

Economic

Review

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For almost a decade, market reform in Mexico has meant trade expansion for Texas. Economic Review examines how Texas' economic composition is adjusting to the state's changing trade patterns with Mexico, both since NAFTA took effect in 1994 and since Mexico joined GATT in 1986.

**Sticky Prices:
What Is the Evidence?**

Mark A. Wynne

**The Texas Banking Crisis
And the Payments System**

*Robert T. Clair, Joanna O. Kolson,
and Kenneth J. Robinson*

**The Role of Merchandise
Exports to Mexico in the
Pattern of Texas Employment**

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**Another Strong Year
For the Eleventh District**

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Economic Review

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The Role of Merchandise Exports to Mexico in the Pattern of Texas Employment

Kelly A. George and Lori L. Taylor

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In 1987, Texas exported \$25 billion worth of merchandise to foreign countries. Twenty-six percent, or \$6.5 billion, of those exports went south to Mexico. By 1994, Texas merchandise exports to Mexico had grown to more than \$18.5 billion per year (in 1987 constant dollars). Texas merchandise exports to Mexico (in real terms) have grown more than 10 percent a year for six of the last seven years.

Using input–output analysis, Kelly George and Lori Taylor find that merchandise exports to Mexico, while representing only about 5 percent of Texas output, have grown in ways that have substantially influenced the composition of the state's economy. The authors attribute a small portion of the state's overall job gains since 1987 to rising merchandise exports to Mexico but find that almost all Texas employment growth in high-tech manufacturing sectors stems from trade with Mexico.

Another Strong Year For the Eleventh District

Fiona D. Sigalla

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The Eleventh District marked its eighth year of economic expansion in 1994. Employment grew strongly in all three Eleventh District states—Louisiana, New Mexico, and Texas. Although the past prominence of the oil and gas sector is well-known, in 1994 the region prospered despite continued declines in the energy industry. A robust U.S. economy stimulated demand for District manufacturing and service industries, which helped drive the economy.

Fiona Sigalla surveys the 1994 performance of the Eleventh District economy and finds that a favorable business climate and expanding trade in goods and services to Mexico helped the Eleventh District grow faster than the nation. While slower economic growth in the United States and uncertainty in Mexico will be drags on the District economy in the year ahead, 1995 should be another good year for District states.

ERRATA

Economic Review, Fourth Quarter 1994, incorrectly presented two figures in the article entitled, "Would the Addition of Bond or Equity Funds Make M2 a Better Indicator of Nominal GDP?" Data displayed in Figure 3 (page 7) and Figure 4 (page 10) were switched, so that the correct Figure 3 appeared under the Figure 4 heading, and vice versa. Corrected copies of the article are available by writing the Public Affairs Department, Federal Reserve Bank of Dallas, P.O. Box 655906, Dallas, TX 75265-5906, or by calling (214) 922-5257.

Sticky Prices: What Is the Evidence?

Mark A. Wynne

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This article reviews the idea that sticky prices are important for understanding business cycles. Mark Wynne begins with a critical survey of the literature documenting the stylized facts about prices in individual markets. His first point is that there is remarkably little evidence that the actual transactions prices of most products are, in fact, sticky. Such evidence as there is to support the notion of widespread price stickiness is heavily biased toward low-tech products that account for a very small fraction of total output and is a thin reed on which to base a theory of business fluctuations. Furthermore, the observation that posted prices do not change very frequently cannot always be interpreted as evidence that markets are not clearing. There is some evidence to suggest that frequently firms alter product characteristics other than price to allocate goods and services, and that these changes in product characteristics are unobserved.

In view of the difficulty in interpreting whether prices are at other than market-clearing values, Wynne argues that the only true test of a model in which price stickiness plays a major role in explaining business cycles is to look at how well it explains the cyclical phenomena it is supposed to explain. One simple test of a model along these lines consists of looking at the various correlations generated by the model and comparing them with the data. Wynne reviews some recent attempts along these lines and concludes that, while there may be some role for price stickiness in explaining business cycles in the U.S. economy, the case remains unproven.

The Texas Banking Crisis And the Payments System

Robert T. Clair, Joanna O. Kolson,
and Kenneth J. Robinson

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The Federal Reserve System plays a crucial role in the payments system that is especially important during periods of financial turmoil. In this article, Robert Clair, Joanna Kolson, and Kenneth Robinson explain the process and the risks involved in clearing checks in the private sector. They compare these processes and risks with the essentially risk-free check-clearing service the Federal Reserve System offers. During banking crises, they hypothesize, banks will increase their check-clearing through the Federal Reserve to minimize their risk exposure. A model of Federal Reserve check-clearing volume is constructed and estimated. The empirical results show that during banking crises, Federal Reserve check-processing volume rises as banks seek safer methods of clearing checks. Consequently, Federal Reserve payment services are important tools in minimizing the disruptive effects of banking crises on the economy.

Sticky Prices: What Is the Evidence?

Mark A. Wynne
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After nearly two hundred years of theorizing, we still do not have a very clear understanding of the mechanism whereby changes in the stock of money affect the economy in the short run. This article reviews one of the most popular explanations for why money affects output. This is the idea that prices are “sticky” at nonmarket-clearing levels, thus creating the potential for changes in the money stock to influence the real economy.

One of the most important questions in economics concerns whether and how changes in the stock of money affect the levels of output and employment. More specifically, how can changes in the stock of a nominal quantity, such as the number of dollar bills outstanding, affect the level of a real quantity, such as the total amount of goods and services produced in any given year or the number of workers to be employed in the production of that output? Given that the Federal Reserve’s primary means of influencing the pace of economic activity in the United States is through changes in the stock of money, the question is of immediate importance for the conduct of monetary policy.¹ Yet despite the importance of this question, it remains one of the great unsettled issues in economics. After nearly two hundred years of theorizing, we still do not have a very clear understanding of the mechanism whereby changes in the stock of money affect the economy in the short run. This article reviews one of the most popular explanations for why money affects output. This is the idea that prices are “sticky” at nonmarket-clearing levels, thus creating the potential for changes in the money stock to influence the real economy.

The intuition for why changes in the nominal money stock can affect real output in a sticky-price environment is straightforward. Consider a situation in which the economy is in a state of monetary equilibrium. All individuals are holding their desired levels of cash balances, which typically might be expressed in terms of some number of weeks of income. Individuals have arrived at these holdings by trading off their need for cash to facilitate transactions with the cost of holding cash rather than some higher yielding asset. Absent any change in individuals’ need to finance transactions or the relative return on cash versus other assets, they will be willing to hold their existing stocks of cash indefinitely.

Suppose now that the monetary authority engineers an increase in the money stock such that each individual’s cash holdings increase by exactly 10 percent. Suppose also that the increase is a one-time occurrence, in the sense that it is unanticipated and will not be repeated. One way this might occur would be by means of the metaphorical helicopter drop employed by Milton Friedman in his analyses of the effects on real activity of changes in the stock of money.² On average, individuals will now find themselves holding a larger stock of cash than before. Since their previous level of cash holdings was optimal, given their transactions needs and the costs of

holding cash, and since nothing has changed to alter these determinants of their cash holdings, individuals, on average, now hold more than their desired stock of cash. To return to their original level of money holdings, the individuals will increase their spending until their cash balances are back at their original level. However, if all individuals are simultaneously trying to spend down their cash balances, and nothing has happened to make people willing to produce more, the result will be upward pressure on prices. In the long run, equilibrium will be restored when the prices of all goods rise in the same proportion as the initial increase in the money stock.

The more difficult question is what happens during the transition to the new equilibrium. If the prices of all goods and services increased immediately in the same proportion as the money stock, the adjustment would be completed instantaneously and that would be the end of the story. However, if (for whatever reason) some producers are slow to adjust their prices in the face of the increase in nominal demand and choose instead to increase output, we might see an increase in output during the transition period. This failure to adjust prices immediately may come about for a variety of reasons, including, for example, a misinterpretation on the part of some firms of the increased demand for their product or the existence of some menu cost associated with changing prices. Whatever the reason, the failure of prices to adjust rapidly generates the potential for changes in the nominal stock of money to affect real output.

The focus in this article will be on price stickiness or rigidity rather than wage stickiness. Sticky prices or wages are both potential sources of nonneutralities of money, and both may play a role in propagating nominal shocks. However, most economists are skeptical of interpretations that view the failure of nominal weekly or monthly wage payments to fluctuate with business conditions as evidence of stickiness. A better interpretation, many argue, is that periodic wage payments are installment payments on a long-term labor contract (either implicit or explicit) and thus play relatively little allocative role (see, for example, Barro 1977). Incentives other than the promise of higher wages induce workers to work harder during booms; one example might be the implicit promise of being allowed to slack off when things are quieter. Other reasons for being skeptical about the importance of wage rigidity as a propagation mechanism are recent evidence that wages are, in fact, remarkably flexible, and the counterfactual implications of theories with wage stickiness at their core.³

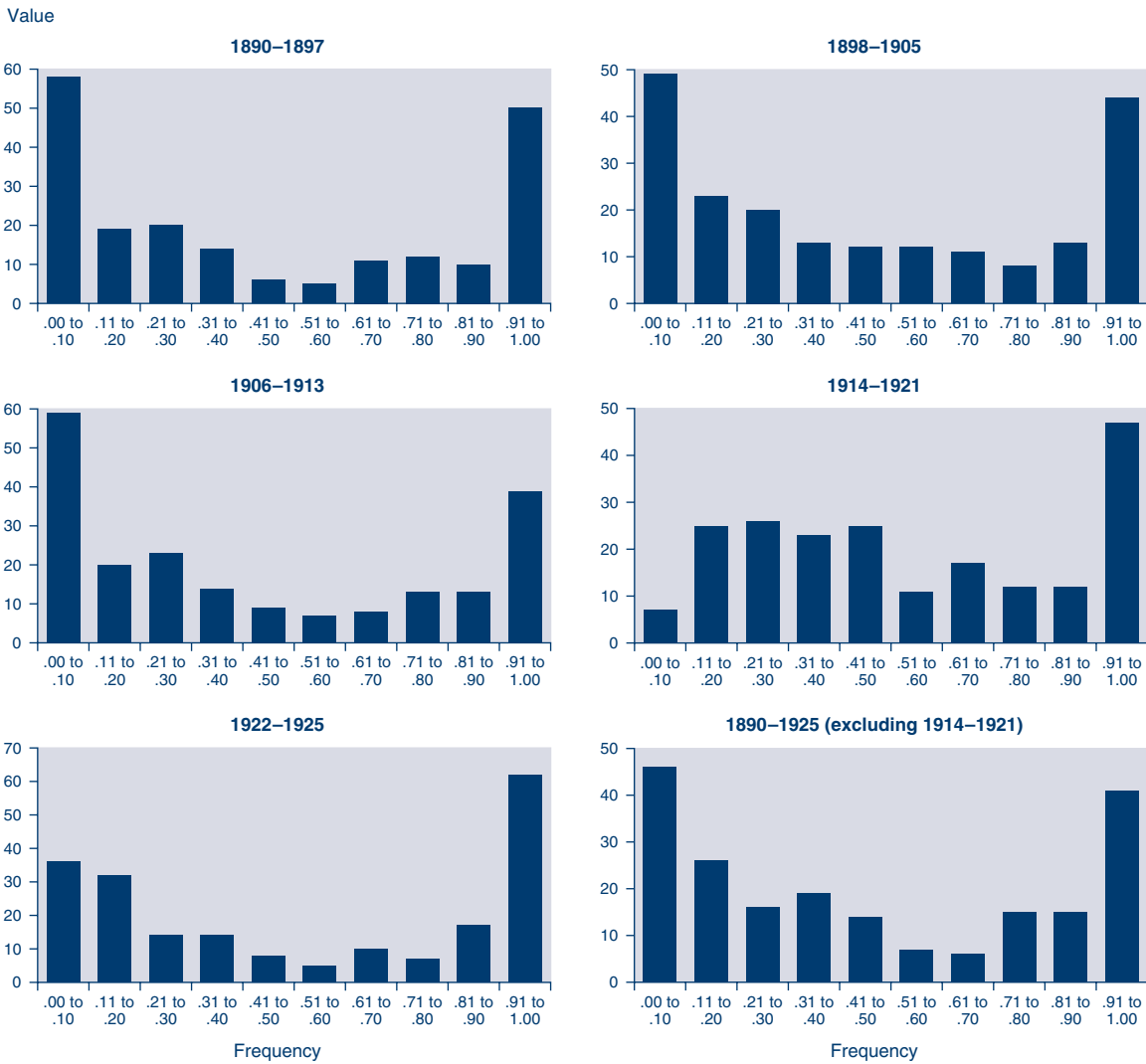
The facts about price stickiness

A common criticism of the raw data used to construct the widely used consumer and producer price indexes is that the prices that go into these indexes are list rather than transactions prices. That is, the raw price series do not reflect the prices at which actual transactions take place but rather some irrelevant list price at which relatively few transactions occur. Wynne and Sigalla (1993) review some of the evidence on this problem. The list-transactions problem takes many forms, depending on whether the prices in question are for intermediate or final goods. Firms may be reluctant to report actual transactions prices to the industrial price program that gathers data for the producer price index (PPI) because of fears the data may be used in antitrust litigation or fall into the hands of competitors.⁴ Thus, some have argued that price data should be collected from buyers rather than sellers.

This approach is nearly what is done in the data collection of prices for the consumer price index (CPI). Bureau of Labor Statistics (BLS) reporters visit a variety of stores and collect data on the various products that are to be priced for the CPI. The reporters make adjustments to these products for some but not all discounts. Thus, when pricing automobiles, the BLS collects the car's sticker price; the average discount offered over the recent past; and the prices for standard options, dealer preparation, and delivery to get a measure of car prices that better approximates the prices the average consumer actually pays. One form of discounting that is not taken into account in collecting data for the CPI involves cents-off coupons. The BLS only discounts products for those coupons attached to products for redemption at the time of sale. Clearly, the use of coupons could imply greater price flexibility than is revealed in examinations of the official price statistics, but by how much is uncertain. It is clear, however, that coupon use varies with the state of economic activity.

One other aspect of the official price indexes makes them unsuitable for assessing the overall degree of flexibility of the price of a product. That is, for a variety of reasons, the prices that go onto the official indexes are usually averages of prices obtained from different outlets or firms. Such averages can fluctuate either more or less than their constituent price series, making them unreliable guides to the overall flexibility of prices. Despite these shortcomings of official price statistics, the first study I review (Mills 1927) is based on an analysis of raw BLS data. The review of the literature begins with this study because, despite some serious shortcomings, it

Figure 1
Distribution of 206 Commodities
(Classified by Frequency of Monthly Price Changes)



remains one of the most comprehensive assessments of price flexibility, and it also establishes certain results about the frequency of price changes that later studies confirm.

The behavior of wholesale prices, 1890–1924

The earliest study of the frequency of price changes for individual products is probably Mills (1927). Mills studied data collected by the BLS for the purposes of constructing the wholesale price index (WPI) and constructed a measure of the frequency of price changes for an individual commodity by dividing the number of months in which a change in price is recorded by the total number of months for which a price is quoted, less one. Thus, if we have price data for, say, wheat for a ten-year period (120 months), and if

in 119 of those months the price changed, then the index would take on a value of one (119/119). Alternatively, if there were no price changes over the ten-year period, the index would take on a value of zero (0/119). Mills constructs this measure for each of the 206 commodities in his data set for six different periods. The resulting class frequencies are plotted in Figure 1. The value of Mills' index is plotted in interval increments on the horizontal axis, while the frequency of each interval value is plotted on the vertical axis. If every product in the sample exhibited a price change in every month of a particular sample period, the rightmost bar on the graph would equal 206 (the number of commodities in the sample), with zeros elsewhere. Likewise, if no commodity exhibited a price change during any month of the sample, all the mass of the distribu-

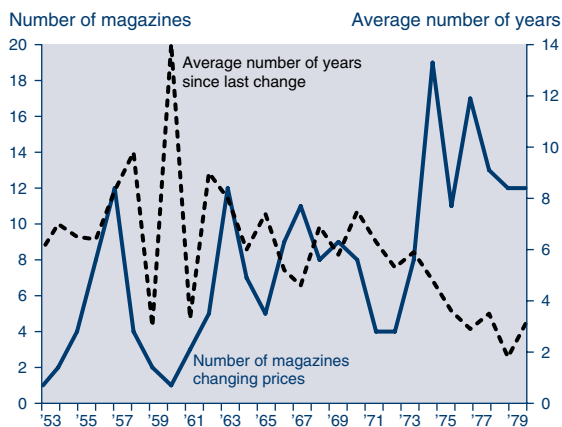
tion would be concentrated in the leftmost bar on the graph, with zeros everywhere else.

The most striking feature of these graphs is the uniformity of the U-shaped distribution of price changes. That is, there are a lot of products for which prices change relatively infrequently, and there are a lot of products for which prices change frequently. Perhaps not surprisingly, the only products with an index value of one in all the sample periods are farm products (hogs and sheep). For a lot of other products, prices change almost every month (that is, index values for these products are close to one). Another point to note about Figure 1 is how the distribution of price changes shifted during the period including the years of World War I (1914–21).

While Mills' results are of great interest, there are at least two important problems with the data he uses. First, despite his claims that the data are not averages, it is not clear that this is the case. Examination of Table 1 of the appendix to his book reveals many commodities for which it seems likely that the data used are, in fact, averages over several price quotations. The second problem is that data collected for the BLS's industrial price program have often been criticized as reflecting list prices rather than transactions prices. Both the Stigler report (NBER 1961) and the Ruggles report (U.S. Executive Office of the President: Council on Wage and Price Stability 1977) make this point forcefully. Finally, some of the criticisms of later studies that will be noted below are probably also applicable to Mills' study. Specifically, adjustment for quality change was essentially nonexistent in the early years of the BLS, which raises the possibility that some of the price stickiness found by Mills may have been accompanied by quality deteriorations.

The newsstand prices of magazines. Cecchetti's (1986) study of the newsstand prices of magazines is probably the most widely cited and influential piece of evidence that prices are sticky. Cecchetti looked at the prices of thirty-eight magazines over the period 1953 to 1979. One virtue of this data set is that the prices are known to be transactions prices rather than just list prices. The use of discounts for newsstand magazine purchases is rare.⁵ The main stylized facts about price stickiness presented by Cecchetti are shown in Figure 2. Two points are noteworthy. First, the prices of the magazines in the sample change relatively infrequently. At most, only half the magazines in the sample change price in any one year (the peak year being 1974). Second, note the increased frequency of price changes and decline in the average number of years since the last price change as inflation accelerated in the late 1970s.

Figure 2
Magazine Price Changes, 1953–79



Cecchetti also observes that the average decline in real price between nominal price changes increased dramatically during the 1970s. He interprets this as evidence of “incredible” price stickiness, which can only be explained by high fixed costs of price changes.

Nevertheless, the Cecchetti study raises numerous questions that undermine the broader inferences that can be drawn from it. For a start, one has to note the small size of the sample of prices studied. Cecchetti himself concedes that a mere one-third of all magazine sales in his sample are single-copy (newsstand) sales. Most people buy magazines through subscriptions. What do we know about the prices of magazines purchased through subscriptions? Obviously, when one enters a subscription for a magazine, one obtains (typically) a year's worth of issues of the magazine at some fixed average price over the period of the subscription. Yet frequently magazines offer various discounts for subscribing, either in the form of “professional courtesy” discounts or reduced rates for longer subscription periods.⁶

A potentially more serious shortcoming of the Cecchetti study is the absence of any control for quality. In view of Blinder's recent survey findings (discussed below), one wonders whether magazine publishers effectively raise the price of their magazines by changing such aspects of product quality as the publication's size, the ratio of advertising to nonadvertising pages, or the number of color versus black-and-white pages. Are stockouts at newsstands more common as the real price of magazines declines with rising inflation?⁷

This is essentially the point Koelln and Rush (1993) make. Echoing an earlier argument by Carlton (1983), Koelln and Rush note that magazine publishers may alter some aspect of their

product's quality to adjust the effective price during the period between nominal price changes. Koelln and Rush specifically identify the possibility of altering the number of pages of text as a potential means of offsetting declines in real price during the interval between price changes. Koelln and Rush look at "net page" and price data over the 1950–89 period for seven magazines (five of which were included in Cecchetti's sample). The authors note that the magazine with the most inflexible size over this period also had by far the largest number of nominal price changes. They interpret this observation as supporting the hypothesis that variation in quality (magazine size, in this case) is a potentially important alternative to variation in price. Koelln and Rush also find a statistically significant (positive) relationship between the number of text pages in a magazine and the real price of the magazine. That is, as inflation erodes the real price of a magazine during the interval between nominal price changes, the number of text pages tends to decline. Koelln and Rush conclude that the price rigidity Cecchetti's study uncovered is significantly overstated.⁸

A third potential objection to Cecchetti's findings has to do with potential sample selection bias. Since the primary objective of Cecchetti's study was to investigate the determinants of the frequency of nominal prices changes, he explicitly chose to study prices that were not determined in auction markets but rather were known a priori to remain fixed for relatively long periods. Thus, Cecchetti (1986, 256) notes that the newsstand prices of magazines "exhibit the *desired* property of discrete and infrequent adjustment" (emphasis added). This, of course, raises the question of how representative the sample of prices Cecchetti examined is of all prices in the economy.

The prices of industrial commodities. Carlton (1986) revisits the data collected by Stigler and Kindahl (1970) in their monumental study of the behavior of industrial prices. Part of the objective of the Stigler–Kindahl study is to collect accurate data on transactions rather than list prices for industrial commodities. As noted above, it has long been suspected that the aggregate price indexes the BLS publishes are based on list rather than transactions prices. To get around the list–transactions price problem, Stigler and Kindahl collect data from buyers rather than sellers, the presumption being that buyers have less of an incentive to report list rather than transactions prices than do sellers.⁹ Stigler and Kindahl also make corrections for discounting and for changes in product specification. Their sample period is January 1, 1957, through December 31, 1966.

The commodities for which price data were collected were intermediate products used in manufacturing and were preselected to satisfy two important criteria. First, Stigler and Kindahl focus on the prices of those commodities "for which the charge of inflexible prices has been heard most frequently" (Stigler and Kindahl 1970, 23). The reason for this focus is the authors' interest in testing certain theories of administered prices. Thus, the prices they collected were preselected to exhibit some degree of price rigidity. Stigler and Kindahl's second criterion for price data is the absence of rapid quality change in the products, which helps avoid the difficulty of disentangling quality from price changes. Stigler and Kindahl note that "the problem of measuring change in the quality of products is *the* major unresolved task of all price collection" (Stigler and Kindahl 1970, 23), and this remains as true today as it was when they wrote their book twenty-five years ago.

Carlton concludes on the basis of his analysis of the Stigler–Kindahl data that there is significant price rigidity in many industries. For industries like steel, chemicals, and cement, Carlton finds that prices are, on average, unchanged for more than one year. Furthermore, there is a positive correlation between price rigidity and the size of price changes. In other words, the longer prices are rigid, the greater the eventual price change. But just as there are many examples of products and transactions for which prices remain fixed for long periods, so too are there many instances of small price changes (meaning a change of less than 1 percent). This observation suggests that either the costs of changing price are very small or that the costs of being at the wrong price are very high. With either explanation, the observation of long periods of price rigidity is difficult to explain. Interestingly, Carlton finds a negative relationship between price rigidity and the length of association between buyers and sellers, making an installment payment interpretation of the observed price rigidity implausible. Finally, Carlton finds no evidence that prices downward are more rigid than upward.

Of all the studies of price flexibility, the Carlton–Stigler–Kindahl study is the most comprehensive in that it looks at the prices of the largest number of products. Nevertheless, the findings need to be interpreted with caution. As noted, Stigler and Kindahl's preselection criteria make the prices of the products they study unrepresentative of prices of all products. Another point to note about Carlton's results is that during the period covered by his data, WPI inflation averaged only 1.1 percent a year.¹⁰ It

would be interesting to have a study as comprehensive as the Stigler–Kindahl exercise repeated for a period of higher inflation.

Prices in retail catalogs. The most recent study documenting the behavior of transactions prices is Kashyap (1991). Kashyap looks at the behavior of the transactions prices of twelve retail goods over the period 1953 to 1987 from the retail catalogs of three firms: L. L. Bean, Inc.; The Orvis Company, Inc.; and Recreational Equipment, Inc. (REI). Kashyap sidesteps the problem of dealing with quality change by looking only at the prices of products that are homogeneous over long periods. The specific products are a pair of hunting boots, pair of moccasins, chamois shirt, blanket, and duffel bag from L. L. Bean; a bamboo fly rod, fly, poplin fishing hat, pair of binoculars, chamois shirt, and blanket from Orvis; and a chamois shirt from REI. All three of the companies in the study fix their prices for six-month intervals, implying that there are at most two price changes that can be observed each year. Kashyap collected data by copying prices from old catalogs. Prices are list prices for one unit of an item: no account is taken of discounts for bulk purchases that each company has occasionally offered. Kashyap provides no data on the size of these discounts (he simply asserts that they are “very slight”) or on their frequency. He also ignores “sales prices which may have been available for very short periods” (Kashyap 1991, 6–7).¹¹ One key advantage of Kashyap’s data over that analyzed by Cecchetti is that the goods are high-volume goods for which even small changes in price produce nontrivial changes in revenue. By contrast, subscriptions and advertising are far more important sources of revenue for magazine publishers than are newsstand sales.

Kashyap draws three main conclusions from his empirical analysis:

1. Nominal prices are typically fixed for periods longer than one year, and the time between price changes is very irregular.
2. Prices change more often during periods of high inflation but not by larger amounts than during periods of low inflation.
3. When prices do change, the sizes of the changes are widely dispersed.

Kashyap notes that his data strongly contradict simple versions of (S,s) pricing models. For example, the simple versions of these models that assume that price changes should always be in one direction are rejected by the frequency of price reductions. Two-sided (S,s) models that

keep the size of the change in each direction fixed are rejected by the finding that the size of price changes, when they do occur, is highly variable. Furthermore, the absence of any correlation between the average size of price changes and the (core) rate of inflation poses serious problems for simple tractable versions of (S,s) models.¹²

Kashyap addresses the possibility that catalog prices might be suspected of being artificially sticky by citing Rees’ (1961) finding that catalog prices tend to closely track prices in retail outlets. However, Rees (1961, 138) explicitly notes the following:

There is a problem in the determination of the period during which catalog prices are in effect. Special sales and in some cases price increases may be announced shortly after catalogs are issued, and we have no collection of such announcements. Changes in the proportion of all sales made through special sales catalogs and changes in the difference between general catalog and sales catalog prices could introduce bias into our indexes.

Furthermore, the sample of products Rees examined was in no sense random. Specifically, the sample of goods Rees looked at was a judgment sample of nondurable goods, although he made a deliberate effort to include both goods that were little influenced by innovation or technical change over the sample period and goods that were subject to significant quality changes. It would be interesting to know whether today, with the growth of catalog shopping, Rees’ results still hold up. The problem remains that the products Rees looked at are not in any sense representative of the wide range of products consumers typically buy. As for the possibility of changes in delivery lags as prices become more out of line, Kashyap asserts that since most of the products in his sample are popular and have been carried by the different retailers for long periods, the retailers have a good sense of what demand for the products looks like, thus rendering stockouts less common.

Evidence from interviews. Blinder (1991) proposed interviewing actual price setters in business firms to gain insights into the factors that underlie decisions to change prices. The primary objective of Blinder’s study was to find evidence that would allow us to discriminate between competing theories of price stickiness, rather than document how frequently the firms in his sample changed their prices. Blinder notes that testing the notion that prices are sticky is probably impossible, as

price stickiness usually means nothing more than that prices change less rapidly than their unobservable Walrasian market-clearing values. While Blinder does not report raw data on price changes for the firms in his survey, he does report two findings relevant to this survey of the literature. First, most firms in Blinder's sample (55 percent) claim to change their prices no more than once a year, with only 10 percent of companies changing price as often as once a month. Blinder interprets this observation as evidence of significant price rigidity. Of even more importance in the interpretation of this result is the finding that three-fourths of the sample firms, when asked to rank the underlying factors in their decision not to change prices when demand is high or low, said they changed some other aspect or quality of their product instead. Specifically, 76 percent of the firms in the sample accepted the notion that delivery lags could be lengthened or quality of auxiliary service reduced as alternatives to raising prices when demand is tight.¹³ These findings echo Carlton's earlier hypothesis that price may be only one of several mechanisms firms use to allocate output and raise serious questions about the interpretation of observed nominal rigidities.

Assessment of the evidence

In assessing the evidence on price stickiness, one cannot help but be struck by the scant documentation of how frequently prices actually change. I have been able to find only three studies (Cecchetti, Carlton, and Kashyap) that make a serious attempt to document price stickiness in the postwar United States. Although this review of the literature includes the earlier work by Mills, his is probably the most suspect study cited.

Another striking aspect of price stickiness documentation is the very small fraction of gross domestic product (GDP) it covers. It is remarkable that Cecchetti's results on the newsstand prices of magazines should receive such widespread attention in view of the trivial fraction of GDP those sales represent.¹⁴ The most comprehensive of the modern studies is Carlton (1986), but the products in that study were all intermediate rather than final goods. However, Ball and Mankiw (1994) argue that when it comes to assessing the importance of sticky prices as an explanation for monetary neutrality, it is necessary only that those goods purchased with money (by which they seem to mean currency) exhibit stickiness, since the prices of goods bought with credit do not directly affect the demand for money. Ball and Mankiw note that goods purchased with currency are typically small retail items (such as newspapers and hair-

cuts) and that experience suggests these are the goods for which prices are most sticky.

The third observation about the evidence is that, in many cases, the sample of prices studied is biased toward the inclusion of prices that were known a priori to be relatively inflexible. Thus, Cecchetti was primarily interested in estimating models of price adjustment rather than documenting facts about price changes when he compiled his data on the newsstand prices of magazines. Likewise, Stigler and Kindahl were primarily interested in testing theories of administered pricing (and thus biased their sample toward products for which administered [or rigid] prices were thought to be particularly prevalent) when they assembled the price data later analyzed by Carlton (1986). Finally, despite Kashyap's citing earlier work by Rees (1961) that found that prices in catalogs tend to mimic prices at retail outlets remarkably well, the fact remains that there is potentially a lot more flexibility in catalog prices than Kashyap documented.¹⁵

Another way in which the prices documented as being relatively sticky fail to represent all products is the homogeneity of the documented products over time. Because of the difficulty of separating price changes due to changes in the quality of a product from pure price changes, most of the studies focus only on products for which this is not likely to be a problem. Thus, the Stigler-Kindahl data set contains a lot of low-tech products like steel and lumber, and Kashyap focuses on consumer goods like shirts and shoes that exhibit little or no quality changes over time. But the fact remains that many high-tech products have remarkably flexible prices. Would anyone seriously suggest that the appropriate (quality-adjusted) prices of personal computers stay fixed for very long? Indeed, durable goods in general tend to have very flexible prices, as witnessed by the frequent sales for electronic equipment. Returning to the more basic end of the consumer products spectrum, food prices (especially those of fresh fruit and vegetables) fluctuate in line with market conditions.¹⁶ As for services, barbers may not change the price of a haircut very often, but the same cannot be said for airfares.

Carlton (1983) raised an important point concerning the interpretation of findings that the prices of some or many products are sticky or inflexible. He notes that the observation that the price of a product is inflexible for long periods is meaningless if the product changes over time. The specific example he considered was one in which delivery lags could be lengthened in lieu of raising price when demand is tight. As evidence for the potential importance of this mechanism for

allocating output, Table 1 shows the standard deviations of price and delivery lags in selected industries. In each case, delivery lags are more variable than price, in some cases considerably so. But Carlton's point applies more generally and to aspects of the product other than time to delivery. Thus, to note that the price of a magazine stays fixed for, say, a year is not very interesting if the magazine changes its ratio of advertising to text during the year. Koelln and Rush (1993) note such a possibility in connection with Cecchetti's study of magazine prices. Similarly, to note that the price of a piece of apparel stays fixed for a long period is not very informative if instead the fabric content of the item changes. Indeed, just such a phenomenon occurred during WWII when price controls held the nominal price of various consumer goods constant. Manufacturers skirted these price controls and effectively raised prices by lowering the quality of the goods.¹⁷ Blinder's interview study lends further credence to this possibility with the finding that most firms in his sample accepted that changes in delivery lags or other aspects of the product were a common alternative to nominal price increases.

While these studies document many cases in which prices stay fixed for long periods, they also find many instances in which prices are very flexible, changing frequently and often by small amounts. The earliest evidence on this is the U-shaped distributions plotted by Mills for wholesale prices in the pre-World War II period. Carlton also finds many instances of frequent and small price changes in the Stigler–Kindahl data set, and Blinder observes that about 10 percent of the firms in his sample change their prices as often as once a month.

Finally, there is evidence that price changes

are more frequent during periods of high inflation than during periods of low inflation. This is one of the main findings of Cecchetti's study, and is also reported by Kashyap. Additional evidence on the frequency of price adjustment during periods of high inflation in Israel is presented in Sheshinski, Tishler, and Weiss (1981); Lach and Tsiddon (1992); and Eden (1994). The importance of this result is that it demonstrates that firms' pricing policies are not unresponsive to changes in the environment. Thus, a monetary policy aimed at stabilizing output and predicated on the notion that price changes occur at fixed intervals would be based on a false assumption.

Blinder (1991, 1990) writes that attempts to test the notion that prices are sticky are hindered by the ambiguity of the terms "sticky" and "flexible." To say that prices are sticky often means no more than that they are less flexible or adjust less rapidly than Walrasian market-clearing prices. However, this is a rather amorphous benchmark, since Walrasian market-clearing prices are themselves unobservable. Of course, the sensible thing to do then is to test the other predictions of the theory. Do models with sticky prices do a better job at explaining business cycles that do models with perfect price flexibility?

Ball and Mankiw (1994, 35–36) note that "A scientific theory should be judged not only by the intrinsic appeal of its assumptions, but also by its ability to explain observed facts—especially ones that it was not explicitly designed to explain." In view of the scant evidence on price rigidity and the inherent difficulties in augmenting such evidence as there is, perhaps the best way to assess the quantitative importance of price rigidities for understanding fluctuations in economic activity is to compare the performance of models with price rigidities with that of models with fully flexible prices to see which does better in explaining the stylized facts of the business cycle.

Cho and Cooley (1990) explore the quantitative implications of nominal price contracts (or sticky prices) for the transmission and propagation of shocks in a standard business-cycle model. The model they study is a variant of the one-sector, neoclassical growth model augmented with a cash-in-advance constraint. They study the effects of nominal price contracts that vary in length from one to eight periods on the propagation of both monetary and technology shocks, with prices set each period on the basis of expected marginal costs. Cho and Cooley show that only a small amount of price stickiness is needed in their model to generate output volatility of the same magnitude as observed in the U.S. data. Monetary shocks propagated by nominal

Table 1
Price and Delivery Lag Fluctuations

SIC code	Industry	Standard deviation of log of price	Standard deviation of log of delivery lag	Median delivery lag in months
22	Textile mill products	.06	.17	1.26
26	Paper and allied products	.05	.08	.46
331	Steel	.03	.25	1.95
34	Fabricated metals	.03	.18	3.06
35	Nonelectrical machinery	.04	.25	3.63
36	Electrical machinery	.05	.10	3.86

SOURCE: Carlton (1983, Table 1).

price stickiness for a small number of products thus may be an important element in furthering our understanding of the business cycle under certain price-setting rules. However, nominal shocks by themselves propagated by nominal contracts are not a viable alternative to technology shocks as a source of business cycles: while monetary shocks propagated by nominal contracts can generate output volatility of the right order of magnitude, other features of such a model are inconsistent with the facts of U.S. business cycles.

The consequences of price stickiness in a general equilibrium model have also been investigated by Ohanian and Stockman (1994a, b), who examine an economy in which some prices are set in advance and some are free to change instantaneously. Prices in the sticky-price sector are assumed to be set at their expected market-clearing level. Ohanian and Stockman show that only a small degree of price stickiness may be sufficient to generate big effects from nominal shocks. However, as the model studied by Ohanian and Stockman abstracts from capital accumulation, it is not clear how robust their results are. In particular, the inclusion of capital accumulation would introduce an additional margin along which substitution could occur in response to exogenous disturbances, necessitating the existence of a larger sticky price sector to generate plausible liquidity effects. Just how much larger is an open question.

A key shortcoming of the Cho–Cooley and Ohanian–Stockman analyses is that they graft ad hoc price-setting rules onto otherwise standard general equilibrium models. Beaudry and Devereux (1993) overcome this problem by examining a model in which intermediate goods-producing firms find it optimal to preset prices, and do so in a way that maximizes expected profits.¹⁸ Beaudry and Devereux find that their model is able to match key features of the data reasonably well, in the sense that the impulse responses computed for the model for monetary and technology shocks are similar to those generated by U.S. data. In particular, the endogenously sticky prices generate a quantitatively important propagation mechanism for nominal shocks.

In contrast to the studies just mentioned, the results of Kydland (1991) suggest that sticky prices may have little role to play in explaining output fluctuations. Kydland finds that an equilibrium business-cycle model with price flexibility can account for about two-thirds of the fluctuations in output and the price level as a response to technology shocks alone. All movements in the price level come about as a result of real shocks;

there are no fluctuations in the money stock. Since prices in the real world are more volatile than prices in the model, sticky prices may explain little about the remaining one-third of volatility that cannot stem from technology shocks alone.

Conclusions

The notion that nominal price rigidities play an important role in the transmission and propagation of nominal shocks to the real economy is one of the oldest ideas in economics, dating back at least to the work of David Hume in the eighteenth century. In this article, I make two points about this literature. First, despite its widespread acceptance among economists, there is remarkably little evidence to support the notion that prices are sticky. The only way to determine how frequently prices change is to collect and examine data on the prices paid in individual product transactions. To date, I have been able to uncover only three studies that document the frequency of price adjustment in the U.S. economy. Given the importance of price stickiness to much of contemporary macroeconomic thinking, one would have thought that there would be a lot more evidence to support this assumption.

My second major point in this article is that the evidence, in many cases, must be interpreted with caution. If buyers and sellers are able to alter product characteristics other than price to arrive at market-clearing outcomes, it is not clear that the observation that posted prices are sticky implies a role for interventionist policy. If private markets are achieving efficient outcomes without the aid of the government, the government would do best by doing nothing. Carlton (1989) concludes his survey of how markets clear with this comment:

The importance of price diminishes once one recognizes that price alone may not be clearing markets and, instead, that price in conjunction with other mechanisms, such as a seller's knowledge of a buyer's needs, is performing that function. Indeed, if price is not the sole mechanism used to allocate goods, it becomes less interesting to observe whether price remains rigid. Although a rigid price does imply inefficiency under any of the simple models in which price alone is the exclusive mechanism used to achieve efficient resource allocation, a rigid price does not imply inefficiency in a world in which price is but one of the many methods firms are using to allocate goods to customers.

Despite the caveats about evidence of price stickiness, it may well be that only a small degree of genuine price stickiness is needed for nominal or monetary shocks to generate a quantitatively significant role as a source of business cycles. The recent results of Cho and Cooley and Ohanian and Stockman are particularly suggestive in this regard. Can models that assume nominal rigidities are an optimal response to some aspect of the economic environment reproduce the key facts of the U.S. business cycle? The question remains open.

Even if prices are fully flexible, this does not imply that monetary policy has no role in affecting the level of output. Sticky prices are only one mechanism whereby changes in the stock of nominal money can affect the real economy. Recent literature has sought to explain the real effects of monetary policy by invoking the notion of market incompleteness. Thus, the outcome of the debate on whether sticky prices matter for understanding business cycles may have little to do with how effectively the Federal Reserve can contribute to smoothing the business cycle.

Notes

This article originated in a set of comments on "A Sticky-Price Manifesto" by Laurence Ball and N. Gregory Mankiw, presented at the Second Annual Texas Conference on Monetary Economics. I am grateful to reviewers John Duca, Evan Koenig, and Carlos Zarazaga for comments. I also thank Peter Hartley and Finn Kydland for useful comments.

- ¹ The Fed also influences the level of economic activity through changes in reserve requirements. Such changes affect the real opportunities for borrowing and lending and are thus considered more likely to have an influence on real economic activity.
- ² See, for example, chapter 2 of Friedman (1992).
- ³ See, for example, Gordon (1990), who notes that only price stickiness is needed to generate cycles in real output, given a path of nominal aggregate demand. Gordon adds that price flexibility is fully consistent with nominal wage rigidity as long as profits are sufficiently flexible.
- ⁴ Foss (1993) discusses how the threat of antitrust litigation discourages accurate reporting of transactions prices by firms.
- ⁵ Although not anymore: it is now quite common for bookstores to offer discounts of 10 percent on the purchase of books or magazines when the customer joins the store's "frequent buyer" program.
- ⁶ For example, the average price per issue of *The Economist* is lower for a two-year subscription than for a one-year subscription.
- ⁷ It is worth noting that insofar as changes in the real characteristics of a product result from nominal

shocks, this supports the notion that money does have an effect on real output, even though prices, when properly measured, may be completely flexible.

- ⁸ Koelln and Rush also note that advertising further complicates the interpretation of sticky magazine prices. Insofar as revenue from advertising is more important to the magazine publisher than revenue from newsstand sales, the appropriate interpretation of observed sticky cover prices is not clear. The authors note that prior to the inclusion of advertising in *Reader's Digest* in 1956, the number of pages in each issue had declined in several steps from 180 pages in January 1950 to 168 pages in January 1955. To limit the complications introduced by advertising, Koelln and Rush focus on magazines for which they think advertising is relatively unimportant.
- ⁹ Stigler and Kindahl do, in fact, find that their measures of transactions prices were substantially more flexible than the BLS price indexes.
- ¹⁰ CPI inflation averaged 1.8 percent a year over the same period.
- ¹¹ Kashyap also ignores any postage and handling charges. He claims that this factor is less serious than it might seem, as all Bean prices include these charges, and the Bean prices can be used to establish all the results reported in the study.
- ¹² Simple menu-cost arguments cannot explain the infrequency of price changes in catalogs. The menu cost in such a case is just the cost of printing the catalog, and this cost is the same whether none or all of the prices change.
- ¹³ Again, the question relevant to an understanding of potential transmission or propagation mechanisms for monetary policy is whether "tight" demand can result from a nominal shock. See note 8.
- ¹⁴ The closest way to assess the relative importance of magazine sales in GDP is to look at the ratio of consumer spending in the category "Magazines, newspapers, and sheet music" to GDP. Over the period covered by Cecchetti's study, spending in this category amounted to less than one-half of 1 percent of GDP (0.41 percent to be precise)!
- ¹⁵ It is also worth asking how representative catalog sales are of all retail sales in terms of the demographics of the buyers. One suspects that most catalog sales covered in Kashyap's study were to relatively prosperous consumers with relatively high opportunity costs of time.
- ¹⁶ Levi, Bergen, and Dutta (1994) look at the price of selected brands of orange juice in a retail outlet and find that the prices of some brands change, on average, every two weeks.
- ¹⁷ For a discussion of quality deterioration in connection with price controls during wartime, see Rockoff (1984).
- ¹⁸ Ireland (1994) also shows that in an economy in which some firms must set prices one period in advance, the optimal pricing rule does not equate the preset price

with expected marginal costs, except when shocks are serially uncorrelated.

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The Texas Banking Crisis and the Payments System

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The purpose of this article is to establish empirically the significant effect the Texas banking crisis had on check-clearing within and outside the Federal Reserve System. Historically, banking crises often caused or exacerbated a decline in real economic activity, resulting in lost jobs and income. The Federal Reserve System, along with other government programs, limited the damage from the Texas banking crisis.

As our nation's central bank, the Federal Reserve System plays a vital role in promoting a smoothly functioning economy. The Federal Reserve pursues basic macroeconomic goals of price stability and full employment in fulfilling its responsibilities for monetary policy, banking supervision, and payments-system operations. By providing payments-system services, such as electronic transfers and check-processing, the Federal Reserve facilitates the exchange of funds that is necessary to complete economic transactions. This third role, to provide efficient clearing of payments, frequently goes unnoticed. Most individuals do not know how the checks they deposit are collected. And if the system keeps on working as well as it has in the recent past, they probably never will.

Completing the payments required in economic transactions involves risks.¹ Banks expose themselves to financial risks by accepting for deposit checks drawn on other banks, especially when the banks clear these payments among themselves through clearinghouses or correspondent banks.² These risks increase during periods of economic and financial stress.

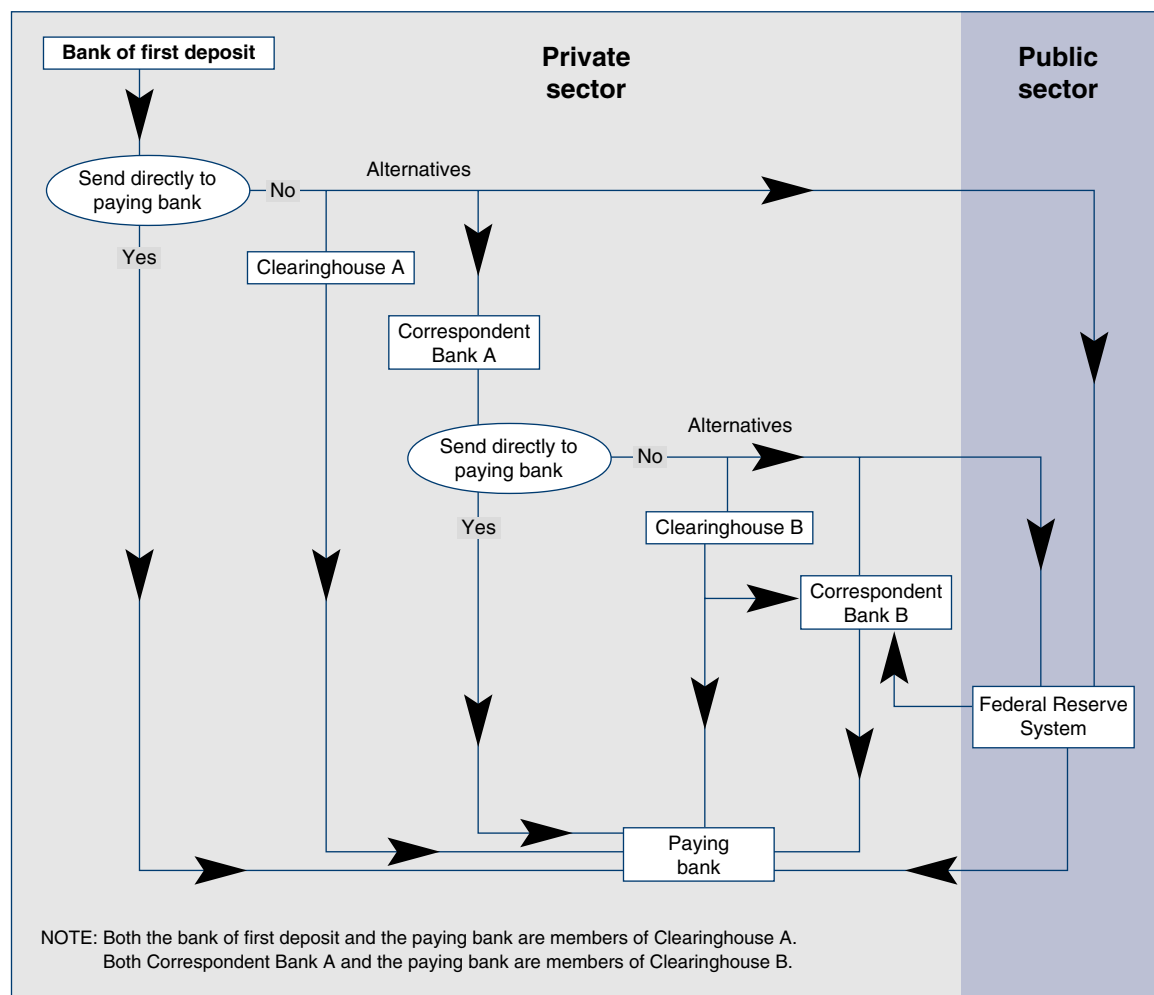
The Federal Reserve System offers an alternative to clearing payments through clearinghouses and private wire transfer networks. Banks that use the Fed's payment services reduce their risk exposure. Therefore, during periods of financial stress, the Federal Reserve provides a safer means of completing payments, permitting economic transactions to continue without worry about how the payments will clear.

The purpose of this article is to establish empirically the significant effect the Texas banking crisis had on check-clearing within and outside the Federal Reserve System. Historically, banking crises often caused or exacerbated a decline in real economic activity, resulting in lost jobs and income. The Federal Reserve System, along with other government programs, limited the damage from the Texas banking crisis. One factor minimizing the spillover effect of the banking crisis to the nonfinancial sectors was the Fed's providing a safer method of clearing payments.

How checks are cleared

A check can be cleared—that is, presented to the bank on which it was drawn—by several different methods in the private sector. The bank that receives the check in deposit is called the *bank of first deposit* (BOFD); the bank on which the check is drawn is called the *paying bank*. The BOFD can present the check directly to the paying bank, present the check through a clearinghouse, or engage the services of a correspondent

Figure 1
Alternative Ways to Present a Check for Collection



bank to present the check to the paying bank.³
 The collecting bank could physically present the check directly to the paying bank and demand payment in what is called *direct presentation* (Figure 1). But with nearly 27,000 depository institutions in the United States, it would be highly inefficient and costly to deliver checks to every paying bank nationally or even regionally. To improve efficiency, banks within a city or region often form clearinghouses where participating banks present the checks drawn on all the other participating banks (Clearinghouse A in Figure 1). About 20 percent of all U.S. financial institutions are members of clearinghouses, which range in size from two to more than 600 members.⁴ Membership in a clearinghouse association offers a financial institution a low-cost alternative to paying an intermediary for check collection services. Member institutions in the generally nonprofit associations establish rules regarding how and when they present checks and credit/debit accounts through the exchange.

When a BOFD receives a check for deposit drawn on a bank that is not a member of its clearinghouse, it must use an alternate method to present the check. Direct presentation is still an option, but it could be costly. The BOFD often deposits the check at a correspondent bank (Correspondent Bank A in Figure 1). Correspondent banks, often called simply *correspondents*, are usually large commercial banks that clear substantial volumes of checks. These banks have established extensive arrangements to clear checks, maintain equipment to sort checks, and contract for air and ground transportation to deliver checks regionally or nationally. A bank using the services of a correspondent is called a *respondent bank* or a *respondent*. Staying within the private sector, the correspondent can present the check directly to the paying bank, or indirectly through a clearinghouse where both the correspondent and the paying bank are members (Clearinghouse B in Figure 1), or it can present the check to another correspondent (Correspondent Bank B in Figure

1) that services the paying bank, either directly or through a clearinghouse.

The Federal Reserve Banks offer check-clearing services similar to those correspondents offer. Any U.S. depository institution can purchase payment-clearing services from the Federal Reserve.⁵ The Fed presents the checks either directly to the paying bank or the paying bank's correspondent (or third-party processor) or transports the checks to another Federal Reserve facility for direct presentment to the paying bank or the paying bank's correspondent (or processor). The Fed operates a network of forty-six Federal Reserve Banks, branches, and Regional Check Processing Centers to clear checks. This system supports the Federal Reserve's task of providing sorting and transportation of checks drawn on any depository institution in the country. The Federal Reserve clears approximately one-third of the total checks written and presented for collection to institutions.

In check collection, the Federal Reserve competes most directly with correspondents. The Federal Reserve Banks' largest competitors, however, are also their largest customers. Correspondents often use the Federal Reserve to collect checks drawn on paying banks that are not members of a mutual clearinghouse or that can be presented more economically by being passed to the Federal Reserve for handling.

A closer look at correspondent banking relationships

Many smaller institutions clear most or all payments through correspondents. Correspondents typically operate on either a regional or national basis. Regional correspondents rely on either the Federal Reserve Banks or national correspondents to collect checks on more remote banks. National correspondents compete with the Federal Reserve on a national level, presenting checks for payment to as many as 200 other institutions.⁶ A correspondent also may handle wire transfers and provide automated clearinghouse (ACH) services for other institutions.

Correspondents provide a variety of services in addition to payment processing and clearing. These include currency and coin services, Treasury tax and loan (TT&L) clearing, securities safekeeping and clearing, securities purchase, federal funds purchase and sales, cash management, investment services, credit card services, data processing, international banking, trust services, and loan participations. The Federal Reserve provides only some of these services. Service bureaus and third-party processors are alternative service providers in payment-clearing,

data processing, international banking, safekeeping, and credit card services.

In a correspondent relationship, the respondent typically keeps balances with the correspondent for the purpose of clearing payments. The respondent's primary risk in this relationship is that the correspondent could fail, and the respondent could lose the uninsured portion of the clearing account. Furthermore, if the respondent has lent federal funds to the correspondent, these uninsured funds could be lost. Even if the funds are not lost, access to them could be disrupted while the federal deposit insurer is closing the correspondent.

The risk exposure of the correspondent to a respondent's failure is less than that of the respondent to the correspondent's failure. Correspondents expose themselves to risk if they are providing credit to the respondent, usually as very short-term credit, such as federal funds sold. If the respondent were to fail, the correspondent would return the checks drawn on the respondent to the bank of first deposit. Thus, the correspondent protects itself from risk of loss, but it may incur a significant cost in returning these checks.

Probably the most important event in making respondents aware of their risk exposures was the collapse of Continental Illinois National Bank in 1984. While no respondent lost funds in Continental, the respondents became aware that losses were possible, depending on the Federal Deposit Insurance Corporation's (FDIC) method of resolving the bank failure.

Continental's financial condition deteriorated rapidly during spring 1984. On May 17, the FDIC, the Federal Reserve System, and the Comptroller of the Currency announced a temporary assistance program. In June 1984, the FDIC estimated that 2,299 commercial banks held deposits at Continental and that 179 of these banks might fail if Continental failed. Furthermore, Continental had been active in international financial markets, prompting concerns that its failure could trigger an international financial crisis. The FDIC designed an assistance program for the Continental collapse that protected all of Continental's respondents and correspondents from loss.

Continental's collapse made banks much more aware of their risk exposure in correspondent banking relationships, although preliminary reports seriously overestimated the problem's severity.⁷ While regulators treated Continental's continued operation as essential to maintaining stable financial markets, small banks were concerned that other correspondents might not be considered "too big to fail." Alternative FDIC responses to bank failures, such as liquidation,

might cause respondents with deposits above the insured limits to lose the uninsured portions of their deposits.

In times of financial stress, such as occurred in the Eleventh Federal Reserve District in the late 1980s, banks seek to lower their risk exposure.⁸ The Federal Reserve offers a risk-free alternative method of collecting payments. While the Federal Reserve requires banks to maintain an account, there is no risk that the Fed could fail. Therefore, the balances in these Fed accounts are safer than if respondents deposited them at correspondents. By risk-free, we mean there is no danger the Federal Reserve will fail as the payment processor. The party seeking payment still may not be paid if the bank on which the payment is drawn refuses to honor the check because it is drawn on insufficient funds, has an invalid endorsement, is forged, or for a variety of other legal reasons. But these reasons have a well-established precedent in law, and the procedures to return the payment are well-defined.

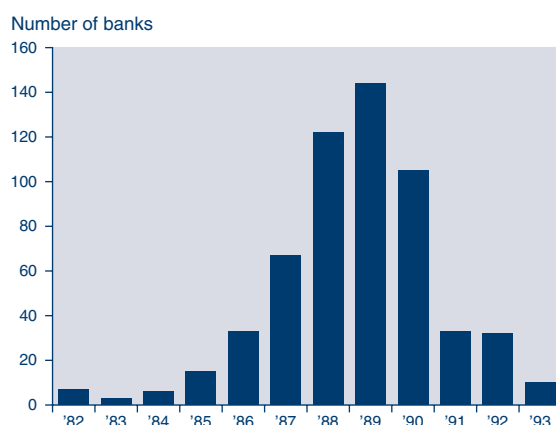
If respondents become concerned that their correspondent might fail, they could present their checks for collection through the Federal Reserve and avoid the risk exposure associated with clearing through the correspondents. Similarly, if the financial condition of a broad cross-section of respondents were to deteriorate, correspondents could decide their risk exposure in providing correspondent services is too large and exit the business. Their exit would leave some respondents and their customers with limited access to wholesale banking services.

Breakdown in correspondent banking during the Texas banking crisis

Financial institutions in the Eleventh District suffered unprecedented upheaval in the 1980s. Oil prices weakened in 1982 and virtually collapsed in 1986, precipitating a host of asset-quality problems at the District's financial institutions. In addition, severe overbuilding created a glut of commercial real estate space. Return on average assets of District commercial banks turned negative in 1986. Problems with business loans surfaced initially, but problem real estate loans eventually overshadowed them. Commercial bank failures in the Eleventh District rose sharply in the latter half of the 1980s, as shown in Figure 2.⁹

Thrift institutions in the Eleventh District suffered even more severe losses during this period. Nearly half of all District thrifts were insolvent at the end of 1988. At the end of 1989, less than one-fourth of the thrifts in the District were both profitable and solvent. The number of thrift closures would have been extremely high,

Figure 2
Eleventh District Commercial Bank Failures, 1982–93



but inadequate funding of the Federal Savings and Loan Insurance Corporation (FSLIC) prevented thrift regulators from aggressively closing insolvent thrifts through most of the 1980s.

Financial-sector difficulties in the Eleventh District reached heights not observed since the Great Depression. Unlike the events that occurred during the 1930s, though, widespread financial panic was not evident. Depositor confidence in the latter half of the 1980s was maintained, primarily due to the existence of federal deposit insurance. While not without serious unintended consequences, the federal guarantee of deposits was successful in averting widespread financial market instability, despite epidemic commercial bank and thrift failures.¹⁰ However, as evidence mounted that several large financial institutions in the Eleventh District were facing severe problems, some large, uninsured depositors moved their funds elsewhere. This movement of funds presumably reflected the fear that deposits in excess of insured limits might be lost.¹¹

Widespread instability was also averted by several innovative techniques for resolving financial-sector distress. New resolution techniques implemented by the FSLIC and the FDIC were often successful in achieving an orderly transition in cases of thrift and commercial bank insolvencies.¹² Moreover, legislation passed in 1980 extended Federal Reserve discount window privileges to all depository institutions, providing an additional tool for averting a financial crisis.

As conditions in the Eleventh District's financial community began to erode, correspondent banking relationships became strained and sometimes broken. After several small institutions failed during the early years of decline, correspondents closely monitored respondents.

Any negative speculation about a respondent's condition often caused a correspondent to stop payment-processing or sever the relationship with the respondent completely. The Federal Reserve frequently became the payments processor for these respondents.

As the decline continued and the financial health of larger institutions deteriorated, the concerns reversed. The financial instability of many of the District's large correspondents caused respondents to seek other payment-processing arrangements. The number of changes in payment-processing arrangements increased by 57 percent in the years following the failures of the largest District banks.¹³

An empirical test

While anecdotal evidence is interesting, a statistical test of the effect of bank conditions on Federal Reserve check-clearing volumes is necessary to control for other factors that might have affected Fed check-clearing operations. We therefore constructed and estimated a model of check-processing volumes at the twelve Federal Reserve Districts.

In the model, Federal Reserve check-processing volumes are assumed to be related to the level of economic activity within each Federal Reserve District and the state of the banking industry within each District. The following regression equation is estimated:

$$(1) \quad CHECKS = \beta_0 + \beta_1 * ECONOMY + \beta_2 * FINANCIAL + E,$$

where *CHECKS* represents the total volume of checks processed at each Federal Reserve.¹⁴ *ECONOMY* is an employment measure included to control for business-cycle effects on the volume of check-clearing. *FINANCIAL* represents variables used to proxy for the financial condition of the banking industry, and *E* is a random error. The number of checks processed by each Federal Reserve District is published in the Planning and Control System Quarterly Data, Division of Federal Reserve Bank Operations, Board of Governors of the Federal Reserve System.¹⁵

The economic activity variable, *ECONOMY*, is nonagricultural employment in each Federal Reserve District.¹⁶ This variable is estimated by the Federal Reserve Bank of Dallas, using annual county-level data and monthly state-level data, with an adjustment for industrial mix by county. The number of checks processed is expected to be positively correlated with economic activity.

Three different measures of financial-sector condition are tested. First, the ratio of nonper-

forming loans to total loans at District commercial banks is expected to have a positive impact on the volume of checks processed by the Federal Reserve. That is, as nonperforming loans increase, indicating a deteriorating banking sector, the volume of checks processed by the Federal Reserve should rise. Second, the capital ratio of District commercial banks is also used to gauge the strength of the banking sector.¹⁷ Here, a negative relationship is expected. As the capital ratio declines, the volume of checks processed should rise, if indeed the Federal Reserve is acting as the "processor of last resort." Third, the number of bank failures in each District is included as an explanatory variable to measure financial turmoil. The expected sign on the bank failure variable is positive. We obtained the bank financial ratios from the Report of Condition and Income and the number of bank failures from the Federal Deposit Insurance Corporation.

The data are a pooled time series cross-section utilizing the twelve Federal Reserve Districts over the period from fourth-quarter 1982 to fourth-quarter 1993. Using cross-section data should improve the quality of the test by increasing the variability of explanatory variables. Furthermore, the Eleventh District was not the only District that experienced a weak financial sector. Including other Districts decreases the likelihood that an increase in Federal Reserve check-processing volume would be inappropriately attributed to financial-sector weakness.

Because pooled data are used, an error components model was assumed in the estimation procedure. The assumption underlying this model is that the disturbance term in the regression is composed of three independent components: one component associated with time, one associated with the cross-section units, and the third component is assumed to vary in both time and spatial dimensions.

In the following model:

$$y_{it} = \sum_{k=1}^p X_{itk} \beta_k + \epsilon_{it}; \quad i = 1, \dots, N; \quad t = 1, \dots, T,$$

N is the number of cross-sections, *T* is the length of the time series, and *p* is the number of independent variables. Under the error components model, the random errors, ϵ_{it} , are assumed to have the following decomposition:

$$\begin{aligned} \epsilon_{it} &= u_i + v_t + w_{it}, \\ u_i &\sim N(0, \sigma_u^2), \\ v_t &\sim N(0, \sigma_v^2), \text{ and} \\ w_{it} &\sim N(0, \sigma_w^2). \end{aligned}$$

The individual error components are assumed to

satisfy the following conditions:

$$\begin{aligned} E(u_i v_i) &= E(u_i w_{it}) = E(v_i w_{it}) = 0, \\ E(u_i u_j) &= 0 \quad (i \neq j), \\ E(v_i v_s) &= 0 \quad (t \neq s), \\ E(w_{it} w_{is}) &= E(w_{it} w_{jt}) = E(w_{it} w_{js}) = 0 \\ &\quad (i \neq j; t \neq s). \end{aligned}$$

Generalized least squares estimation produces consistent parameter estimates.¹⁸ Because the estimates of the first-order autocorrelation coefficients are very close to 1, first differences of all the variables (in logs) are used in the estimation (with the exception of the bank failure variable).¹⁹

Several different tests are conducted for determining the appropriate pooling method. The tests show that the error components approach is statistically superior to the hypothesis that no differences existed across Federal Reserve Districts, and it is superior to the hypothesis that the inter-District differences are fixed effects.

The results of estimating equation 1 appear in Table 1. Four models are tested, all of which show that Federal Reserve check-processing volumes are positively correlated with the level of economic activity. Models 3 and 4 utilize the capital ratio as the indicator of bank financial condition; it is significant, with the expected sign in both cases. Models 1 and 2 use nonperforming loans as the indicator of bank condition; it is insignificant in explaining Federal Reserve check-processing volumes. Similarly, bank failures, which are included in models 1 and 3, are insignificant as an explanatory variable.

These results support the hypothesis that banks increase their use of Federal Reserve check-clearing services when banking conditions deteriorate. Banks appear to be most concerned about bank capitalization.²⁰ This implies that banks have foresight and act in anticipation of potential bank failures. The insignificance of the bank failure variable suggests that respondent and correspondent banks respond before the banks actually fail. This evidence is consistent with Federal Reserve attempts to maintain a smoothly functioning payments system in the face of unprecedented financial-sector distress.

The insignificance of nonperforming loan ratios in models 1 and 2 suggests that banks are more focused on the immediate indicator of failure, bank capitalization, rather than on an indicator of potential future reductions in capital. Nonperforming loans may be an indicator of future declines in capital, but a well-capitalized bank could sustain higher than average nonperforming loans and remain solvent.

A final test is conducted to determine if the

relationship between the financial condition of banks and the volume of Federal Reserve check-clearing existed only in those Federal Reserve Districts that could be characterized as suffering severe banking crises. This is done by including an interaction term, which is the cross-product of the measure of banking difficulties with a dummy variable for each of the Federal Reserve Districts. The results are not affected. In models that included nonperforming loans (1 and 2), the employment variable remains significant, and the only interaction terms that are significant are for the Eighth and Tenth Districts. For models with capital ratios (3 and 4), the employment variable and capital variable are statistically significant, while none of the interaction terms is significant. This test implies that banks across the country were sensitive to the financial condition of the banking industry in their Districts when deciding on a check-processing arrangement.

The impact of the Texas banking crisis on Federal Reserve payment services

The financial industry problems not only caused an increase in checks processed by the Fed's Eleventh District operations, as shown above, but also increased the amount of handling these checks required. Eleventh District check-processing volume increased by 9.8 percent from 1987 to 1989, while the other Federal Reserve Districts averaged only a 2.8-percent increase. The above-average increase in the Eleventh District was largely attributed to increased check volume from banks with total deposits between \$30 million and \$500 million. Check volume from these banks cleared through the Fed increased by more than 50 percent between 1987 and 1989 and accounted for 64 percent of the total increase in all checks processed by the Eleventh District Fed.

These small to mid-size institutions were most often respondents that previously cleared payments through correspondents. Often, these institutions viewed their processing with the Federal Reserve as only a temporary arrangement. Because the Fed does not supply all correspondent services, these banks intended to resume payment-processing with a new correspondent. The increase in Eleventh District processed check volume was particularly significant because of the associated check-handling requirements. The Fed's new customers sent most of the additional volume with limited presorting done to the checks. This meant more sorting and handling of the checks by the Reserve Banks.

Various check-processing support areas also faced increased demands and pressures. Frequently, banks requested check collection ser-

Table 1
Determinants of Federal Reserve Check-Processing Volume

Independent variables	Dependent variable: <i>CHECKS</i>			
	Model			
	1	2	3	4
<i>INTERCEPT</i>	.0044 (.004)	.0046 (.005)	.0047 (.004)	.0051 (.004)
<i>EMPLOYMENT</i>	.4792* (.206)	.4697* (.206)	.5758** (.1954)	.5650** (.1953)
<i>NONPERFORMING</i>	-.006 (.012)	-.007 (.012)		
<i>CAPITAL</i>			-.1655** (.0340)	-.1638** (.0340)
<i>FAIL</i>	0 (0)		0 (0)	
Summary Statistic				
SSE	.2035	.2035	.1981	.1982

* = Significant at the 5-percent level.

** = Significant at the 1-percent level.

vices from the Fed on short notice. The Fed often had to handle these checks on an exception basis until databases could be updated, forms could be delivered, and notifications completed. The new management of failed banks that had been acquired often requested changes in delivery of processed checks and associated accounting information. If the FDIC liquidated a failed paying bank, the Fed had to intercept and return these checks to the BOFD. The additive effect of ownership changes, correspondent changes, liquidations, and branching meant three to four changes daily in sorting procedures for Dallas Office check operations. The updating required to the District's Customer Information System (CIS) database increased significantly from 1986 to 1990. By 1988, updates to the CIS required about four hours of clerical time daily at the Federal Reserve Dallas Office, and half of the requested changes required same-day handling.

Outlook for the future

The Eleventh District banking industry has recovered from its financial difficulties; therefore, the pressure on the payments system has been reduced. The improvement in performance, coupled with the resolution of failed commercial banks, has resulted in a substantial improvement in the health of District commercial banks. Assets held by healthy commercial banks rose from less

than 30 percent of total Eleventh District commercial banking assets in 1988 to 97 percent in third-quarter 1994.²¹ By the end of third-quarter 1994, only 9 percent of the Eleventh District's commercial banks could be characterized as unhealthy, and these were smaller than average banks holding only 3 percent of total commercial banking assets in the District.

The improvement in the health of the Eleventh District commercial banking industry has resulted in increased correspondent banking activity in payment-processing and other services. With consolidated operations and improved efficiencies, the correspondents have improved their competitive position and have seen opportunities to generate fee income. In addition, the risk of providing correspondent services has declined as banking conditions have improved.

As banks have established new correspondent relationships, Federal Reserve service trends again have changed. From 1990 to 1993, the Eleventh District saw a 1.3-percent increase in checks submitted for processing and collection, versus a 12-percent increase from 1985 to 1989. As correspondents attempt to avoid costs and optimize use of existing check-processing capability, the Eleventh District has received more checks that require little or no machine sorting.

The other significant change resulted from statewide branching of the large holding compa-

nies. As bank holding companies consolidated their affiliated banks into branches, they changed their check routing numbers to that of the lead bank in the holding company. This change created a substantial shift in workload at the Dallas Fed, with additional checks deposited early in the day for processing. The workload shift required changes in personnel, work schedules, and assigned duties.

The Federal Reserve provides a needed safety valve

The Federal Reserve System provides a risk-free method of clearing payments. The account balances held at the Federal Reserve that are necessary to clear payments are not exposed to risk even during periods of financial crisis. Some have called the Federal Reserve the “processor of last resort.” A more accurate description would be that in a financial crisis, there is a “flight to quality.” Our empirical test demonstrates that Federal Reserve check-processing volumes rose when banking conditions deteriorated.²² The Fed represents the safest method of clearing payments.

If the Federal Reserve could not provide this risk-free payment-clearing service, then turmoil in the financial markets could have negative effects on the economy. Difficulty in determining how the payment for a transaction would clear might hamper the sales of goods and services. Such problems would place an additional cost on businesses and could slow an already weak economy. At a minimum, without the Federal Reserve’s payment operations as a backstop, businesses and banks would have to invest in reducing payments-system risk. Banks might need to maintain multiple correspondent relationships, and businesses might alter their policies for accepting payment, such as requiring payments to clear before delivery of goods.

For the Federal Reserve to maintain the ability to respond to a financial crisis, it must maintain an ongoing payment-clearing operation that can be expanded as necessary. Such operations are complex and cannot be established overnight. A financial crisis can develop faster than the Fed could establish a payment-clearing operation from scratch.

The banking crisis in the Eleventh District is an example of the Federal Reserve’s response to the temporary needs of financial institutions during a crisis. Now that the Eleventh District’s economy and its banking industry have recovered, the Fed’s role in clearing payments has diminished. Perhaps the one positive result of the regional economic downturn and the banking crisis that followed was the test of the Federal

Reserve System’s ability to clear payments and minimize spillover from the banking crisis to the payments system.

Notes

- ¹ Before the creation of the Fed, the risk involved in accepting a check as payment was more explicit. Parties accepting checks often discounted the face value to reflect the cost and risk of clearing. One reason for creating the Fed was to establish on-par clearing of checks. On-par clearing requires that a check not be discounted—that is, that it be accepted for its full face value.
- ² The term *bank* is used in this article to refer to any depository institution, including commercial banks, savings and loan associations, mutual savings banks, and credit unions. Where necessary to make a distinction, the term *commercial bank* is used to refer to institutions chartered by the Office of the Comptroller of the Currency or state banking agencies and typically insured by the Bank Insurance Fund managed by the Federal Deposit Insurance Corporation (FDIC).
- ³ If a check drawn on one bank is deposited by another customer of the same bank, then there is no collection process. The bank simply debits the account of the party that wrote the check and credits the account of the party that deposited the check.
- ⁴ U.S. General Accounting Office (1989, 37).
- ⁵ The Depository Institution Deregulation and Monetary Control Act of 1980 mandates that Federal Reserve services be available to all U.S. depository institutions and that the Fed charge an appropriate price for these services. Fed pricing is set as a markup over costs, with an adjustment factor for the profits the private sector would require and the taxes the private sector must pay.
- ⁶ U.S. General Accounting Office (1989, 12).
- ⁷ For a detailed analysis of the number of likely commercial bank failures that might have resulted from the Continental failure, see the staff report entitled “Continental Illinois National Bank Failure and Its Potential Impact on Correspondent Banks” in U.S. House of Representatives (1984).
- ⁸ The Eleventh Federal Reserve District includes Texas, northern Louisiana, and southern New Mexico.
- ⁹ For more on the performance of Eleventh District financial institutions in the past decade, see Robinson (1990).
- ¹⁰ For more on the problems associated with federal deposit insurance, see Kane (1989, 1985). Subsidized deposit insurance with uniform premiums encouraged bankers to take greater risks and discouraged depositors from carefully monitoring banks’ risks.
- ¹¹ For example, as FirstRepublic Bank’s troubles became increasingly apparent, depositors began shifting their

funds to safer institutions. From December 1987 to mid-February 1988, FirstRepublic lost a total of \$1.14 billion in average deposits (Apcar 1988).

¹² For a discussion of these new techniques and their related problems, see Cole (1990) and Kane (1989).

¹³ Each change in processing arrangement required an update to the Eleventh District's Customer Information System (CIS). Numerous updates to the CIS reflected the shift of clearing arrangements and the commercial bank merger activity driven largely by commercial bank failures. In the two years before 1988, the average annual number of changes in correspondent banking relationships was 237.5 in the Dallas Office of the Eleventh District. The failures of major Eleventh District commercial banks began in 1988. In the following three years, the average number of changes in correspondent bank relationships rose to an estimated 373 in the Dallas Office. By comparison, in 1993, there were only 184 changes in the Dallas Office's correspondent banking relationships.

¹⁴ While the optimal dependent variable would probably be market share, such data do not exist.

¹⁵ One variable that would have improved the model is, of course, the price of Federal Reserve check-clearing services relative to private-sector prices. Unfortunately, such pricing data do not exist. Anecdotal evidence indicates that the Fed was receiving the costlier checks to clear, which would drive up the Fed's prices relative to the private sector. This relative price effect would be in the opposite direction of the empirically significant effect that banks seek safer clearing arrangements in chaotic times.

¹⁶ Retail sales may be a better measure of economic activity that would correspond to the need to clear checks. Unfortunately, it is not possible to construct a retail sales variable by Federal Reserve District. A test of this model based solely on Texas retail sales data and Eleventh Federal Reserve District check-clearing was not materially different in results. Furthermore, the Pearson correlation coefficient between retail sales in Texas and employment in Texas was 0.97.

¹⁷ The capital ratio is the Tier I equity-to-asset ratio.

¹⁸ See Fuller and Battese (1974).

¹⁹ While there may be some concern that the model is picking up a secular trend of declining capital ratios and increasing Federal Reserve check-clearing volumes, the fact that the model is estimated in first differences and that there is no evidence of residual autocorrelation alleviates such concerns.

²⁰ Current capital ratios are released on a lagged basis, especially for small banks. Tests with lagged values of capital ratios were insignificant. This result suggests that banks have knowledge of the financial condition of their correspondents and respondents, and the current capital ratio is a reasonable proxy for this knowledge.

²¹ A simple definition of a healthy commercial bank is one

with a capital ratio at least a half of a percent above regulatory minimums, troubled assets less than 3 percent of total assets, and profits.

²² The Eleventh Federal Reserve District is not the only example. See Clair, Kolson, and Robinson (1994) for details of the effects of the Rhode Island crisis and the failure of the Bank of New England on Federal Reserve check-clearing.

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The Role of Merchandise Exports To Mexico in the Pattern of Texas Employment

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T*exas has been a major beneficiary*

of Mexico's trade liberalization.

Adjusted for inflation, Texas' merchandise

exports to Mexico have nearly tripled

since the first quarter of 1987. While

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products more competitive in Mexico

than they would otherwise have been,

thereby fueling the expansion.

Under the North American Free Trade Agreement (NAFTA), Mexico has reduced its average tariff on U.S. goods to approximately 11 percent and will reduce it to nothing by 2010.¹ However, these cuts represent only the latest in a series of tariff reductions by the Mexican government. In the latter half of the 1980s, the Mexican government instituted four major tariff reforms that produced two major reductions in tariff rates (Lustig 1992).

Texas has been a major beneficiary of Mexico's trade liberalization. Adjusted for inflation, Texas' merchandise exports to Mexico have nearly tripled since the first quarter of 1987.² While Mexico's liberalization only partially explains the boom in merchandise exports, it clearly has made Texas products more competitive in Mexico than they would otherwise have been, thereby fueling the expansion.

In this article, we use an input-output model of the Texas economy to evaluate the employment consequences of the recent expansion in Texas' merchandise exports to Mexico. Because the input-output model describes the interrelationships among industries, it allows us to identify not only the employment gains by industries that export directly but also the employment gains by industries, like transportation services, that interact with the direct exporters. We find that merchandise export growth can explain only a small fraction of Texas' overall employment growth since 1987 but can explain much of the employment growth in specific industries. In particular, we find that all of the recent growth in high-technology manufacturing may be explained by increasing merchandise exports to Mexico.

The link between trade and employment

Nationally, import and export changes have few lasting effects on the level of employment. Over time, workers displaced by increased import competition find jobs in other industries. Similarly, workers hired by growing export firms generally surrender existing jobs. While the composition of employment can change dramatically, the level remains essentially unchanged.³

Regionally, however, the situation is very different. As employment patterns shift in response to trade, workers can move geographically, as well as occupationally. After all, the cultural and legal barriers that make it difficult to move across national borders in response to labor market conditions seldom inhibit movement across state lines. Thus, when an increase in exports attracts workers to the petrochemi-

cal industry, it also attracts them to states like Texas that are home to petrochemical firms. Furthermore, because proximity to Mexico can reduce transportation costs, increases in exports to Mexico also encourage firms in those export-oriented industries to locate in Texas rather than in other states.

Measuring the total influence on Texas employment of the state's increasing trade with Mexico requires information on the full range of trade between the two jurisdictions. Thus, we would need data not only on Texas merchandise exports and imports but also on imports and exports of services like tourism and health care. After all, Texas imports services from Mexico whenever Texans vacation in Cancun and exports services to Mexico whenever Mexicans vacation in San Antonio.

Unfortunately, data on Texas' trade in services and merchandise imports from Mexico are not available.⁴ Therefore, we focus our analysis on the role that Texas' merchandise exports to Mexico play in the state's economy.⁵ Given this narrow focus, our analysis reveals only part of the influence that increasing trade with Mexico has had on the Texas economy. However, because merchandise exports to Mexico represent nearly 5 percent of Texas gross state product (GSP), our analysis describes an important part of the total trade picture.⁶

Input–output analysis

We use an input–output model of the Texas economy to trace the changes in the composition and level of employment that can be attributed to the actual, quarterly changes in merchandise exports since first-quarter 1987. Input–output analysis is an analytic framework that describes the interrelationships between industries and households as a system of simultaneous equations.⁷ Each equation represents a sector of the economy. The sectors generally correspond with industries, but some models also include the household sector to reflect the influences that employment changes can have on household demand. Our model of the Texas economy, which we obtained from the Economic Analysis Center of the Texas Comptroller of Public Accounts, incorporates a household sector.

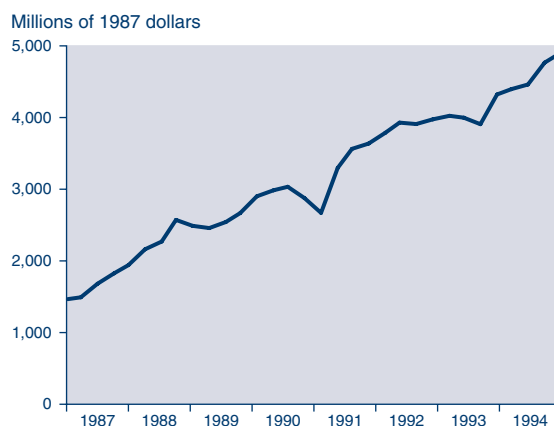
The equation for any given industry describes the total value of that industry's output as the sum of the value of that industry's output that is sold to consumers, the value of that industry's output that is used in the industry's own production process, and the value of that industry's output that is sold as an input to

other Texas industries. For example, the 1986 input–output table of the Texas economy indicates that 97 percent of the output of the Texas aircraft industry was consumed locally or exported, 2 percent was used in the production of other aircraft or space vehicles in Texas, and 1 percent was used as an input by firms providing transportation services in Texas. Firms in other states and other countries are consumers from Texas' perspective, so their purchases are included as part of consumption.

Because the inputs of one industry come from the outputs of another, input–output tables also enable users to trace the ways in which each industry uses the products of every other industry. For example, the input–output table described above indicates that to produce \$1,000 worth of output, the Texas aircraft and parts industry uses \$13 worth of Texas electronics, \$4 worth of metals fabricated in Texas, and \$36 worth of business services provided by Texas firms.

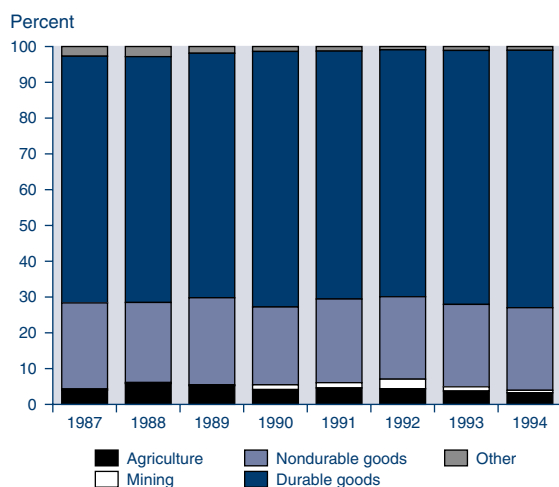
Simultaneously solving the system of 158 equations (representing 157 industries and the household sector) yields the amount of output from each industry that is needed to satisfy consumers' final demands and Texas industry's intermediate-goods demand. By changing final demand, solving the system of equations again, and comparing the industry output across the two cases, one finds the change in each industry's output that would be necessary to satisfy the observed quarterly change in export demand. This change in output reflects not only direct changes in demand but also changes in demand for intermediate goods and changes in household demand induced by changes in worker income.

Figure 1
Texas Exports to Mexico, 1987:1–94:4



SOURCE: Massachusetts Institute for Social and Economic Research.

Figure 2
Average Share of Texas Exports To Mexico by Sector, 1987–94



SOURCE: Massachusetts Institute for Social and Economic Research.

In this modeling framework, industry employment should change at the same rate as industry output. Input–output analysis assumes constant returns to scale and a fixed relationship between factor inputs. For example, if manufacturing \$1 worth of apparel requires 50 cents worth of textiles, then manufacturing \$2 worth of apparel would require \$1 worth of textiles. It also implicitly assumes that labor and capital supplies are perfectly elastic, so that all industries could increase output with-

out changing relative prices for goods or factors. Thus, if the model predicts that a given change in final demand would increase output in the electronics industry by 10 percent, then employment in the electronics industry should also increase by 10 percent.

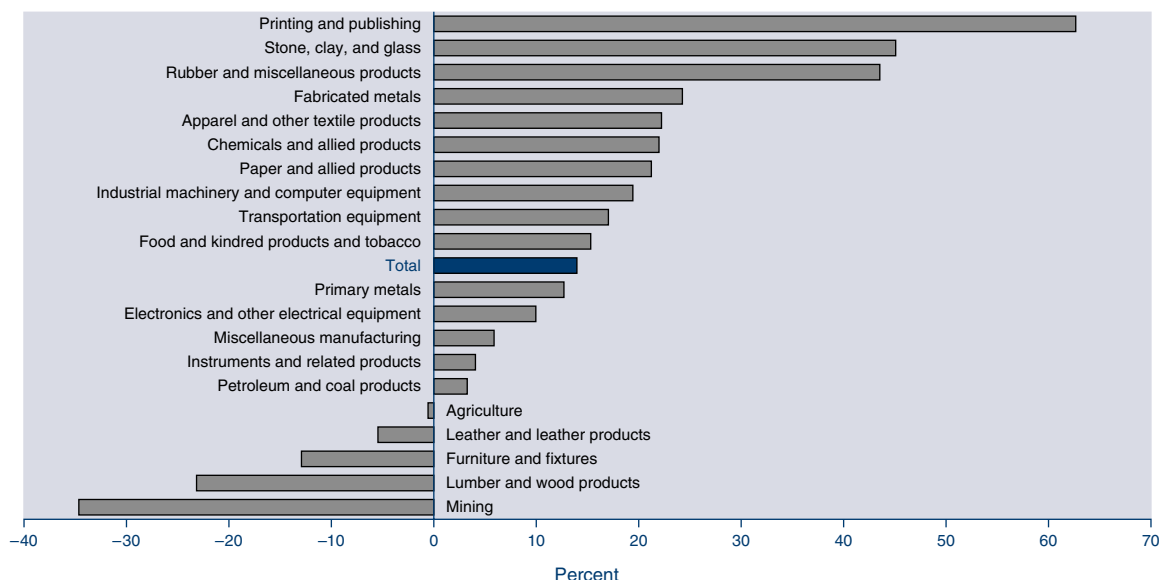
We use data on average industry employment in the model's year (1986) to predict the changes in industry employment attributable to the quarterly changes in merchandise exports.⁸ For each industry, the sum of the quarterly changes in employment indicates the total change in employment between first-quarter 1987 and fourth-quarter 1994.

Changes in Texas' merchandise export trade with Mexico

In 1987, Texas exported \$25 billion worth of merchandise to foreign countries.⁹ Twenty-six percent, or \$6.5 billion, of Texas merchandise exports went south to Mexico. By 1994, Texas merchandise exports to Mexico had grown to more than \$18.5 billion per year (in 1987 constant dollars). Real Texas merchandise exports to Mexico have grown more than 10 percent a year for six of the past seven years (*Figure 1*).

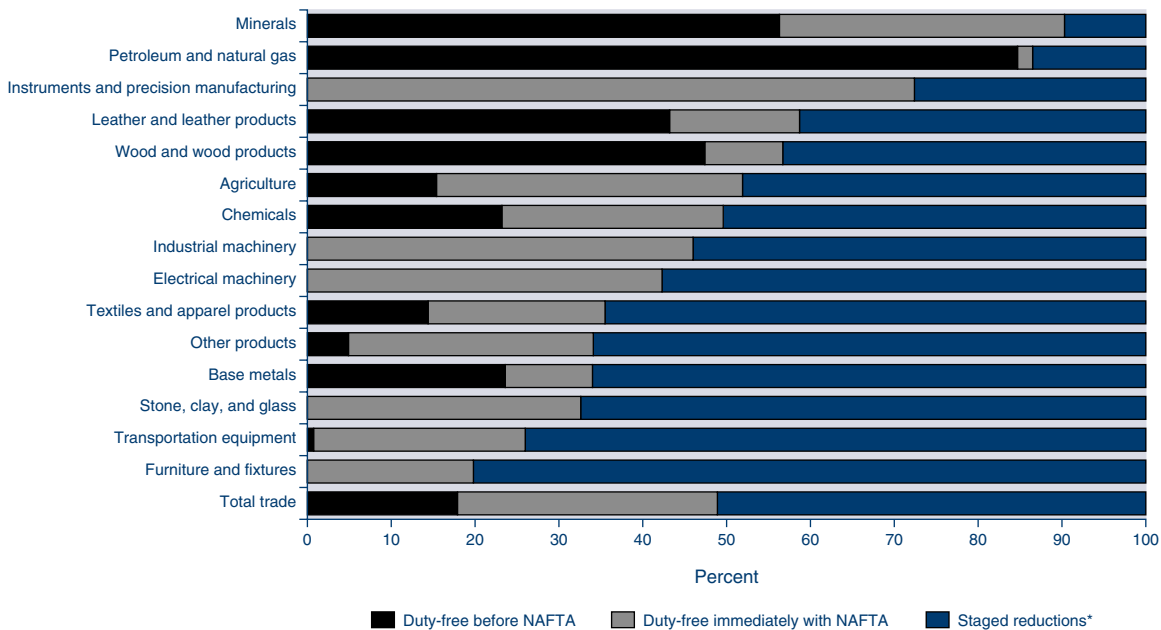
Despite such rapid growth, the general mix of the goods exported to Mexico from Texas has not changed dramatically since 1987 (*Figure 2*). Durable goods consistently account for approximately 70 percent of Texas' merchandise exports.¹⁰ Nondurable goods account for more than

Figure 3
Percentage Change in Real Texas Merchandise Exports to Mexico after NAFTA



SOURCE: Massachusetts Institute for Social and Economic Research.

Figure 4
Percentage of Industry Trade and the Timing of Zero Tariffs



* Includes tariffs that will be reduced in equal annual increments over five to fifteen years. Some staged reductions began January 1, 1994, while others will not be implemented until future years.

SOURCE: United States International Trade Commission (1993).

20 percent of total merchandise exports. Agricultural goods, mining, and other exports (scrap and waste, secondhand merchandise, and special classification goods¹¹) make up the remaining 10 percent of merchandise exports.

At a less aggregate level, however, the pattern of merchandise exports shows more variation. The electronics and other electrical equipment category remains Texas' primary merchandise export to Mexico, but the industry's share of total Texas merchandise exports declined from almost one-third in 1987 to almost one-quarter of merchandise exports in 1994. Merchandise export shares have also declined substantially for petroleum and coal products, paper and allied products, chemicals and allied products, and industrial machinery and computer equipment. On the other hand, export shares have more than doubled since 1987 for printing and publishing, transportation equipment, and instruments and related products.

The pattern of exports after NAFTA

Figure 3 details the changes in Texas' merchandise exports since the implementation of NAFTA. Real merchandise exports to Mexico from Texas increased 14 percent between 1993 and 1994. Printing and publishing exports grew 63 percent during that period. Other industries that experienced dramatic growth in exports

produce stone, clay, and glass, and rubber and miscellaneous products.

Solid growth in merchandise exports to Mexico following the implementation of NAFTA is particularly striking when one considers the other factors acting to suppress demand. The peso was weaker in 1994 than it had been in 1993, making Texas exports more expensive. Mexico's gross domestic product growth rate was barely positive in 1993 and early 1994 and much weaker than in 1991 and 1992. And finally, political instability in Mexico slowed foreign investment and expansion plans.

Figure 4 details the changes in tariffs with the implementation of NAFTA. For example, the figure indicates that 15 percent of agricultural exports to Mexico were duty-free before January 1, 1994, an additional 37 percent of agricultural exports became duty-free on January 1, 1994, and the tariffs will be reduced in stages for the remaining 48 percent of agricultural exports (U.S. International Trade Commission 1993).

Surprisingly, there is little apparent correlation between the industries that experienced a major boost in exports during 1994 and the industries that experienced a major reduction in tariffs.¹² For example, on January 1, 1994, tariffs dropped to zero for more than 70 percent of instruments exports, yet exports by the instru-

ments industry grew only 4 percent in 1994.

There are a number of possible explanations for this lack of correlation. Price elasticities differ from industry to industry, making some industries more responsive to tariff changes than others. Mexico may have introduced nontariff barriers (like additional inspections or paperwork requirements) that offset the tariff reductions in some industries. Finally, the tariffs are classified according to commodities, while the exports are classified according to industries. At the two-digit level of aggregation, the two series do not correspond exactly, and that lack of correspondence could blur the connection between tariff cuts and export growth.

The employment consequences of increasing merchandise exports to Mexico

Although Texas' merchandise exports to Mexico have nearly tripled since 1987, they still represent less than 5 percent of GSP. Therefore, it would be surprising if merchandise export growth could explain a large percentage of Texas employment growth. Our analysis indicates that 6.1 percent of Texas employment growth between first-quarter 1987 and fourth-quarter 1994 can be attributed to increasing merchandise exports to Mexico.¹³ On average, 3 percent of Texas employment growth can be attributed to the direct effects of increases in merchandise exports to Mexico, while another 3.1 percent of Texas

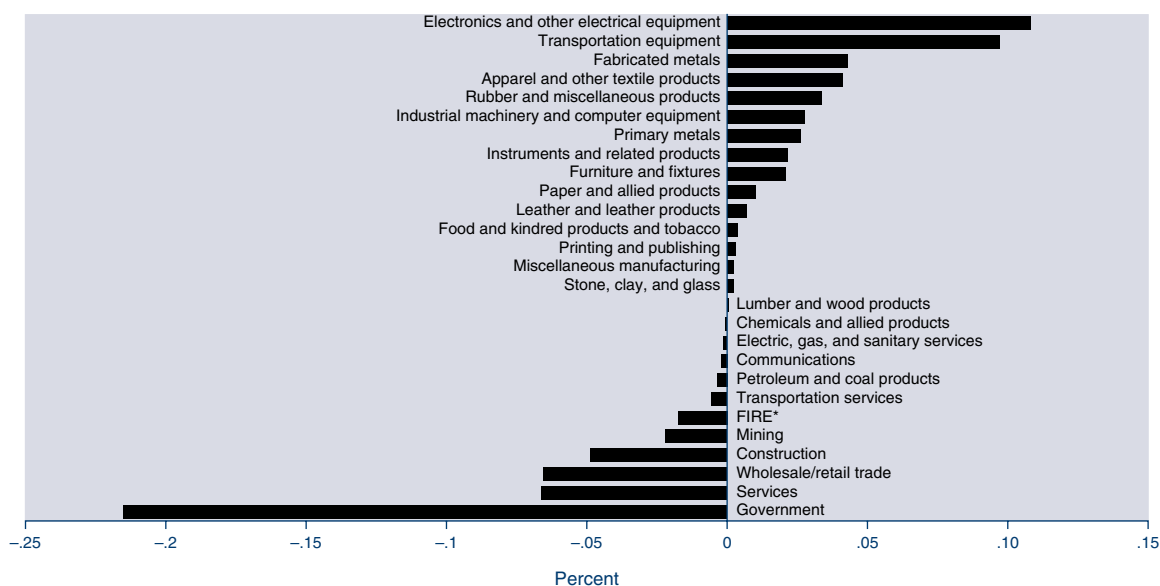
employment growth can be attributed to corresponding multiplier effects.

While merchandise export growth cannot explain much of total employment growth, it has had a considerable influence on the composition of the Texas economy. As Figure 5 indicates, increasing merchandise exports to Mexico encouraged workers to shift toward industries that manufacture durable goods like electronics and other electrical equipment and transportation equipment and other electrical equipment and transportation equipment.¹⁴ The electronics and other electrical equipment industry gains the most employment share because exports to Mexico represent a disproportionately large percentage of that industry's production. Especially rapid export growth produced gains in employment share for the transportation equipment industry.

When some industries gain employment share, others must necessarily lose it. Not surprisingly, our analysis indicates that increases in merchandise exports cause employment to shift away from industries that do not produce merchandise exports. Multiplier effects determine the extent of the losses for these industries. Industries that are closely linked to merchandise exporters—such as the transportation-services industry—lose less employment share than industries that are not closely linked.

In Figure 6, we compare the actual employment composition in 1994 with the em-

Figure 5
Changes in Employment Composition Due to Changes in Real Texas Merchandise Exports to Mexico, 1987–94

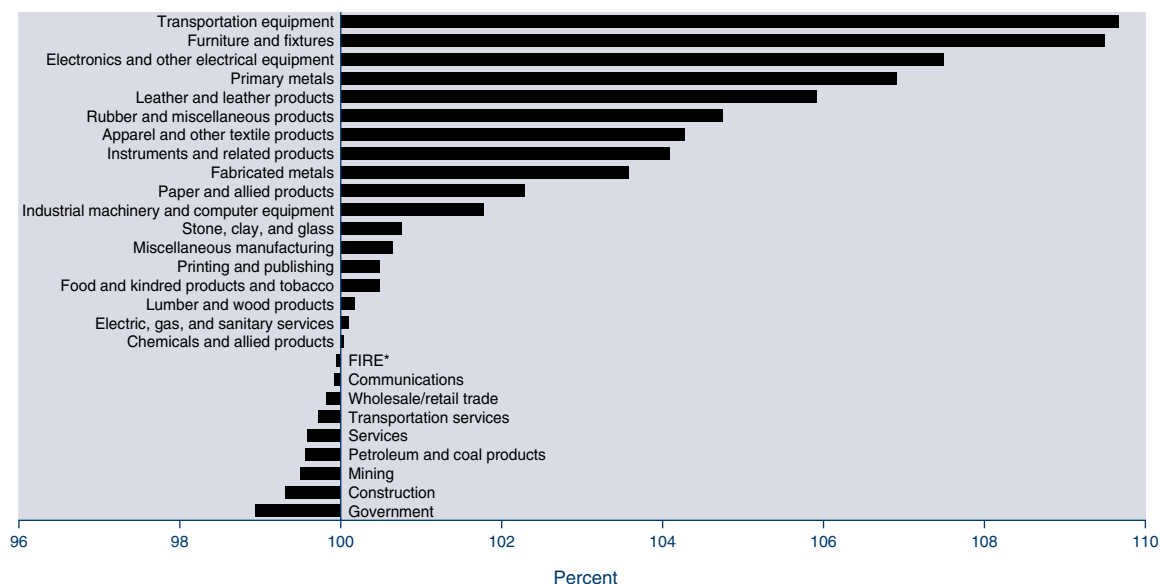


* Finance, insurance, and real estate.

SOURCES OF PRIMARY DATA: Massachusetts Institute for Social and Economic Research; U.S. Department of Labor, Bureau of Labor Statistics.

Figure 6

Ratio of Employment Share to Predicted Employment Share Absent Growth In Merchandise Exports to Mexico, 1994



* Finance, insurance, and real estate.

SOURCES OF PRIMARY DATA: Massachusetts Institute for Social and Economic Research; U.S. Department of Labor, Bureau of Labor Statistics.

ployment composition we predict would have occurred if merchandise exports to Mexico had not changed.¹⁵ This analysis allows us to isolate those industries in which increasing merchandise exports to Mexico have had a significant influence on employment shares. We find that four industries—transportation equipment, furniture and fixtures, electronics and other electrical equipment, and primary metals—would have had much smaller shares of Texas employment had merchandise exports to Mexico remained unchanged. We estimate that since 1987, all the gains in employment in the electronics and other electrical equipment and furniture and fixtures industries, and more than half of the gains in the primary metals industry, can be attributed to increasing merchandise exports to Mexico. Furthermore, we calculate that employment in transportation manufacturing would have fallen much more rapidly over the past few years if increases in merchandise exports to Mexico had not partially offset declines in defense spending by the U.S. government.

A common denominator among three of the four industries that have gained considerable employment share through increasing merchandise exports is that major components of these industries are classified as high-technology manufacturers by the Bureau of the Census. To be classified as a high-technology manufacturing

industry, spending on research and development must be more than 50 percent above the U.S. average (Bureau of the Census 1993). We estimate that increasing merchandise exports to Mexico can explain all of Texas' employment growth in high-tech manufacturing since 1987.¹⁶ However, the relationship need not be causal because our analysis does not discriminate between increases in Texas merchandise exports that reflect increasing Mexican demand and increases in Texas merchandise exports that reflect export firms' relocating to Texas from other states.

While the input-output analysis reveals those industries that have been highly influenced by increasing merchandise exports to Mexico, it also reveals those industries that have been essentially unaffected. For example, the analysis indicates that increasing merchandise exports to Mexico have had little influence on the employment shares for energy-related manufacturing (chemicals and petroleum and coal products). This potentially surprising result reflects the fact that while these industries represent 10 percent of Texas merchandise exports to Mexico, exports to Mexico represent less than 1 percent of gross output for these industries.¹⁷

Sensitivity analysis

The preceding analysis uses data on the "origin of movement to port" to evaluate Texas'

merchandise exports to Mexico. Recently, the Commerce Department has also released data using “state of ZIP code of exporter” to allocate merchandise exports among the states. Because the ZIP-codes series begins in the first quarter of 1993, it was not appropriate for our longer term analysis. However, we wondered if an analysis of the employment effects of merchandise export growth after NAFTA would be sensitive to the export series used.

To make the two series comparable for sensitivity analysis, we restrict our evaluation to year-over-year changes in real merchandise exports that have not been seasonally adjusted.¹⁸ For each industry and each series, predicted employment after NAFTA is the sum of actual employment in the fourth quarter of 1993 and the predicted change in employment for 1994.¹⁹

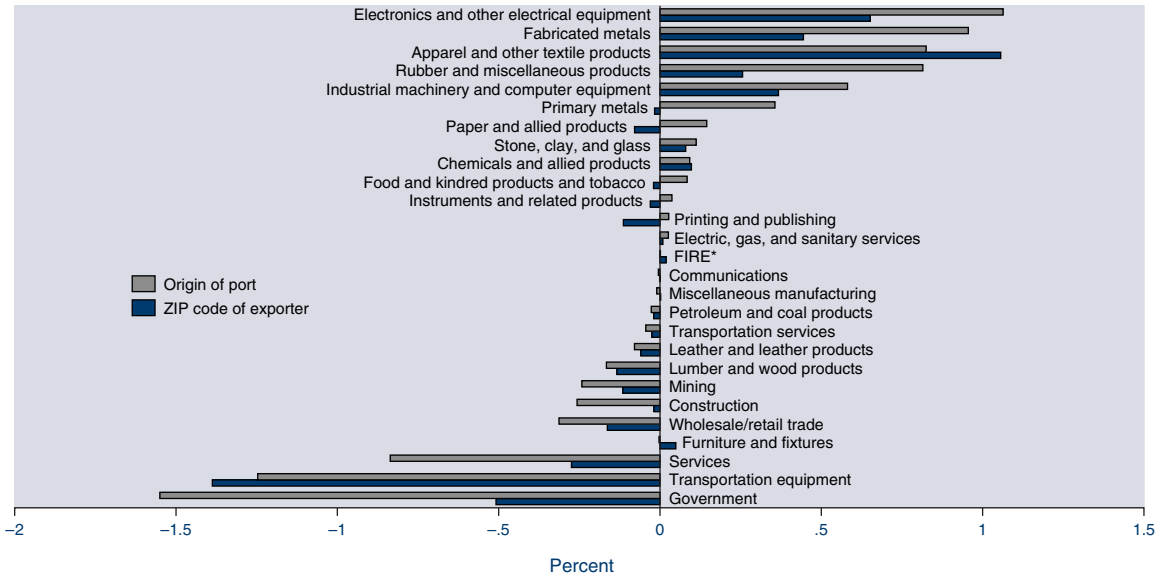
Figure 7 indicates the difference in employment share between the fourth quarter of 1993 and the predicted employment after NAFTA for each merchandise export series. While the correspondence is not exact, the two merchandise export series generate estimates of employment impact that are qualitatively similar. In either case, the primary beneficiaries of recent increases in merchandise exports to Mexico produce electronics and other electrical equipment, fabricated metals, and apparel.

and other textile products. The analysis predicts modest growth in employment share for these industries as a result of export growth after NAFTA. Similarly, regardless of the measure of merchandise exports, the analysis predicts a decline in employment share for government, transportation equipment manufacturing, and narrowly defined services such as business services and health care. Thus, our results appear qualitatively insensitive to changes in the definition of merchandise exports.

Conclusion

Our analysis of the employment consequences of increasing merchandise exports to Mexico is more suggestive than definitive for a number of reasons. An input-output model is particularly well-suited to identifying multiplier effects that are not readily apparent, but it cannot incorporate changes in production technology. Therefore, the model will underestimate the employment consequences of export growth for any industry that has become more labor-intensive over time (and vice versa) and will not capture any changes in the interrelationships among industries. Furthermore, data limitations prevent us from describing the employment changes that growth in merchandise imports or bilateral services trade could induce. Because trade is an exchange, it is possible that the compositional

Figure 7
**Change in Industry Composition after NAFTA:
 Two Measures of the Effects of Export Growth**



* Finance, insurance, and real estate.

SOURCES OF PRIMARY DATA: Massachusetts Institute for Social and Economic Research; U.S. Department of Labor, Bureau of Labor Statistics.

effects of merchandise exports are fully offset by merchandise imports or by the pattern of trade in services.

Our analysis suggests that growth in Texas' merchandise exports to Mexico can account for only a small fraction of the employment growth in Texas since 1987. However, we find that the growth of merchandise exports to Mexico has had a considerable influence on the composition of the Texas economy. In particular, growth in merchandise exports can explain all of the recent growth in high-tech manufacturing.

Notes

Our thanks to Stephen P. A. Brown, David Gould, Keith Phillips, and Fiona Sigalla for their helpful comments and suggestions and to Carla Miller for her assistance with the export data.

¹ Data on Mexican tariff rates were provided by Mexico's Department of Commerce and Industrial Development (SECOFI).

² Data on merchandise exports to Mexico from Texas are not available for prior years.

³ Changes in trade flows can change real wages, but recent research by Kydland (1995) indicates that changes in real hourly compensation have little long-term influence on hours worked per household.

⁴ We considered using data on U.S. trade in services with Mexico and U.S. merchandise imports from Mexico as proxies for the corresponding Texas data but rejected that approach because we would not expect Texas' trade to be proportionately similar to U.S. trade. Given its close proximity to Mexico, Texas is likely to be a disproportionately large trading partner in services. Texas is also likely to consume a disproportionately large share of Mexican goods that are expensive to ship. Consumption of imports from Mexico may also be unusually heavy because Texas' large population of Mexican-Americans is more familiar with Mexican products. (For a discussion of the effects that immigrants can have on imports, see Gould 1994.)

⁵ This analysis does not incorporate any effects that increasing exports to Mexico from other U.S. states may have on Texas.

⁶ We have extrapolated GSP using data on national productivity trends and Texas employment after 1991.

⁷ For a more detailed discussion of input-output analysis, see Miller and Blair (1985) and the Texas Comptroller of Public Accounts (1989).

⁸ For each industry, the input-output table indicates the percentage change in output and employment (ϕ_t) that would be required to satisfy the observed change in merchandise exports for period t . Therefore, the change in industry employment in each period that is attributable to changes in merchandise exports would be $L_i \cdot \phi_t$, where L_i is the average employment in

industry i for 1986.

⁹ The merchandise export data were provided by the Massachusetts Institute for Social and Economic Research (MISER). The data are based on "origin of movement to port" state-level export codes derived from standard industrial classifications. We use the fixed-weight GDP deflator to adjust the nominal export data for changes in the U.S. price level and use the SAS Institute's X-11 procedure to seasonally adjust the real export data.

¹⁰ Mexico's *maquiladora* program undoubtedly contributes to the heavy emphasis on durables in the merchandise export mix.

¹¹ Special classification goods include military equipment, miscellaneous equipment, antiques, donations and charity, and magnetic tape recordings.

¹² The Pearson correlation between the percentage of merchandise exports to Mexico becoming duty-free on January 1, 1994, and the percentage growth in merchandise exports between 1993 and 1994 is only 0.3040.

¹³ While increasing merchandise exports to Mexico can explain only a fraction of total employment growth since 1987, they could explain much of the differential in growth between Texas and the United States. Employment has been growing faster in Texas than in the United States since 1988 (Sigalla 1995).

¹⁴ Figure 5 indicates the difference in employment share between first-quarter 1987 and the predicted employment for each industry in fourth-quarter 1994. The predicted employment for each industry is the sum of actual employment in first-quarter 1987 and the total change in employment attributable to increasing merchandise exports to Mexico between first-quarter 1987 and fourth-quarter 1994.

¹⁵ We estimate employment shares in the absence of merchandise export growth by subtracting the total predicted change in employment due to merchandise export growth from the observed level of employment in 1994.

¹⁶ In Texas, employment in high-tech manufacturing industries represents 100 percent of the chemicals industry, 93 percent of the petroleum refining and coal products industry, 92 percent of the instruments and related products industry, 88 percent of the transportation equipment industry, 86 percent of the electronics and other electrical equipment industry, 28 percent of the industrial machinery industry, and 19 percent of the primary metals industry (Bureau of the Census 1993 and Bureau of Labor Statistics 1993). Our analysis indicates that increasing merchandise exports to Mexico should have generated 17,900 high-tech manufacturing jobs between first-quarter 1987 and fourth-quarter 1994. Texas actually added 13,500 high-tech manufacturing jobs during that period. However, the actual job gains would have been much greater if defense contractors in the transportation

equipment industry had not laid off thousands of workers over the period in question.

- ¹⁷ We determine export's share of gross output for each industry by comparing the value of exports to Mexico in 1987 with estimates of gross output for 1986 from the input–output table. Assuming that output grew between 1986 and 1987, our estimates represent an upper bound on export's share of gross output.
- ¹⁸ The full analysis uses seasonally adjusted data, but the ZIP-codes series is too short to seasonally adjust. We use seasonally unadjusted data for both series in the sensitivity analysis to avoid introducing an additional reason for differences between the two series. As before, we adjust both series for inflation, using the U.S. fixed-weight GDP deflator.
- ¹⁹ The predicted changes in employment for 1994 represent the changes in employment that the input–output table indicates would be necessary to support the total change in industry exports between 1993 and 1994.

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Another Strong Year for the Eleventh District

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The nation's economy grew very strongly in 1994, but the Eleventh District economy grew even faster, in part by attracting some of the country's most rapidly expanding industries. Eleventh District employment has grown more strongly than the rest of the country for six consecutive years.

The Eleventh District economy marked its eighth year of economic expansion in 1994 with broad-based employment growth in all three Eleventh District states—Louisiana, New Mexico, and Texas.¹ Robust U.S. and global economies stimulated demand for District manufacturing and services. The District's favorable business climate encouraged growth by attracting firms to relocate or expand in the Southwest, and the North American Free Trade Agreement, or NAFTA, bolstered the District's trade with Mexico.

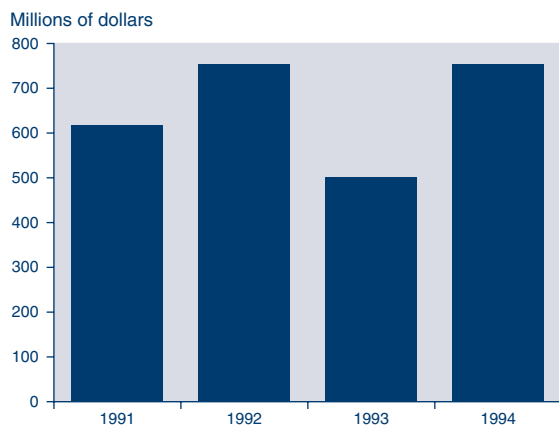
All sectors of the District economy except energy and defense-related industries experienced robust growth in 1994. The construction boom that began in 1993 continued into 1994. Manufacturing and service industries posted strong gains. The region prospered despite continued declines in the once-dominant energy industry. Defense reductions again lowered employment for specific manufacturing and federal government positions, although declines were smaller than in previous years. The sector-by-sector portion of this article elaborates on the 1994 performance of specific industries.

Although 1994 was a year of robust growth, the Eleventh District economy shows signs of slowing in 1995. In the past year, several District industries reported that shortages of inputs and workers were pushing up costs and limiting growth. As the expanding U.S. economy neared full capacity, interest rates rose,² which began to slow District growth. At the end of 1994, the sudden drop in the value of the Mexican peso caused a sharp reduction in demand for retailing and other services along the border. The peso's decreased value will reduce District exports in 1995 and add a heavy dose of uncertainty to the region's economic outlook.

A magnet for fast-growing industries

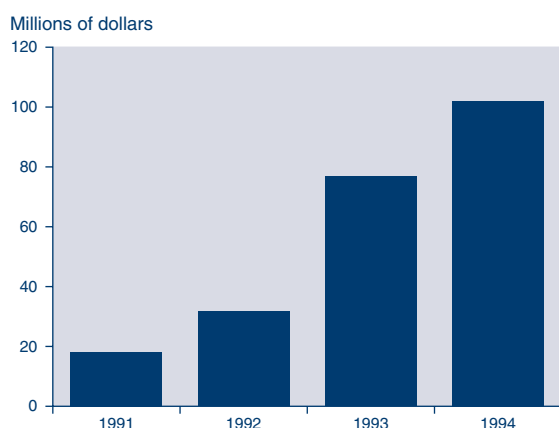
The nation's economy grew very strongly in 1994, but the Eleventh District economy grew even faster, in part by attracting some of the country's most rapidly expanding industries. Eleventh District employment has grown more strongly than the rest of the country for six consecutive years.³ In 1994, employment in the three-state District grew 4 percent, faster than the nation's job growth of 3.1 percent. The District's employment growth in 1994 exceeded its 1993 rate of 3.3 percent and its 3-percent average over the past twenty-six years. As discussed in the box entitled "All Three Eleventh District States Grew Faster than the Nation," Louisiana, New Mexico, and Texas all contributed to the Eleventh District's strong performance in 1994.

Figure 1
Louisiana Merchandise Exports to Mexico



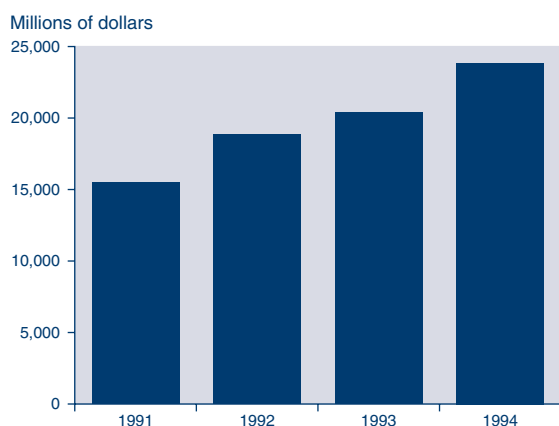
SOURCE OF PRIMARY DATA: Massachusetts Institute for Social and Economic Research.

Figure 2
New Mexico Merchandise Exports to Mexico



SOURCE OF PRIMARY DATA: Massachusetts Institute for Social and Economic Research.

Figure 3
Texas Merchandise Exports to Mexico



SOURCE OF PRIMARY DATA: Massachusetts Institute for Social and Economic Research.

Many factors are attracting firms to the Eleventh District—particularly Texas and New Mexico—but a low-cost business climate is the reason companies relocating to the area cite most often.⁴ The District has relatively low wages, regulation, and tax burden.⁵ With the area's low prices and construction costs, many firms find building a new factory in the Southwest cheaper than refitting an existing building elsewhere in the country. Texas and New Mexico, with research facilities and computer-literate graduates from local universities, have been particularly successful in attracting California firms.⁶ The District's central location reduces the costs of shipping, travel, and communications for companies that operate on both coasts and in Canada and Mexico. In recent years, the District's large population of bilingual residents has been an asset for companies doing business with Latin America.

Low land prices, taxes, and construction expenses also make the Southwest's cost of living desirable to workers, who can buy more goods and services with a given wage than their counterparts in most other areas of the country. In 1993, for example, Austin was the site of more California business relocations and expansions than any other U.S. city.⁷ Companies moving to Austin were able to pay their workers lower nominal wages, and yet, because of lower costs of living, the workers enjoyed higher living standards.⁸

The appeal of the region's business and living costs has helped keep population growth robust. A high birth rate and migration into New Mexico and Texas kept the states among the fastest growing in the country in 1994. Eleventh District states added 1,625,000 residents between July 1, 1993, and July 1, 1994, for a total population of more than 24 million.

Growing trade with Mexico

Trade with Mexico has been an increasing stimulus for the Southwest economy since 1986, when Mexico joined the General Agreement on Tariffs and Trade (GATT) and began liberalizing its economy.⁹ In recent years, Mexican demand for Southwestern retailing, manufacturing, and tourism has helped these industries become among the fastest growing in the United States. In 1992, Wal-Mart opened its largest U.S. store in Laredo, replacing a smaller store that was already the chain's nationwide sales leader. Across the highway is the second largest Target store in the United States.

A strong and growing network of shipping and transportation infrastructure makes the District an important distribution hub. Nearly 75 percent of goods traded between the United States

and Mexico travel on Texas highways. Most of those goods flow through Laredo, the largest inland port on the U.S.–Mexican border. Houston has the largest water port serving Mexico. Ports in Galveston and New Orleans also ship large quantities of Mexican goods, and a new port in Shreveport–Bossier City has opened to help funnel goods between the Midwest and Mexico. In 1994, NAFTA provided a catalyst to U.S.–Mexican trade by reducing the risk and lowering the cost of participation in Mexico's economy. On January 1, 1994, 48.9 percent of U.S. exports entered Mexico duty-free, compared with 17.9 percent in 1993.

NAFTA's implementation was a starting gun for further development of District transportation services, warehousing, and infrastructure. Transportation services employment in the District states grew 6.6 percent in 1994. While Louisiana and New Mexico posted strong increases, the strongest growth was in Texas, where air, trucking, and railroad companies raced to expand their cargo facilities. Texas employment in railroad, trucking, warehousing, and transportation services increased 9.9 percent in 1994.

In addition to transportation services, other industries in the service sector profited by helping companies comprehend changing regulations and unfamiliar laws and tax codes. Accounting, communications, consulting, and legal firms set up new offices to help companies learn how to trade. Legal firms facilitated an increase in joint ventures, mergers, and acquisitions, as firms joined forces to overcome informational and cultural obstacles and speed entry into a new market. A large Hispanic population and already strong ties to Mexico helped make the region's workers valuable to budding international companies.

The strong growth of U.S.–Mexican trade since NAFTA's implementation is particularly startling, given the relative weakness of the Mexican economy. Mexico was in recession when NAFTA became law on January 1, 1994. Although observers expected the Mexican economy to accelerate in 1994, political uncertainty slowed growth and led many investors to move cautiously.

Still, trade and investment in Mexico picked up strongly in 1994. All three states in the Eleventh District profited from rising exports to Mexico. As shown in Figure 1, in 1994 Louisiana merchandise exports to Mexico increased 50.3 percent over 1993.¹⁰ As Table 1 shows, agricultural products, chemicals, and petroleum products are among Louisiana's top export industries. New Mexico's merchandise exports to Mexico rose 32.9 percent in 1994, as shown in Figure 2. Table 2 lists New Mexico's top export industries in 1994, which were computer equipment, oil and gas, electron-

Table 1

Louisiana's Top Ten Merchandise Export Industries to Mexico
(1994 Year-to-Date)

	Millions of dollars	Change from 1993 (Percent)
Agricultural production—crops	\$408.7	160
Chemicals and allied products	109.5	4
Petroleum and coal products	70.3	10
Food and food products	48.9	–32
Industrial machinery, computer equipment	30.9	–1
Paper and allied products	19.9	15
Transportation equipment	14.9	365
Lumber and wood products	6.7	99
Stone, clay, and glass products	5.9	3
Electronics, electric equipment, excluding computers	5.8	–38

Table 2

New Mexico's Top Ten Merchandise Export Industries to Mexico
(1994 Year-to-Date)

	Millions of dollars	Change from 1993 (Percent)
Industrial machinery, computer equipment	\$28.7	111
Oil and gas extraction	21.1	81
Electronics, electric equipment, excluding computers	14.7	–48
Chemicals and allied products	12.9	37
Apparel and other textile products	6.9	92432
Agricultural production—crops	5.3	72
Food and food products	4.1	43
Lumber and wood products	2.7	5
Instruments and related products	.9	168
Rubber and miscellaneous plastic products	.8	–1

ics, and chemicals. Texas has been the most successful U.S. state in capitalizing on the expanding Mexican market. In 1994, 47 percent of all goods exported to Mexico from the United States were made in Texas.¹¹ Figure 3 highlights the steady growth in Texas merchandise exports to Mexico, which increased 17 percent in 1994. Texas' top ten export industries to Mexico, listed in Table 3, include electronics, transportation equipment, computers, and metals. Texas exports to Mexico represent a significant share of the state's economy. In 1993, for example, Texas' \$20.4 billion in merchandise exports to Mexico constituted about 20 percent of the state's total manufacturing sales. Exports to Mexico, while growing in all three District states, constitute a larger percentage of the Texas economy than New Mexico's or Louisiana's. Texas' exports of goods and services to Mexico, as listed in Table 4, represent approximately 6 percent of gross state product.¹²

NAFTA's passage generated great enthusi-

Table 3

Texas' Top Ten Merchandise Export Industries to Mexico

(1994 Year-to-Date)

	Millions of dollars	Change from 1993 (Percent)
Electronics, electric equipment, excluding computers	\$5,799.2	13
Transportation equipment	3,757.4	20
Industrial machinery, computer equipment	2,397.6	23
Fabricated metals	1,514.2	28
Chemicals and allied products	1,430.5	25
Instruments and related products	1,125.1	7
Rubber and miscellaneous plastic products	1,067.5	47
Food and food products	1,009.5	16
Primary metals	1,031.8	17
Apparel and other textile products	727.1	23

Table 4

1994 Exports to Mexico as a Percentage of Gross State Product

	Merchandise exports	Service exports	Total exports
New Mexico	.3%	Miniscule	.3%
Louisiana	.7%	.1%	.8%
Texas	5.0%	1.0%	6.0%

asm for new trade with Mexico and may have stimulated investment in anticipation of rising trade. Many service-sector companies—such as law, consulting, and transportation firms—reported opening or expanding offices designed to attract Mexico-related business. Several cities expanded infrastructure investment to accommodate expected increases in trade with Mexico.

The recent peso devaluation may have taken some of the momentum away from NAFTA and delayed some investment directed at selling to that market. The peso's sudden devaluation reversed a long-held managed exchange rate policy. The policy change was costly to many investors and has increased uncertainty for companies doing business south of the border. Over the long term, however, Mexico remains a burgeoning market for goods and services, and the District is well-positioned as a base for firms that want to export to that market.

Slower growth in 1995

Eleventh District economic expansion is likely to slow slightly in 1995, although growth should remain faster than the national average. A favorable business climate, trucking deregulation, and long-term prospects for growing trade with Mexico will not fully offset the effects of a slowing national economy, higher interest rates,

and the peso's devaluation. After increasing by an estimated 4 percent in 1994, employment in Eleventh District states is likely to grow about 2.5 percent in 1995.

A slower national economy and higher interest rates than in 1994 will likely curb the District's economic expansion in 1995. After nearly four years of U.S. economic expansion, interest rates rose in 1994. Higher interest rates began to slow the District's construction industry in 1994, curbing the region's homebuilding boom.

Although growth will probably slow, many positive factors driving the District economy will continue in 1995 and should help the region grow faster than the national average. The Southwest's relatively low cost of living and doing business will continue to attract firms. The cost of trucking goods within each state will be cheaper in 1995, thanks to the federally mandated deregulation of intrastate trucking that went into effect on January 1. This legislation is expected to have a large impact in Texas, which had one of the most regulated trucking markets in the nation.

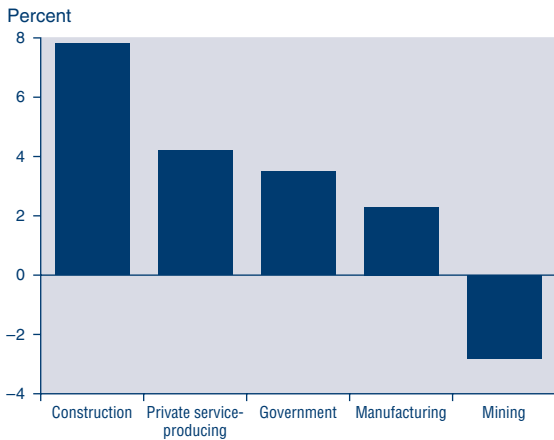
Mexico's economy is an important wildcard in the Eleventh District's economic forecast. At a minimum, Mexicans are likely to purchase fewer Eleventh District goods and services in 1995 because the peso devaluation makes U.S. goods more expensive than they were in 1994. A positive result of the peso devaluation will be that Eleventh District firms and consumers can purchase goods and services from Mexico more cheaply.

**A sector-by-sector overview:
A broad-based expansion**

The District's expansion in 1994 was broad-based, with the exception of energy and defense-related industries. Rapidly expanding service and manufacturing industries helped feed a booming construction sector. As shown in Figure 4, construction had the fastest employment growth. Private service-producing industries, which include transportation, trade, business services, finance, insurance, and real estate, posted the second fastest job gains. The District's manufacturing sector also had relatively strong employment growth, given the sector's weak employment growth nationwide over the past few years. The mining sector continued to decline in 1994. Government employment growth accelerated to 3.5 percent in 1994, but was outpaced by the 4.1-percent rate of the private-sector expansion.

While construction had the fastest employment growth, that sector's employment is relatively small and added only 0.4 percentage points

Figure 4
1994 Eleventh District Employment Growth



SOURCES OF PRIMARY DATA: U.S. Bureau of Labor Statistics; Federal Reserve Bank of Dallas.

to the District's employment increase in 1994. As shown in Figure 5, the service sector added the bulk of new jobs in the Eleventh District in 1994, contributing 2.7 percentage points to employment growth.

Construction booms

Construction employment surged 7.8 percent in 1994, posting its strongest growth since 1978. Booming nonresidential and apartment construction more than offset slower growth in homebuilding. Labor and materials shortages in some areas suggested that capacity constraints limited District construction growth.

Three huge, billion-dollar semiconductor factories led the upswing in nonresidential construction. A new Intel factory was under construction in Rio Rancho, New Mexico, and Motorola and Advanced Micro Devices built factories in Austin. Construction of petroleum refining facilities also was brisk in 1994, driven by heavy demand and regulations. Some construction was necessary to bring refineries into compliance with new regulations under the Clean Air Act, parts of which took effect at the end of 1994. The demise of the proposed Btu¹³ tax reduced uncertainty and stimulated building at several refineries along the Gulf Coast.

Retail and restaurant construction also picked up in 1994. Demand was heavy for retail space large enough to house warehouses, known as "supercenters," as was demand for restaurant space. Growth of gambling-related tourism in Louisiana boosted construction of hotels, restaurants, and casinos there.

Although rising interest rates slowed growth in 1994, District residential construction remained

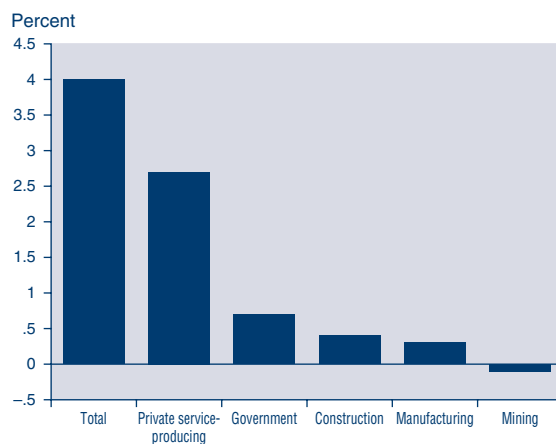
strong. Apartment construction more than doubled during the year. Single-family home building slowed but remained relatively strong after surging in 1992 and 1993.

Manufacturing gains speed

Eleventh District manufacturers were busy in 1994. Booming construction, a strong national economy, and expanding exports spurred heavy demand for District durable goods. Several manufacturing industries reported that they could not expand fast enough to meet demand, and their prices increased. In April, heavy overtime pushed Eleventh District average weekly hours worked in manufacturing to a record 43.8, among the highest in the nation. District manufacturing employment increased 2.3 percent in 1994. While the growth rate appears relatively slow compared with other sectors of the economy, manufacturing employment has been growing faster in District states than in the nation for eight years.

Manufacturing in District states was boosted by strong growth in construction supplies, automotive, and high-technology products. Production was strongest for construction-related industries, such as brick, cement, fabricated metal, steel, lumber, furniture, electrical products, and glass. Despite continued defense industry reductions and layoffs in 1994, District production of electronics, computers, and instruments remained very strong. The Southwest is a growing heartland for high-tech producers, such as computers, semiconductors, and telecommunications industries. Worldwide demand for these products has spurred

Figure 5
1994 Employment Growth by Sector As a Percentage of Total Employment



SOURCES OF PRIMARY DATA: U.S. Bureau of Labor Statistics; Federal Reserve Bank of Dallas.

All Three Eleventh District States Grew Faster than the Nation

Louisiana, Texas, and New Mexico each contributed to the Eleventh District's strong performance in 1994. Employment in all three District states grew faster than the national average of 3.1 percent. As shown in Figure A, employment growth was strongest in Louisiana and New Mexico. Rapid growth of Louisiana's casino industry led to a 5.6-percent employment increase in 1994, after a 3-percent rise in 1993. In New Mexico, rising exports and strong growth of high-tech industries helped boost job growth 5.3 percent in the past year. Both Louisiana and New Mexico posted the strongest job growth since 1978. The Texas economy also grew strongly in 1994, with employment increasing 3.5 percent. Expanding exports boosted employment growth in manufacturing and services in the state.

While employment growth was strong in all three District states, population growth has been more uneven. Population growth in Texas and New Mexico has been much stronger than in Louisiana. Between April 1, 1990, and July 1, 1994, population increased 9.1 percent in New Mexico, 8.2 percent in Texas, and 2.2 percent in Louisiana. All three states had a very high birth rate, but Texas and New Mexico had a large influx of people moving into the state. More people moved out of Louisiana than moved into the state, however.

Louisiana hits a jackpot

Despite its population decline, the Louisiana economy roared in 1994, with the fastest employment growth in more than fifteen years. Louisiana's economic growth had been sluggish since the oil bust in 1986, but in 1994 its employment accelerated to one of the fastest growth rates in the nation. Much of the state's rapid growth can be attributed to Louisiana's gamble on the casino industry. Renewed strength in energy-related manufacturing and services also boosted the state's economy.

Development of the casino industry has spurred growth in the state's construction, manufacturing, and service sectors. In 1994, 26.5 million tourists visited Louisiana,¹ bolstering demand for hotels and restaurants. Building of hotels, restaurants, and casinos led to a 7.9-percent jump in construction employment in 1994, while construction of riverboats was a catalyst for growth in the state's manufacturing sector.

Louisiana's energy industry also had a very good year, as the state benefited from particularly strong demand for petrochemicals and drilling activity in the Gulf of Mexico. Louisiana provides most of the service activity for rigs in the Gulf—a very lucrative industry in the past year.

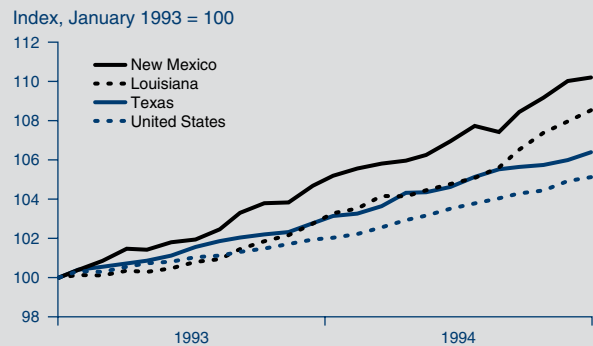
New Mexico: The District's perennial leader

The New Mexico economy continued its solid expansion in 1994. For several years, rapidly growing high-tech industries have given New Mexico one of the nation's fastest rates of employment growth. New Mexico's economy also has benefited from a large growing government sector, including a defense industry that is relatively stable compared with other states.

New Mexico's growing nexus of telecommunication and computer industries has spurred rapid growth in the construction, manufacturing, and service sectors. Much of the state's growth has been in Albuquerque and Rio Rancho, in the semiconductor and electronic equipment industries.

New Mexico's large public sector accelerated in 1994, despite slight reductions in federal government employment.

Figure A
Total Nonfarm Employment



Twenty-five percent of New Mexico workers are employed by the government, mostly at federal research and defense labs in Los Alamos and Sandia. So far, New Mexico has escaped major defense cuts because the state's defense industries focus more on research and development than on procurement.

Mighty Texas continues its solid expansion

Texas is by far the District's largest state. With 18.4 million residents, Texas surpassed New York in 1994 to become the nation's second most populous state.² The Texas economy grew strongly in 1994, thanks to continued expansion of high-tech industries and healthy export growth.

The growth in high-tech industries is reflected in the state's manufacturing and construction sectors. Austin—home of two of the largest microchip manufacturers in the world, Motorola, Inc. and Advanced Micro Devices—is also home to the world's leading producer of wafer fabrications systems, Applied Materials.³ Expansion of these and other computer-related manufacturers has continued to attract other high-tech firms and suppliers. Construction of manufacturing and research facilities and homes in Austin absorbed the area's labor force and stimulated demand for the state's construction materials. Healthy expansion of high-technology industries is not limited to Austin. The Houston economy is benefiting from the strong growth of Compaq, which has become second only to IBM as the largest computer producer. Vibrant growth of telecommunications manufacturers in Richardson (near Dallas) also has stimulated the state's economy.

Last year, Texas' service sector continued its solid expansion despite slower growth in tourism and health care. Restructuring at hospitals and other health service organizations hit Texas' economy relatively harder than other District states because of the industry's size in the state. Texas has a large health research and biotechnology industry and exports many health services to international visitors. A decline in Texas' tourism industry also slowed service growth. The state's tourism industry received heavy competition from Louisiana's thriving casino industry in 1994, reducing demand for hotels and tourist attractions.

¹ Louisiana Department of Culture, Recreation, and Tourism.

² California is the most populous state.

³ Sharp (1993).

expansion of research facilities and construction of huge factories in Texas and New Mexico. Many California firms have relocated to the Eleventh District to be close to these large manufacturers and research facilities.

Strong worldwide demand for District refining, petrochemicals, and oil field equipment and services held energy-related manufacturing steady despite weaknesses in oil and gas extraction. As major refining centers, Texas and Louisiana are the only U.S. states that export large quantities of energy products to other parts of the country—particularly the East Coast. Demand for these products was heavy all year, and capacity utilization at regional refineries was high. However, changing regulations concerning the introduction of reformulated gasolines under the Clean Air Act kept profits volatile and generally weak. Petrochemical production was extremely strong and highly profitable in 1994. The recovery of the international economy and strong national growth improved the market for Gulf Coast petrochemicals, which led to high capacity utilization, low inventories, and six rounds of price increases for basic chemicals such as ethylene and propylene.

The service sector accelerates

Strong growth in communications, transportation, retail and wholesale trade, and business services, along with growing trade with Mexico, stimulated the District service sector in 1994. After several years of restructuring and downsizing, most industries resumed hiring in 1993, spurring broad-based expansion of the service sector in 1994. After a 3.7-percent increase in 1993, private service-sector employment growth accelerated to 4.4 percent in 1994.

The sector's strongest job growth was at business service firms that had heavy demand for temporary, or just-in-time, employees. Employment also grew strongly at District transportation firms, as NAFTA encouraged firms to expand their air cargo, trucking, and warehouse facilities. District cargo firms reported increased shipments for all modes of transportation, including intermodal shipping, which is a combination of carriers, such as trucking and air. Growing U.S.–Latin American trade also helped boost expansion of the District's telemarketing industry because of the region's large bilingual population and location in the Central time zone.

Other fast-growing District services include wholesale and retail trade employment, particularly in building materials, automotive, and eating and drinking establishments. Recent expansion of gambling facilities in Louisiana boosted tourism to

record levels and increased employment at hotels, bars, restaurants, and other tourist attractions.

Not all District service industries are expanding rapidly, however. Employment in health services continued to decelerate in 1994, growing just 4.1 percent after increases of 4.5 percent in 1993, 4.7 in 1992, and an average 6.3 percent per year between 1987 and 1991. Competition from health maintenance organizations (HMOs) and proposals for national health insurance have encouraged health service companies across the nation to restructure. Several hospitals in District states reported job losses after cost-cutting led to more outpatient care.

Continued consolidations and restructuring reduced employment slightly at financial services firms in District states. Banks in Louisiana, New Mexico, and Texas are in good financial shape, however, and loan growth was strong in 1994.¹⁴

The energy industry continues to decline¹⁵

The energy industry declined in 1994, continuing a trend that started in 1982. Dwindling reserves led major companies to turn away from oil exploration in the District—and the United States—which shrank the region's energy sector. In 1994, District oil and gas employment fell 3 percent. Although the sector's employment rose in Louisiana and only declined slightly in New Mexico, Texas lost energy-related jobs, possibly because the state is headquarters for several major oil and gas companies that have been restructuring and downsizing. Although the District economy still is tied to swings in oil and gas prices, the effects of those swings have diminished in recent years.¹⁶

Low oil and natural gas prices contributed to weakness in the energy sector in 1994. Real oil prices at the start of 1994 were at pre-Arab-oil-embargo levels of 1973. Oil prices strengthened during 1994, as the global recovery and strong national expansion continued. A declining dollar also contributed to upward pressure on oil prices. Still, West Texas Intermediate crude oil averaged just over \$17 per barrel in 1994, relatively low compared with prices over the past several years.

In contrast, natural gas prices were very strong at the start of 1994, after one of the coldest winters of the twentieth century. Prices weakened during the year, however, falling to \$1.47 per million Btu in November, the lowest November price since 1986. Large supplies, weak demand, and competition with low oil-product prices helped keep natural gas prices relatively low during the year.

Despite comparatively weak energy prices, drilling activity in District states increased 7.3 percent in 1994. One reason drilling remained strong may have been new technologies that lowered drilling costs and made drilling more attractive at lower prices. Producers can use new seismic exploration technologies to look for oil and natural gas in previously unexplored salt structures. This new capability greatly reduces the cost of drilling in these areas and has spurred a tremendous amount of drilling activity in the Gulf of Mexico, the site of many of the region's most productive wells.

Government employment growth accelerates

While the District's government sector has grown more slowly than the rest of the economy for the past three years, employment growth in the sector has been accelerating despite continued reductions at the federal level. In 1994, government employment in District states increased 3.5 percent, after rising 2.4 percent in 1993.

State and local government employment rose in all three District states in 1994. The strongest growth occurred in Texas, where court-ordered improvements in prisons and mental health facilities contributed to a 4.7-percent rise in state government employment.

Federal government employment in Eleventh District states held steady in 1994, after declining in 1993 and 1992. Defense reductions in New Mexico and Texas cut the federal government's employment of civilians in those states, although such employment increased 2.2 percent in Louisiana.

Agricultural surprises

For Southwest agriculture, 1994 was a year of surprises: unexpectedly good crop and livestock production after very dry conditions in some areas early in the year, a steep and sudden drop in beef prices in the spring, and at year's end, a good harvest—particularly from irrigated fields—and the highest harvest-time prices for cotton in fifteen years.¹⁷ With low prices for livestock products, 1994 farm income is expected to be lower than in 1993.

The increasingly global marketplace is boosting demand for District agricultural products. This year, producers benefited as strong worldwide demand pushed up cotton prices after crop losses in Pakistan and India. NAFTA stimulated demand for many District products, including livestock, animal products, sugar cane, soybeans, grains, and feeds.

Conclusion

Economic growth in Eleventh District states, once dependent on a prominent energy industry, today is driven by a relatively low cost of living and growing trade with Mexico. In 1994, NAFTA and a robust national economy also helped the three District states attract new business and gain employment faster than the national average.

After a strong year in 1994, economic growth in Louisiana, New Mexico, and Texas is likely to slow in 1995. The national economic slowdown and higher interest rates than in 1994 are expected to inhibit employment growth in District states. The diminished value of the peso and continued political uncertainty in Mexico also are likely to restrain the region's economic growth in 1995. Despite these negative factors, however, the Eleventh District will probably remain one of the fastest growing areas in the country.

Notes

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- ¹ The Eleventh District includes northern Louisiana, southern New Mexico, and Texas. This analysis, however, is based on data for the entire states of Louisiana, New Mexico, and Texas.
- ² Nationwide capacity constraints, coupled with economic expansion in excess of the natural rate of growth, prompted the Federal Reserve to raise interest rates six times in 1994. Over the business cycle, market forces also push up interest rates.
- ³ This record is based on the growth rate of jobs from December to December each year. Based on the percentage change in the twelve-month annual average, District employment has grown more strongly than the nation for five consecutive years.
- ⁴ For further discussion of the Southwest business climate, see Brown and Anderson (1988).
- ⁵ For the past two decades, Louisiana, New Mexico, and Texas per capita state and local tax burdens have been below the national average, according to the Advisory Commission on Intergovernmental Relations.
- ⁶ The University of Texas at Austin has one of the largest installed bases of MacIntosh computers in the world, making graduates strong candidates for high-tech jobs.
- ⁷ In the past two decades, about two-thirds of Austin's manufacturing relocations have come from metropolitan San Jose, California.
- ⁸ At the end of 1993, the average cost of a home in Santa Clara County, California—the heart of Silicon Valley—was \$252,264. The average cost of a house in Austin was \$114,800.

⁹ The George–Taylor article, also in this issue, concentrates on the average effects Texas exports to Mexico have had on Texas employment between 1987 and 1994. The authors conclude that the dramatic growth in merchandise exports between 1987 and 1994 accounts for only a small fraction of the employment growth in Texas. As they indicate, their analysis describes only part of the total trade picture. In particular, they were unable to measure the effects of increasing trade in services, merchandise imports from Mexico, and any spillovers from increasing exports to Mexico from U.S. states other than Texas. In this article, I use data on U.S. and Texas trade flows and anecdotal information to discuss the broader trade picture.

¹⁰ Adjustments to the data from the U.S. Census Bureau, Foreign Trade Division, were performed by the Massachusetts Institute for Social and Economic Research (MISER). Exports are measured by state of origin; products are measured from the state where they begin the journey to point of export. This measure may attribute goods to the state where they are warehoused prior to beginning the journey to point of export. In the case of Southwest exports to Mexico, this measure is likely to overstate exports.

An alternative measure available from MISER calculates state exports to Mexico from the ZIP code of origin. The ZIP code measure may attribute an export from the ZIP code of the state where the manufacturer is headquartered, rather than the ZIP code of the manufacturing facility. In the case of the Southwest, this measure is likely to understate exports. Based on the ZIP code of origin measure, Louisiana exports to Mexico increased 106.2 percent, New Mexico exports to Mexico declined 10.4 percent, and Texas exports to Mexico increased 10.9 percent in 1994.

¹¹ This statement is based on data from the U.S. Census Bureau, Foreign Trade Division, adjusted by MISER.

¹² Gross state product data are Federal Reserve Bank of Dallas estimates for 1994. Merchandise exports are from MISER. Services are assumed to equal 20 percent of merchandise exports, which is the average percentage of U.S. service exports to Mexico, based on estimates from the U.S. Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis. (Total U.S. service exports to the world average 40 percent of merchandise exports.) While service exports are likely to vary by state, Eleventh District states are closer to Mexico and would be expected to export more services than other states. Consequently, estimates for services are likely to understate actual service-sector exports.

¹³ Btu, or British thermal unit, is the quantity of energy required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 degrees Fahrenheit.

¹⁴ Clair (1995).

¹⁵ Research by Steve Brown, Bill Gilmer, and Mine Yücel contributed to this section.

¹⁶ Brown and Yücel (forthcoming).

¹⁷ Anderson (1995).

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