

# The Contribution of Economic Data to Bank-Failure Models

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\* This working paper reports the details of one part of a three-part study done in close collaboration with John O'Keefe and Katherine Samolyk. See Nuxoll, O'Keefe, and Samolyk (2003). While each author had primary responsibility for one part of that study, many of the ideas in this part were developed in close collaboration with O'Keefe and Samolyk.

The opinions expressed here are the author's and do not necessarily reflect the views of the FDIC.

## **Abstract**

The wave of bank failures during the late 1980s and early 1990s was caused in part by a series of regional recessions. This paper examines whether the FDIC can use state-level economic data to forecast bank failures and finds that these data do not improve models that use only bank-level data. The paper also proposes a number of explanations for the lack of improvement.

Virtually all economists would accept that economic conditions affect the health of banks. An FDIC research team has investigated whether this basic theory can be translated into a forecasting model, and specifically whether nonbank economic data can be used to improve forecasts of bank health. This project was a systematic effort to explore the somewhat surprising result noted by some of the developers of the Federal Reserve System's off-site program: regional economic variables do not improve the forecasts of bank health.<sup>1</sup>

This paper reports on one aspect of that project: whether nonbank data can improve bank-failure forecasts.<sup>2</sup> In general, we find that economic data do not improve these forecasts despite the fact that the data are statistically significant.<sup>3</sup> Possible explanations for this result are explored in the conclusion.

This paper begins with a short description of the relationship between bank conditions and economic events in several regions in the United States. The second section describes both the bank-specific and the economic data used in this exercise. The third discusses bank-failure models in general before turning to whether economic data improve failure models. The conclusion speculates about the possible reasons that state-level economic data do not improve the forecasts.

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<sup>1</sup> See Cole, Comyn, and Gunther (1995), 8.

<sup>2</sup> For the purposes of this paper, bank failures include banks that are resolved by the FDIC and cases of open-bank assistance.

<sup>3</sup> It is impossible to demonstrate conclusively that including economic data in forecasting models is futile. A vast number of models are conceivable, so anyone who really believes in the usefulness of economic data would argue that the problem is that the wrong model has been tested. The failure of one model, or even of numerous models, does not necessarily reflect on all models. Obviously, this observation applies to any negative empirical finding. Nonetheless, the negative finding of this paper, despite extensive specification searching, must raise questions about any future forecasting exercise that does successfully use economic data. In particular, one must ask whether the success is due to the power of the model or is the result of a lucky data-mining expedition.

## Bank Conditions and Economic Events

A casual examination of data from the past couple of decades might suggest that there is a very weak connection between the health of the economy and the health of the banking sector. Figure 1 plots the growth rate of personal income (solid line) in the United States as well as the number of bank failures (broken line). The number of failures did increase shortly after the recessions of 1973 and 1980–1982. However, failures actually peaked in 1989, following a period of steady economic growth. During the recession of 1991–1992, fewer banks failed than in preceding years

However, most accounts that stress the importance of the economy to the banking industry stress the importance of local economies. The FDIC's *History of the Eighties* (1997) refers extensively to local economic conditions in its discussions of the difficulties experienced by agricultural banks and of banking problems in the Southwest, New England, and California. Until the 1980s, many states severely limited the geographic market for banks by legally restricting branching and bank holding companies. Consequently, almost all banks tended to draw all their deposits from their home states and to make the bulk of their loans in a very circumscribed area. The relevant economic conditions for most banks were local, not national.

Figures 2–5 are analogous to figure 1; however, they plot the growth of personal income for an individual state (solid line) against the percentage of banks that failed in that state (broken line).<sup>4</sup> Figures 2, 3, and 4 plot events in Texas, Massachusetts, and

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<sup>4</sup> These figures plot the number of failures as a percentage of the banks in existence in the state the previous December. The raw number of failures might be deceptive because Texas, for example, had many more banks than Massachusetts.

These figures plot the growth rate of personal income in the state minus the growth rate of personal income in the United States. Rapid growth in the rest of the country probably tends to induce growth in all the states because the goods and services produced within a state are sold to customers in the rest of the country. Subtracting the two growth rates produces a positive number if the state is growing more rapidly than the rest of the United States, and a negative

California—states that had notable banking crises. In contrast to figure 1, these seem to confirm the conventional wisdom that recessions cause banking failures. However, figure 5 plots events in Ohio, a state that had substantial economic problems but only a handful of bank failures.<sup>5</sup> Ohio is not unique in this regard. Apparently, banking crises tend to occur as a result of economic problems, but not all episodes of economic distress produce banking crises.

A closer examination of the figures does reveal a definite pattern. The economies of Texas, Massachusetts, and California all grew more rapidly than the economies in the rest of the United States for several years before the problems developed, whereas Ohio (and other states that did not have banking crises) did not experience a boom. This fact suggests that banking crises tend to follow a boom/bust cycle. This pattern might occur because banks tend to lend aggressively in those states experiencing booms. Many of those loans then might go sour when the economy deteriorates, and the more aggressive banks might suffer large losses and fail.<sup>6</sup> Banks in less buoyant markets do not have the temptation to gamble on growth.

This pattern suggests that any model that uses state-level economic data to forecast bank failures should look back over a number of years and should be structured to allow for this sort of dynamic. The next section explains how this was done.

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number if it is growing more slowly. This number is a better indicator of the intrinsic strength of a state's economy. Moreover, it yields a clearer relationship between local economic problems and banking problems.

<sup>5</sup> Ohio had five bank failures between 1980 and 1995. In December 1980, 407 banks filed Call Reports. By December 1995, mostly because of mergers, only 255 filed.

<sup>6</sup> FDIC (1997) provides some documentary and statistical evidence for this theory.

## The Data and the Model

Table 1 describes the variables that were used in the set of specifications of the model discussed in this working paper, and table 2 reports the sample medians, means, and standard deviations for the variables. Table 1 also describes some alternative economic variables that were explored. The first panel of each of the first two tables describes Call Report variables and examination variables. These are standard examination and Call Report data that have been used by both academic and government researchers in bank-failure models. There are three important categories of data: prior CAMEL ratings, capital/asset ratios, and loan-quality ratios. Other variables were also used, but the results indicated that these three categories of variables have the most explanatory power.<sup>7</sup> All Call Report data were from the December reports. No effort was made to eliminate stale CAMEL ratings.<sup>8</sup>

The Call Report and examination data are basically control variables. The variables of interest are the economic variables. The economic data were chosen with the criterion of whether they were likely to contribute to the accuracy of forecasts of failure among all FDIC-insured commercial banks. This criterion eliminated a number of data series.

Some data are simply not available on a timely basis. For example, Gross State Product (GSP) might be a better indicator of economic conditions than personal income.

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<sup>7</sup> See Hooks (1995) for a discussion of failure models. Demirgüç-Kunt (1989) has an overview of the earlier literature.

<sup>8</sup> The effect of examination intervals on forecast accuracy was considered, however. The model had higher Type II and lower Type I errors for banks that had not been examined recently. A lower percentage of these banks failed.

This finding contrasts with Cole and Gunther (1998). Cole and Gunther find that, on average, a failure model has more difficulty forecasting the failure of banks that have not been examined recently. The key is that Cole and Gunther compare the whole power curves, whereas we are comparing a specific section of the power curves—the section that is associated with observations with specified probabilities of failure.

However, GSP data are available only with a lag of a couple of years, so 1998 data might be available only in 2000.

Second, the data must exist for times and locations in which there were a substantial number of bank failures. For example, even with the best data one could probably not estimate any sort of reasonable bank-failure model for the states of Alabama, Georgia, Mississippi, North Carolina, and South Carolina. These five states had a total of 18 bank failures between 1980 and 1995, and there are simply not enough observations to estimate accurately any kind of model. Similarly, there was one bank failure in 1997 in the whole United States, so it is impossible to estimate any reasonable bank-failure model based solely on the data for that year.

Finally, other data are available for some regions but not for all. These data are potentially useful only for a subset of FDIC-insured banks; but this project had a broader focus. For example, a wide variety of series on local economic conditions are available only for a few states or cities. Forecasts of regional economic conditions might be a very useful indicator of the likelihood that banks in a region will fail in the future. Many firms produce those forecasts for some states or cities. However, the coverage of these forecasts is spotty, so their usefulness is limited.

Three broad categories of data meet the basic criterion: personal-income data, employment data, and banking aggregates.<sup>9</sup> Table 1 lists a number of these data series as “State Economic Variables” or “Alternative State Economic Variables.” During the course of this project, each of these data series was tested. In general, the employment

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<sup>9</sup> All dollar-denominated numbers were deflated to 1992, though deflation makes no difference except in the specifications that pool the data for different periods.

data were the least useful, and growth in personal income and growth in total loans made by banks headquartered in a state improved the failure models the most.

In order to include the type of dynamic discussed above, we used five years' worth of data in the models. For example, if the growth rate in personal income was used, the model included five growth-rate terms—the rates from the year before the Call Report, from two years before it, and from three, four, and five years before it. Some experimentation revealed that using five years of data produced coefficients that were imprecisely estimated. The data are highly correlated, so the model cannot distinguish the effects of growth five years earlier from the effects of growth three years earlier. For that reason, most work used the growth rate of personal income between three and five years earlier, the growth rate two years earlier, and the previous year's growth rate.<sup>10</sup> This approach produced more precise coefficient estimates and better forecasts.

Throughout this project, a logistic model was used. This is a standard model among both academics and bank regulators.<sup>11</sup> The model was fitted on bank failures that occurred within two years of the Call Report date, so the model can be said to have a two-year horizon.

After the model was fitted, out-of-sample forecasts were done. Because of the two-year horizon, the forecasts were based on data from the Call Report two years after the Call Report used to fit the model. For example, the model was fitted on failures in 1990 and 1991, Call Report data from December 1989, and the CAMEL rating for the

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<sup>10</sup> As in figures 2–5, the personal-income growth rate actually used is the difference between the personal-income growth rate in the state and the rate in the nation.

Table 2 reports an apparently puzzling result: the mean and median growth rates are negative. However, these numbers are weighted by the number of banks in each state. The negative number means that the states with a large number of banks grew more slowly than the rest of the country.

<sup>11</sup> The Federal Reserve System has, for several years, used an off-site system that includes a logistic model to forecast bank strength.



last exam before December 1989. The coefficients were then used with Call Report and examination data from December 1991 to forecast failures in 1992 and 1993. In principle, the necessary data would have been available at the end of 1991 to forecast the failures over the next two years.<sup>12</sup> This exercise mimics the way the FDIC or other banking agency might use such a model.

This model was estimated both as a cross section and as a pooled time-series cross section. This paper reports on the cross-section models estimated on data from the Call Reports of December 1986, December 1989, and December 1992 as well as on a pooled time-series cross-section model.<sup>13</sup> These results are broadly representative of a much wider group of results.

These models have two types of errors, conventionally called Type I and Type II errors. Type I errors occur when the model indicates that a bank will survive, but the bank does not survive. Type II errors occur when the model predicts that a bank will fail, but it actually survives. More colloquially, Type I errors occur when the model frees the guilty, and the Type II errors occur when the model convicts the innocent.<sup>14</sup>

These models do not produce an unambiguous prediction that a bank will fail; rather, they estimate the probability that a bank will fail. A bank is projected to fail if its

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<sup>12</sup> In reality, the Call Report data and the examination data are available with a lag, so the data would have been available in early 1992.

<sup>13</sup> The December 1986 cross section, for example, used Call Report data from that date as well as data from the last examination before December 1986 and failures from the years 1987 and 1988.

Because of the two-year horizon, there is both an “even” and an “odd” version of the pooled model (the former uses Call Report data from even-numbered years, the latter from odd-numbered years). Both forms were tested, and there were no material differences. This paper reports the even version.

<sup>14</sup> The terminology of Type I and Type II errors is adopted from hypothesis testing. Simpler criteria for forecasts can be developed. Such criteria, however, would necessarily involve some system of weighting the two types of error. For instance, there are criteria involving rank-order statistics, but these can be interpreted as assigning an equal weight to the two errors. In bank-failure models, Type I errors are usually thought more serious, but there is no general agreement about the appropriate weights.

estimated probability exceeds a specific threshold level. Raising the threshold necessarily decreases the number of projected failures. Decreasing the number of projected failures also reduces the number of failures accurately forecasted, as well as the number of surviving banks projected to fail. Thus, a higher threshold increases the level of Type I errors and decreases the level of Type II errors. One can easily graph the trade-off between Type I and Type II errors by varying the threshold.

These graphs can be used to compare the accuracy of various models. More accurate models have a lower level of Type I errors for any given level of Type II errors. That is, the curve representing a more accurate model lies below and to the left of the curve for a less accurate model; or equivalently, the curve lies closer to the origin (which represents no Type I errors and no Type II errors).

It should be noted that such curves can intersect. In these cases, one model is not unambiguously better than the other.<sup>15</sup>

These errors can be measured both in-sample and out-of-sample. In-sample graphs use the same data that were used to estimate the model, so they reflect the fit of the data. However, for FDIC purposes, the critical criterion is not statistical fit but forecasting power. Forecasting is by definition out-of-sample, so out-of-sample errors are more relevant to the model's usefulness to the FDIC.

For example, the model was estimated on failures in 1990 and 1991, Call Report data from December 1989, and the CAMEL rating for the last exam before December

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<sup>15</sup> Actually, bank supervisors are most interested in the section of the curve that represents a low level of Type II errors. Bank supervisors have limited resources to devote to monitoring banks intensively. Failure models and other off-site models can be used to identify those banks that are in the most danger of failing so that supervisors can allocate those resources. Type II errors amount to a waste of resources because supervisory resources are diverted to banks that are not in danger of failure. Because of the constraint, supervisors are undoubtedly most interested in not wasting resources, that is, in low Type II errors. Consequently, they would be most interested in whether, for low levels of

1989. Type I and Type II errors are calculated in terms of the ability of the model to correctly identify failures in 1990 and 1991—that is, in terms of the data used to estimate the model. The forecasting exercise uses the coefficients of this same model and December 1991 data to forecast failures in 1992 and 1993. Because the model was developed without data from 1992 or 1993, the Type I and Type II errors of this exercise are more indicative of the usefulness of the model.<sup>16</sup>

## Results

Table 3 reports results for four different samples. The first column gives the coefficient estimates and standard errors when December 1986 data are used to estimate the probability of failures in 1987 and 1988. A positive coefficient means that higher levels of the variable are associated with a larger probability of failure. One asterisk indicates that the coefficient is significant at least at the 10 percent level, two indicate 5 percent, and three indicate 1 percent. The chi-squared statistic is for the null hypothesis that all three loan/growth coefficients are zero. The three asterisks indicate that the null can be rejected at the 1 percent level of significance.

The second and third columns give the results of using December 1989 and December 1992 data to forecast failures in the following two years. The final column gives pooled results in which December 1984 data are used to forecast failures in 1985 and 1986, December 1986 data are used to forecast failures in 1987 and 1988, and so

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Type II errors, one model has better levels of Type I errors than another. Bank supervisors are relatively uninterested in whether two curves intersect at high levels of Type II errors.

<sup>16</sup> Forecasts for the pooled model were done using a “rolling” system of estimation. For forecasts based on the December 1991 Call Report, the pooled model was estimated on data for the period before that date. For December 1993 forecasts, two years of data were used to develop the model.

forth. The failures in this pooled data set occurred between 1985 and 1996; this period includes the vast majority of failures of institutions insured by the FDIC.

The results generally indicate that banks with lower levels of capital, higher levels of past-due loans, and lower loan-loss reserves are more likely to fail. These results are completely consistent with conventional wisdom and previous studies. Other results have not been as thoroughly documented, but they are consistent with what one might expect. Banks with worse CAMEL management and liquidity ratings are also more likely to fail.<sup>17</sup> In addition, banks that have not been examined recently are more likely to fail. Low income is not a consistently significant indicator of failure, but at least the sign on net income is consistently negative.

The capital, asset, and earnings CAMEL ratings are mostly statistically insignificant, and their coefficients are often the “wrong” sign. One possible explanation is that the capital/asset ratio as well as the loss/reserves ratio conveys the relevant information in the capital rating, whereas the two past-due loan terms are redundant with the asset rating, and the earnings rating adds nothing to the net-income term. There are no variables in this specification that are obvious measures of management quality or liquidity.

The charge-off/bad loans ratio changes sign, and in the pooled model there is a statistically significant relationship between high charge-offs and failure. One could argue either that high charge-offs indicate that the bank has problems in the loan portfolio (and is likely to fail) or that the bank is dealing with the problems in the portfolio (and is likely to survive). The statistical results do not differentiate between these two theories.

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<sup>17</sup> A CAMEL rating of 5 is worse than a CAMEL rating of 1.

Finally, there is an ambiguous but generally statistically significant relationship between a bank's loan growth and its probability of failure. Small variations in loan growth are not economically significant, however, because the coefficients are very small. For example, in the pooled regression, consistent loan growth of 18 percent per year has about the same effect as a 1 percent difference in the capital/asset ratio.<sup>18</sup>

Table 4 reports the results of including the state-level economic data. The chi-squared statistic is for the null hypothesis that the coefficients on the state data all equal zero. The results in this table are representative in that the state data are usually highly significant. If the chi-squared statistic exceed 12.84, the variables are significant at least at the 5 percent level. The statistics in table 4 exceed this standard by a wide margin. This result is not quite universal; there are some specifications in which state data are insignificant in the early 1990s.

The economic data have the expected signs. The negative coefficient on the previous year's personal-income growth means that failure is more likely when the state in which the bank is headquartered is growing less rapidly than the rest of the United States. The positive coefficient on the growth that occurred between three and five years earlier means that high growth in the past tends to put banks at more risk. The data confirm the impression of a boom/bust pattern to bank failures.

Moreover, the coefficients are economically significant. The effect of a 1 percent decrease in the capital-asset ratio has about the same effect as being located in a state that

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<sup>18</sup> Mathematically,  $(-1\%) * (-0.373) = 18\% * (0.0050 + 0.0079 + 0.0036)$ . This general result is robust across samples and specifications. This does not translate directly into a probability of failure because the logistic is nonlinear.

This result might seem to contradict previous research that indicates that high growth is a high-risk strategy, a theory that found its way into the provisions of FDICIA. However, the specification includes past-due loans and is limited to a two-year horizon. Possibly, within two years of failure, the quality of the loan portfolio already reflects the negative effects of high growth. If that is true, then within two years of failure, loans past due (which resulted from rapid past growth) are a better indicator than the growth itself.

was growing 1.4 percent more rapidly than the rest of the nation and is now growing 1.4 percent less rapidly.<sup>19</sup>

Figure 6 shows the in-sample trade-off between Type I and Type II errors for the Call Report data from December 1986. The broken line graphs the trade-off between Type I and Type II errors for the model that uses only bank data, while the solid line shows the trade-off for the model that includes state economic data. The inclusion of state data clearly improves the model. The model without state data can achieve a 10 percent Type II error (about 1,200 banks incorrectly considered probable failures) only at the cost of a 23.2 percent Type I error (84 missed failures). The model with state data can attain a 10 percent Type II error with only a 10.2 percent Type I error (37 missed failures). These results are not too surprising because the chi-squared statistic in table 4 indicates that the state data considerably improve the fit of the model. Figure 7 shows analogous results for the December 1989 Call Reports. The two curves actually intersect in this case. Though the state data are statistically significant, there is no obvious advantage to using the additional data in this period.

Though a model with more data necessarily has at least as good a fit as models with less data, the same is not true for forecasting. It is well known among macroeconomic forecasters that more sophisticated models often perform worse than simpler models.

Figures 8 and 9 show the results of two forecasting exercises. Figure 8 shows the results of using the model estimated on December 1986 Call Report data to estimate the probability of failure in 1987 and 1988. In principle, an economist could have estimated this model in January 1989 and used the coefficients and Call Report data from

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<sup>19</sup>  $(-1\%) * (-0.373) = (-1.4\%) * (-.134) + 1.4\% * (0.053 + 0.076)$

December 1988 to forecast failures in 1989 and 1990. Figure 8 shows that the addition of state data does not improve the model.<sup>20</sup> Figure 9 tells a similar story for forecasts of 1992 and 1993.<sup>21</sup> These figures are representative of a large number of specifications. While it is possible to find specifications in which state data actually improve forecasts for some periods, we were unable to find a specification in which state data consistently improved forecasts. Indeed, for most specifications, the inclusion of state data actually produced noticeably worse forecasts for some periods. A model that included state data would have misled regulators during some periods.<sup>22</sup>

### **Possible Explanations**

There are a multitude of possible explanations for these results. First, the specification might be incorrect. All empirical work runs this risk.

Arguably, this project has been more affected by the opposite problem: during the course of this project, numerous specifications were tested with the goal of finding the correct specification. The search was done in terms of both statistical significance and forecasting power. Such searches can easily produce spurious results that owe more to overfitting than to any underlying economic relationship. Consequently, the results of

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<sup>20</sup> In the section of the graph of most interest to bank regulators, the model with state data does notably worse. Bank regulators cannot reasonably accept high levels of Type II error because a forecast with high Type II error would suggest that a substantial fraction of the banking industry would fail in the next two years. Bank regulators do not have the resources to monitor intensively a substantial fraction of the banking industry. For example, if bank regulators could actively monitor 10% of the population, they would be most interested in the section of the graph with about a 10% Type II error. With a 10 percent Type II error (about 1,100 nonfailures forecasted to fail), the model without state data would have missed 17 failures (a 6.23 percent Type I error), and the model with state data would have missed 28 failures (a 10.26 percent Type I error).

<sup>21</sup> The model is estimated using December 1989 Call Report data and 1990 and 1991 failures. That model is used along with December 1991 Call Report data. Again, in most of the section of the graph of interest to regulators, the model that uses only bank data does better.

a specification search might be suspect. In fact, the current project searched and did not find results. The problem is not overfitting, but the lack of results.

Second, it is possible that the conventional wisdom is simply wrong. This is highly unlikely because almost any specification shows that state economic data are highly significant, in-sample.

Third, it is possible that we have too little data on the relationship between local economic conditions and banking failures. During the period between 1980 and 1995, there were four major waves of banking failures: in the oil states of the Southwest, in the Northeast, in California, and in the agricultural sections of the Midwest. There were other minor crises (for example, in Alaska and Utah), but these affected relatively few banks. The limited number of events might not be sufficient to estimate a general relationship.

Fourth, as the savings and loan crisis demonstrated, the failure of a bank is a legal, not an economic, event. A bank does not fail when it becomes insolvent; a bank fails when the relevant bank supervisor says that the bank has failed. Some have argued that a policy of forbearance was replaced by a policy of closing problem institutions quickly. In 1991, this change was legally mandated by the prompt corrective action provisions of FDICIA.

This policy change would change the timing of bank failures relative to economic events. Events in Texas and Massachusetts are suggestive. If supervisors close banks only after banks have had a chance to work out problems, then there will be a lag between economic crises and banking crises. There was approximately a three-year lag

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<sup>22</sup> Using a pooled model does not change this basic result. In fact, in-sample fit is worse in some periods in a pooled model. Including more data only improves the average fit of a model; the use of more data does not necessarily



in Texas (c.f. figure 2). However, if supervisors close banks quickly, the lag will be shorter. Banks in Massachusetts failed soon after that state went into recession; figure 3 shows practically no lag. If this is the case, the forecasting model performs poorly because the model is looking for the same lag in Massachusetts that it found in Texas.

Fifth, bank data are economic data. Any reasonable model of bank failure includes a number of variables that reflect the health of the local economy. Loans past due 30–89 days, for example, are procyclical and seem to be roughly contemporaneous.<sup>23</sup> Because bank balance sheets reflect local economic conditions, the question is whether other economic data, such as personal-income growth, add anything to that information.

Bank data do have one important advantage in failure models. The bank is affected by the economy in which it does business. And virtually no bank markets coincide with state boundaries. Most banks have only a few branches and do business in a relatively small area, so their health depends less on the condition of the state economy than on whether the local factory shuts down or whether local farmers can survive a drought. On the other hand, some banks lend out-of-state, exposing part of their portfolio to events in other states.<sup>24</sup> Of course, money-center banks do business throughout the world, so the less-developed-country crisis is an inherent part of the history of banks

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improve the fit in each year.

<sup>23</sup> There is a weak relationship (a correlation coefficient of  $-0.233$ ) between loans past due 30–89 days at banks headquartered in the state and personal-income growth in the state. The relationship is statistically significant and of the same order of magnitude as the correlation of either employment growth or the unemployment rate with personal-income growth.

The contemporaneous relationship is strongest, but there are two important caveats. First, the contemporaneous relationship is between past-due loans at the *end* of the quarter and income growth *during* the quarter. The timing problem is inherent in any comparison between stocks and flows. Second, the difference between contemporaneous, leading, and lagging correlation coefficients is tiny. The correlation coefficient between income growth and loans past due at the end of the previous quarter is  $-0.216$ , and between income growth and loans past due at the end of next quarter,  $-0.211$ .

As one might expect, there is a lagging relationship with loans past due 90+ days and income growth.

Credit card banks are omitted from this analysis.

<sup>24</sup> Banks lent far from the home state even before interstate banking.

during the 1980s. Currently, the federal agencies do know where banks have branches and how much money has been deposited in those branches. However, even if these data were completely accurate (and they are probably not), the major risk to banks is loans, not deposits. Given these problems, it is virtually impossible to measure economic conditions accurately within a bank's market.

The bank's balance sheet, however, indicates economic conditions precisely within the bank's market. Of course, that information is noisy because the quality of the management and other factors affect the balance sheet. Arguably, this is an advantage, for the question is not the health of the economy where the bank does business but how the economy affects the bank. That effect depends heavily on the quality of management.

Hence, state economic data might add little to forecasting models because they do not add any information to the data already in the model.

It must be stressed that these explanations are conjectural. Some are logically impossible to verify (for example, logically one can never show that there is no additional information in data). Moreover, the proposed reasons are undoubtedly incomplete.<sup>25</sup>

Though the reasons for our failure to find an effect are not obvious, it is obvious that we did not find a way to use state economic data to improve forecasts of bank failure.

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<sup>25</sup> Most importantly, the surge of failures between 1980 and 1995 was unique in FDIC history. This suggests either that regional recessions did not occur before 1980 (which seems implausible) or that something happened after 1980 to make banks more susceptible to failure.

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**Table 1**  
**Variables Used in the Failure Model**

**A. Call Report Variables**

Capital	Equity as a percentage of total assets
Net Income	Net income as a percentage of total assets
Due 30	Loans past due 30–89 days as a percentage of total assets
Loans Past Due 90+	Loans past due 90 or more days plus nonaccruing loans plus other real estate owned (repossessed real estate) as a percentage of total assets
Reserves	Loan-loss reserves as a percentage of loans past due 90 days plus nonaccruing loans plus other real estate owned
Charge-offs	Charge-offs as a percentage of loans past due 90 days plus nonaccruing loans plus other real estate owned
Loan Growth— Past Year	Percentage growth in total loans (deflated by the GDP deflator) between the December Call Report and the December Call Report of the previous year
Loan Growth— 2 Years Earlier	Percentage growth in total loans (deflated by the GDP deflator) between the December Call Report of the previous year and the December Call Report of the year before that
Loan Growth— 3–5 Years Earlier	Average percentage growth in total loans (deflated by the GDP deflator) between the December Call Report of two years earlier and the December Call Report of five years earlier

**B. Examination Variables**

CAMEL C	Capital component of CAMEL rating
CAMEL A	Asset component of CAMEL rating
CAMEL M	Management component of CAMEL rating
CAMEL E	Earnings component of CAMEL rating
CAMEL L	Liquidity component of CAMEL rating
Examination Interval	Number of days between the Call Report date and the last examination, divided by 365

**C. State Economic Variables**

P.I. Growth— Past Year	Percentage growth in total personal income during the past year minus the comparable number for the United States
P.I. Growth— 2 Years Earlier	Percentage growth in total personal income two years ago minus the comparable number for the United States
P.I. Growth— 3–5 Years Earlier	Average percentage growth in total personal income three to five years ago minus the comparable number for the United States

**D. Alternative State Economic Variables**

Per Capita Personal Income Growth
Disposable Personal Income Growth
Per Capita Disposable Personal Income Growth
Employment Growth
Unemployment Rate
Growth in Total Loans reported by all banks headquartered in the state
Growth in Total Assets reported by all banks headquartered in the state

*Notes for alternative state economic variables:* Five years of data were used. All variables were run both as levels and as differences from the comparable U.S. value. All variables were run both as levels and as differences from the comparable U.S. value. All dollar values were deflated by the GDP deflator. Total loans and assets are from the December Call Report. Thrifts and credit card banks were excluded.

**Table 2**  
**Basic Statistics for Model Variables**

**A. Call Report Variables**

	Median	Mean	St. Dev
Capital	8.31	8.97	4.19
Net Income	0.99	0.82	2.52
Loans Past Due 30	0.84	1.14	1.11
Loans Past Due 90+	0.91	1.64	2.31
Reserves	0.74	0.87	0.63
Charge-offs	0.24	0.52	1.21
Loan Growth—Past Year	3.45	3.97	34.09
Loan Growth—2 Years Earlier	3.53	4.36	32.93
Loan Growth—3–5 Years Earlier	9.09	13.73	61.89

**B. Examination Variables**

	Median	Mean	St. Dev
CAMEL C	2	1.78	0.85
CAMEL A	2	1.97	0.96
CAMEL M	2	2.09	0.79
CAMEL E	2	2.13	1.06
CAMEL L	2	1.67	0.71
Examination Interval	0.65	0.88	0.90

**C. State Economic Variables**

	Median	Mean	St. Dev
P.I. Growth—Past Year	-0.33	-0.56	2.78
P.I. Growth—2 Years Earlier	-0.38	-0.57	2.73
P.I. Growth—3–5 Years Earlier	-1.67	-2.61	6.22

*Notes:* Medians, means, and standard deviations were calculated across all banks (excluding credit card banks) between 1984 and 1996. The Call Report variables and the state economic variables are as of the end of December, and the examination variables are for the last exam before the end of December.

**Table 3**  
**Coefficient Estimates for Different Samples—State Data Not Included**

	1986	1989	1992	Pooled
Intercept	-2.898 ***	-3.745 ***	-7.046 ***	-5.010 ***
	0.529	0.761	1.736	0.284
Capital	-0.463 ***	-0.588 ***	-0.489 ***	-0.373 ***
	0.043	0.059	0.105	0.023
Net Income	-0.065	-0.054	-0.121	-0.123 ***
	0.040	0.046	0.096	0.021
Loans Past Due 30	0.177 ***	0.301 ***	0.143	0.159 ***
	0.043	0.050	0.098	0.022
Loans Past Due 90+	0.117 ***	0.180 ***	0.133 ***	0.130 ***
	0.023	0.031	0.047	0.011
Reserves	-1.258 ***	-0.247 *	-0.102	-0.243 ***
	0.250	0.145	0.441	0.047
Charge-offs	0.268 ***	-0.471 *	-0.492	0.077 ***
	0.082	0.251	0.922	0.017
CAMEL C	-0.203	-0.085	-0.434	-0.034
	0.128	0.206	0.441	0.078
CAMEL A	-0.132	-0.263	-0.172	0.140 *
	0.130	0.200	0.406	0.076
CAMEL M	0.362 ***	0.474 ***	0.602 *	0.280 ***
	0.119	0.160	0.318	0.067
CAMEL E	-0.083	0.109	0.623 *	-0.063
	0.099	0.161	0.355	0.061
CAMEL L	0.756 ***	0.442 ***	0.650 **	0.587 ***
	0.096	0.141	0.275	0.055
Examination Interval	0.444 ***	0.016	0.364	0.411 ***
	0.068	0.180	0.293	0.042
Loan Growth—Past Year	0.0075 **	0.0085 *	-0.0012	0.0050 ***
	0.0035	0.0048	0.0092	0.0017
Loan Growth—2 Years Earlier	0.0110 ***	-0.0019	0.0095	0.0079 ***
	0.0030	0.0035	0.0078	0.0015
Loan Growth—3–5 Years Earlier	-0.0081 *	0.0207 ***	0.0037	0.0036 *
	0.0048	0.0038	0.0093	0.0020
Chi-Squared on Loan Growth	20.721 ***	29.433 ***	1.211	7.0510 *
Number of Banks	11872	11191	10777	66714
Number of Failures	362	228	47	1096

*Notes:* For each variable, the coefficient is in the first line. The standard error of the coefficient is in the second line.

\* Significant at the 10% level.

\*\* Significant at the 5% level.

\*\*\* Significant at the 1% level.

The Call Report variables are as of the end of the year, and the examination variables are for the last exam before the end of the year. Failures occurred within two years of the Call Report.

**Table 4**  
**Coefficient Estimates for Different Samples—State Data Included**

	1986	1989	1992	Pooled
Intercept	-4.057 ***	-4.295 ***	-7.641 ***	-5.190 ***
	0.633	1.049	2.787	0.325
Capital	-0.436 ***	-0.569 ***	-0.573 ***	-0.373 ***
	0.044	0.060	0.121	0.023
Net Income	-0.081 **	-0.006	-0.037	-0.102 ***
	0.041	0.048	0.099	0.022
Loans Past Due 30	0.102 **	0.262 ***	0.196 *	0.128 ***
	0.045	0.053	0.108	0.023
Loans Past Due 90+	0.096 ***	0.211 ***	0.119 **	0.127 ***
	0.023	0.032	0.050	0.011
Reserves	-0.984 ***	-0.255 *	-0.095	-0.215 ***
	0.252	0.148	0.448	0.048
Charge-offs	0.224 ***	-0.347	-0.151	0.067 ***
	0.084	0.255	0.737	0.017
CAMEL C	0.002	0.005	-0.445	0.075
	0.129	0.204	0.455	0.078
CAMEL A	-0.203	-0.265	-0.125	0.118
	0.135	0.198	0.420	0.077
CAMEL M	0.503 ***	0.512 ***	0.634 *	0.337 ***
	0.122	0.163	0.354	0.067
CAMEL E	-0.119	0.245	0.654 *	-0.086
	0.101	0.167	0.374	0.062
CAMEL L	0.573 ***	0.341 **	0.583 *	0.553 ***
	0.098	0.145	0.297	0.055
Examination Interval	0.389 ***	-0.011	0.424	0.373 ***
	0.072	0.177	0.332	0.044
Loan Growth—Past Year	0.0126 ***	0.0076 *	0.0008	0.0062 ***
	0.0033	0.0045	0.0107	0.0017
Loan Growth—2 Years Earlier	0.0113 ***	-0.0036	0.0017	0.0078 ***
	0.0031	0.0041	0.0127	0.0015
Loan Growth—3–5 Years Earlier	-0.0177 ***	0.0171 ***	-0.0008	-0.0013
	0.0053	0.0041	0.0114	0.0022
P.I. Growth—Past Year	-0.213 ***	-0.142 **	-0.361 **	-0.134 ***
	0.019	0.076	0.151	0.010
P.I. Growth—2 Years Earlier	-0.100 **	-0.048	0.067	0.053 ***
	0.048	0.113	0.129	0.018
P.I. Growth—3–5 Years Earlier	0.326 ***	0.181 ***	0.517 **	0.076 ***
	0.061	0.053	0.237	0.017
Chi-Squared on P.I. Growth	143.526 ***	28.485 ***	22.187 ***	114.442 ***
Number of Banks	11872	11191	10777	66714
Number of Failures	362	228	47	1096

*Notes:* For each variable, the coefficient is in the first line. The standard error of the coefficient is in the second line.

\* Significant at the 10% level.

\*\* Significant at the 5% level.

\*\*\* Significant at the 1% level.

The Call Report variables are as of the end of the year, and the examination variables are for the last exam before the end of the year. Failures occurred within two years of the Call Report.

Figure 1

**Personal Income Growth and Bank Failures**  
United States (1970–1995)

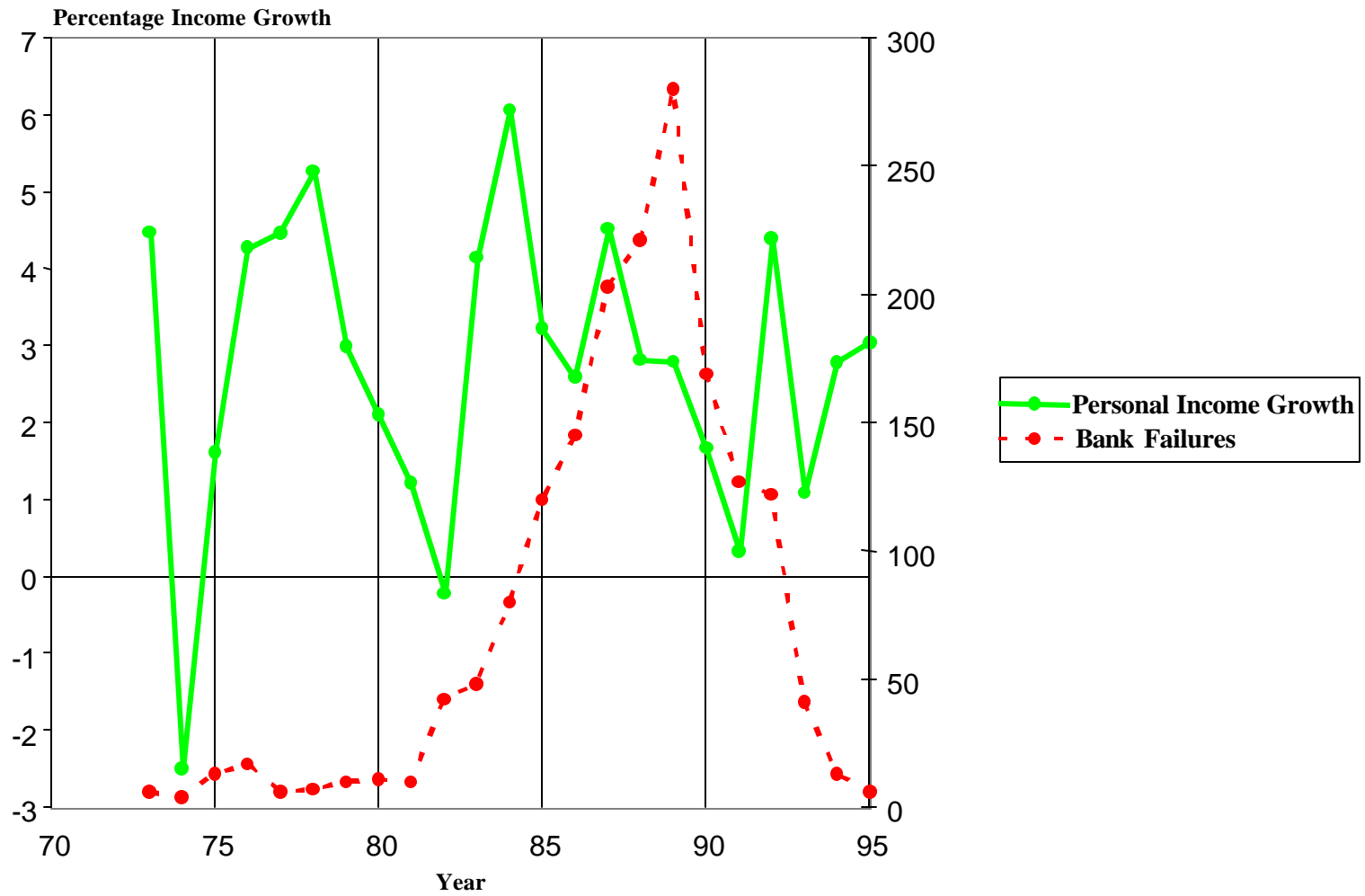




Figure 2  
Personal Income Growth and Bank Failures  
Texas (1980–1995)

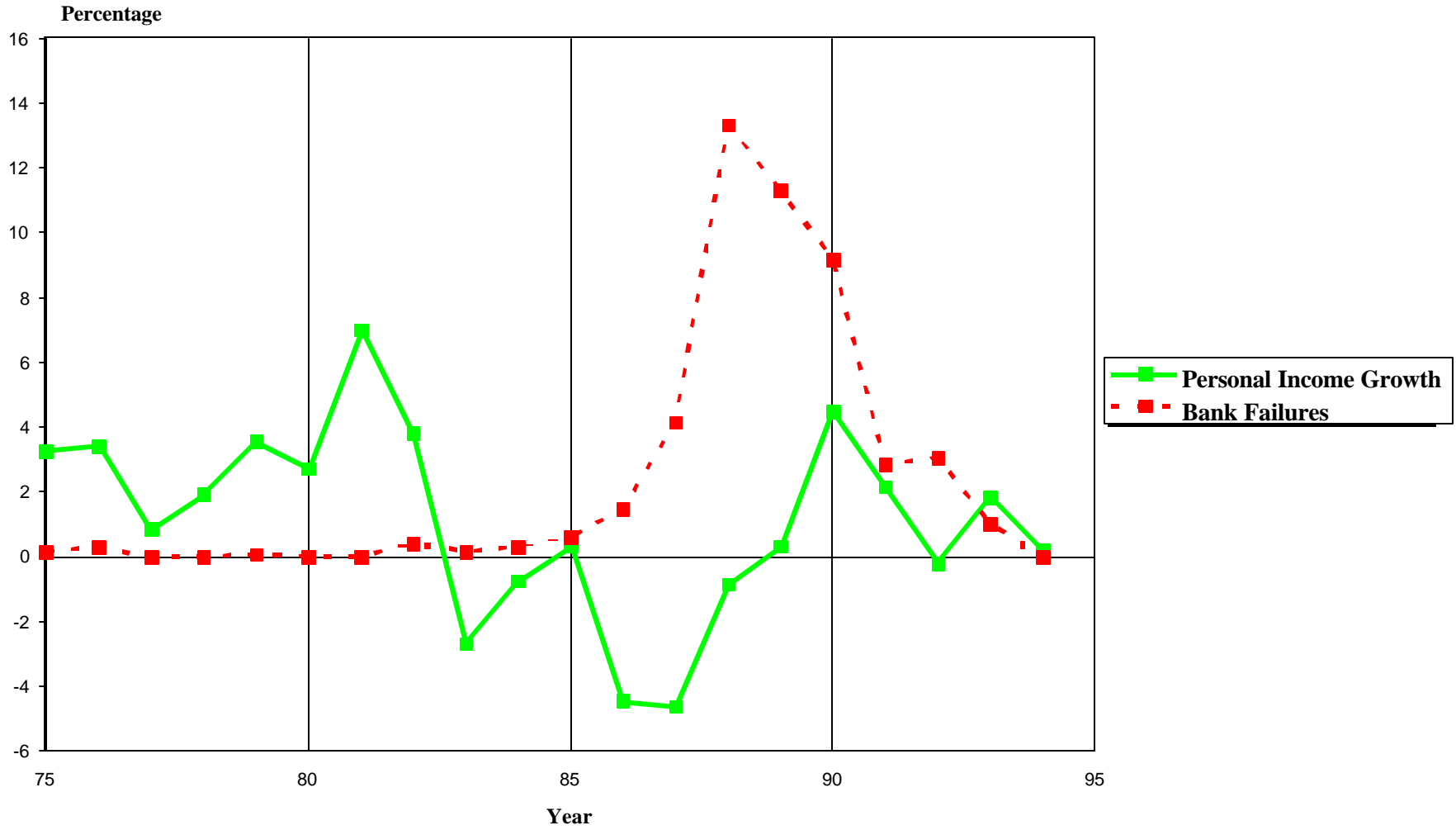


Figure 3  
Personal Income Growth and Bank Failures  
Massachusetts (1980–1995)

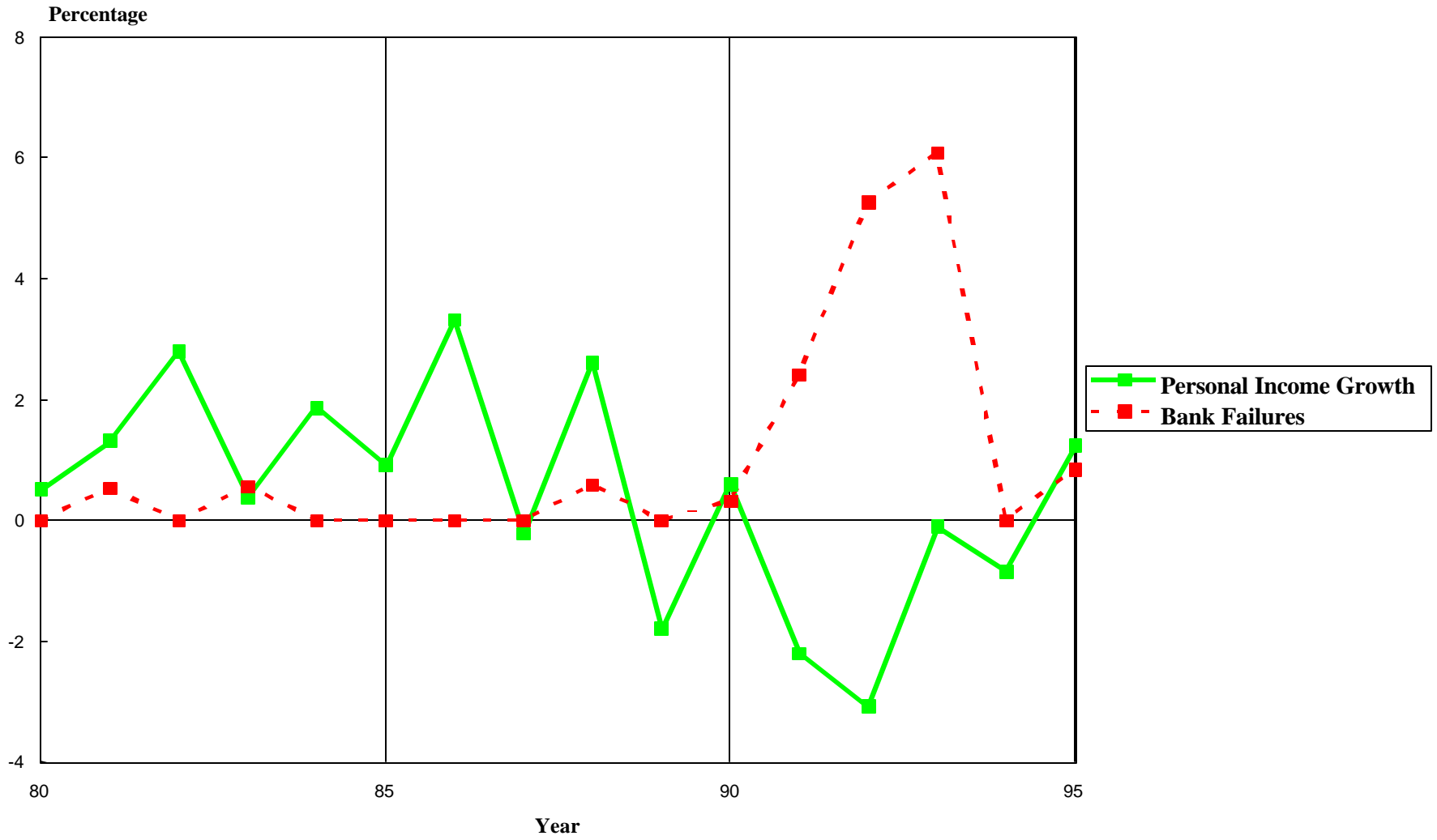


Figure 4  
Personal Income Growth and Bank Failures  
California (1980–1995)

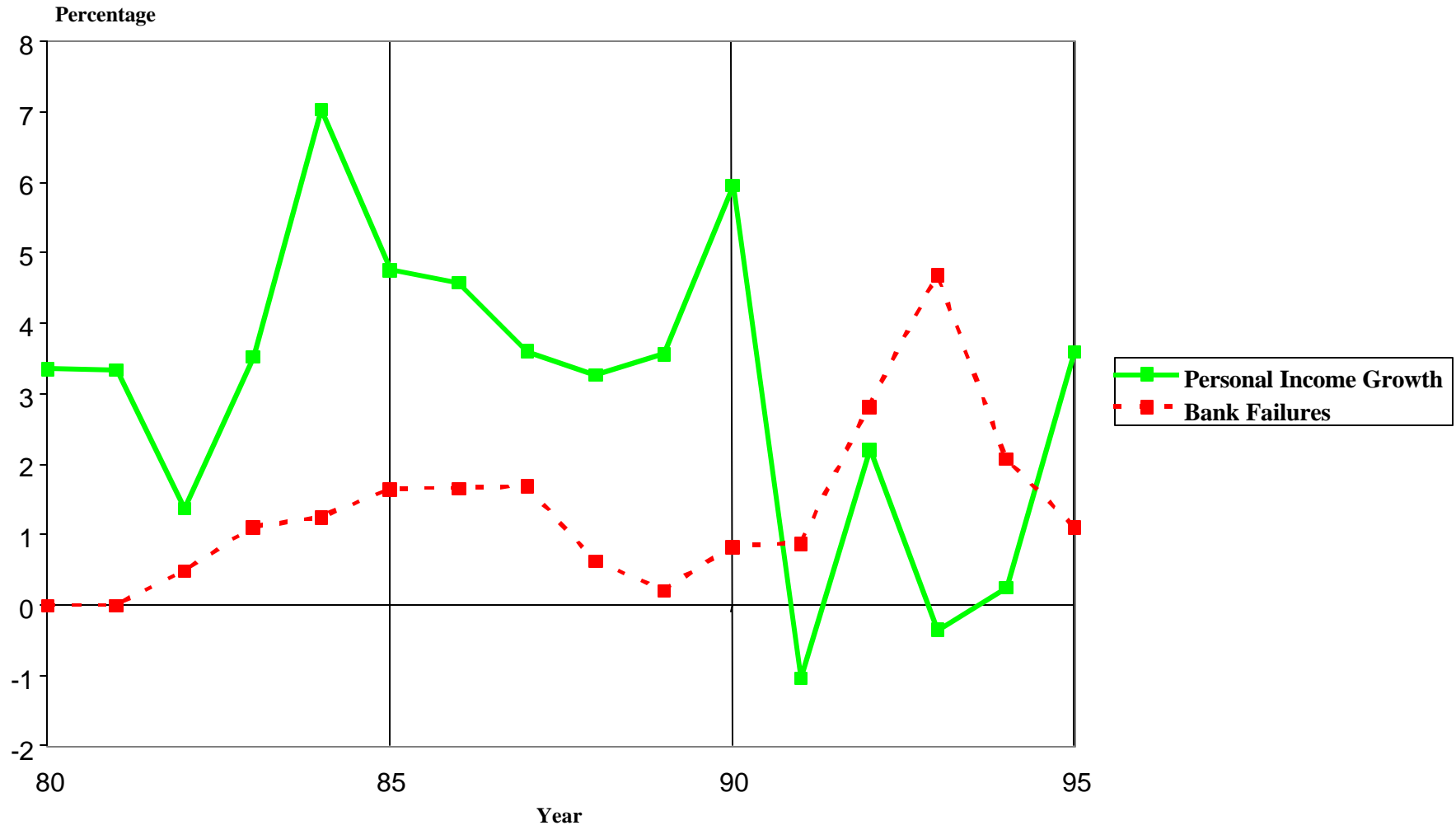


Figure 5  
Personal Income Growth and Bank Failures  
Ohio (1980–1995)

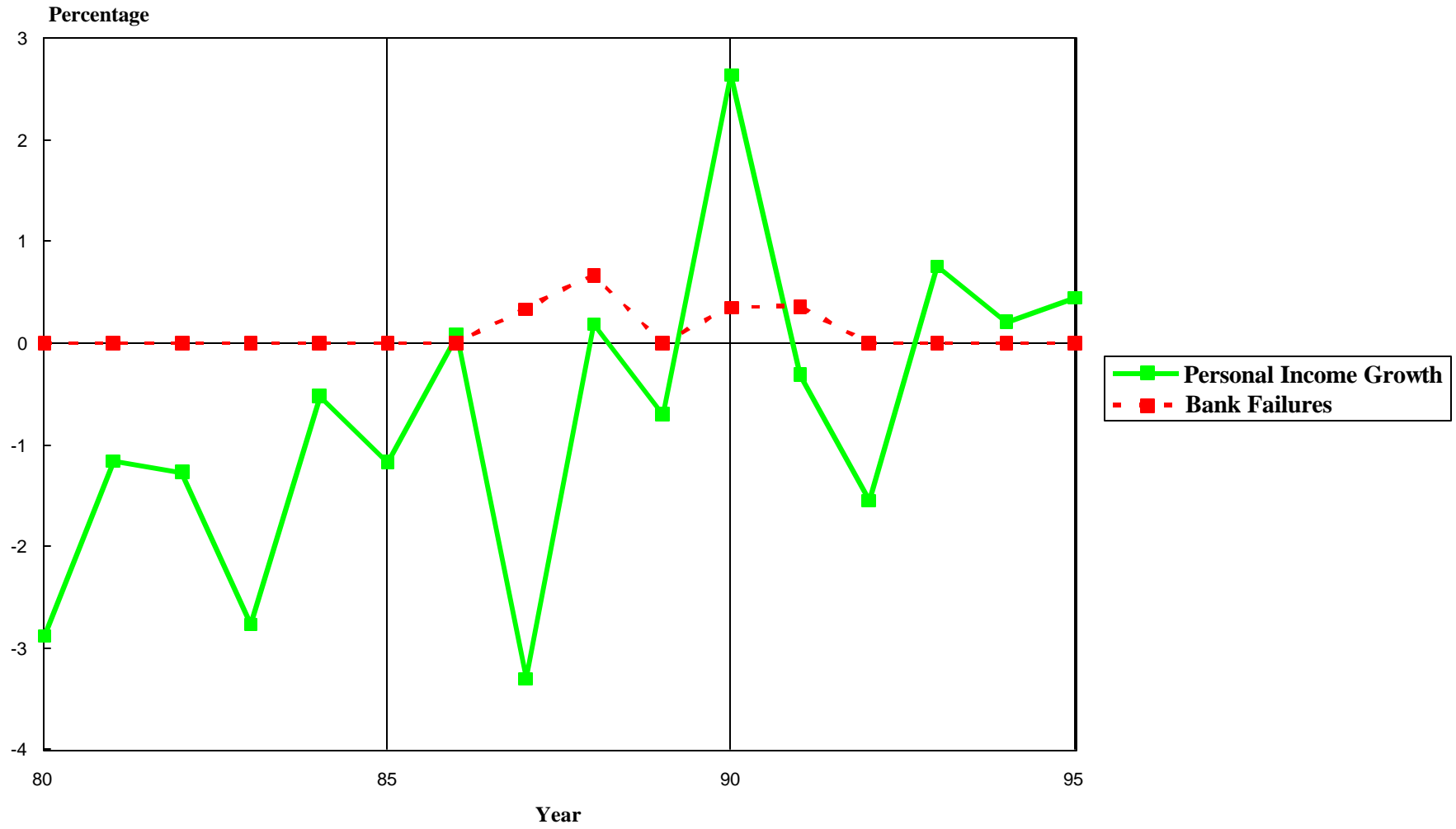


Figure 6

**In-Sample Fit**  
Failures in 1987 and 1988

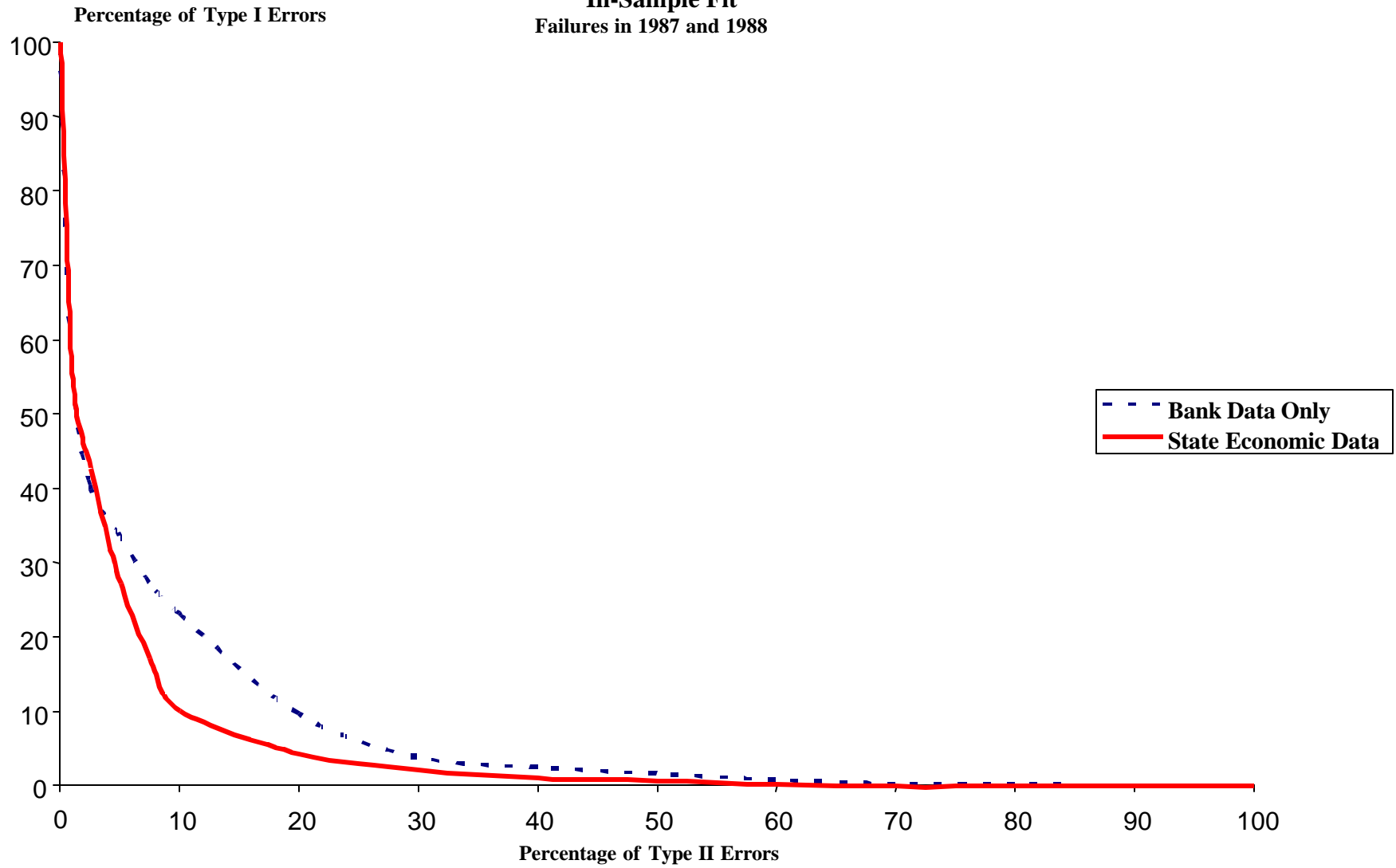


Figure 7  
**In-Sample Fit**  
Failures in 1990 and 1991

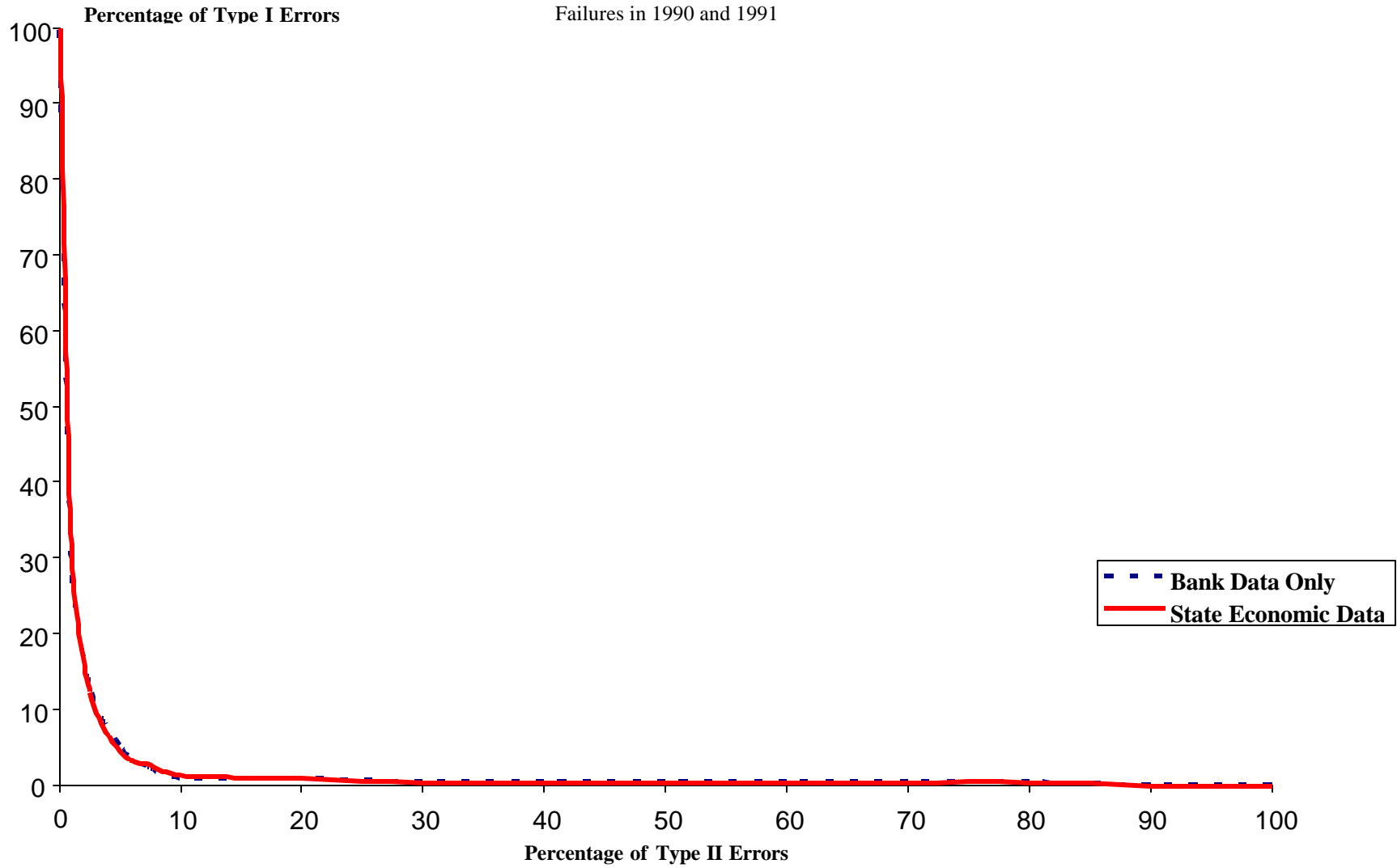


Figure 8  
Out-of-Sample Forecasts  
Failures in 1989 and 1990

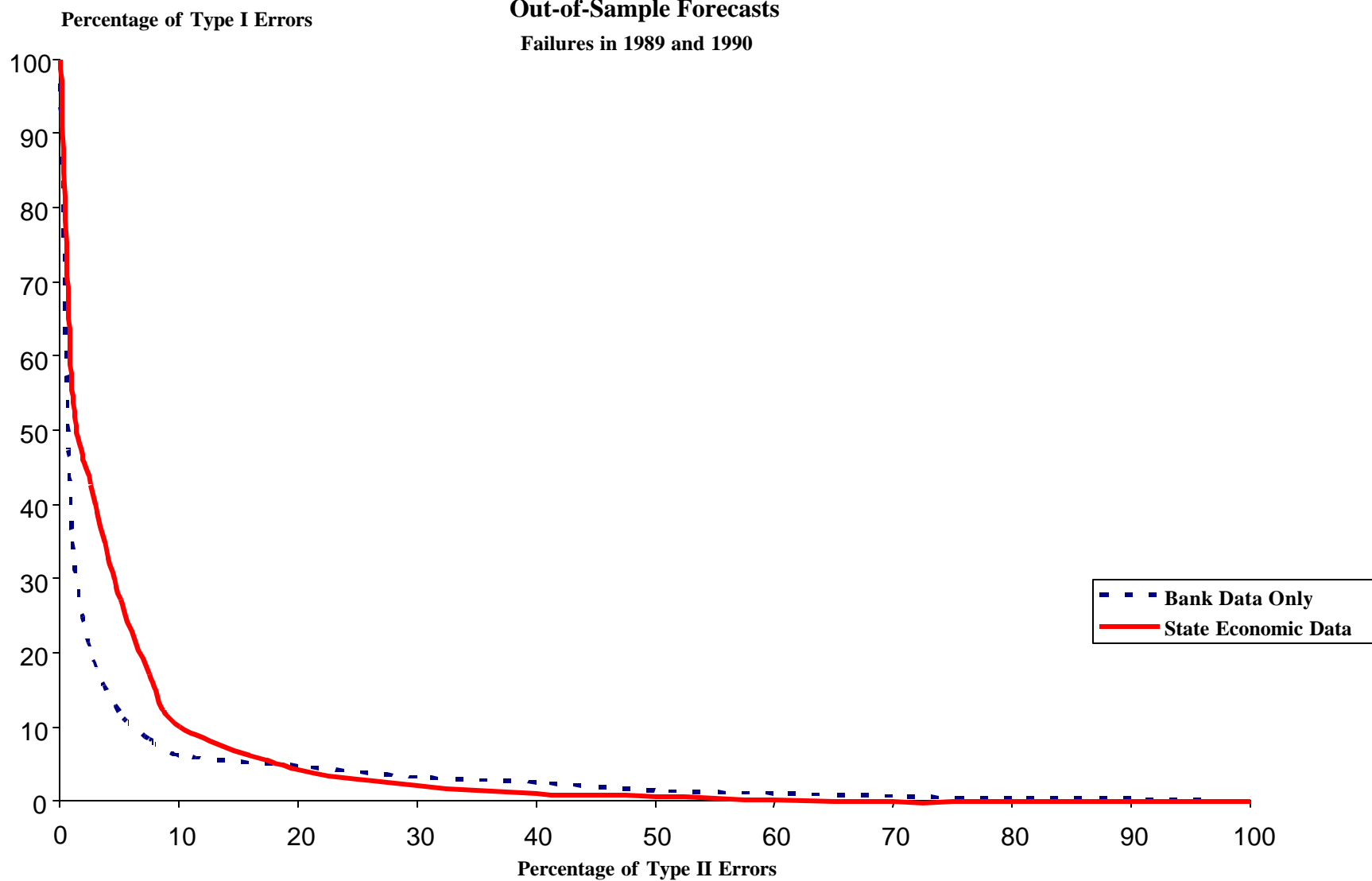


Figure 9  
**Out-of-Sample Forecasts**  
Failures in 1992 and 1993

