in Figure 1. The average values of the gross and net rates were 15.2 and 9.4 percent, respectively, implying an average rate of physical depreciation of 5.8 percent per year. Both rates achieved their maximum values of 18.4 percent (gross) and 13.0 percent (net) in 1965 and their minimum values of 12.2 percent (gross) and 5.6 percent (net) in 1982. Evidently, both rates of return exhibit a downward trend during the sample period. As the regressions in Table 1 indicate, before accounting for serial corre-

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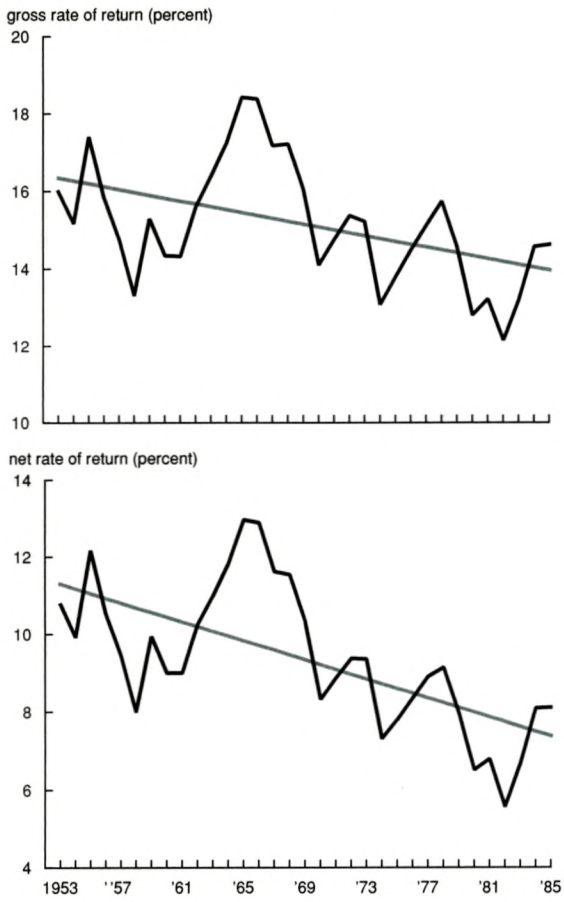
Figure 1
Rate of return to private capital



lation and cyclical effects the trend lines are highly significant, with the gross rate of return falling, on average, by 7.5 basis points per year and the net rate declining by a more substantial 12.2 basis points.

In a recent article, Feldstein and Summers (1977) investigated the behavior of similar rates of return and presented evidence that the downward trend apparent in the raw data disappeared upon accounting for serial correlation and cyclical effects. But the results presented here in Table 1 indicate that while the estimates of the trend are reduced in both cases, only the trend estimate for the gross rate of return becomes insignificantly different from zero at conventional levels. Indeed, the trend estimate in the net return case still implies a strong negative movement in the rate of return on the order of 7.5 basis points per year. This difference in trend behavior shows up in a strong positive trend in the implied depreciation rate of capital of 4.6 basis points per year (associated t-statistic = 9.426). On the other hand, the similarity in the response of both rates of return to cyclical factors implies that the depreciation rate is not affected, to any significant degree, by movements in the capacity utilization rate. This last result points out dramatically a basic deficiency in the depreciation methodology utilized by the Department of Commerce because we would expect true economic depreciation to be positively related to intensity of use of the capital stock.

Thus, some evidence of a falling return to private capital over the sample period remains even after controlling for serial correlation and the cyclical variability of capacity utilization. In the next section we consider the possibility that the public capital stock may play a leading role in explaining this trend in the nation's rate of profit.

Public capital, public spending, and the rate of return

We now focus on the importance of public sector capital accumulation to the rate of return to private capital. Consider, as a benchmark, a neoclassical production technology for aggregate output with employment (n_t), private capital (k_t), and public capital (k_t^g) as factor inputs.[1]

The fundamental hypothesis of interest is that the public capital stock is productive and complements the private capital stock in the sense that an increase in public sector capital—holding fixed private factors of production—raises the marginal product of private capital.[2]

We estimate the following rate-of-return equation:[3]

$$r_t\beta_0 + \beta_1 t + \beta_2 \ln(n_t/k_t) + \beta_3 \ln(k_t^g/k_t) + \beta_4 cu_t + z_t \qquad (1)$$

where r_t is the average rate of return to private capital (net or gross); n_t, k_t, k_t^g are defined as above and cu_t is defined as capacity utilization rate. The aggregate employment variable is total employment while the net public capital stock variable is obtained along perpetual inventory lines comparable to that of net private capital. The results of estimating equation (1)

Table 1
Rate of return to private capital

dependent variable	const	time	cu	p	DW	R^2	SSE
rg	.203 (11.301)	-.00075 (-2.901)	-	-	.696	.214	.006
rn	.178 (9.639)	-.00122 (-4.623)	-	-	.634	.408	.007
rg	.006 (.183)	-.00028 (-1.229)	.201 (6.053)	.386 (2.251)	-	.775	.002
rn	-.015 (-.424)	-.00075 (-2.976)	.196 (5.951)	.455 (2.755)	-	.843	.002

rg = gross rate of return to private nonfinancial corporate capital
rn = net rate of return to private nonfinancial corporate capital
p = first order autocorrelation coefficient
DW = Durbin-Watson statistic
R^2 = adjusted coefficient of determination
SSF = sum of square residuals

by ordinary least squares, as well as by first order autoregressive and instrumental variables techniques, are shown in Table 2. In all regressions, the signs of the estimated coefficients are in accordance with the neoclassical argument that a higher private capital-labor ratio tends to depress the rate of return to capital as well as the hypothesis that a higher level of public capital, given the levels of employment and private capital, raises the rate of return. As a specific case, focus on the ordinary least squares results. Holding fixed the level of employment, a 1 percent increase in the private capital stock (and hence in the capital-labor ratio) would lower the gross and net rates of return by $-(\hat{\beta}_2 + \hat{\beta}_3)/r$ percent, or by 38.4 and 38.1 basis points, respectively. A 1 percent increase in the public capital stock, relative to its private counterpart, would raise the gross and net rates of return by $\hat{\beta}_3/\bar{r}$ percent, or by 19.1 and 21.4 basis points. Public capital appears to be of comparable importance to private capital in determining the profitability of the nation's private stock of plant and machinery.

The introduction of the capital-labor and public-private capital ratios only slightly diminishes the role of cyclical factors in the movement in the return to capital. A one percentage point increase in the capacity utilization rate from its sample average value of 81.9 percent raises the gross rate of return by 15.1 basis points and the net rate of return by 14.8 points. Cyclical factors clearly appear to affect the profitability of capital in a positive fashion.

As noted, the results in Table 1 suggest—at least for the case of the net rate of return—that even after taking into consideration serial correlation and cyclical effects there is a downward trend in the profitability of capital. The introduction of the additional variables in Table 2 to help explain the rate of return changes the previous picture in a dramatic fashion. There is now a tendency for the gross and net rates of return to rise on the order of 50 basis points per year. This would imply a neutral rate of technical change of $(\hat{\beta}_1/\bar{r})$x100 per year, or 3.29 percent for the gross rate of return and 5.43 percent for the net rate of return. These point estimates are clearly too high, given the average growth rate of real gross national product of 3.2 percent during this period. Nevertheless, the more reasonable value of 2 percent per year falls within the 95 percent confidence intervals for estimates of both rates of return.

The values of the Durbin-Watson statistic lie within the inconclusive range of the test at the 5 percent level. To account for the possibility of serial correlation, equation (1) was reestimated with a first order autocorrelation correction. The estimated value of the autocorrelation coefficient was relatively low and statistically insignificant at the 10 percent level for both rates of return. Furthermore, the

Table 2
Rate of return to private capital and public capital

dependent variable	method	const	time	ln(n/k)	ln(k^g/k)	cu	p	DW	R^2	SSE
rg	OLS	1.490 (2.569)	.005 (3.171)	.171 (2.643)	.191 (4.547)	.151 (4.381)	-	1.551	.840	.0013
rn	OLS	1.455 (2.599)	.005 (3.125)	.170 (2.732)	.214 (5.273)	.148 (4.461)	-	1.473	.894	.0012
rg	FOAC	1.465 (2.107)	.005 (2.650)	.167 (2.158)	.198 (3.947)	.141 (3.767)	.220 (1.169)	-	.849	.0012
rn	FOAC	1.403 (2.044)	.005 (2.521)	.164 (2.142)	.219 (4.439)	.140 (3.839)	.254 (1.364)	-	.902	.0011
rg	IV	1.705 (2.782)	.005 (3.350)	.195 (2.851)	.202 (4.668)	.143 (4.057)	-	-	.841	.0013
rn	IV	1.762 (2.969)	.005 (3.461)	.205 (3.095)	.230 (5.481)	.137 (4.017)	-	-	.894	.0012

OLS = ordinary least square
FOAC = first order autocorrelation correction
IV = instrumental variables
rg = gross rate of return to private nonfinancial corporate capital
rn = net rate of return to private nonfinancial corporate capital
p = first order autocorrelation coefficient
DW = Durbin-Watson statistic
R^2 = adjusted coefficient of determination
SSE = sum of squared residuals

estimated coefficients and standard errors remained nearly unaltered.

An apparently troubling aspect of the estimation, particularly for the coefficient of the employment − private capital variable, is the possible simultaneity bias arising from the joint determination of employment and the rates of return. Treating the employment-capital variable as potentially endogenous, the equation was again reestimated by instrumental variables, with the trend value of employment relative to the private capital stock and time taken as instruments. The results are shown in the last two rows of Table 2. This aspect of simultaneity evidently is not a matter of particular concern.

Thus, it seems clear that the rate of return to private capital is strongly and positively related to the public capital stock. This offers a clue to the mystery of the downward trend in the profit rate over the sample period. For as can be noted from Figure 2, the ratio of public to private net capital stocks has fallen persistently since 1964, from a peak of .840 in that year to .564 in 1985. Given the employment − private capital ratio, this implies that gross and net rates of return to private capital have been depressed, relative to the level which would have arisen if the public capital ratio had been steady.

Figure 2
The declining ratio of public capital stock relative to private capital stock (1982 dollars)

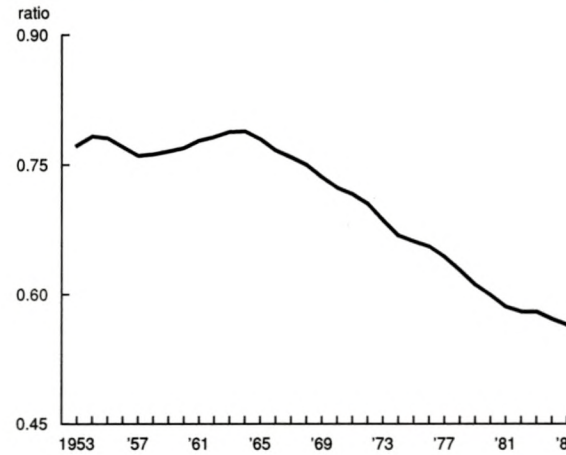


Table 3 contains estimates of expanded rate of return equations where the ratio of total government expenditure on goods and services to the private net capital stock has been added to the list of regressors. The introduction of this variable has no discernible impact on the estimated coefficients of the original variables, and its own estimated coefficient is of negligible statistical importance. Even taking the coefficient estimates as valid, the results suggest that a 1 percent increase in the level of government

Table 3
Rate of return to private capital, public capital, and government spending

dependent variable	method	const	time	ln(n/k)	ln(k^g/k)	ln(g/k)	cu	p	DW	R^2	SSE
rg	OLS	1.429 (2.379)	.005 (3.048)	.163 (2.413)	.178 (3.533)	.012 (.497)	.149 (4.242)	-	1.568	.842	.0012
rn	OLS	1.384 (2.392)	.005 (2.997)	.161 (2.479)	.198 (4.093)	.014 (.602)	.146 (4.319)	-	1.499	.895	.0012
rg	FOAC	1.419 (1.988)	.005 (2.586)	.161 (2.014)	.188 (3.253)	.009 (.342)	.141 (3.699)	.207 (1.081)	-	.849	.0012
rn	FOAC	1.354 (1.931)	.005 (2.471)	.158 (2.033)	.208 (3.696)	.011 (.398)	.139 (3.778)	.237 (1.245)	-	.902	.0011
rg	IV	1.653 (2.594)	.005 (3.224)	.188 (2.626)	.191 (3.679)	.010 (.405)	.142 (3.945)	-	-	.842	.0013
rn	IV	1.703 (2.768)	.005 (3.332)	.197 (2.850)	.218 (4.333)	.011 (.465)	.135 (3.907)	-	-	.895	.0012

OLS = ordinary least square
FOAC = first order autocorrelation correction
IV = instrumental variables
rg = gross rate of return to private nonfinancial corporate capital
rn = net rate of return to private nonfinancial corporate capital
p = first order autocorrelation coefficient
DW = Durbin-Watson statistic
R^2 = adjusted coefficient of determination
SSE = Sum of squared residuals

expenditure relative to the capital stock would raise the gross rate of return by only 1.2 basis points and the net rate of return by 1.4 points.

The evidence presented here suggests the importance of distinguishing not only between the financial and real elements of fiscal policy, but between various sorts of government spending as well. Specifically, while public capital boosts the profitability of private plant and equipment, the overall flow of government spending has little or no such impact.

Conclusion

The analysis of the effects of fiscal policies on aggregate economic variables may roughly be placed into financial and real categories. The new-classical or equilibrium approach to fiscal policy is often characterized, and criticized, as implying the "irrelevance" of budgetary policies on economic outcomes. Such characterization and criticism is inaccurate. While adherents to this approach typically claim such irrelevance for the particular lump sum financial policy pursued by the government, broad scope remains for fiscal policy effectiveness along real channels, including tax incentive and public expenditure policies.

Indeed, this paper has presented evidence which suggests that while the overall level of government spending on goods and services may not affect the marginal product of capital (more specifically, the return to capital) the accumulation of capital goods by the public sector does have such an effect. The elasticity of the rate of return to capital—gross or net of physical depreciation—with respect to public capital is strongly positive and of comparable magnitude to the corresponding elasticity with respect to private capital. Furthermore, the decline in the public capital stock, relative to that of private capital, accounts for much of the apparent downward trend in the profit rate in the United States over recent years.

[1] We may write the marginal product of capital as

$$r_t = \frac{\partial f}{\partial k}(n_t, k_t, k_t^g) \cdot g(u_t, t)$$

where $r_t \equiv$ marginal product of private capital, $n_t \equiv$ aggregate employment, $k_t \equiv$ private net capital stock, $k_t^g \equiv$ public net capital stock, and $u_t \equiv$ technological shock. Further, assuming that the primitive function f(·) is linearly homogenous in its arguments allows us to invoke Euler's theorem and write

$r_t \equiv h(n_t/k_t, k_t^g/k_t) \cdot g(u_t, t)$.

[2] Or $\partial h(\cdot)/\partial(k_t^g/k_t) > 0$.

[3] This is an approximation to the second equation in Footnote 1.

Appendix

Data used in this study

The raw data on the net fixed capital stocks are contained in Musgrave (1986 a, b), Tables 8 and 15. The year-end published data are converted to a mid-year average value for construction of rates of return.

The data on gross and net capital income are found in the *National Income and Product Accounts,* Table 1.16 (lines 20, 27, 35).

The land and inventory data are from *Balance Sheets for the U.S. Economy 1946-85,* pp. 21-25.

The capacity utilization rate, overall government spending (goods and services), and employment (total civilian labor force) are taken from the *Economic Report of the President* (1987).

year	rg	rn	k9/k	g/k	k/n	cu
53	.160	.108	.773	.362	17873.8	.893
54	.152	.099	.784	.316	18877.2	.801
55	.174	.122	.782	.291	18999.2	.870
56	.578	.105	.771	.280	19317.6	.861
57	.148	.095	.761	.282	20062.9	.836
58	.133	.080	.763	.287	21024.7	.750
59	.153	.100	.766	.281	21056.5	.816
60	.144	.090	.770	.277	21263.3	.801
61	.143	.090	.778	.286	21842.5	.773
62	.156	.103	.783	.292	22069.0	.814
63	.164	.110	.789	.289	22437.7	.835
64	.172	.118	.790	.285	22743.3	.856
65	.184	.130	.780	.280	23250.0	.895
66	.184	.116	.767	.289	23892.7	.911
67	.172	.115	.759	.298	24635.1	.867
68	.172	.103	.750	.295	25294.1	.870
69	.160	.083	.736	.278	25902.6	.867
70	.141	.089	.724	.259	26841.0	.792
71	.154	.094	.716	.248	27664.8	.774
72	.152	.094	.705	.241	27716.1	.828
73	.131	.073	.686	.227	27973.5	.870
74	.145	.078	.669	.221	28696.6	.826
75	.151	.084	.661	.219	29988.0	.723
76	.157	.089	.565	.214	29694.1	.774
77	.146	.092	.643	.210	29419.4	.814
78	.128	.080	.628	.208	29213.9	.842
79	.132	.065	.611	.201	29594.6	.846
80	.128	.065	.599	.198	30579.8	.793
81	.132	.068	.585	.194	31281.9	.783
82	.122	.056	.580	.194	32366.1	.703
83	.132	.067	.579	.193	32508.3	.740
84	.146	.081	.571	.195	31937.7	.805
85	.146	.081	.564	.202	32285.6	.801

rg = gross rate of return to private nonfinancial corporate capital
rn = net rate of return to private nonfinancial corporate capital
k9/k = ratio of public to private net capital stock (1982$)
g/k = ratio of total government spending on goods and services to net private capital stock (1982$)
k/n = ratio of net private capital stock to total employment (1982$)
cu = manufacturing capacity utilization rate

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Daylight overdrafts: Rationale and risks

Douglas D. Evanoff

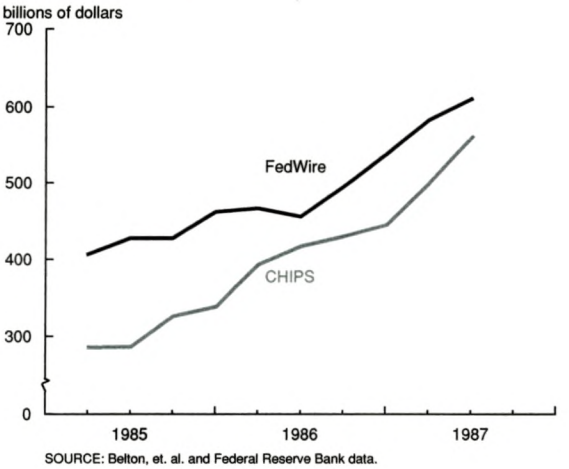
The U.S. payments system consists of thousands of economic agents transferring claims to financial assets. Although disagreement may exist on specific payment system issues—such as externalities, public-good aspects, and the proper oversight role of government—few people doubt the importance of a smoothly operating payment system to the efficient functioning of the economy. In fact, it has been argued that the necessity of assuring an orderly payment system is the major justification for regulation of the banking industry (Mussa 1986). Other observers emphasize the important role of the payment system but are less convinced about the need to regulate its operations closely.

Payment system risk resulting from nonsecured intraday credit extensions has recently come under increased scrutiny by banks and federal regulators. This paper analyzes that risk and, in particular, addresses issues related to intraday or daylight overdrafts on large-dollar transfer networks, i.e., the Federal Reserve's wire transfer system (FedWire) and the Clearing House Interbank Payments System (CHIPS). First it briefly describes the problem, some factors causing it, and the existing approach used by the Federal Reserve to contain the risks associated with daylight overdrafts. Next, a basic supply-and-demand model is utilized to determine the optimal levels of intraday credit and to analyze how changes in public policy, industry practices, and transaction activity could alter the level of overdrafts. The merits of alternative policies to limit daylight overdrafts are also considered.

Payment system risk

The largest dollar volume of transfers in the U.S. occurs through two large-dollar electronic transfer systems—FedWire and CHIPS.[1] Volume on these networks has grown significantly in recent years (see Figure 1). There are numerous reasons for this growth, including the maturity of financial markets, accounting practices, bank regulation, and profitable banking opportunities. The 1981 introduction of same-day settlement for CHIPS is believed to have had a significant effect on that network's volume.[2]

Figure 1
Average daily payments volume on large dollar transfer networks



SOURCE: Belton, et. al. and Federal Reserve Bank data.

These networks process transactions of comparable dollar magnitudes, although there are significant differences in the type of transactions and the mechanics involved.[3] Because the Federal Reserve guarantees the transfers, transactions on FedWire are transfers of final "good funds" between financial institutions.[4] CHIPS is a private network on which provisional transfers are recorded, followed by the actual settlement of net positions for each participant at the end of the day through the Federal Reserve.

Regardless of differences between the two networks, similar risks can arise. Using either network, an institution can transfer funds that are not actually in its account at the time of the transfer, thereby creating a "daylight" over-

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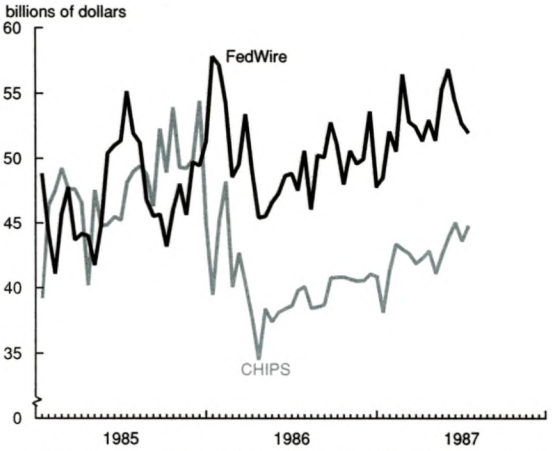
draft.[5] If, by the close of business, a bank is unable to cover transfers sent during the day, someone must bear the burden of the default. For transfers on FedWire, the Federal Reserve and, ultimately, the taxpayer would absorb the loss. CHIPS would utilize a potentially complex "unwinding" process in which all transfers initiated by the failing institution would be reversed. This unwinding, it is argued, could lead to defaults by other institutions that depend on funding from the initial defaulting bank. In a worst-case scenario, failure would spread throughout the banking system in a domino fashion.

The existing incentive structure for institutions to monitor and account for payment system risk is believed to have promoted the growth of daylight overdrafts. The receiving institution on a FedWire transfer is provided good funds by the Federal Reserve regardless of the condition of the sending institution. No incentive exists for the receiver to monitor the sending bank, because only the Federal Reserve stands to lose in the event of a failure.[6] This could cause daylight overdrafts to be greater than they would be in the absence of the Fed guarantee. Additionally, previous statements, as well as the actions of regulators, may lead institutions to believe that the regulators, out of fear of systemic failure, will intervene if a large institution defaults on a private transfer network such as CHIPS. The result is a tendency to ignore or play down risks associated with incoming transfers. The perception of little, if any, default risk increases the level of risk assumed beyond what private markets without a perceived guarantee would produce. This mispricing of risk on Fedwire is believed to have resulted in a significant increase in the level of daylight overdrafts.

Overdrafts and systemic risk

The growth in overdrafts has resulted in increased risk, which must be absorbed by payment system participants or the Federal Reserve. However, risk taking is not bad per se. It is an integral part of banking. Banks are in the business of managing risks, particularly those that are diversifiable. Many argue that, as long as payment system risk can be properly assigned, it should not be considered a major issue.

Figure 2
Daylight overdraft volume



SOURCE: Belton, et. al. Figures presented are biweekly average overdrafts which are derived by averaging each institution's maximum daily overdraft over the period.

The major public policy issue arises from the potential for systemic risk. While preventing contagious failures should be a goal of regulatory policy, no evidence exists suggesting that failures of this type have been common. Benston and Kaufman (1988), Benston, et. al. (1986), Rolnick (1983), and Aharony and Swary (1983) examined earlier periods and found few periods in which systemic risk appeared to be the cause of failures. However, if there were substantial evidence that daylight overdrafts would lead to systemic failure, it would justify regulatory intervention in this activity.

Such evidence was the topic of a recent study. Using actual transfer data, Humphrey (1986) simulated the effects of the unexpected settlement default of a major CHIPS participant.[7] A similar exercise was conducted based on the default of a large associate participant, i.e., one settling through a major participant. It was assumed in each situation that settlement default by one party would lead to an unwinding of transactions, according to CHIPS guidelines. This unwinding of transfers would obviously affect the positions of other participants.[8] Humphrey assumed that the unwinding would cause other participants to be unable to settle if their new net position was negative *and* was deteriorated by an amount equal to or exceeding their equity capital. This then precipitated an additional round of unwinding. The simulation continued until all participants

in the hypothetical analysis were able to settle according to the above criteria.

The findings were quite dramatic. The hypothetical failure of a large participant resulted in nearly half (50) of the network's members, with over a third (38 percent) of the dollar payments, failing to settle. Repeating the simulation using data from a different day produced similar results except that the set of institutions most adversely affected by the settlement default was quite different from the set affected under the initial simulation. Thus, the study suggests that institutions cannot insulate themselves by closely scrutinizing the creditworthiness of participants with which they frequently conduct business. Rather, the various payments are too intertwined, complex, and irregular to allow an institution or regulator to predict the ramifications of a settlement failure.

The simulated settlement failure of a large associated member of CHIPS resulted in similarly discouraging results. A similar number of CHIPS participants (49) and dollar volume of transfers (31 percent) failed to settle. Simulations with an alternative set of daily transaction data produced only slightly better results. The failure of an institution initiating less than 1 percent of CHIPS volume still led to the failure of 33 institutions and the default of more than 22 percent of total system dollar volume.

Although on the surface the findings suggest that a regulatory function may be required, several factors may mitigate the problem of a failure to settle.[9] The banks in these simulations may face a liquidity instead of a solvency problem. Although the magnitude of the loss is substantial, participants may be able to cope with the loss by using internal or external sources. Even late in the day, Fed Funds may be obtainable in the open market to offset the loss. However, the most important factor preventing settlement failure is access to the Federal Reserve discount window. In fact, in these scenarios the window should be accessible to allow it to perform its stated purpose, i.e., to lend funds on a collateralized basis to liquify solvent institutions. If a bank failed to settle, systemic problems could be totally avoided if discount window credit were available to provide reserves to the remaining institutions. They would then be able to settle and continue operations in the following days until appropriate court actions determined the portions of total debt positions to be absorbed by the various participants in the transfer network. Settlement failure by a participant does not imply that some funds will not be forthcoming to the remaining participants, even if the defaulting bank is insolvent. The problem is one of timing. Use of the discount window tides the remaining solvent institutions over until the affairs of the failed bank are settled.

It is also important to emphasize that such Federal Reserve advances would not constitute a bailout, because the affected institutions may ultimately receive less than full settlement from the CHIPS network. The disturbing results from the simulations would occur only in the case where the CHIPS unwinding process transpired in a vacuum without any funding assistance from outside forces.[10]

Regulatory response to daylight overdrafts

Until recently, overdrafts were not a major issue. In the late 1970s the Federal Reserve evaluated risk resulting from daylight overdrafts and found that large overdrafts were occurring and considerable risk existed which was not being adequately considered. As a result, the Fed began evaluating policy alternatives aimed at controlling such risk. Its initial objective was to prompt banks to view payment system risk as standard credit risk. That is, banks should realize that credit is being extended when overdrafts occur. The Federal Reserve sought public comment on various options to control overdraft-induced risk including 1) collateralization; 2) settlement insurance; 3) rolling settlement; 4) charging for intraday credit; 5) sender net-debit caps; 6) bilateral net credit limits; and 7) finality of payment.[11] The first four alternatives were tentatively rejected, and closer evaluation was given to the remaining three.

The initial program, adopted in 1985 for implementation in 1986, incorporated overdraft caps. The program required each institution incurring overdrafts on FedWire, or any private transfer network, to assess itself and determine a daily and a biweekly daily average limit (some multiple of capital) across all networks. Since implementation of the Federal Reserve's risk reduction program in 1986, the

growth in overdrafts has slowed (see Figure 2). During the same period, overdrafts as a percent of total payments have declined (Belton, et. al.). In January 1988, caps were lowered 15 percent with an additional 10 percent reduction tentatively scheduled in May. Private transfer networks that settle through the Federal Reserve were required to establish caps (bilateral net-credit limits and network sender net debit caps) on the amount of daily exposure to every other participant in the network. CHIPS is currently the only large-dollar transfer network toward which this program is directed. Future controls on the Federal Reserve's book-entry securities system are expected, and alternative policies are currently being evaluated.

Determining the optimal level of intraday credit

The purpose of the Federal Reserve's Risk Reduction Program was to contain the level of risk associated with overdrafts and to instill an understanding of the actual risks involved. Since the program began, financial institutions have come to realize that the risks involved are quite substantial and have taken steps to modify payment practices.[12]

Although it is generally understood that the previous level of daylight overdrafts was too high, the actual level of activity toward which the system should strive is unknown. Many fear that continued reductions in allowable levels eventually will have significant adverse effects on the functioning of the payment system. The prevailing attitude among policymakers appears to be to continue lowering allowable overdraft levels until it begins to over-constrain the payment system. This approach, obviously, is an inexact process.

The "optimal" level of daylight overdrafts needed to support a certain level of transaction activity can be derived conceptually. While it is difficult to quantify this desired level, the conceptual derivation provides insight into the causes of overdrafts and the potential effect of changes in market factors and banking policy alternatives.

Daylight overdrafts occur because they have value. However, they also impose a cost on the entity providing the overdraft credit. Socially optimal behavior would result in a level of daylight overdrafts sufficient to cause the benefit from the last dollar of overdraft to equal the cost of creating it. In analyzing overdrafts, both supply and demand factors need to be considered.

The demand for intraday credit

Intraday credit has intrinsic value for a financial institution because incoming and outgoing transactions are not synchronized perfectly. Lack of synchronization arises from several sources including 1) existing payment system practices; 2) regulatory accounting procedures, e.g., intraday timing of credits; 3) the time element involved with transferring funds; and 4) the uneven inflows and outflows associated with day-to-day activity of customers. Although the precise impact of each of these is unknown, each adds uncertainty and creates the potential for a mismatch between receipts and payments.

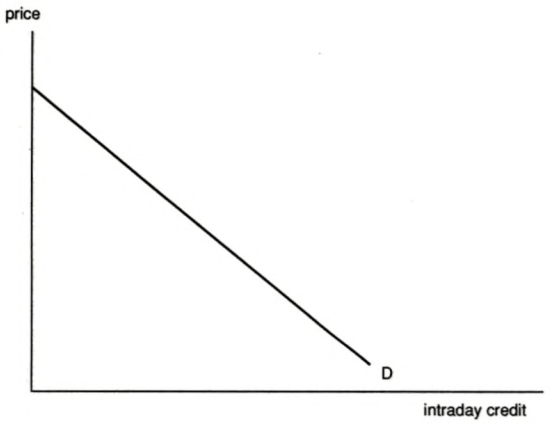
The demand for overdrafts is actually a derived demand because the overdraft itself does not provide direct utility or consumer satisfaction. Rather it can be considered an input that interacts with other factors and enables the financial institution to provide a service to customers, the completion of transactions, that has utility.[13]

Holding other things constant, in a private market the quantity of intraday credit demanded can be expected to decrease as the cost incurred by the user increases. As the cost increases, less overdrafting will occur, alternatives to overdrafts will be sought out, and total payment system transactions will decrease.

Additional factors that could change the demand for intraday credit (i.e., demand determinants) include those that affect the synchronization problem.[14] It is evident that the demand for intraday credit is a derived demand, because any changes in payment system volume and elements affecting it would be a determinant of the demand for the credit. The price (cost) and availability of related inputs or procedures that can serve as alternative means to carry out transactions would similarly affect the demand for intraday credit. While some of these factors can be changed by financial institutions, many are outside the control of the individual firm.

Figure 3 depicts the demand for intraday credit for a particular level of payment system

Figure 3
Demand for intraday credit



activity, given fixed values for the determinants discussed above.[15]

The supply of intraday credit

The supply of intraday credit in a private market can be considered conceptually similar to the supply of any other product; that is, it slopes upward to reflect the costs to the producer. The pertinent costs would include 1) the transaction costs of initiating the transfer; 2) a credit-risk element that is expected to increase with additional amounts of credit; and 3) an opportunity cost incurred as a result of not having the funds available for alternative uses.

Prior to the Fed's current Risk Reduction Program, the transaction cost was the only applicable cost to wire initiators of transferring funds via FedWire. If an institution had a zero balance and the benefits from a transfer exceeded its cost, then it was beneficial to initiate. When the transfer was sent via FedWire, the Federal Reserve would supply the credit by passing "good funds" to the receiving institution. Thus, credit risk would be assumed by the Federal Reserve but not charged back to the sending institution. The opportunity cost of the physical transfer to the Federal Reserve, because of its unique position as central accountant, would be nearly zero.

If the funds were sent through private markets and accepted as "good" funds, then credit would actually be supplied by the receiver of the funds. The receiving bank would consider the credit risk involved and decide whether or not to accept the transfer, expecting the funds to be made good by the end of the day. Again, if there are no limits on daylight overdrafts, the opportunity cost of "supplying" the funds approaches zero.

The supply curve for intraday credit, incorporating the three cost components, is shown in Figure 4. S_1 is the supply curve if only fixed transaction costs exist, while S_2 incorporates the credit risk incurred by the supplier of the funds. Supply is shown as an increasing function of price because, in a private market, additional units of intraday credit would be supplied only if the price received offsets the increasing cost (risk). S_3 incorporates the previous two costs plus the opportunity cost of supplying funds. Given the potential for unlimited daylight overdrafts, the opportunity cost approaches zero. Although included here for completeness, the opportunity cost is expected to be relatively minor and is excluded from the remaining analysis.

Figure 5 combines the supply and demand for intraday credit. This can be used to derive the equilibrium level and to better understand the Federal Reserve's cause for concern about daylight overdraft levels.

Given no limits on daylight overdrafts and no consideration of credit risk by users, the equilibrium level of intraday credit would be Q_1. This depicts the situation on FedWire before the implementation of the risk reduction program. The Federal Reserve assumed all the payments risk, and the opportunity cost of intraday credit was essentially zero. With increased wire transfer capabilities and improved

Figure 4
Market supply of intraday credit

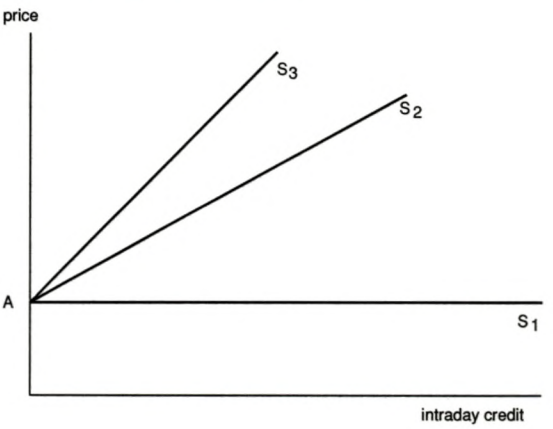
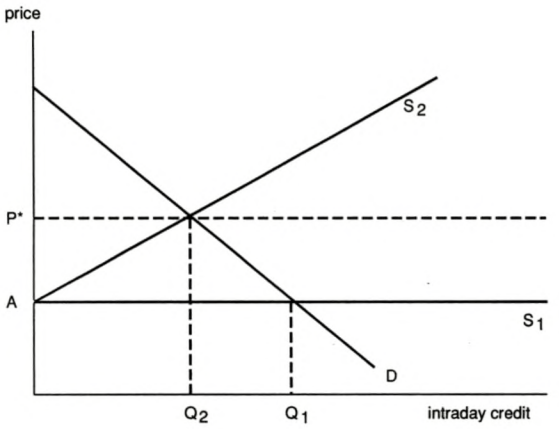


Figure 5
Market equilibrium level of intraday credit



communications among market participants, the number of profitable transactions grew in recent years, greatly increasing the amount of intraday credit.

A stated purpose of the risk reduction program was to encourage financial institutions to realize that credit risk was being created when daylight overdrafts occurred. If this risk, created by the sending institution, is also borne by that institution, then the equilibrium level of intraday credit declines to Q_2.[16] While it is difficult to quantify these costs with any degree of precision, it is expected that the cost generated from credit risk exceeds that from transaction costs at current levels of intraday credit. Thus, if the total credit risk of intraday credit were accounted for, the level would probably decline significantly.

We can use the above analysis to evaluate the effects of policy alternatives on the level of intraday credit. If both risk and transaction costs were accounted for, Q_2 would be the optimal level of intraday credit, with price equal to P*. Currently, however, in FedWire transactions the risk is not borne by the sender. Similarly, if institutions expect receivers to be "bailed out" when settlement failure occurs on private networks, the risk will also not be accounted for by the institutions using these networks. Thus, excessive intraday credit approaching Q_1 will be utilized.

Caps and pricing

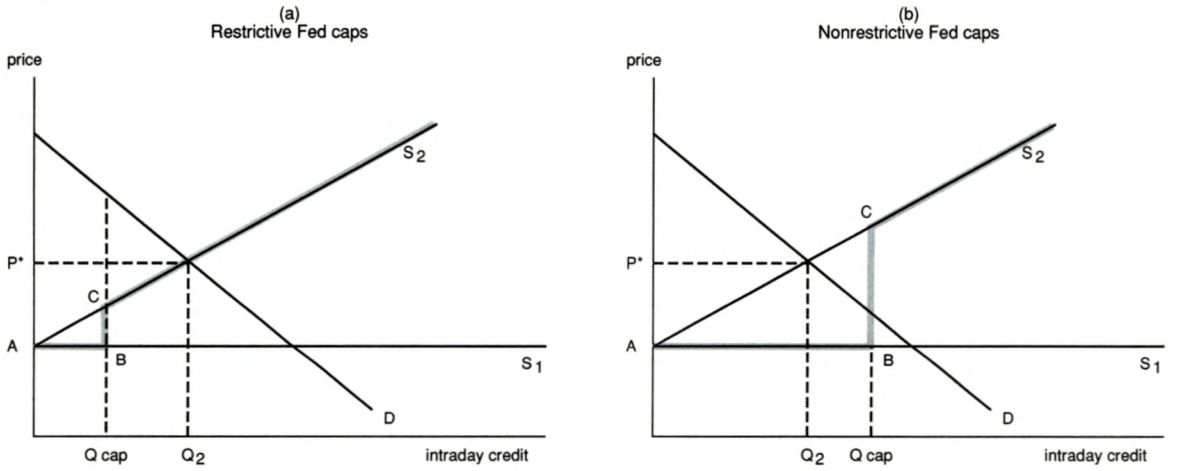
The Fed can adjust for this misappropriation of risk by imposing caps on intraday credit equal to Q_2: the optimal level of intraday credit. Although banks would desire additional funds, the system constraint would preclude it if the Fed is the only source. This optimal level can be generated on FedWire if banks fully utilize credit limits.

Alternatively the Federal Reserve could charge for the extension of intraday credit. Ideally, the price would vary by institution based on the level of bank riskiness. However, assuming an average level of risk is generated and one price is charged to all institutions, the supply curve S_1 shifts upward to a price generating output Q_2 . The effect, shown in Figure 5 as producing P*, would be to reduce intraday credit toward the socially optimal level.

This analysis conceptually generates the socially optimal level of intraday credit and considers policy alternatives assuming the Fed is the only source of credit. It implies that if the regulator has sufficient information to determine Q_2, then either caps or prices could be used to generate the optimal amount of overdrafts. It can also be shown that setting overly restrictive caps or prices can lead to suboptimal levels of credit, causing undue restraint on the payments mechanism. However, there is the potential for the development of a private market as an alternative source of daytime funding. As the Fed implements increasingly restrictive caps or prices, alternative means to decrease overdrafts will be utilized. A private intraday market is one of those alternatives. It is likely that other means to eliminate the need for intraday borrowings may first be utilized, resulting in a lower demand for credit in general (a leftward shift of the demand curve). However, as alternatives are exhausted, the use of private intraday borrowings may become the most viable means available to execute transactions.

The earlier analysis is modified slightly when alternative sources of funding are considered. If the Fed uses caps, restrained institutions will utilize their allowable overdraft and then consider alternative sources. Thus, the Fed will always be included as the initial source of funding. Institutions willing to supply funds to the market will consider the credit risks involved and be willing to extend additional loans at a rate sufficient to account for that risk. If all risk is accounted for, then the supply curve described earlier, S_2, would be the

Figure 6
Managing intraday credit with Fed overdraft caps



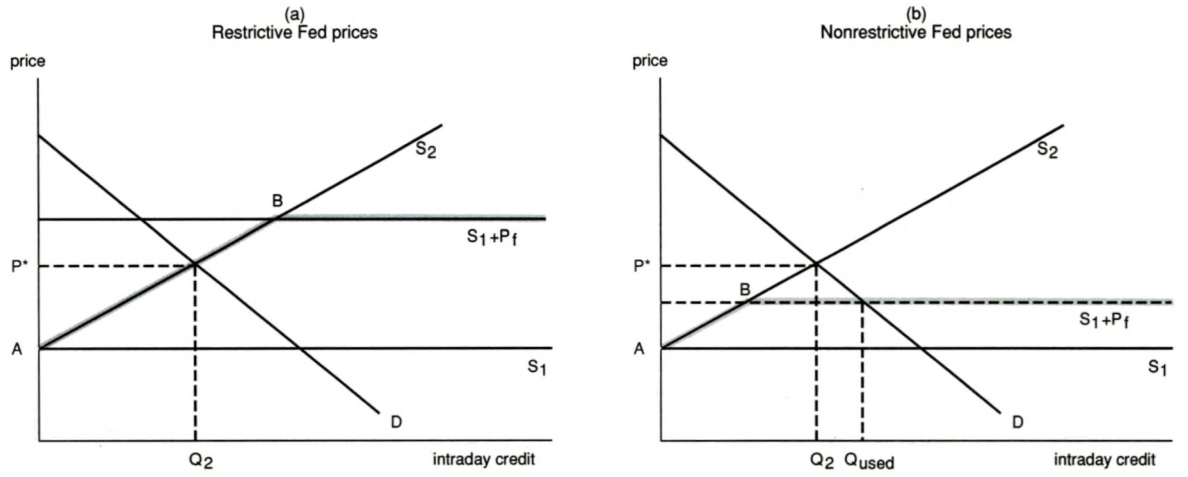
relevant curve to depict the amount of intraday credit made available.

Institutions seeking intraday credit would first use their allowable overdrafts with the Fed and then buy residual funds at the market rate determined by the interaction of supply and demand factors. Risk would be shared by both the Fed and private providers of credit. The resulting perceived supply curve to borrowers would be the discontinuous relationship A-B-C-S_2, shown in Figure 6(a). In the example shown, Fed caps are restrictive and the residual demand, $Q_2 - Q_{cap}$, is obtained in the private intraday market at a price of P*. Examples assuming the Fed cap is set accurately to obtain Q_2 or is not restrictive can also be constructed. The non-restrictive cap example is depicted in Figure 6(b). Here credit is overutilized from a societal view (Q_{cap} is used) and the Fed is the sole source of funding.

Pricing of overdrafts by the Fed would also create incentives for development of a private intraday market. As shown in Figure 5, the appropriate market price given payments volume, risk factors, and the resulting supply and demand of intraday funds is P*. However, as in the case of caps, the funds can be provided by either the Fed or private institutions. The provider will be determined by the price set by the Fed. If it sets a price below P*, then an excessive amount of credit will be used and the Fed will be the sole source of funding.[17] Rational private suppliers of funds will not be willing to supply funds because prices below P* will not adequately compensate them for the risk assumed. Similarly, if the Fed price is set above P*, then private sources will provide all intraday credit and the socially optimum level will again be reached. Figure 7(a) presents the case where the Fed sets a price above that required to generate the socially optimal level. The perceived market supply curve is A-B-($S_1 + P_f$). Again, examples can be constructed in which the Fed price is set to produce Q_2 or where it is set below what is required to keep intraday credit below this level (e.g., Figure 7(b)). Therefore, if the price is set above or at P* the socially optimum level will be obtained. Only under-pricing by the Fed would create excessive daylight overdrafts.

Both caps and pricing have problems as well as advantages. If the regulator had sufficient information to determine the optimal level of intraday credit, then either caps or pricing could be used to generate the optimal level of overdrafts. With caps, the institutions could continue to get free intraday credit but would be constrained to levels deemed reasonable by the regulator. However, the credit provided by the Fed would still be underpriced. Individual institutions could, therefore, use more of it than they would if a price were imposed. Caps also are not very flexible. Although we have presented the analysis assuming a fixed demand, credit needs change daily. The imposition of fixed caps may not allow for this changing need. Finally, evidence suggests that the risk of systemic failure is not closely related to the size of the overdraft of the failing institution. In the CHIPS simulations

Figure 7
Managing intraday credit with Fed pricing of overdrafts



discussed earlier, the hypothetical failure of a relatively small associate participant caused settlement problems for a number of other CHIPS participants. In fact, in one simulation where the failing institution generated less than 1 percent of CHIPS payments, the number of simulated settlement failures was nearly as large as when the failure of a large participant was assumed. Thus, caps may not solve the problem they are directed at, although there is little doubt that they improve the risk problem.

Pricing by the Fed would have the standard economic benefit of allocating intraday credit based on the need and ability of institutions to pay for it. However, determining the proper price may be difficult; particularly in an environment of changing demand. If it is too low, the Fed will become the sole source of funding and the resulting system risk will exceed optimal levels. Too high a price may decrease the overdraft demands on the Fed, although it would also provide incentive for the establishment of a private intraday market to avoid the constraint. This again would create a favorable spreading of risk. Under-pricing appears to create the more serious problem and the Fed may want purposely to charge a relatively high price.[18] This would result in lower Fed overdrafts and would encourage various alternatives, including the development of a private market which could more accurately set prices. This new market would redistribute funds during the day in a manner similar to that of the Fed Funds market's overnight funds distribution. Ideally the market could determine the rate and the Fed could tie its rate to that instead of devising one by fiat.

The decision between caps and pricing depends on how daylight overdrafts are viewed. If they are considered detrimental then caps or outright prohibition would seem appropriate. However, they should be deemed as a rational development of transaction activity, producing value for the institution involved and efficiency in the payments system. Given this view, the only issue is one of properly distributing the resulting risk.

An additional concern with pricing is the potential ability of "high-rolling" or high-risk institutions to incur significant risk-generating daylight overdrafts. Thus, it has been proposed that both a cap and prices be imposed. However, controlling the high-risk institution appears to be a separate regulatory function. "Bad behavior" warrants separate regulation. It is perfectly appropriate for a regulator to require an institution to cease inappropriate behavior. But this would appear to be separate from the standard risk assignment or allocation process that should apply to payments activity and was the objective of the Risk Reduction Program. If, as proposed above, the Fed charged a relatively high price for overdrafts, it would obtain additional information about the condition of institutions. Frequent overdrafters on FedWire could be either poor managers of their accounts or be considered relatively risky by other institutions and therefore unable to obtain intraday funds at competitive rates. In either case the Fed could

serve in a consulting role and identify potential problem firms. Separate regulation, perhaps caps, may indeed be required for these firms. However, they are exceptional cases, and there seems to be little benefit in treating all firms as if they were potential problem firms.

Thus, the optimal level of intraday credit can be determined by finding the level where the additional benefits received are equal to the cost of the credit. Although this is derived conceptually, the assumptions seem reasonable and are consistent with economic theory. The preceding analysis indicates that, as long as risk is not accounted for, the level of intraday credit will exceed the social optimum. It appears that pricing would be the preferred means to reduce risk and to allocate it properly.

A few practical issues need to be addressed, however, to reduce the above analysis to a workable policy.[19] For example, frequent overdrafters at the Fed will need to be subjected to close scrutiny, because it is likely that they have exhausted private alternatives and are using the Fed as a least-cost alternative. For these firms, separate regulation—perhaps caps—may be more important than implied in the above analysis.

A second issue concerns the quality of Fed operations. If the Fed decides to charge fees for overdrafts, then its transfer network should be of sufficient quality to allow a reliable flow of transactions. It would be unfair to charge for overdrafts when they were the result of computer down-time at Fed offices.

Another consideration is whether or not institutions will actually consider all costs when deciding on a market price for intraday borrowings.[20] For example, earlier we discussed the situation on private transfer networks in which participants believe that someone would come to the rescue of an insolvent institution that was unable to settle. As a result, institutions perceive the risks assumed to be less than the true costs borne by society. On private networks, this can be resolved by requiring participants to agree to and be legally bound to a form of multilateral netting by novation combined with a loss-sharing arrangement for obligations of the failed participant, that is, to settlement finality. With FedWire it could be accomplished by accurately pricing overdrafts or eliminating the Fed's provision of payment finality.

A final issue needing additional evaluation is the impact of Fed overdraft policy on the implementation of monetary policy. As caps or prices become restrictive there will be a tendency for banks to hold excess balances to avoid overdrafts. This could spill over to overnight balances and affect the level of excess reserves. If the increase in excess balances is relatively constant and therefore predictable, the Fed's Open Market Desk will be able to account for the increase when implementing policy. If it is not predictable the Desk has an additional variable to consider when determining appropriate open market operations. The development of an intraday credit market could also have implications for the level and variability of the ovenight Fed-Funds rate. The current "overnight" rate, which is essentially a 16-hour rate, may become intertwined with a rate from the intraday market. Thus, Fed Funds borrowed at noon for repayment the following morning will be priced at a rate different from the rate for funds borrowed at 4:00 p.m. Variations in the intraday rate could cause fluctuations in the one-day rate. While the actual effect is unknown, it would be surprising if the intraday and overnight rate did not become intertwined.

Conclusions

Because of the maturing of financial markets and increased use of electronic transfer systems to move funds, there has been a significant increase in large dollar payment system activity. The increase has occurred within an environment in which tradition, explicit and implicit guarantees, accounting practices, and regulations have imposed on banks a significant synchronization problem between incoming and outgoing funds transfers. This problem has been partially resolved by increasing the use of daylight overdrafts on large-dollar transfer networks. The Federal Reserve became concerned with the risk associated with these overdrafts and recently introduced steps to limit them and the attendant risk. Fear of potential systemic risk heightened the Federal Reserve's concern.

Given the environment in which banks operate, the use of overdrafts is economically rational. The existing incentive structure encourages overdrafts because they are the least costly alternative to synchronize payment flows. In this paper we utilize basic supply and demand analysis to show that the use of over-

drafts is warranted and that attempts to eliminate or decrease them to excessively low levels produce inefficiencies. However, they have been overutilized from a societal perspective because the resulting risk has not been properly assigned. Thus, policy alternatives should be considered which properly allocate the risk resulting from overdrafts.

The analysis indicates that, if sufficient information exists, either the imposition of overdraft caps or pricing of overdrafts can produce the socially optimal level. However, given that this information is not always available, the preferred policy may be to have the Fed stand ready to provide liquidity to the markets, set a relatively high charge on overdrafts, and closely monitor institutions which frequently approach it for funding. This would encourage the use of efficient alternative means to resolve the synchronization problem, including the development of a private intraday funds market in which the marketplace would set prices and allocate risk. Such a market would have numerous similarities with the current overnight market.

Daylight overdrafts involve risk similar to that of any credit extension. If treated as such and properly priced they will be utilized in a socially optimal fashion. The existing inappropriate incentives producing overutilization should be eliminated and policy should be considered which pushes the pricing and risk allocation decisions toward the private marketplace.

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[1] Other private large-dollar networks have existed in the recent past. For a discussion of these and dollar volumes on the various networks see Humphrey (1984).

[2] Prior to this, CHIPS had next-day settlement. The potential for changes in account positions of foreign institutions held by CHIPS members was therefore greater in the earlier period. The delayed settlement, and resulting increased risk, produced a transfer service which was inferior to that which exists today. Thus, volumes were smaller.

[3] For an analysis of transfer volumes and their purposes see "A Study of Large-Dollar Payment Flows through CHIPS and Fedwire" (1988).

[4] The Fed actually provides final settlement for each transfer sent to a receiving bank and expects the sending bank to cover its position. We use the term "guarantee" in a non-legal sense throughout. Lawyers might quibble.

[5] CHIPS is essentially a message network with final positions being settled at the end of the day. Physical transfer of funds does not occur during the day; therefore, actual overdrafts do not occur. However, participants are legally obligated to make payment on messages they have sent during the day. Thus, overdraft positions are being realized.

[6] For customers with which the receiving bank regularly conducts business, there may indeed be knowledge about the creditworthiness of the sending institution. This knowledge would be obtained because the banks conduct business resulting in risky overnight exposure. However, payment system risk is perceived to be zero, resulting in no additional incentive to consider intraday risk. Obviously, the Federal Reserve does assume risk by guaranteeing FedWire transfers and would monitor the condition of the sending bank.

[7] The element of surprise is important, or participants would have adjusted their exposure to the failing institution. In fact, the sudden unexpected failure of a participant appears to be the only type of failure that would present systemic problems.

[8] The assumed failing institution actually had a net *credit* position, thus, the exposure of other institutions is less than would be the case with a true failure.

[9] Humphrey listed these in his article, thus, it may be that the author was trying to emphasize the extent of complexity involved with the unwinding process more than analyzing systemic problems.

[10] The simulations were also performed on CHIPS activity before bilateral credit limits were imposed by the network. It would be interesting to perform the same exercise under current procedures. If the size of the overdraft is not a major determinant of the total number of institutions and dollar value of transfers which fail, as one of the initial simulations suggests, the new procedures may have little effect on the simulation results.

[11] These are defined in detail in "Reducing Risk on Large Dollar Transfer Systems," Board of Governors of the Federal Reserve System, 1985.

[12] For example, in a private conversation an employee of a large money center bank stated that, in response to the Fed's initial concern about overdrafts, senior management asked for an analysis of the daily exposure of the bank. They were shocked to find the overdraft exposure exceeded that of total Latin American debt.

[13] Alternatively the daylight overdraft could allow the financial institution to carry out a transaction for itself which has a positive expected return.

[14] For a list and discussion of alternative means to improve the synchronization problem, see Mengle, Humphrey, and Summers (1987). These can be

considered alternatives to overdrafts and/or use of an intraday funds market (discussed below) in completing desired transactions.

[15] The supply-and-demand analysis discussed is similar to that found in Mengle, Humphrey, and Summers (1987).

[16] The risk component included incorporates the total risk from the credit; i.e., it is assumed to include any negative externalities generated by overdrafting institutions. As an overdraft occurs, the lending institution may account for the risk imposed on it, but additional risk may permeate throughout the banking system as the lending institution passes funds on to others, assuming they will be good funds. This generates the potential for systemic risk. Both risk components are assumed to be imbedded in S_2. Also, the risk is created by the sender only if the receiver accepts the transfer and considers it "good funds."

[17] There is an implicit assumption being made in the present analysis that each bank uses the same portion of its respective caps. Therefore, each bank fully uses its cap, then approaches the Fed. Actually, banks will use their cap at different paces; some using all of it, others none, and others only a small fraction. The banks using their caps first would be the ones entering the market first for intraday funds. Thus, this could actually occur before Q_2 credit is used. In the graphics this would influence the sharpness of the break in the supply curves.

[18] Mengle, Humphrey and Summers (1987) produced estimates between 100 and 125 basis points as "best guesses" of appropriate intraday rates. To be conservative the Federal Reserve could price at the high end of this range or above it. Obviously, more research is required before deciding on the actual rate. Federal Reserve pricing above the market rate would also appear justified, since individual firm pricing would not account for negative externalities resulting in systemic risk (Mengle 1985). However, any positive rate would have favorable effects (Flannery 1987).

[19] Much of the discussion here assumes the development of a private intraday market. Thus, credit terms, conventions, etc. are presumably established by private parties.

[20] Consideration should be given to risk externalities not considered by the individual bank and implicit guarantees expected by bankers.

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