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FRB CHICAGO ECONOMIC
PERSPECTIVES

A review from
the Federal Reserve Bank
of Chicago

NOVEMBER/DECEMBER 1986

ECONOMIC PERSPECTIVES
November/December 1986
Volume X, Issue 6

Economic Perspectives is published by the Research Department of the Federal Reserve Bank of Chicago. The views expressed are the authors' and do not necessarily reflect the views of the management of the Federal Reserve Bank.

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ISSN 0164-0682

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Can the monetary models be fixed?

Diane F. Siegel and Steven Strongin

For years M1 has been regarded as the single most reliable tool for the formation and execution of monetary policy. Serving as both compass and rudder, it forecast future rates of economic growth and inflation, while providing the Federal Reserve with a powerful mechanism to affect those rates. Simple single-equation money/income models provided forecasts of comparable accuracy to the forecasts of multiple-equation commercial models.[1] But after 1980, the M1 models suddenly lost their forecasting ability and they have not recovered it since. Many suggestions have been made to improve the performance of the M1 models in the 1980s. Most have recommended changes in the measures of money or income used in the models.

In this paper we apply some of these suggestions to a monetary model to see if they improve its performance in the 1980s. Our approach differs from that of previous studies in that our model separately analyzes the money/real income and money/inflation relationships rather than focusing only on the money/nominal income relationship. The two relationships break down so differently in the 1980s that separate analysis is necessary to understand the large changes in the money/income relationship that have occurred.

The collapse of the money/income relationship is most often attributed to changes in the behavior of the monetary aggregates brought about by the financial deregulation and innovation of the 1980s. Following the passage of the Depository Institutions Deregulation and Monetary Control Act in 1980, the financial sector went through an extended series of fundamental changes. New types of accounts were created. The rules governing old accounts were revised. Nonbank institutions continued to innovate to better compete with banks. These changes significantly altered the individual and corporate patterns of money usage.

From the beginning, many hoped that adjusting the definition of money to account for all of these changes would improve the performance of the money/income models. The suggestions for new definitions ran the gamut from redefining money in the narrowest possible fashion, using only accounts that existed before deregulation, to using credit measures that include every conceivable financial asset. Others suggested sophisticated weighting schemes in which the "moneyness" of each component of the money supply is separately estimated and those estimates are used to produce a functional money measure.

Other proposals have focused on the income side of the equation. Most money/income models are estimated using GNP, which measures production, as the income variable. Some have argued that GNP is inappropriate for the money/income models because money is held primarily to finance purchases of goods and services. The relationship between money and domestic demand is thus thought to be closer than the relationship between money and GNP. Recent changes in the international sector have widened the difference between domestic demand and GNP. A number of demand variables which adjust GNP for imports and changes in inventories have been suggested to correct this problem.

Our tests of several alternative money and income measures yield the following conclusions: 1) The observed problems persist no matter what money and income measures are used, casting doubt on the strategy of definition changes. 2) The breakdowns in the money/real income and money/inflation relationships are fundamentally different and attempts to analyze only the nominal income relationship obscure the problems. 3) The money/inflation relationship seems to have changed in a simple, and potentially predictable, fashion. Changes in the rate of money growth still seem to affect the inflation rate much as they did in the past. However, the rate of inflation that would exist in the absence of money growth, i.e. the constant term in the inflation equation, is now significantly lower. 4) The breakdown of the

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money/real income model is very erratic, apparently reflecting real economic shocks which are not included in the model. A pure monetary model is simply not sufficient to explain real growth in the 1980s.

Recent history of the money/income relationship

The money/income relationship has been one of the major tools of macroeconomic analysis in this century. It was used to explain everything from the Great Depression of the 1930s to the stagflation of the 1970s. Its reliability in the postwar period, even in the simple velocity ratio of nominal GNP to M1, caused it to become increasingly important for policy decisions. This importance was codified in the Humphrey-Hawkins bill of 1978, which required the Federal Reserve to target the aggregates and report those targets to Congress twice a year. In 1979, the Federal Reserve revamped its operating procedures to improve its control of the aggregates. In 1980, Congress passed the Monetary Control Act which was intended to aid monetary control by subjecting a broader range of financial institutions to reserve requirements. And even as late as 1984, the Federal Reserve revised its entire method of reserve accounting in order to further improve monetary control.

But, as laws and institutional arrangements were being changed to take better advantage of the money/income relationship, the monetary aggregates were becoming less and less reliable as policy guides. In 1982, M1 velocity growth strayed seriously from its three percent historical trend rate, actually falling 2½ percent, as the recession exceeded expectations in depth and length. In 1983, with the recovery underway, real growth returned to historical patterns and ended the apparently short-term anomaly in the money/real income relationship. Inflation, however, had fallen significantly below what historical patterns would have predicted. As a result, the nominal velocity measure continued to fall, now at a 3¼ percent rate. Again, the velocity decline was widely thought to be temporary. It was attributed to an increase in money demand following the introduction of NOW accounts and a rapid decline in interest rates.

In 1984, inflation continued below predictions based on historical precedents, but real income began to grow faster than historical relationships would have indicated. This combination of anomalies brought the nominal velocity ratio back near its three percent trend growth rate, and analysts began to talk about a shift in the trade-off between real income and inflation. Imports, the value of the dollar, and fiscal policy were frequently cited factors for the new trade-off. This shift was viewed as a minor problem, especially since it was considered a favorable development.

Unfortunately, in 1985 the real side of the economy cooled off and the "good" inflation news just kept coming, causing another major fall in velocity, again at a 2½ percent rate. These constant runs of new and different behavior finally took their toll. Many economists and policymakers lost faith in the monetary models and began to take a more skeptical view of the post hoc explanations that had been used to explain the models' behavior in the 1980s.

Methodology

This paper uses the FRB Chicago-Gittings money/income model[2] to test some of the money and income measures that have been proposed to improve the performance of the money/income relationship. The model is similar to most monetary models with the one exception that it divides the relationship into two equations which explain inflation and real income growth separately.[3] Both equations include money growth in the current and 20 preceding quarters, three lags of the endogenous variable, and the rate of growth of real energy prices in the previous two quarters.

Earlier work—Siegel (1986)—has shown that both the real growth and inflation equations lost their forecasting ability in the 1980s, but that the deterioration took a very different course in each case. This suggests that different factors may be causing the breakdowns of the two relationships. To explore the possibility that different solutions are required for the two equations, we apply the suggested money/income corrections to each one.

The effectiveness of the various proposals is judged by comparing the forecasting accuracy of the equations when they are estimated with the suggested money and income measures. The two equations are estimated over 50 samples which begin in the second quarter of 1964 and end in every quarter from the fourth quarter of 1973 through the first quarter of 1986. Forecasts from these estimations are constructed for the first quarter following the sample periods. This produces forecasts one quarter ahead of each of the 50 samples for every quarter from 1974 through the second quarter of 1986.

The errors from these forecasts are cumulated over time and graphed in order to highlight the development of trends in the estimated money/income relationship. Periods of stability and change in the relationship can be easily identified by the slope of the cumulative forecast error graph. If an equation is performing well, its cumulative error graph will be fairly level as positive and negative errors offset each other over time. If the relationship shifts so that estimations based on past experience consistently overpredict either inflation or real growth, the resulting run of negative forecast errors will cause the cumulative error graph to decline steeply. If a shift causes an equation to underpredict persistently, the cumulative error graph will increase steeply.

The money measures tested on the FRB Chicago-Gittings equations include the standard aggregates[4] M1A, M2, M3, and L as well as three weighted indexes, MQ, MSI1, and MSI2, which have been proposed to improve the measurement of assets that provide monetary services. Data on the three experimental, or functional, indexes do not begin until 1970, so the current and 20 past quarters of money growth required to estimate the model are not available for these indexes until the second quarter of 1975. Thus, the equations with these variables are estimated over expanding samples which begin in the second quarter of 1975 and end in every quarter from the fourth quarter of 1979 through the first quarter of 1986. This yields one-quarter-ahead forecasts beginning in 1980.

We compare the performance of the aggregates which are narrower than M1 with that of those which are broader to see if the problems of the money/income model can be attributed in part to the range of assets included in M1. The aggregates in the narrow category are M1A and the MQ and MSI1 experimental indexes. M1A does not include the other checkable deposits of M1. MSI1 covers the same asset categories as M1, and MQ includes slightly more assets than M1, but they both give the greatest weight to the currency and demand deposit components. The M2, M3, L, and MSI2 aggregates all cover a broader range of liquid assets than M1.

In addition to comparing the impact of the assets covered by the money measure, we examine the effectiveness of different approaches to money measurement through the performance of the three functional indexes. The three indexes focus on the qualities which have long been associated with the theoretical concept of money. They are designed to include only assets which appear to perform the services expected of money. The MQ index attempts to directly identify those assets which are strictly used for transactions purposes. It includes the M1 components, money market fund shares, savings accounts subject to telephone transfer, and MMDAs, but weights each by its net rate of turnover in purchasing final products.[5]

The MSI1 and MSI2 indexes estimate the degree of monetary services offered by the components of M1 and M2 by the rate of return which people sacrifice to hold each asset. The components which pay the lowest rates of interest are inferred to be the greatest providers of monetary services. The indexes weight the components by the interest cost of holding them, so that those with the most monetary characteristics will have the most influence. The interest cost of each type of asset is estimated as the difference between its interest rate and the maximum of the rates paid on Baa bonds and the components of L.[6]

The equations estimated with the different money aggregates are then compared to an estimation which excludes money growth entirely (the no money model) but still includes the lagged endogenous variables and the growth of real energy prices. The purpose of this comparison is to determine if the money aggregates add any explanatory power to the model in the 1980s. If the forecasts are better when money growth is included in the equations, then money has apparently contributed information to the model. If the forecasts are worse with money growth in the equations, then the monetary aggregates have apparently detracted from the model's predictive power.

The real growth equation is also used to test two alternative income variables. The first is a measure of domestic demand for final goods and services. Wenninger and Radecki (1985) argue that since people are thought to hold money to finance transactions, money growth may have greater effect on the growth of total domestic purchases than on the growth of the GNP production measure. The disparity between the production and domestic demand measures has grown in recent years as imports have increased in importance. Domestic purchases of foreign goods are part of final demand but not GNP. The final demand variable tested in this paper is GNP plus imports, minus exports, and minus the inventory changes of business and the Commodity Credit Corporation. This includes all purchases for current consumption within the U.S. but eliminates transactions made either outside the U.S. economy or for consumption in another period.

The second real growth measure tested excludes real government spending in order to test an assumption implicit in the GNP and final demand models concerning such expenditures. Both GNP and final demand include government expenditures, even though money growth is only thought to affect the private spending of consumers and businesses. The employment of these two variables to estimate money/income models is thus based on the premise that government spending is a perfect substitute for private spending; that is, a rise in government spending will cause an equal decline in private spending.

In the more likely case that some government expenditures are substitutes for private spending and some are not, only the substitutable expenditures should be included in the income variable. Failure to make this correction is not a serious problem as long as the composition of government spending is fairly steady over time. The coefficients of the money/income model would merely adjust somewhat to compensate for such a constant misstatement of the income variable. But the dramatic changes in government spending patterns since 1980 could have changed the mix of expenditures which are substitutable for private expenditures. The inclusion of government spending in the money/income models should therefore be considered as one possible source of the breakdown of such models in the 1980s.

We attempt to correct for this distortion by eliminating real government spending entirely from real final demand. This measure is equivalent to the sum of real consumption and real fixed investment. We also estimate two specifications of the equation with real government spending included directly as an independent variable. In one case the dependent variable is real final demand growth, and in the other it is real final demand growth less real government spending growth.

The following two sections present the results of the estimation of the inflation equation with the various monetary aggregates and the estimation of the real growth equation with the aggregates and the two alternate income measures.

Money/inflation: Performance of the broad aggregates

The inflation equation's cumulative forecast errors follow essentially the same pattern whether the model is estimated with M1 or the broader aggregates (see Figure 1). There are few significant trends through 1981, although the cumulative errors of the M1 equation do rise sharply in 1974 and 1975.[7] The relatively good performance of the inflation equations in the latter 1970s does not continue in the 1980s. In the second quarter of 1981, the cumulative errors of *all* the equations in Figure 1 begin a steady linear descent. This evidence suggests it is unlikely that the money/inflation relationship can be repaired in the 1980s simply by broadening the definition of money. The failure of the MSI2 equation to produce superior forecasts is an indication that the efforts to construct a functional money measure also may not lead to an improved money/inflation model.

The severity of the money/inflation relationship's breakdown is further dramatized by the equation which excludes money growth, for its forecasts in the 1980s are better than those of all the equations estimated with monetary aggregates. This suggests that M1 and the broader aggregates may actually be providing misleading information about the future course of inflation.

Both Figure 1 and the average forecast errors in Table 1 indicate that the M1 and the broader aggregate equations all overpredict inflation at a remarkably constant rate over the 1980s. Table 1 splits the 1980s breakdown period into two subperiods which appear in Figure 1 to have somewhat different rates of descent, but the average overprediction of inflation in the two periods is still found to be

Figure 1
Cumulative forecast errors of inflation equation—M1 and broader aggregates

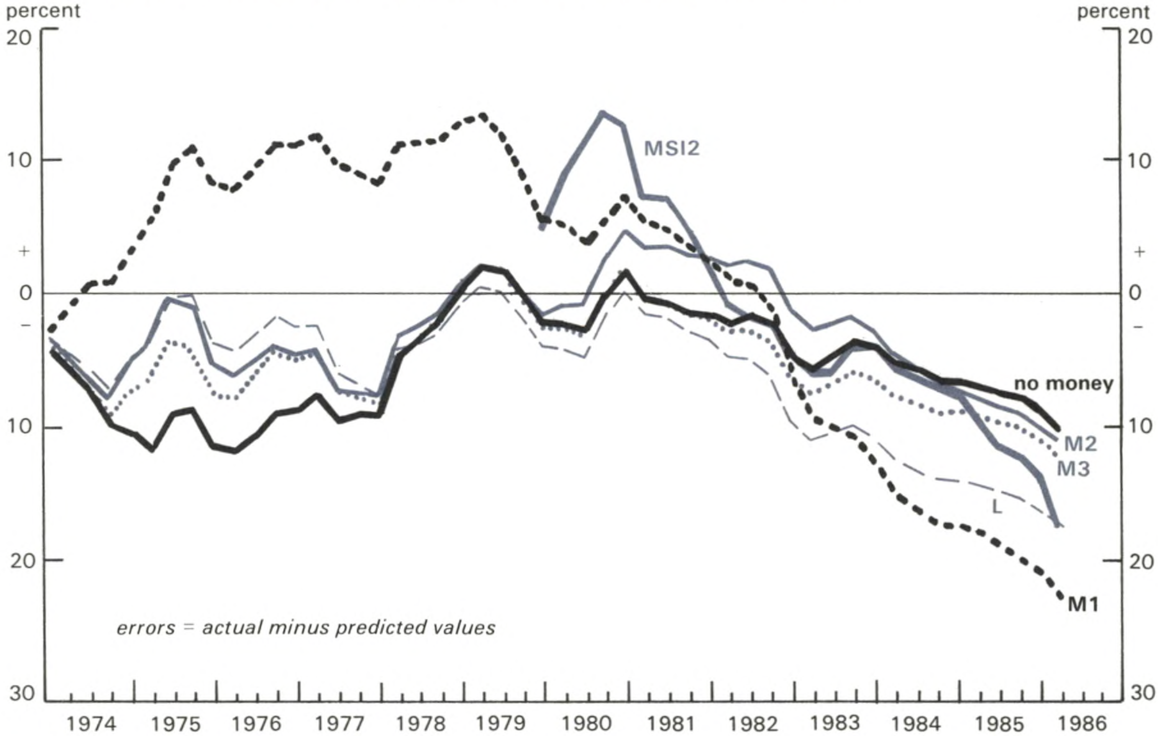
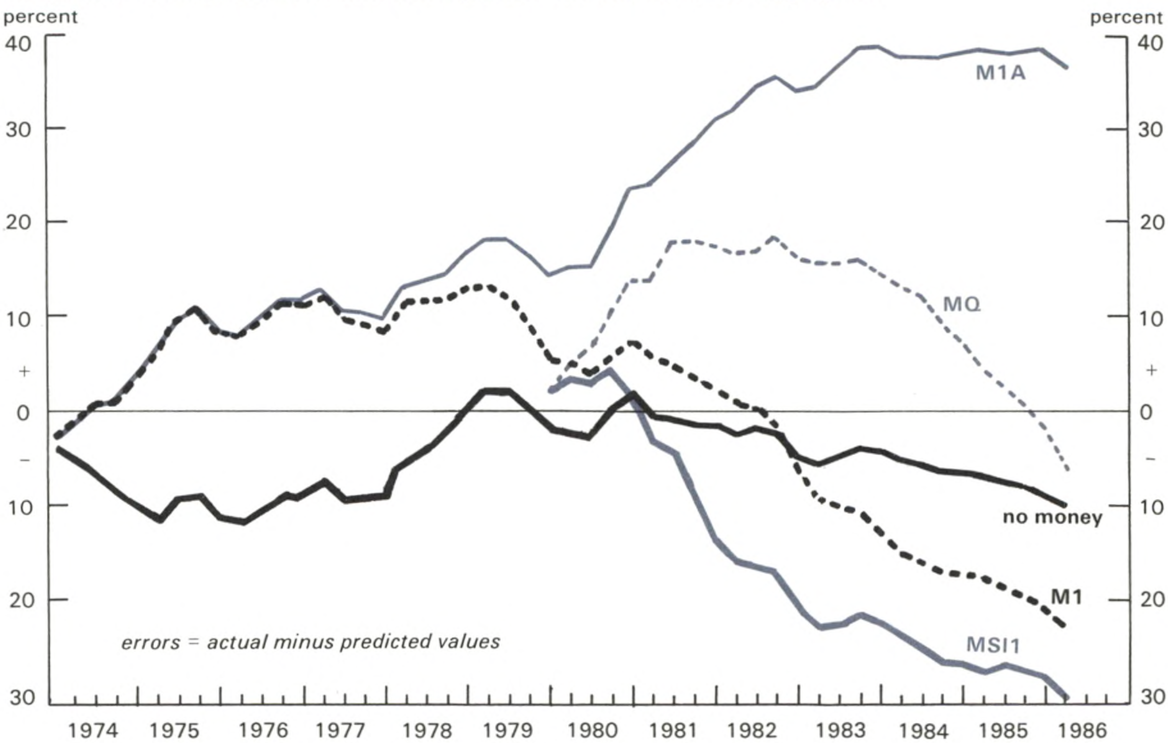


Figure 2
Cumulative forecast errors of inflation equation—M1 and narrower aggregates



very similar. The constant rate of overprediction suggests two conclusions about the breakdown of the money/inflation relationship. First, there may have been a simple change in the constant term of the regression. Such a shift would cause a constant bias in the forecasts and thus lead to the steady linear descent which we observe in the cumulative errors. Second, the change may be permanent. If the model were simply making a one time adjustment to financial deregulation, we would expect the slope of the cumulative errors to flatten over time, not to maintain a constant downward course as it does for 5½ years.

This suggests that a simple adjustment to the constant term after 1980 might allow a money-based model to outperform the no money model. In estimations of several such models, money growth does contribute positive information in the 1980s.

Simulation of these adjusted models indicates that the shift in the constant term lowers the long run inflation rate by roughly five percent. But the overall pattern of inflation's response to money growth in the adjusted model is very similar to that of the money/inflation model before the 1980s. Thus, a change in the rate of M1 growth will have a similar effect on inflation as in the past. One caveat is that this adjusted model is a post hoc explanation and must therefore be viewed with skepticism. In fact, attempts to include a constant correction in a dynamic estimation of the model failed to produce an estimation superior to the no money model.

Table 1
Average forecast errors of inflation equations during 1980s breakdown

	81Q2-83Q4	84Q1-86Q2
M1	−1.6	−1.2
Broader aggregates		
MSI2	−1.5	−1.3
M2	−.6	−.9
M3	−.7	−.6
L	−.9	−.7
Narrower aggregates		
M1A	1.4	−.1
MQ	.2	−2.2
MSI1	−2.1	−.8
No money	−.5	−.6

Money/inflation: Performance of the narrower aggregates

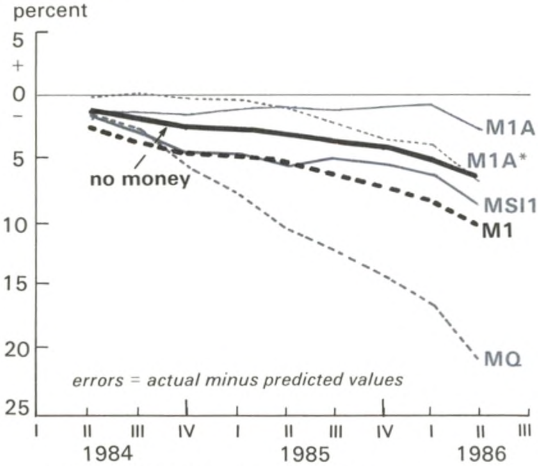
The experience of the equations estimated with the narrow aggregates is more diverse than that of the broader aggregate equations (see Figure 2). The cumulative errors of the MSI1 equation slope steadily downward throughout the 1980s just like the cumulative errors of the M1 and broader aggregate equations. This general pattern is not followed, however, by the narrowest aggregates, M1A and MQ. Instead of overpredicting inflation throughout the 1980s, they both have a period of consistent underprediction beginning in 1980. This underprediction could be due to depressed growth of the two aggregates as funds shifted out of demand deposits and into the NOW accounts which were authorized on a national basis at the end of 1980.

In the case of the MQ equation, the adjustment to the NOW accounts appears to have been completed by late 1981. At that point, the equation stops underforecasting inflation, and by 1984 its behavior begins to resemble that of the broader aggregate equations. From 1984 through early 1986, the MQ equation has a downward sloping cumulative error graph just like the broader aggregate equations.

The portfolio adjustment appears to have had a more prolonged effect on the M1A equation, for the M1A cumulative errors continue climbing through 1983. The errors are then flat through early 1986, suggesting that the M1A equation was so affected by the period of portfolio adjustment that it cannot return later to the same behavior as the other equations. The M1A cumulative errors do behave more like those of the other equations when the episode of underprediction, the fourth quarter of 1980 through the fourth quarter of 1983, is removed from the sample. Figure 3 shows that with this adjustment, the M1A equation overforecasts inflation in every quarter from the fourth quarter of 1984 through the second quarter of 1986.

None of the standard or experimental narrow aggregates provides significantly better forecasts in the 1980s than the M1 equation. Furthermore, the no money equation again seems to have the lowest forecast errors in the 1980s. Thus, it does not appear that the performance of the money/inflation model can be

Figure 3
Cumulative forecast errors of inflation equation after 1984 Q2—M1 and narrower aggregates



*1980 Q4-1983 Q4 excluded from sample.

significantly improved by narrowing the aggregate or estimating it with functional weights. In addition, it appears that deregulation has further complicated the interpretation of the money/inflation equation when the narrow aggregates are used.

Money/real income: Performance of different aggregates

The FRB Chicago-Gittings real income equation performs much the same whether it is estimated with M1 or aggregates with broader or narrower asset coverage. The cumulative forecast errors produced when the equation is estimated with M1, the broader aggregates, and without any money variable are plotted in Figure 4. Table 2 gives the average forecast errors between the apparent turning points of these equations. The equations all have fairly constant cumulative errors from 1974 through 1980, but they begin to break down seriously in early 1981 just as the inflation equations also start to go off track. In 1981 and 1982, all the cumulative error graphs fall sharply, indicating persistent overprediction of real growth. The majority of the error graphs then rise steadily from 1983 through early 1984 before flattening out or falling into a slow decline through the second quarter of 1986.

This error pattern is so consistent across the equations that the only apparent deviations are in cases where the general pattern is merely more pronounced. The M1 equation experiences two periods of substantial decline and increase in the latter 1970s which are much milder for the other equations. The general increase that begins in 1983 lasts longer for the M1 equation, extending all the way through mid-1984, and the slight decline of late 1985 and early 1986 is more marked. The MSI2 equation has a much larger increase in late 1980 than the other equations, and it falls more steeply after 1983.

The close similarity between the error patterns of M1 and the broader aggregates strongly suggests that broadening the aggregate will not put the money/real growth equation back on track in the 1980s. The poor forecasting record of the MSI2 equation suggests that the weighted index approach does not offer the solution either. In fact, the forecasting performance of the equation that does not include money growth is often better or comparable to that of the equations estimated with the aggregates. Its cumulative error graph follows the same pattern as that of the equations which include money growth, but the slope is not as steep in many cases. This suggests that M1 and the broad monetary aggregates are contributing very little or even misleading information to the real economic growth equations in the 1980s.

Very similar results are obtained when the real growth model is estimated with the aggregates that are narrower than M1. The cumulative errors of those equations conform quite closely to the error pattern of the broader aggregate equations. (See Figure 5 and Table 2.) Thus, the performance of the money/real growth relationship in the 1980s is not improved by either narrowing or weighting the aggregate measure. Again, the no money equation often has the best forecasting record in the 1980s, indicating that in some cases the narrower aggregates also reduce the model's predictive power.

The alternation of the equations between episodes of overprediction and underprediction indicates that a single adjustment such as the constant term shift in the inflation case will not salvage the money/real income model. The erratic forecasting performance in the 1980s suggests that the equations were thrown off

Figure 4
Cumulative forecast errors of real income models—M1 and broader aggregates

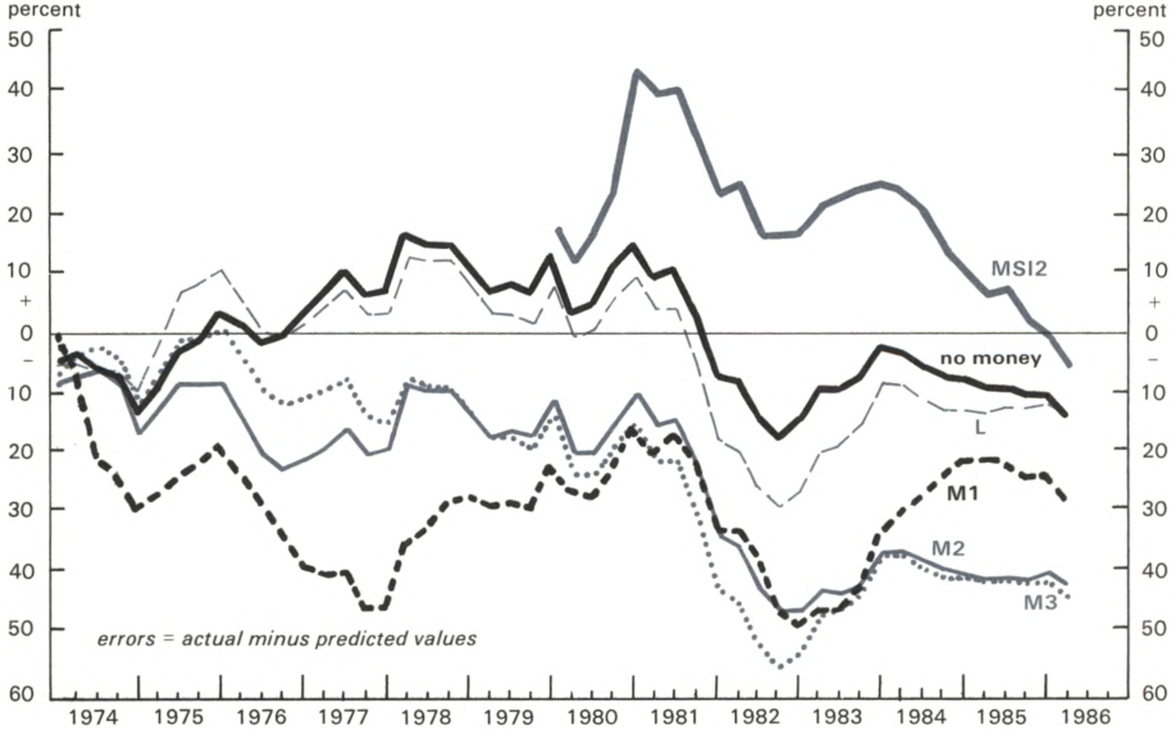


Figure 5
Cumulative forecast errors of real income models—M1 and narrower aggregates

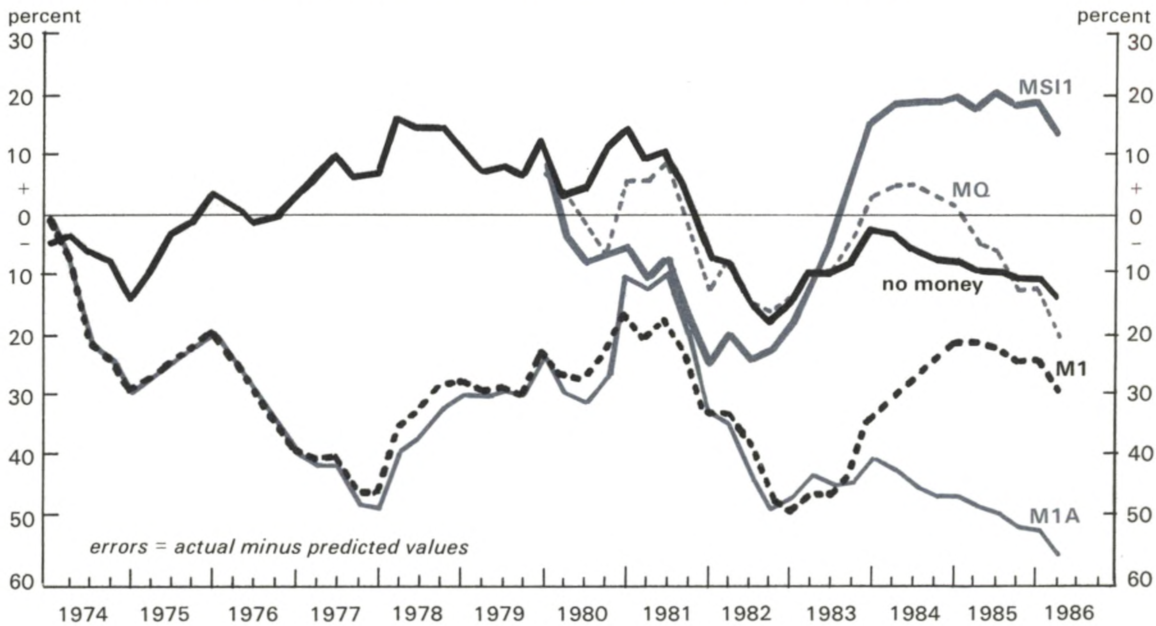


Table 2
Average forecast errors of real growth equations during 1980s breakdown

	81Q2-82Q4	83Q1-84Q1	84Q2-85Q1	85Q2-86Q2
M1	−4.4	2.5	3.2	−1.5
Broader aggregates				
MSI2	−4.0	1.9	−3.8	−3.1
M2	−5.2	2.0	−1.0	−.3
M3	−5.9	3.8	−.9	−.7
L	−5.6	4.2	−1.2	−.2
Narrower aggregates				
M1A	−5.6	1.8	−1.6	−2.0
MQ	−3.2	3.9	−.4	−4.5
MSI1	−2.5	7.7	1.0	−1.3
No money	−4.7	3.2	−1.4	−1.3

course by economic shocks not included in the model. Further research should attempt to identify such shocks and incorporate them into the money/real income models.

There have been many recent economic events which could have seriously disrupted the real growth process. Likely candidates include the deregulation of the financial sector, the rapid oil price increase of 1979, the oil price decline of 1985-86, the tax law changes in 1981, the large increase in the value of the dollar and subsequent deterioration of the U.S. trade position, and finally the very large fiscal deficits.

Additional evidence in favor of the unmodeled shock explanation is provided by the puzzling finding that the equation that excludes money growth often produces better forecasts in the 1980s than the aggregate equations. Shocks external to the model will reduce the forecasting ability of the aggregates if the Federal Reserve responds to them by changing the money growth rate. For example, suppose the Fed increased money growth in response to a shock which produced unexpectedly low growth. As long as the shock is not explicitly included in the model, the higher money growth would lead to predictions of greater economic growth just as actual growth falls due to the shock. In such a case, inclusion of money growth in the model actually reduces the accuracy of the forecasts, and money growth appears spuriously to be a misleading indicator.

Money/real income: Performance of different income measures

The real income equation's performance in the 1980s also is not significantly improved by changing the income variable. Figure 6 charts the cumulative forecast errors when the equation is estimated with M1 as the monetary aggregate and the real growth rates of GNP, final demand, and consumption plus fixed investment as alternative dependent variables.

The real final demand variable improves the equation's forecasting accuracy a little in 1981 and 1982, but makes it slightly worse in 1983 and 1984. The cumulative error graph of the real final demand equation drops less sharply than that of the real GNP model in the 1981-82 period, but it rises more steeply in 1983-84. The real consumption plus fixed investment variable produces an equation which behaves much like the real GNP equation in the 1980s. Its decline in 1981-82 is almost identical to that of the real income equation, and its rise in 1983-84 is a little steeper. The two specifications that include real government spending as an independent variable also follow the same cumulative error pattern as those of the three estimations shown in Figure 6.

It is somewhat surprising that these alternative estimations produce poorer forecasts than the real GNP equation after 1983, for this is when the importance of imports and the changed patterns of government spending should have been greatest. Our results show that the deterioration of the money/real income relationship in the 1980s is not caused primarily by GNP's failure to accurately measure either domestic transactions or private spending.

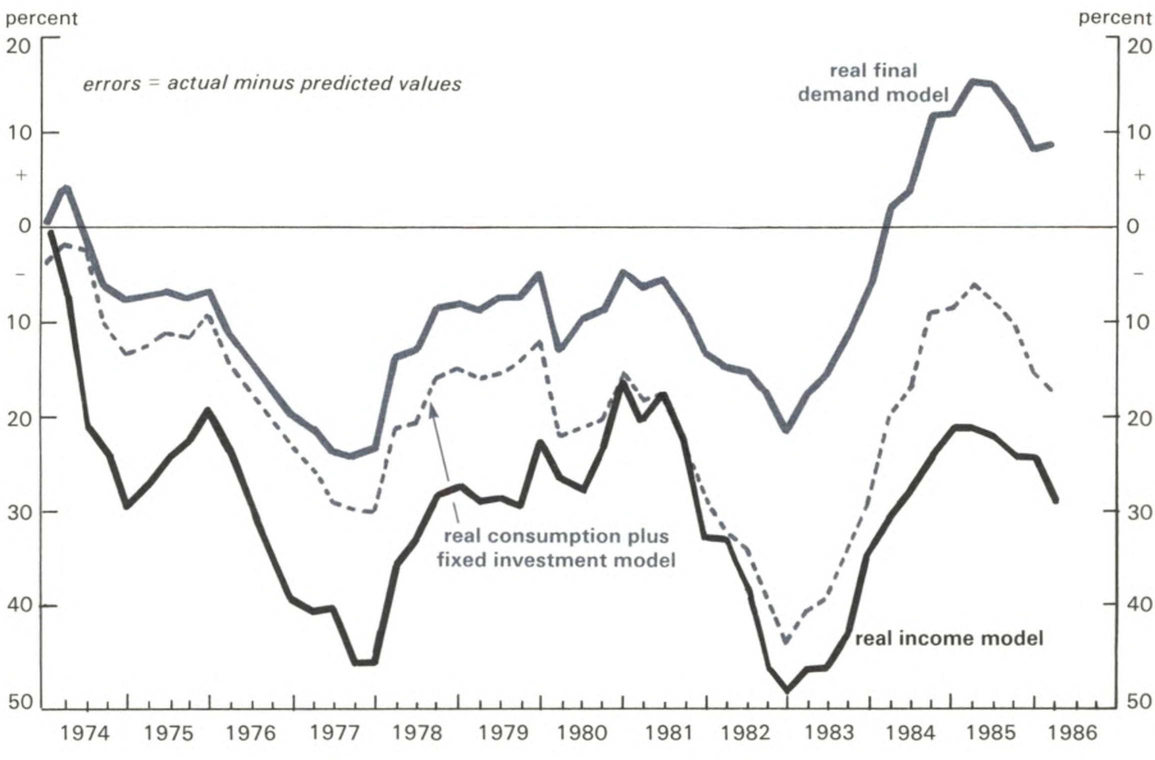
Conclusion

The money/income relationship broke down severely after 1980, prompting some economists to suggest that different money and income measures might improve its performance. In this paper, we estimate the inflation and real growth equations of the FRB Chicago-Gittings money/income model using a range of money and income measures in order to test some of these suggestions. We find that none of the alternative measures significantly improves the two equations' forecasting accuracy in the 1980s. In fact, the patterns of the equations' poor performance are very consistent no matter which monetary aggregates and income measures are used. As the breakdown appears unrelated to the component mix of the aggregates, it is not surprising that the experimental indexes, which assign functional weights to the components, are unable to provide significantly better results.

All our estimations clearly indicate that the inflation and real growth equations experience very different types of deterioration in the 1980s. The inflation equation overpredicts inflation at a remarkably constant rate from 1981 through early 1986. This suggests that a single constant adjustment to the money/inflation equation may be sufficient to correct the problem of the 1980s. The real growth equation, on the other hand, has a very erratic error pattern in the 1980s, with long periods of both overprediction and underprediction. This could have been caused by economic shocks which affected real growth but are not explicitly included in the model.

These findings have several implications for monetary policymakers. First, increases in the rate of money growth should not be entirely ignored as an indicator of possible future in-

Figure 6
Cumulative forecast errors of real growth models with M1 and alternative income measures



creases in inflation. Second, the money/real income model needs significant revision before it can be relied on for policy purposes. Pure monetary models cannot adequately explain the path real economic growth has taken in the 1980s.

[1] For comparisons of the St. Louis model with several large structural models see: Leonall C. Andersen and Keith M. Carlson, "A Monetarist Model for Economic Stabilization," Federal Reserve Bank of St. Louis *Review*, vol. 52 (April 1970), pp. 7-25; Gary Fromm and Lawrence R. Klein, "A Comparison of Eleven Econometric Models of the United States," *American Economic Review*, vol. 63 (May 1973), pp. 385-393; and Yoel Haitovsky and George Treyz, "Forecasts with Quarterly Macroeconometric Models, Equation Adjustments, and Benchmark Predictions: The U.S. Experience," *The Review of Economics and Statistics*, vol. 54 (August 1972), pp. 317-325.

[2] See Thomas Gittings and Steven Strongin, "The Current FRB Chicago-Gittings Model," *Economic Perspectives*, Federal Reserve Bank of Chicago, (July/August 1986), pp. 10-12, for a description of the model used in this paper. The model explained in that article is estimated with two restrictions which force it to behave as if money has a neutral impact on economic growth. We do not impose these restrictions in this paper because we feel many of the aggregates tested are too broad to conform to the assumption of neutrality.

[3] There is some evidence that the specification of the monetary model does not greatly affect its performance in the years examined here. The FRB Chicago-Gittings model and a recent version of the St. Louis equation were found to have very similar forecasting records from 1974 through early 1986 in Diane F. Siegel, "The Relationship of Money and Income: The Breakdowns in the 70s and 80s," *Economic Perspectives*, Federal Reserve Bank of Chicago, (July/August 1986), pp. 3-15.

[4] M1A is currency plus demand deposits at commercial banks minus demand deposits at foreign banks and official institutions; M2 is M1 plus savings and small denomination time deposits at all depository institutions, overnight repurchase agreements issued by commercial banks, overnight Eurodollars held by U.S. residents at foreign branches of U.S. banks, Money Market Deposit Accounts, and money market fund shares; M3 is M2 plus large denomination time deposits at all depository institutions, term repurchase agreements issued by commercial banks and thrifts, term Eurodollars held by U.S. residents at foreign branches of U.S. banks and at all banking offices in the United Kingdom and Canada, and institutional money market mutual funds; L is M3 plus bankers acceptances, commercial paper, Treasury bills, other liquid Treasury securities, and U.S. savings bonds.

[5] See Paul A. Spindt, "Money Is What Money Does: Monetary Aggregation and the Equation of Exchange," *Journal of Political Economy*, vol. 93 (February 1985), pp. 175-204, for a description of the MQ index.

[6] See William A. Barnett, "Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory," *Journal of Econometrics*, vol. 14 (September 1980), pp. 11-48 and William A. Barnett and Paul A. Spindt, "Divisia Monetary Aggregates: Compilation, Data, and Historical Behavior," Staff Studies 116 (Board of Governors of the Federal Reserve System, May 1982) for further description of the MSI1 and MSI2 indexes.

[7] In 1974 and 1975, money growth was much lower relative to economic growth than people expected. At the time this episode was called the "missing money phenomenon." Of the many explanations offered for the low money growth, the most likely attributed it to increased business use of overnight repurchase agreements for transactions purposes. See Gillian Garcia and Simon Pak, "Some Clues in the Case of the Missing Money," *American Economic Review*, vol. 69, (May 1979), pp. 330-334.

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ECONOMIC PERSPECTIVES—Index for 1986

Small business, big job growth

Eleanor H. Erdevig

Introduction

Efforts to quantify and better describe the importance of small business within the United States economy have emphasized the importance of small business as a major source of job generation. The findings have important implications for both national and state policies directed toward the small business sector. On a regional basis, the states of the Midwest, in particular, view small business programs as one way to offset major job losses that have ravaged their industrial base.

While significant strides have been made toward a better understanding of the significance of small business to the economy, many questions remain. For example, just what is a small business? Is it measured in terms of employment size, sales volume, age, number of offices, or some combination of factors? How many small businesses are there and how rapidly do their numbers expand and contract? Improvements to data bases are suggestive of some answers, but many truly small businesses (the cottage industries, for example) are not captured in these data bases.

This article summarizes the recent research on the process of job generation by small businesses. The importance of small business to the Seventh Federal Reserve District states—Illinois, Indiana, Iowa, Michigan, and Wisconsin—is compared with the nation. Lastly, the contribution of small businesses to employment growth in the District over the business cycle and in major industry categories is analyzed.

Recent research

Before the late 1970s, little was known about the relationship between individual firms and the aggregate economy. Research had focused on either the macro economy and its aggregate measures (such as the gross national product and its components) or on the individual firm as the independent unit of analysis.

The absence of reliable information on how individual firms influence aggregate economic activity has hampered efforts to develop public policies that generate jobs for people and places that need them. When little is known about who generates jobs, where they are generated, how they are created, and thus who are most likely to respond to public policies, it is difficult to design and implement efficient and effective economic policies for an area.

In 1979 David L. Birch of the Massachusetts Institute of Technology published pioneering research on the structure of the job generation process. Birch relied on a data file known as Dun's Market Identifier file (DMI) from Dun and Bradstreet. This data base contained information on 5.6 million business establishments at four different points in time—1969, 1972, 1974, and 1976. From this source he was able to define and measure for each firm the processes by which change takes place, with emphasis on new formations, expansions, contractions, dissolutions, and movements. By aggregating firms at any given location, he was able to describe in considerable detail how economic change occurs in that location.

The results of this research were startling. Among the major findings were the following:

- Most of the variation in job growth among states and areas is due to differences in the rate of job generation (i.e., births and expansions of firms), not to differences in rates of job loss (i.e., deaths and contractions).
- Virtually no firms migrate from one area to another in the sense of physically relocating their operations. Branching, however, is quite important, particularly in manufacturing, and it is differential branching, not physical migration, that causes many of the regional differences in job growth.
- The components of job change are sensitive to the business cycle. For most states, births and expansions of firms were fewer and deaths and contractions were more numerous during an economic downturn than during a preceding upturn.

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• Small firms—defined as those with 20 or fewer employees—generated 66 percent of all new jobs in the country during the early seventies. Middle-sized and large firms, on balance, provided few new jobs in relation to their size.

• On a regional basis, small firms generated all the net new jobs in the Northeast, 67 percent in the Midwest, 60 percent in the West, and 54 percent in the South.

Birch concluded that: "The job generating firm tends to be small. It tends to be dynamic (or unstable, depending on your viewpoint)—the kind of firm that banks feel very uncomfortable about. It tends to be young."[1]

Subsequent research by Birch and MacCracken on corporate employment growth over time confirmed that the size effect almost totally dominates the age effect. While there is some tendency for all size groups to grow more (or decline less) at younger ages than older ones, it is not a marked effect, nor is it universal. Size in general was found to be a much better predictor of job growth than age, with a major break between firms with more than 20 employees and those with less. Over the period studied, 1969-1976, the share of net job creation attributable to very small businesses was found to fluctuate between 50 and 70 percent, depending upon economic conditions and the performance of other firms. The authors suggested that it was better to view the corporation as "an adaptive, learning system than in terms of a maturing, aging system, with increased size and/or stability dulling the ability to adapt."[2]

Beginning in 1979 the Small Business Administration (SBA), following a Congressional mandate, began the development of a small business database (SBDB) to be used for historical description and policy analysis. The file known as the U.S. Enterprise and Establishment Microdata file (USEEM) of the SBDB was developed under contract at the Brookings Institution and is based primarily on the Dun's Market Identifier files (DMI). The USEEM contains cross-sectional business microdata as of 1976, 1978, 1980, and 1982. Updates are scheduled for every second year thereafter.

Based on the USEEM file, researchers at the Brookings Institution challenged Birch's previous work. Using a definition of "small business" as a firm with fewer than 100 employees, the Brookings researchers contended that small businesses employ only 36 percent of the labor force and generate just 39 percent of net new jobs. These findings contrast to the 70 to 80 percent reported by Birch.

Although the Brookings researchers found that the small business share of employment growth was roughly equivalent to its share of private sector employment, there were exceptions by region and industry. In weak or declining regions and industries, small businesses increased their employment share by expanding and by new start-ups while large businesses failed to open new branches. In expanding regions and industries, large firms experienced high rates of employment growth due to branch births. As a consequence, small firms tend to exert a stabilizing influence, slowing the rate of economic decline in weak industries and geographic regions, and facilitating expansion in strong industries and regions.[3]

Birch and MacCracken had found that small businesses with less than 100 employees had created 82 percent of the new jobs for the period of 1969-1976 compared to the 39 percent found by Armington and Odle in the Brookings file for 1979-1980. When Birch and MacCracken reviewed the Brookings file, they questioned the methodology employed by Armington and Odle. After adjusting for this, they found that the small business share of net job creation for 1979-1980 was about 70 percent and suggested that a range of 65 to 75 percent was realistic.[4]

The U.S. Establishment Longitudinal Microdata (USELM) sample was constructed for the Small Business Administration from the USEEM files specifically for time series analysis of establishment employment growth patterns, such as job generation. The USELM is a stratified sample containing just over eight million establishments that existed at any of the four years in the USEEM files, roughly half of the total establishments represented. This sample file is weighted by employment to represent the entire population of U.S. businesses and is benchmarked to 1976 and 1982 employment totals.[5]

Recent research involving an analysis of the accuracy of the SBDB by comparing the files with state unemployment insurance data, has also provided information on job generation by firm size. Jacobsen (1985) matched records from the SBDB (excluding branches) with unemployment insurance records in Texas from 1978 to 1982. Within the matched population, particularly for small businesses, measures of aggregate employment growth between 1980 and 1982 were found to be very similar. He also found that the major conclusions of the earlier studies were valid, despite distortions caused by reporting lags. Most growth in employment was found to occur among young, small firms. In the matched sample the unemployment insurance data for 1980-1982 for Texas showed employment growth of 23.2 and 16.7 percent for the 1-5 and 6-19 employment size classes, respectively, compared to 3.7 percent for firms with 500 or more employees. Fifty-six percent of the new jobs occurred among firms with less than 20 employees and only ten percent in the largest size (over 500 employees) firms.[6]

Research on job generation in Wisconsin for 1969-1981 also found that very small businesses—those that have 20 or fewer employees—dominate that state's job generation process. Dun and Bradstreet data for 1969-1976 were obtained from David L. Birch to provide an historical perspective and to compare results for Wisconsin with the rest of the nation. Complete annual Wisconsin unemployment insurance data were analyzed for 1977 to 1981.

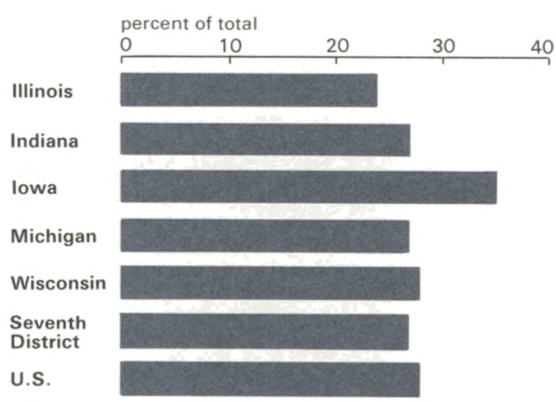
Among the results of that research were the following:

- From 1969 to 1979, very small businesses created more than twice as many net new jobs as their share of total employment would predict, usually more than all other businesses combined.
- Only very small businesses generated more jobs than they lost during the 1979 through 1981 recession years.
- Very small businesses create the most net new jobs in all industry groups, including manufacturing, where they have a smaller share of total employment.
- Even during the 1980-to-1981 recession period, very small manufacturing firms continued to add more jobs than they lost, in contrast to the larger manufacturers,.
- The most important factor in explaining the ability of very small businesses to generate the most net new jobs is that every year, during both economic expansions and recessions, there are many new businesses that start up. The majority of these are very small businesses with 20 or fewer jobs. In addition, very small businesses expand and grow as their markets and product lines expand.
- The job creation rate of very small businesses through both births and expansions is considerably higher than that of larger firms and more than offsets their job loss rates, which are slightly higher than those of larger firms.
- Employment change at larger firms is more sensitive to recession. The relative fall in shares of employment at expanding firms and rise in shares at contracting firms are both greater for larger firms.
- Among the major industrial sectors, the services sector is found to be a consistent and somewhat countercyclical source of net new jobs; the manufacturing sector is sensitive to changes in the business cycle and a very cyclical job generator; and the high technology production sector is small and not a consistent source of new jobs.[7]

Importance of small businesses in Seventh District states

Data on the number of small business establishments are derived from the annual *County Business Patterns* (CBPD) data with the latest as of 1983. An establishment is a single physical location where business is conducted or where services or industrial operations are performed. However, individual establishments are not necessarily separate business firms. The fact that separate locations of a multi-establishment firm are counted as individual establishments tends to overstate the relative importance of small businesses in an

Figure 1
Small business employment: 1983



area. Offsetting this are the small businesses that do not have paid employees and are not included.

According to the latest CBPD data, small businesses generally represent about 88 percent of all establishments, both in the Seventh District and nationally. Among the individual states in the District, the range is from 87 percent in Illinois to 90 percent in Iowa.

More variation exists among the states in the proportion of total employment located in small business establishments. Although employment in small business establishments represents about 27 percent of total employment in the Seventh District compared to 28 percent in the United States, the range among the states in the District is from a low of 24 percent in Illinois to a high of 35 percent in Iowa.

The proportion of establishments that are small businesses and their proportion of total employment varies considerably among industries. Agricultural services has the highest proportion of employment in small businesses at 60 percent nationally and in the Seventh District at 73 percent. Manufacturing has the smallest proportion at eight percent nationally and seven percent in the Seventh District. Other industries are within these ranges.

Figure 2
Small business employment by industry: 1983

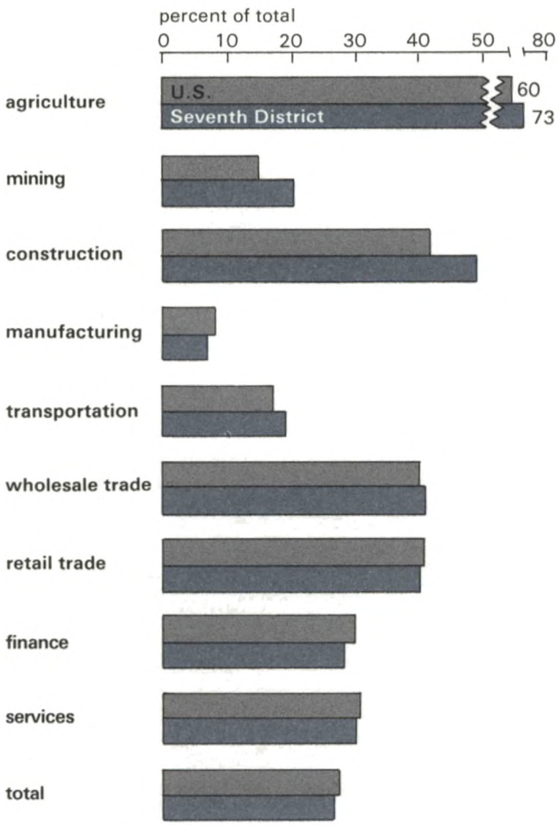
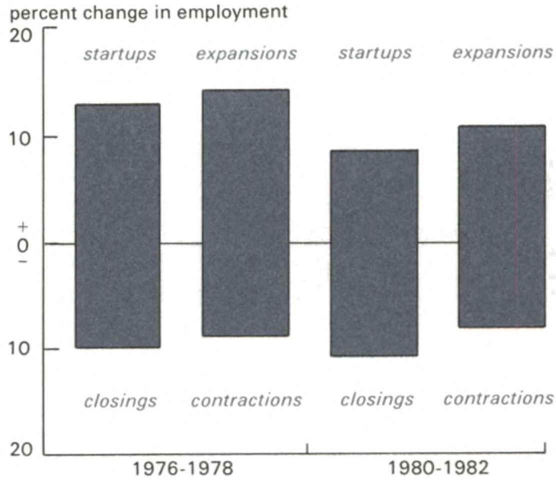


Figure 3
Components of employment change over the business cycle: United States



Components of employment change

The components of employment change are the proportions of employment change that occur in firms that are new, (i.e., births), in existing firms that are expanding or contracting, or in firms that have closed, (i.e., deaths). Comparisons of the behavior of the components of employment change over the business cycle indicate the differences in the sources of change during periods of the cycle.

Utilizing data from the USELM file allows an analysis to be made of employment change during a period of economic recovery and a recession. A comparison of the employment change between 1976-1978 (a period of recovery) and 1980-1982 (a recessionary period)[8] indicates that nationwide most of the difference in employment change between the two periods is due to the decline in births and expansions. Very little of the difference in employment change is due to closings and contractions. About 10 percent of the employment change from 1976 to 1978 was due to closings and about 11 percent in the 1980 to 1982 period—a very small difference. About nine percent was due to contractions in the earlier period and eight percent in the latter period. The major difference between the two periods is in the percentage of employment change due to births and expansions. Thus, births account for about 13 percent of the employment change during the recovery but only nine percent during the recessionary period. Similarly, the percentage contributed to employment growth by expansions dropped from 14 percent in the recovery period to 11 percent in the recessionary period.

These results are rather surprising in light of the emphasis that the media places on plant closings and layoffs. Considerably less attention is given to trends in new incorporations and firms expanding employment.

Comparisons of the sources of employment change in the Seventh District with that in the United States show the same pattern. The proportions of employment change from closings and contractions change very little between the two periods. Most of the differences were from declines in births and expansions.

The percentage change from closings is slightly lower for the District relative to the nation during both periods. The differences due to contractions are mixed. Generally higher birth rates and greater employment growth mean higher closing rates.

The poorer performance of the Seventh District in employment growth during both periods is thus primarily due to lower percentage increases in employment from births and expansions.[9] It also means that a higher percentage of the employment is in firms with no change in employment during the period.

Comparing the components of employment change for small businesses with the components of change for total employment in the Seventh District reveals that small businesses have higher employment rates from births and expansions during both periods of the business cycle. Except for the change in employment from closings during the 1976-1978 recovery period, small businesses also have smaller percentage changes in employment from closings and contractions than total employment throughout the cycle.

As a result of the higher contributions of births and expansions to employment growth and the generally smaller losses from closings and contractions, the contribution of small businesses to overall employment growth exceeds its share of total employment. This is consistent with the Birch results mentioned above.

Figure 4
Components of employment change over the business cycle: United States and Seventh District

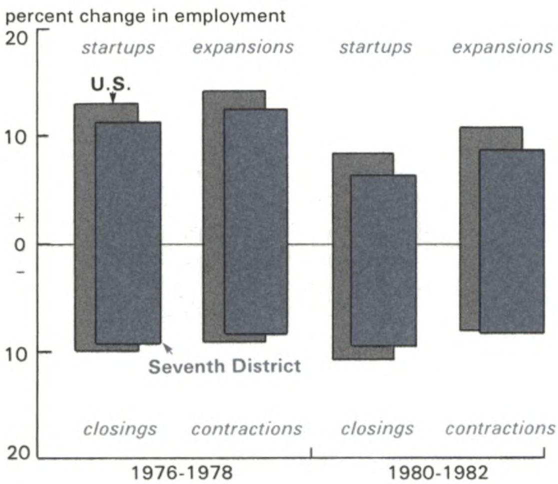


Figure 5
Components of small business and total employment change over the business cycle: Seventh District

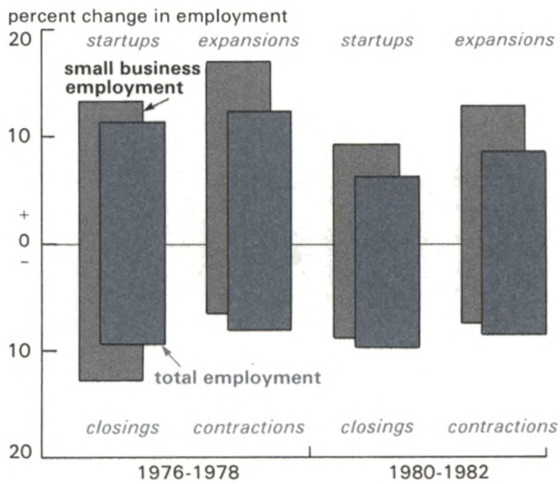


Figure 6
Employment change by firm size: 1976-78

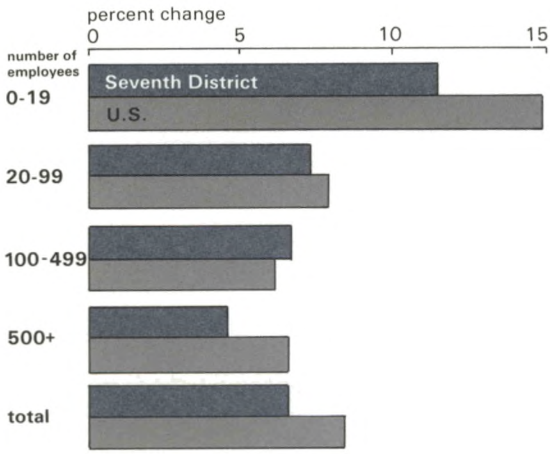
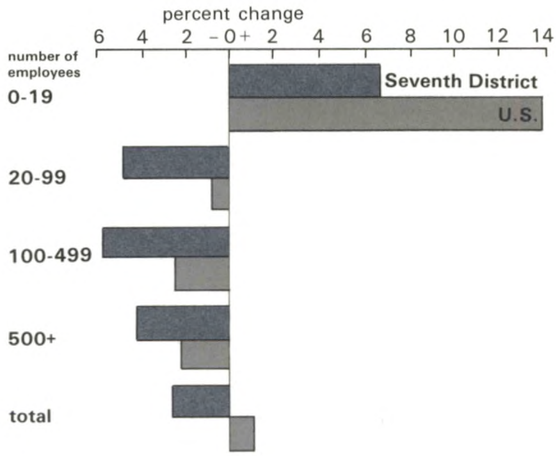


Figure 7
Employment size by firm size: 1980-82



Importance of small businesses to employment growth

Small businesses are important to employment growth during both recovery and recessionary periods. The contributions of small businesses are particularly evident during recessionary periods when employment at medium- and large-sized businesses may be declining in the aggregate but employment growth is continuing in the group of small businesses with fewer than twenty employees.

For both the District and the nation the employment growth rate was greater for smaller firms than for other size groups during the recovery of 1976-1978. (See Figure 6.) With the exception of firms with 500 or more employees in the U.S., employment growth rates decreased as the size of the firm increased. In the Seventh District the rate of employment growth for all firm sizes except those with 100-499 employees was much lower than that nationally, a reflection of the poorer overall economic performance of industry in the District generally.

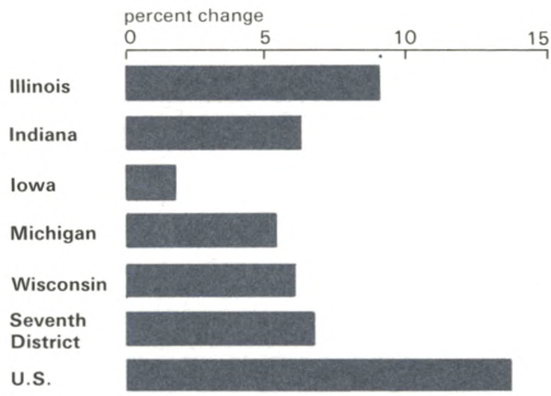
During the period from 1980-1982, the USELM data show that small businesses with less than 20 employees continued to increase employment. Firms in all the other employment size groups lost employment. In the Seventh District, although total employment declined about three percent during this period, small businesses had increased their employment by about seven percent. The same pattern was true for the United States but the employment growth rate for small businesses was greater at 14 percent and the employment loss rate was less for the other firm sizes than in the Seventh District. The growth rate for small businesses in the United States during this period was actually sufficiently large so as to offset the losses at medium- and large-sized businesses and thus produce a net gain in total employment.

Employment growth in small businesses during the recessionary period was not confined to just a few industry sectors but occurred generally in all industries. This was true for the nation as a whole and also in the Seventh District with the exception of the construction industry. The growth rates for employment in small businesses in the Seventh District, however, consistently lagged those in the United States in all major industry sectors.

There was, however, variation in small business growth rates among the industry sectors. Below average small business employment growth rates occurred nationally in retail and wholesale trade and in construction which have a higher base of small business employment. The same was true for these sectors in the Seventh District when compared to the District average. The strongest growth sectors both nationally and in the Seventh District were mining;[10] services, which includes business services; finance, insurance, and real estate; and transportation and communications. Even

Figure 8
Small business employment change by industry: 1980-82

Figure 9
Small business employment change: 1980-82



small businesses in manufacturing and agricultural services, two sectors generally regarded as having performed poorly in employment during the recession, had small business employment growth rates which were slightly above the Seventh District small business average growth rate.

Among the individual states in the District, small business employment growth during the 1980-1982 period varied from a high of about nine percent in Illinois to a low of two percent in Iowa. Only Illinois was above the Seventh District average of seven percent. Small businesses in Illinois contributed half of the total small business employment growth in the Seventh District, but accounted for only about a third of small business employment. Despite a near-average rate of growth for a Seventh District state, small businesses in Michigan accounted for only 15 percent of small business growth in the Seventh District although the state had 25 percent of the area's small business employment.

The major factors contributing to the lagging growth of small businesses in the Seventh District during the 1980-1982 period were low birth rates and low expansion rates. The death rate (closings) of Seventh District small businesses was below the national average. This is consistent with the finding discussed above that areas with lower birth rates generally have lower rates of closings.

Differences in small business growth among Seventh District states were also largely due to relative performance in births and expansion. The stronger performance of Illinois reflected its above District average birth and expansion rates. Iowa's poor performance was due to its lower birth rate and expansion rate and a higher rate of contractions. Michigan and Indiana had similar birth, death, and contraction rates and the difference in contributions of small businesses to employment growth in the two states was due to the somewhat higher rate from expansions in Indiana compared to Michigan.

Employment growth in small businesses in the individual states varied among the major industries. In Indiana, employment growth in small businesses engaged in manufacturing was almost twice the District average and comparable to the national average. In Iowa the rate was half the District average and about one-fourth the national average. Michigan and Wisconsin were below the District average.

Table 1
Sources of small business employment change: 1980-82

	Birth rate	Death rate	Net births	Expansion rate	Contraction rate	Net expansion	Total change
U.S.	12.2	9.5	**2.7**	17.5	6.3	**11.2**	13.8
Seventh District	9.4	8.7	**0.7**	13.2	7.2	**6.0**	6.7
Illinois	10.7	8.8	**1.4**	14.1	6.3	**7.8**	9.2
Indiana	9.2	9.0	**0.2**	13.7	7.6	**6.1**	6.4
Wisconsin	8.8	8.2	**0.6**	13.1	7.5	**5.6**	6.2
Michigan	9.2	8.9	**0.3**	12.7	7.7	**5.0**	5.3
Iowa	7.9	8.5	**−0.6**	10.8	8.4	**2.4**	1.9

Both Illinois and Indiana showed strength in employment growth for small businesses in the finance, insurance, and real estate group. Indiana's strong showing was due mostly to relatively high expansion rates. Again Iowa's performance was poor and that in Michigan and Wisconsin was below the District average.

Small business employment growth in the wholesale trade sector was above the District average in Illinois but also in Michigan. Michigan's strong showing in wholesale trade was apparently due mostly to above average birth rates. Employment in small wholesale trade businesses in Iowa actually declined during the 1980-1982 period.

Conclusions

Analysis of existing small business datasets for Seventh District states gives results consistent with other research emphasizing the importance of small businesses for employment growth. This result holds during both recovery and recessionary periods.

The components of job change that are most sensitive to the business cycle over time are births and expansions. Rates of employment growth from closings and contractions are less variable.

Small firms—those with 20 or fewer employees—create a larger proportion of new jobs than their share of employment in the economy and continue to create jobs even during recessions.

The patterns of employment growth for small businesses in the Seventh District are similar to that in the United States. However, the rates of employment growth were generally lower in the Seventh District during the two periods studied.

The strongest growth industries for small businesses during the recessionary period both nationally and in the Seventh District were mining; services including business services; finance, insurance, and real estate; and trans-

Figure 10
Small business employment change: manufacturing, 1980-82

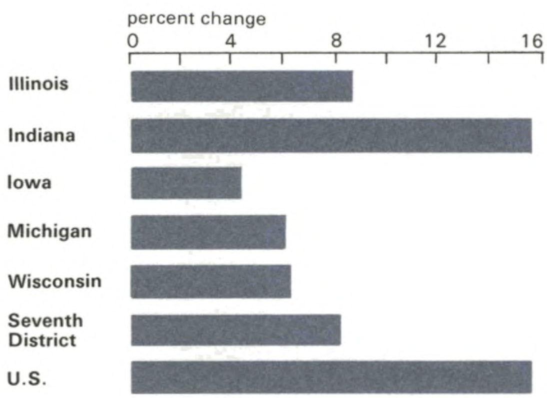


Figure 11
Small business employment change: finance, insurance, real estate, 1980-82

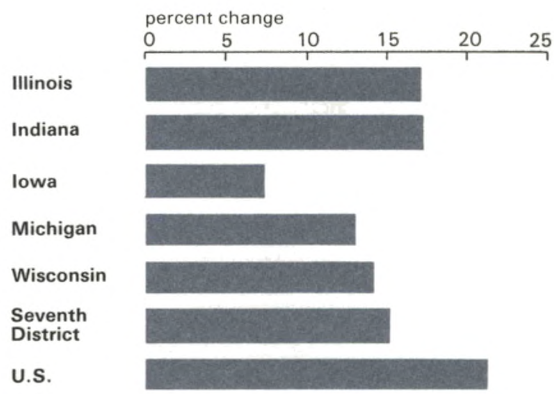
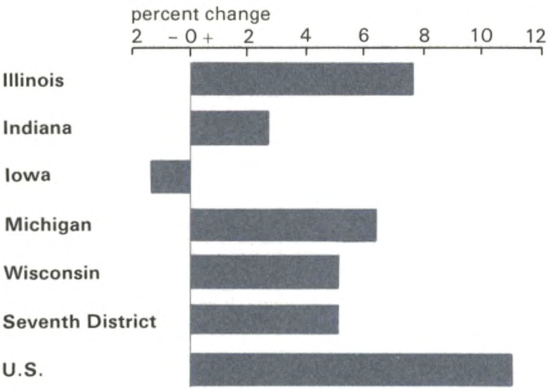


Figure 12
Small business employment change: wholesale trade, 1980-82



portation and communications. The weakest sectors were retail and wholesale trade and construction. Small businesses in manufacturing and agricultural services had small business employment growth rates which were slightly above the overall small business average for the Seventh District.

Most of the variation in job growth among states is due to differences in job creation (i.e., births and expansions), not to the differences in job loss (i.e., deaths and contractions). In fact, areas with higher birth rates, and hence higher employment growth rates, tend to have higher death rates.

Small businesses had the highest employment growth rate in Illinois among Seventh District states and the lowest in Iowa. The stronger performance in Illinois reflects its above District average birth rate and expansion rate. Iowa's poor performance on the other hand was due to its lower birth rate and expansion rate and also a higher rate of business contractions.

The performance in individual states varied by industry. In Indiana, employment growth in small businesses engaged in manufacturing was almost twice the District average and comparable to the national average. In Iowa the rate was half the District average.

Both Illinois and Indiana showed strength in employment growth for small businesses in the finance, insurance, and real estate group. Indiana's strong showing was due mostly to relatively high expansion rates.

Small business employment growth in the wholesale trade sector was above the District average in Illinois but also in Michigan. Michigan's strong showing in wholesale trade was apparently due mostly to above average birth rates.

The findings cited in this study suggest that small business can have a net positive effect on employment, especially if a high rate of start-ups and expansions can be generated. From a public policy point of view the question that remains unanswered by the data is why do small businesses expand more rapidly in some states and regions than in others. Is it due to previous public policies (i.e., subsidized financing and assistance) or is it that some states have a more attractive entrepreneurial climate? The answer to this question will be a major contribution to the formulation of future public policies.

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[2] Birch, David L., and Susan MacCracken, *Corporate Evolution: A Micro-Based Analysis,* M.I.T. Program on Neighborhood and Regional Change, January 1981.

[3] Armington, Catherine, and Marjorie Odle, "Sources of Job Growth: A New Look at the Small Business Role," *Economic Development Commentary,* Vol. 6, No. 3, Fall 1982, pp. 3-7. Armington, Catherine, and Marjorie Odle, "Small Business—How Many Jobs?," *The Brookings Review,* Vol. 1, No. 2, Winter 1982, pp. 14-17.

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[5] For more information on the Small Business Data Base, see *The Small Business Data Base: A User's Guide,* Office of the Chief Counsel for Advocacy, U.S. Small Business Administration, Washington, D.C., June 1986 and Bruce D. Phillips, *The Development of the Small Business Data Base of the U.S. Small Business Administration: A Working Bibliography,* Office of Advocacy, U.S. Small Business Administration, Washington, D.C., Revised November 1985.

[6] Lou Jacobsen, *Analysis of the Accuracy of SBA's Small Business Data Base.* Prepared by the Hudson Institute of the Center for Naval Analysis under

contract to the Office of Advocacy of the U. S. Small Business Administration, August 1985.

[7] *The Job Generation Process in Wisconsin: 1969-1981,* Report 84-2, Bureau of Research, Division of Policy Development, Department of Development, State of Wisconsin, December 1984.

[8] Technically, the 1980-1982 period contains two recessions and one recovery; however, the recovery lasted only 12 months.

[9] Overall employment in the District underperformed trends in nationwide employment. From March 1976-March 1978 seasonally adjusted payroll employment in the District was up seven percent and eight percent in the U.S. From March 1980-March 1982 employment was down six percent in the District and one percent in the U.S.

[10] While strong in percentage terms, this sector has a low starting base of employment.

How the market judges bank risk

Elijah Brewer III and Cheng Few Lee

The risks that a bank faces can be judged by looking at such accounting data as asset composition, quality, and liquidity; capital adequacy; and earnings. Financial theory suggests that the risk sensitivity of a bank can also be judged by examining the returns required by financial markets—specifically the market for bank equities. Using both accounting and market data, we compare the financial characteristics of bank holding companies from different parts of the country. We find that there is a significant but imperfect correlation between accounting-based measures of equity risk and market-based measures of equity risk. We also find that there are regional differences in the market response. For example, the equities of New York City bank holding companies exhibit more sensitivity to certain kinds of risk than do Chicago, California, or regional bank holding companies. Finally, we find that regional differences in branching laws have an important impact on bank equity risk through their effect on a bank's reliance on purchased funds.

Economic risks—as reflected in uncertainty regarding economic growth, inflation, and interest rates—have differential regional impacts because regulation and market forces have led banks to develop different exposures to risk. Regional variation in regulations governing branching, mergers, and acquisitions influence the ability of banking organizations to control their risk. For example, some banking organizations have placed a heavy reliance on purchased funds because branching restrictions make it difficult for them to develop a broad deposit base and thus have access to more stable sources of funds. On the asset side of the balance sheet, geographic constraints and restrictions on mergers and acquisitions tend to limit the ability of some banking organizations to engage in risk-reducing diversification of their loan portfolios. Depending on its part of the country, a bank may be more sensitive to certain kinds of risk.

Risk and bank equity values

In structuring their investment portfolios, bankers choose their exposure to credit, liquidity, and interest rate risks with the expectation of earning a return commensurate with the expected levels of risk. Research on bank failure indicates that bank risk can be evaluated using four key variables: asset quality, liquidity, capital adequacy, and earnings.[1]

Asset quality is particularly important for banks because they assume both a credit and an interest rate risk exposure on most of their assets. Because banks are highly leveraged, large loan or security losses can bring insolvency. Large fluctuations in interest rates can cause great appreciation or depreciation in the value of long-term fixed-rate assets. The quality of assets will be affected both by management's control over its credit review function and by economic conditions. For example, banks may purchase long-term securities that are profitable if interest rates fall or remain stable but could lead to losses if interest rates rise (assuming no hedging). Or, a decline in credit quality can lead to write-offs and reduced earnings in the loan portfolio. As a consequence, the riskiness of bank equity and the probability of negative net worth will be higher, the lower a bank's asset quality.

Bank equity values are also sensitive to liquidity risk. Liquidity risk is the risk that a bank will be unable to fund its assets without paying a premium over the rates paid by other banks on similar liabilities. Banks that depend on short-term deposits and purchased funds are more likely to face a liquidity crisis when asset quality deteriorates. In an extreme case, a bank may be unable to raise funds in private markets at any cost. Although liquidity is rarely the original cause of financial problems for banks, it is usually a firm's inability to meet liquidity needs that signals its imminent end.

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To protect against liquidity risk a bank can lengthen the maturity of its liabilities or increase the marketability of its asset portfolio, thereby giving itself the flexibility to respond to adverse developments in the markets for its liabilities by selling assets. However, because the liabilities for which maturity can be adjusted most readily typically are fixed-rate instruments, the reduction in liquidity risk simultaneously alters the bank's exposure to interest rate risk in the direction of greater losses (or smaller gains) in the event of declining interest rates. As a result, the net effect of such an adjustment on overall bank risk can only be determined empirically.

Bank equity values are also sensitive to the level of book capital relative to total assets. Regulators define a bank's capital as the difference between the book value of its assets and liabilities.[2] Other things equal, a lower ratio of capital to assets depresses the bank equity values because it increases the probability that temporary losses will reduce the bank book capital below the level needed to prevent the Federal Deposit Insurance Corporation from closing the bank.

Bank equity values are affected by the earning power of its assets—the net rate of return on assets. The rate of return on assets influences the bank's ability to attract equity capital. Other things held constant (including asset risk), the higher the rate, the greater the amount of equity capital supplied to the bank. The rate of return on assets influences also the cushion available to absorb losses from bank operations or defaults on assets. Other things held constant, the higher the rate, the more losses the bank can take before its capital position is threatened. Bank risk is affected not only by the rate of return on assets but also by the variability of the rate of return on assets. Banks with highly volatile rates of return on assets will have highly volatile stock prices.

The ratios shown in Table 1 indicate several facets of large bank holding company financial positions by geographic areas. As expected, the book capital-asset (Book value in Table 1) ratios for money center bank holding companies in New York City, Chicago, and California were lower than that for regional bank holding companies. Within the money center category, New York City banking firms had the lowest and Chicago bank holding companies the highest book capital-asset ratios. Other things held constant, lower book capital-asset ratios at money center bank holding companies indicate a greater exposure to the risk of failure, or a smaller cushion to absorb losses from operations or defaults on assets. These findings were similar when using market capitalization-asset (Market value) ratios, with the exception of California bank holding companies. California bank holding companies had higher market capitalization-asset ratios than those bank holding companies located in other areas. However, market capitalization-asset ratios are in general lower than book capital ratios. The simple rank correlation between book capital ratios and market capitalization ratios is 0.70, and it is significantly different from the value of one for perfect correlation. The results suggest that the risk exposure ranking based on market values may imply different exposure rankings as well as a cushion available to absorb losses than ranking based on book values.

Money center bank holding companies finance their higher loan-to-asset (Loans) ratio by placing greater reliance on purchased funds than bank holding companies in other areas.[3] California bank holding companies have on average higher loan-to-asset ratios than other money center bank holding companies, although California bank holding companies reliance on purchased funds is significantly lower, reflecting differences in branching and other regulations. The implications of these ratios for bank risk are complex. The lower purchased funds ratios suggest that those bank holding companies are less exposed to liquidity risk. However, higher loan-to-asset ratios tend to indicate a greater exposure to credit risk.

The higher after tax net return on assets (ROA) at regional bank holding companies together with their less risky profile indicates a larger cushion to absorb losses before their capital position is threatened. Regional bank holding companies' capacity to absorb charge-offs is evident from the ratios in Table 1. Regional and California bank holding companies have both a higher ROA and, with the exception of Chicago bank holding companies, a higher ratio of loan charge-offs to total assets than New York City bank holding companies. The net effect of these various accounting ratios on bank risk and on the return a bank must earn to compensate stockholders for bearing this risk can only be determined empirically by

Table 1
Selected financial ratios for large bank holding companies (average values 1978-1983 as a percent of total assets)

						After tax net income	
Money Center	Book value	Market value	Loans	Purchased funds	Loan charge-offs	Mean	Standard deviation
California (5)	0.0447	0.0398	0.6158	0.4451	0.0063	0.0059	0.0013
Chicago (4)	0.0458	0.0274	0.5562	0.6180	0.0061	0.0042	0.0011
New York City (8)	0.0404	0.0265	0.5525	0.6006	0.0040	0.0054	0.0009
Other Areas (27)	0.0556	0.0363	0.5285	0.3205	0.0069	0.0062	0.0022

Accounting data from yearend reports filed with the Federal Reserve System by large bank holding companies. Price data used in the market value calculations came from Automatic Data Processing, Inc. The share data came from *Moody's Bank and Finance Manual*, Vol. 1, 1978-1983.

relating them to market-based measures of risk sensitivities estimated from stock price data.

Methodology and data

Modern finance theory suggests that bank risk sensitivity can be measured by analyzing stock market returns. Bank equity values are sensitive to all the factors that affect the overall stock market as well as to factors specific to the banking industry. For example, banks are sensitive to "earnings risk" through possible defaults on their loans and investments, changes in loan demand, and potential variability in growth and profitability of their non-portfolio operations. Bank equity values are also sensitive to movements in interest rates because banks typically fail to match the interest sensitivity of their assets and their liabilities. As a result, movements in interest rates affect the market value of each side of the bank's balance sheet and both its net worth and stock values.

The multi-index market model is widely accepted as a characterization of the return-generating process for common stocks.[4] This model is an extension of the common single-index market model in which capital market risk sensitivity can be represented by the equity "beta," or the measured sensitivity of the firm's equity return with respect to the return on the market-wide portfolio of risky assets.

The multi-index market model is employed in this article to capture other determinants of individual stock returns. This study examines two other determinants of bank stock returns: changes in the prospects of a particular industry that would have effects on the entire set of firms in that industry, but not stocks in general, and unanticipated changes in interest rates.

Our multi-index market model takes the following form

$$r_{j,t} = \alpha_j + \beta_{1,j}\, r_{M,t} + \beta_{2,j}\, r_{I,t} + \beta_{3,j}\, r_{F,t} + \varepsilon_{j,t} \qquad (1)$$

where $r_{j,t}$ is the rate of return on stock j in excess of the risk-free rate of interest,[5] $r_{M,t}$ is the rate of return on the market portfolio in excess of the risk-free rate of interest; $r_{I,t}$ is the rate of return on the banking industry stock index in excess of the risk-free rate of interest; $r_{F,t}$ is a measure of unanticipated changes in interest rates; and $\varepsilon_{j,t}$ is an error term. In the linear regression α_j, $\beta_{1,j}$, $\beta_{2,j}$ and $\beta_{3,j}$ are parameters to be estimated. The value of $\beta_{1,j}$, indicates the riskiness of stock j relative to the market as a whole; $\beta_{2,j}$ can be interpreted as representing the industry sensitivity of bank j stock; and $\beta_{3,j}$ measures the effect of unanticipated changes in interest rates on the stock returns of bank j .

Equation (1) was estimated over the period January 1978 through June 1984 using daily returns data (dividends and capital gains) for a sample of 44 bank holding companies.[6] Eight of these bank holding companies were located in New York City, four in Chicago, five in California, and 27 were located in other geographic areas. The 1,642 daily return observations were pooled, yielding 13,136 observa-

Measuring the market's response

The return on the market portfolio was measured by the return on a value-weighted portfolio of the firms on the New York Stock Exchange and American Stock Exchange obtained from the Center for Research in Security Prices (CRSP) data base.

Data from Automatic Data Processing Inc., was used to construct a bank industry stock market index. A total of 71 bank holding companies were included in the sample. For each bank holding company, the aggregate market value of the stock was computed each day by multiplying the share price by the number of common stock shares outstanding. For days on which dividends were paid, the price was adjusted upward by the amount of the dividend for computing the market value that day only.* The bank industry stock index was computed by summing the individual bank holding company market values and then dividing by the value of that sum in 1981.

Interest rates on U.S. Treasury obligations were used to ensure that estimation of the relation between stock returns and unanticipated changes in interest rates was free from "contamination" resulting from changes in default premiums. Three-month Treasury bills were used because they are also pure discount instruments, that is, they bear no coupons.

Unanticipated changes in interest rates were measured by the difference between the actual 3-month Treasury bill rate at time t and the forward 3-month Treasury bill rate embedded in the yield curve at time $t-1$.** The forward rate incorporates expectations and, in equilibrium, this rate is the market forecast of the expected rate for period t .† If interest rates are lower than anticipated in time period t, bank equity values may increase or decrease, depending upon the bank's asset/liability maturity mismatch.

*This procedure is similar to that used to construct the CRSP value-weighted market index. Dividends are included in the CRSP value-weighted index.

**A number of researchers have measured unanticipated changes in interest rates by the change in the 3-month Treasury bill rate from the previous period, $({}_tR_3 - {}_{t-1}R_3)$. Booth and Officer (1985) have shown the experiments using this measure of unanticipated changes in interest rates led to marginally worse fits for their regression equations, smaller interest rate sensitivity estimates and no appreciable differences as to the statistical significance of any of the other coefficients in the equations. For these reasons, $({}_tR_3 - {}_tF_{3,t-1})$ is used as a measure of unanticipated changes in interest rates rather than $({}_tR_3 - {}_{t-1}R_3)$ The forward three-month Treasury bill rate embedded in the current term structure of interest rates can be calculated as follows:

$$_{t+1}F_{3,t} = \frac{(1 + {}_tR_6)^2}{(1 + {}_tR_3)} - 1$$

where ${}_{t+1}F_{3,t}$ is the forward three-month Treasury bill rate embedded in the yield curve at time t; ${}_tR_6$ is the current yield on a six-month Treasury bill in time t; and ${}_tR_3$ is the current yield in time t on a three-month Treasury bill.

†See Hicks (1946) for a discussion of this point, pp. 135-140; pp. 146-147. Fama (1976), in a more recent study, also makes this point.

tions for New York City bank holding companies, 6,568 observations for Chicago bank holding companies, 8,210 observations for California bank holding companies, and 44,334 observations for the group of holding companies in other areas.

The bank returns data are for bank holding companies. For each of the holding companies included, commercial banking was by far the major activity of the firm. Assets at subsidiary commercial banks accounted for more than 81 percent of the parent bank holding company assets for each firm in the sample. On average, commercial bank assets accounted for 96 percent of holding company assets, and 63 percent of holding company income.

Empirical results

Using the pooled data, equation (1) was estimated separately for bank holding companies in each of the four geographic areas using ordinary least squares regression.[7] The results of this exercise are shown in Table 2. The equity values of New York City banks are relatively more exposed to market and industry sources of risks than are California and Chicago bank holding companies. For New York City bank holding companies, the ordinary least squares results indicate that for every one percent change in the return on the market portfolio, bank returns will change 0.81 percent. Additionally, for every one percent change in the banking industry return, bank returns will change by 1.19 percent.

The results in Table 2 also indicate that the equity values of Chicago bank holding companies are less affected by market and industry risks than are the other two money center banking regions. New York City bank holding company stocks exhibited significantly more market and industry sensitivities than the other two groups of money center bank holding companies.[8]

Although banking organizations outside of the money center areas are significantly less sensitive to market and industry sources of risks, their equity values are significantly more exposed to interest rate risk. The coefficient for the interest rate factor is significantly negative for these institutions.

A negative coefficient on the interest rate variable indicates that higher than anticipated interest rates will cause bank holding company equity values to decline. This implies that over the estimation period the interest sensitivity of assets was, on average, greater than the interest sensitivity of the liabilities for the bank holding companies in the sample. This indicates that only the smaller regional banking organizations have a significant exposure to interest rate risk.

Table 2
Risk sensitivities of bank stocks
January 1978 - June 1984

	Intercept	Stock market risk	Banking industry risk	Interest rate risk	$\bar{R}^2$	S.E.E.
Money Center Areas (17)						
California Banks (5)						
OLS	0.0002 (1.086)	0.7423 (37.435)*	0.9116 (31.200)*	0.0019 (0.286)	0.2215	0.0153
Chicago Banks (4)						
OLS	−0.0001 (0.364)	0.6465 (28.374)*	0.7672 (22.848)*	−0.0053 (0.693)	0.1663	0.0157
New York City Banks (8)						
OLS	0.0002 (1.807)***	0.8053 (63.614)*	1.0899 (58.424)*	−0.0030 (0.709)	0.3589	0.0124
Other Areas (27)						
OLS	0.0002 (2.286)**	0.3937 (46.006)*	0.3998 (31.706)*	−0.0228 (7.933)*	0.0677	0.0153

$\bar{R}^2$ is the coefficient of determination corrected for degrees of freedom, S.E.E. is the standard error of estimates, and the numbers in parentheses below the regression coefficients are the absolute values of the corresponding t-ratios. One asterisk indicates that the regression coefficient is significantly different from zero at the 1 percent level. Two asterisks indicate significance at the 5 percent level. Three asterisks indicate significance at the 10 percent level.

Links between accounting and market measures of risk

As discussed above, commercial bankers, through decisions about uses and sources of funds, determine expected return and an associated level of risk for banks' shareholders. It is possible to test whether bankers' decisions as reflected by their accounting statements are related to market, industry, and interest rate risks of bank equity. We chose to test this proposition by relating those accounting ratios in Table 1 to estimates of market, industry, and interest rate risk sensitivities for our 44 bank holding companies. For each bank holding company, the average value of the accounting ratios was calculated by averaging over annual data for the 1979-1983 period. The market, industry, and interest rate risk sensitivities were estimated separately for each of the 44 bank holding companies over the period January 1978 through June 1984 using daily return data.

The results of estimating the relationship between each market-based measure of risk sensitivity and the accounting ratios are shown in Table 3. Where an increase in a financial ratio would be expected to increase risk, that ratio should have a negative impact on bank sensitivity. The coefficient on the book capital ratio has a negative sign and is significantly different from zero in both the market and industry equations. The after-tax net income-to-assets variable was positive and only significantly different from zero in the interest rate equation. In all three equations, the purchased funds ratio and the loans-to-asset ratio both have a positive sign and are statistically significant. Neither the standard deviation of the after-tax net income nor the loan charge-offs ratio has a statistically significant effect on the three market-based measures of a bank's risk sensitivity.

These results reveal the nature and the degree of impact that certain financial ratios have on banks' market-determined measures of risk sensitivity. Bank risk sensitivities increase when both loans and reliance on purchased funds rise, or when the book capital-to-asset ratio declines. Variations in these three variables explained a surprisingly large proportion of the variation in financial markets' assessments of the risk of bank equity. These results suggest that there is much more information about bank holding company risk exposure in balance sheet data than in income statement data. Our results also suggest that regional differences in bank holding companies' balance sheet composition explain differences in the equity market perception of bank risk exposure.

Table 3
The impact of financial ratios on market-based measures of risk sensitivity (t values in parentheses)

	Market	Industry	Interest rate
Book capital / Assets	−14.6819 (3.140)*	−16.9681 (2.858)*	−0.4351 (1.298)
After-tax net income / Assets	22.1074 (1.136)	36.6713 (1.484)	4.6945 (3.364)*
Standard deviation of after-tax net income-to-asset ratio	5.1105 (0.254)	−16.3513 (0.639)	2.2129 (1.532)
Purchased funds / Assets	0.8498 (4.193)*	1.4813 (5.757)*	0.0532 (3.658)*
Loans / Assets	0.9441 (2.827)*	1.6802 (3.963)*	0.1014 (4.237)*
Charge-offs / Assets	12.8053 (0.968)	11.2650 (0.671)	−0.3809 (0.402)
Intercept	0.1925 (0.611)	−0.3050 (0.763)	−0.0990 (4.384)*
$\bar{R}^2$	0.6758	0.7527	0.5116

One asterisk indicates that the regression coefficient is significantly different from zero at the 1 percent level.

Conclusions

Our analysis leads to four major conclusions. First, there is a significant but imperfect correlation between balance sheet data and financial market measures of bank equity risk. In particular, differences in reliance on purchased funds, which result in part from differences in local branching laws, have an important impact on the riskiness of bank equity. This confirms previous findings that uninsured deposits are sensitive to bank risk.[9] Second, the three money center areas exhibited significantly different sensitivities to market and industry sources of risk. New York City bank holding companies are more sensitive to market and industry sources of risks than are bank holding companies in other areas, while

Chicago banks are significantly less sensitive. Third, only the equities of bank holding companies in areas outside of the money centers exhibited sensitivity to interest rate changes. Finally, income statement and loan charge-off data seem to provide little information on the risk sensitivity of bank equity values. This raises questions about the usefulness of off-site monitoring of banks based on published income statements.

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[1] See Avery and Hanweck (1984) for a recent study of bank failure, and Barth, Brumbaugh, Sauerhaft, and Wang (1985) for a recent study of thrift-institutions failures.

[2] This view of capital is often referred to as the "accounting" definition of capital. In contrast, the "economic" definition of bank capital focuses on the market value (or net present value) of the bank. These two definitions yield identical values only if all assets (including "goodwill") and liabilities are carried on the bank's balance sheet at their current market values. In practice, however, many bank assets, liabilities, and capital account items are valued on a historical basis rather than at current market values.

[3] Purchased funds are defined as the sum of large time deposits of $100,000 or more, deposits in foreign offices, federal funds purchased and securities sold under agreements to repurchase, commercial paper, and other borrowings with an original maturity of one year or less.

[4] For a more detailed discussion of multi-index market models, see Brewer and Lee (1986).

[5] The risk-free rate of interest is for a security that is free of default and interest rate risks.

[6] Daily return data came from Automatic Data Processing (ADP) data tape. A list of those bank holding companies used in this paper can be obtained from the authors upon request. See Brewer and Lee (1986) for a list of those bank holding companies included in the industry index.

[7] Nearly identical results were obtained using the Fuller-Battese technique for estimating regression coefficients when dealing with cross-section time-series data.

[8] An F test was used to determine if the risk sensitivity coefficients in Equation (1) were significantly different for the three money center areas. The restricted sum of squares was obtained by pooling all the observations into one regression. The unrestricted sum of squares was obtained by summing the error sums of squares for the equations presented in Table 2. The hypothesis that coefficients are equal for the three money center areas can be rejected at the .01 level ($F_{4,27902} = 30.4$).

[9] See Baer and Brewer (1986).

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