federal reserve

SWE

southwest economy

bank of dallas

THE UNSINKABLE TEXAS ECONOMY

THE 1990s WILL GO down in history as the decade of buoyant economic growth in Texas. 1999 was no exception. After a slow start due to the lingering effects of the Asian crisis, the Texas economy bounced back in the second half and finished the year only moderately weaker than in 1998. As shown in Chart 1, job growth was positive and exceeded the national average in each year of the decade.

During 2000, Texas exports, particularly of technology-related products, should accelerate. Although oil and gas prices are hard to predict, the unexpectedly high prices since March 1999 should pump up the budgets of Texas drilling companies, which have only recently begun to add jobs. And, after several strong years, construction activity has begun to slow. An election year always poses a challenge for Mexico, but current indicators suggest that the country will maintain its current economic expansion into 2000 and, thus, will continue to stimulate Texas exports and the border economy. Although tight labor markets will likely restrain Texas job growth, overall these factors suggest that growth in 2000 will be stable to slightly higher than in 1999.
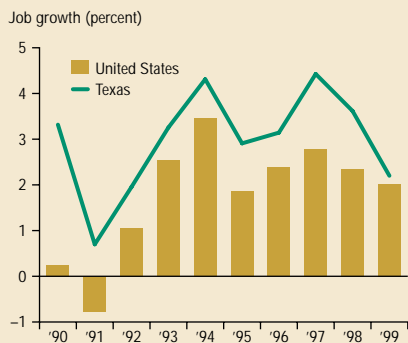
High Oil Prices Providing a Boost

In Texas, we "dance with the one that brung us," and the energy industry has been our partner for a long time. While oil and gas pro-

INSIDE

Chart 1
Texas Economy Strong Throughout the '90s

Job growth (percent)

Legend: United States; Texas

(Bar and line chart showing job growth percent from '90 to '99, y-axis from −1 to 5)

SOURCES: Bureau of Labor Statistics; Federal Reserve Bank of Dallas.

If price expectations hold up, the energy sector will be an important source of growth in 2000.

duction in Texas has declined steadily since the early 1970s and technology-related industries are a growing share of the state's economy, big swings in oil prices can still have a significant economic impact. As shown in Chart 2, broad deviations in Texas employment growth from its trend have correlated highly with oil price movements.

Dallas Fed economists Stephen Brown and Mine Yücel estimate that the state is 75 percent less sensitive to oil price fluctuations today than it was in 1982.[1] Even with the reduction, however, the economists estimate that a 10 percent decline in oil prices that is perceived to be long-lasting would decrease total Texas employment by 0.36 percent. The price of West Texas Intermediate cru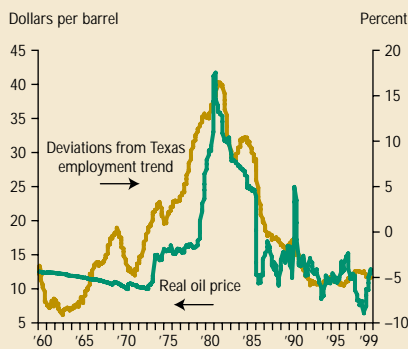de averaged $14.39 per barrel in 1998—a 31.2 percent decline from 1997 after adjusting for inflation. At the end of 1998, most forecasters believed oil prices would remain below $14 per barrel throughout most of 1999. As shown in Chart 3, both the rig count and oil and gas extraction employment dropped sharply from early 1998 through early 1999.

Production cutbacks by OPEC countries and a pickup in world demand for oil caused prices to jump beginning in March 1999, and by year-end the futures market was suggesting oil would average about $23 per barrel in 2000. Although the rig count has bounced back, oil and gas extraction employment is just beginning to recover. Based on the Brown/Yücel model, oil price swings were likely responsible for a significant portion of the overall slowdown in first quarter 1999, and if price expectations hold up, the energy sector will be an important source of growth in 2000.

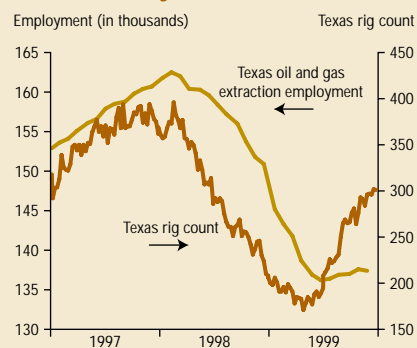## Technology-Related Industries Growing Strongly

As shown in Chart 4, technology-related industries have been an important source of strength for the Texas economy in the 1990s. These industries grew at an average annual rate of 5.6 percent from 1990 to 1998, almost twice the rate of total nonfarm job growth, which averaged 3 percent. The strongest sector was computer-related services, which increased at an annual rate of 10.1 percent. The weakest sector was electronic components including semiconductors,

Chart 2
Real Oil Price Influences Texas Job Growth

Dollars per barrel | Percent

(Line chart from '60 to '99 showing "Deviations from Texas employment trend" and "Real oil price"; left axis 5–45 dollars per barrel, right axis −10 to 20 percent)

SOURCES: Bureau of Labor Statistics; Department of Energy; Federal Reserve Bank of Dallas.

Chart 3
Oil Industry on the Rebound

Employment (in thousands) | Texas rig count

(Line chart from 1997 to 1999 showing "Texas oil and gas extraction employment" and "Texas rig count"; left axis 130–165 thousands, right axis 150–450 rig count)

SOURCES: Bureau of Labor Statistics; Baker Hughes Inc.

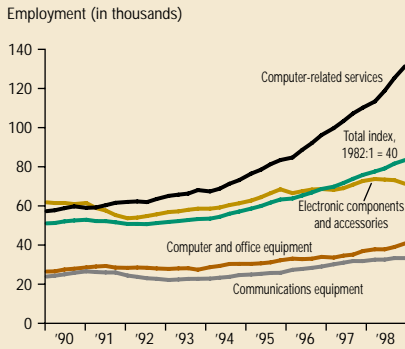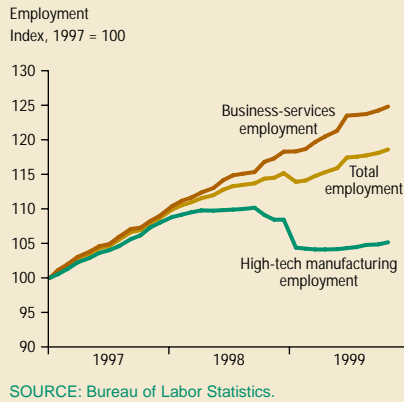**Chart 4**
High-Tech Industry Important Source of New Jobs

Employment (in thousands)

Computer-related services

Total index, 1982:1 = 40

Electronic components and accessories

Computer and office equipment

Communications equipment

'90 '91 '92 '93 '94 '95 '96 '97 '98

SOURCE: Texas Workforce Commission.

Chart 5
High-Tech Jobs Beginning to Pick Up

Employment
Index, 1997 = 100

Business-services employment

Total employment

High-tech manufacturing employment

1997   1998   1999

SOURCE: Bureau of Labor Statistics.

According to most market experts, the outlook for semiconductor sales is strong.

which increased at an annual rate of 1.4 percent. The semiconductor industry has achieved very high productivity growth rates; thus, output in this industry has risen at a much faster pace than employment.
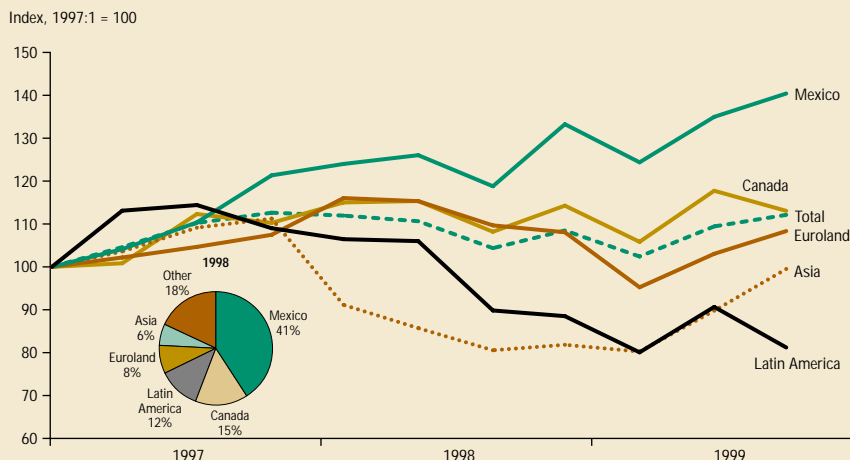
While data from the narrowly defined industries shown in Chart 4 are not available on a timely basis, the more broadly defined categories shown in Chart 5 suggest that the high-tech industries slowed in the first quarter but have since shifted into high gear. According to most market experts, the outlook for semiconductor sales is strong. Industry contacts say that strengthening world demand and the introduction of

new products, particularly in communications, will likely stimulate demand across a wide range of electronic products in 2000.

Exports Continuing Recovery

A main factor driving the slowdown and recovery of the high-tech sector in 1998 and 1999 has been fluctuations in exports due to changing international conditions. As shown in Chart 6, between the fourth quarter of 1997 and the first quarter of 1999 growth in exports to Mexico slowed and exports to

Chart 6
Exports Continue to Bounce Back

Index, 1997:1 = 100

Mexico

Canada

Total
Euroland

Asia

Latin America

1998

Other 18%
Mexico 41%
Asia 6%
Euroland 8%
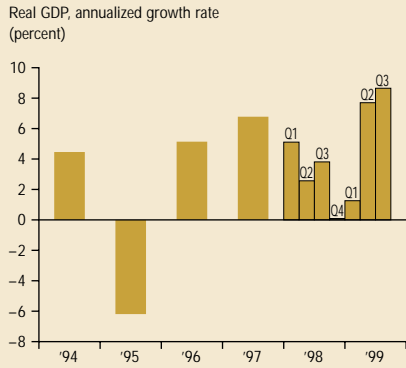Latin America 12%
Canada 15%

1997   1998   1999

NOTES: Data are seasonally adjusted. Euroland includes Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain.
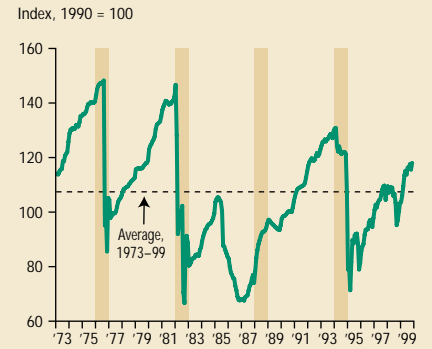SOURCE: Massachusetts Institute for Social and Economic Research.

Chart 7
Mexican Economy Strengthens

Real GDP, annualized growth rate
(percent)

NOTE: Data are seasonally adjusted.
SOURCE: Federal Reserve Board of Governors.

Chart 8
Real Value of the Peso Not High by Historical Standards

Index, 1990 = 100

NOTE: Bars indicate election years.
SOURCE: Federal Reserve Board of Governors.

Mexico looks much less vulnerable to recession than in the years before previous elections.

other Latin American countries, Asia and Europe declined. The weakening and rebound have been particularly acute in chemicals and high-tech products such as electronic equipment and nonelectrical machinery.

Demand from Mexico is likely to continue even as that country goes into an election year. Weak oil prices and the Russian financial crisis stalled Mexico's real output in fourth quarter 1998 and first quarter 1999. With a greater sense of calm in the international markets and strongly rising oil prices, Mexico bounced back in the second and third quarters of 1999 (*Chart 7*). As David Gould highlights in the November/December 1999 issue of *Southwest Economy*, Mexico looks much less vulnerable to recession than in the years

before previous elections.[2] Subdued levels of domestic credit, government spending and the current account deficit all bode well for the Mexican economy going into 2000. The adoption of a flexible exchange rate has also reduced the chance of a currency devaluation and economic crisis. As shown in Chart 8, the real value of the peso in November 1999 was low relative to the average levels prior to past election year devaluations.

Construction Activity Slowing

Although mortgage rates have eased slightly, the overall rise in rates since the end of 1998 has led to a slowing in single-family housing permits (*Chart*

Chart 9
Single-Family Permits Starting to Slow

Number of permits (in thousands)   Percent

Single-family permits*

30-year mortgage rate
(inverted scale)
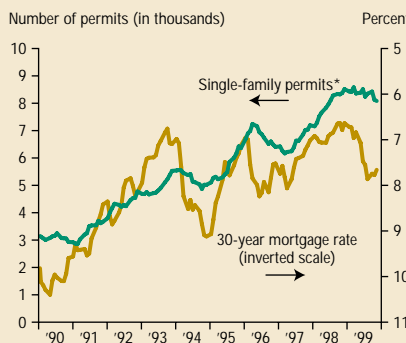
* Four-month moving average.
SOURCES: Bureau of the Census; Federal Home Loan Bank.

Chart 10
Nonbuilding Construction Remains Strong

Contract values
Index, January 1997 = 100

Nonbuilding
Total
Nonresidential
Residential
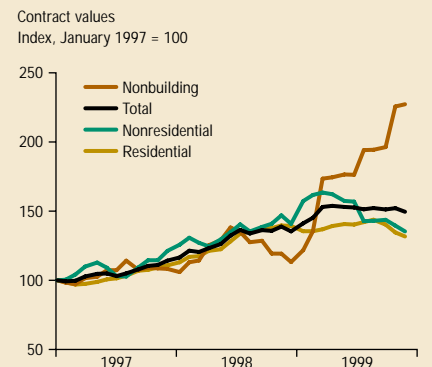
SOURCE: F. W. Dodge Inc.

Chart 11
Manufacturing Activity Picking Up

Index, January 1997 = 100

SOURCE: Bureau of Labor Statistics.

Chart 12
Leading Indicators Pointing to Growth

(Net contributions of components to change in index, July–October 1999)
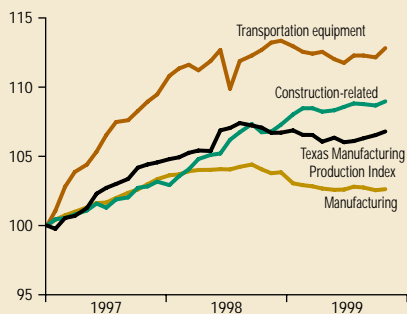
SOURCE: Federal Reserve Bank of Dallas.

9). Continued strength in nonbuilding activity (*Chart 10*), however, has kept overall contract values from slipping significantly. In 1998, Congress adopted a slightly different version of the transportation reauthorization legislation, providing a minimum estimated increase in federal funding of $700 million per year for six years for Texas roadways and bridges. School construction has also been strong.
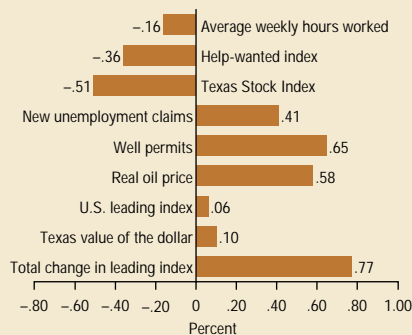
Manufacturing, typically interest rate-sensitive, has been dominated in recent years by international demand and energy markets. Despite higher overall interest rates, manufacturing activity has improved since the second quarter of 1999, even in some of the more interest-sensitive sectors such as transportation equipment and the construction-related industries—stone, clay and glass, fabricated metal products, and lumber and wood products (*Chart 11*). The construction-related industries will likely weaken in the near future if construction activity continues to soften.

Expansion Likely to Continue in 2000

While strengthening international demand and current high energy prices should result in increased opportunities for Texas businesses in 2000, labor market tightness should dampen overall job growth. As Dallas Fed economist Lori Taylor discusses in the September/ October 1999 issue of *Southwest Economy*, many of the large metropolitan areas of the state have very low unem-

ployment rates and very high rates of labor force participation.[3] Thus, getting employment growth in excess of the working-age population growth (about 2.2 percent for Texas in 1998) will require gains in net in-migration. This may be difficult in an environment where almost all regions of the nation are expanding strongly.

Recent movements in leading indicators of the Texas economy confirm a positive outlook for 2000 (*Chart 12*). The Texas Leading Index increased from July to October 1999, with five of the eight components showing gains. A slight decline in the Texas inflation-adjusted export-weighted value of the dollar (inverted in the index) indicates a generally lower international price for products produced in Texas. A lower

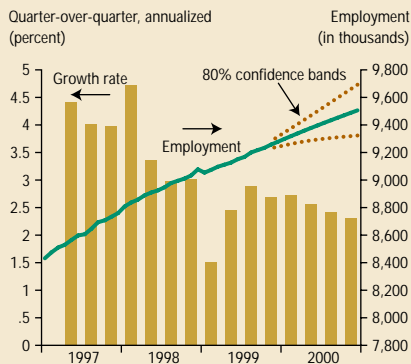price should help the state's international competitiveness.

A rise in the U.S. leading index signaled continued strength in the U.S. economy. Gains in permits to drill oil and gas wells and in the oil price reflect improvements in the energy industry. New unemployment claims declined, suggesting that fewer individuals are expecting to be unemployed for an extended period. A stock price index based on companies with significant employment in the state declined, but it will likely show a pickup in the last two months of the year. Help-wanted advertising and average weekly hours worked signaled some weakness.

A forecasting model based on the movements in the index suggests that job growth should slow only slightly in 2000 from the pace set in the second half of 1999 (*Chart 13*). Because of the weakness in the first quarter of 1999, however, the model predicts that annual employment growth will increase slightly from 2.2 percent in 1999 to 2.5 percent in 2000. Based on the model's past forecasting accuracy, there is only about a 2 percent chance that employment will be lower in either April 2000 or October 2000 than it was in October 1999. Thus, the probability is very high that the Texas economy will remain unsinkable for at least another year.

—Keith Phillips

Phillips is senior economist at the San Antonio Branch of the Federal Reserve Bank of Dallas.

Notes

[1] For a more complete description of the detrended employment series and the relationship between oil prices and the Texas economy, see "The New Texas Economy," Federal Reserve Bank of Dallas *Southwest Economy*, Issue 1, January/February 1999, p. 5.

[2] David Gould, "Can Mexico Weather Its Next Election Cycle?" Federal Reserve Bank of Dallas *Southwest Economy*, Issue 6, November/December 1999, pp. 10–14.

[3] Lori Taylor, "The Economics of Prosperity: A Texas Tale," Federal Reserve Bank of Dallas *Southwest Economy*, Issue 5, September/October 1999, pp. 1–4.

Chart 13
Job Growth to Continue at Moderate Pace

Quarter-over-quarter, annualized (percent) — Employment (in thousands)

SOURCE: Bureau of Labor Statistics.

Productivity, the Stock Market and Monetary Policy in the New Economy

ONE OF THE new economy's defining features is faster productivity growth. The new economy's most prominent (and, to many, most worrisome) feature is a booming stock market. Of the new economy's implications, those for monetary policy are among the most controversial.

In this article I discuss productivity growth—what it is, why it's important and evidence that it has recently been increasing. I also touch on the stock market and what it's saying about expectations for future growth in productivity. However, the bulk of the article is devoted to an analysis of the connection between productivity growth and monetary policy.

The main conclusion is that, for policymakers, whether productivity growth is high or low is less important than whether productivity growth is rising or falling. Rising productivity growth means good times for central bankers. It means the Federal Reserve can realistically hope to deliver low unemployment, rising wages and more rapid output growth, all without any acceleration in consumer prices. Once productivity growth stabilizes—even at a high level—policy choices become more difficult.

The good news is we're experiencing faster productivity growth and have reason to believe this faster growth will continue. Over time, even a small increase in productivity growth can lead to a huge improvement in living standards for Americans. Unfortunately, although productivity can keep rising forever, productivity growth cannot. Hence, we must be prepared for a shift to a less favorable policy environment. Looking ahead, the days of low unemployment without inflation are probably numbered,

even if the days of rapid output growth and high stock prices are not. The big challenge will be recognizing the shift in the policy environment when it occurs.

Productivity Growth

What It Is. When people talk about productivity, what they usually have in mind is labor productivity—output per hour or output per worker. Government statisticians distinguish among three underlying sources of labor productivity growth.

The first is increases in the amount of plant and equipment per worker. For example, I recently had an ink-jet printer installed in my office. It saves me from having to walk down the hall when I print something from my computer. It saves others on the floor from having to wait for my documents to print. So both my productivity and that of my colleagues have increased.

The second source of productivity growth is improvements in the quality of the workforce. One would expect a workforce with more schooling and more job experience to be more productive, on average.

The final source of productivity growth is improvements in technology and in the organization of the production process—in other words, better equipment and better management. The label economists apply to productivity gains from this third source is "multifactor productivity growth."

Why We Care. Productivity growth is important because it is the main determinant of changes in our standard of living. Chart 1 shows the growth rate of GDP per capita along with the growth rate of labor productivity. Note how

Chart 1
Productivity Growth Has a Big Impact on Living Standards

Percent per year
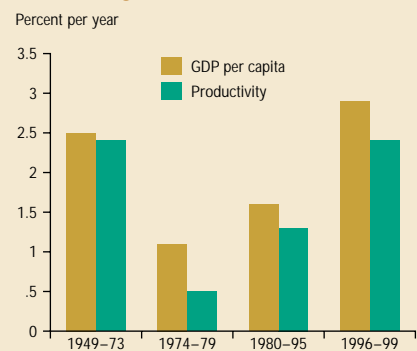
SOURCES: Department of Commerce; Department of Labor; author's calculations.

growth in GDP per capita tends to rise and fall in conjunction with growth in labor productivity.

The most striking feature of the chart is the big slowdown in both productivity and per capita GDP growth during the 1970s. Average annual per capita GDP growth fell from 2.5 percent in the 1950s and 1960s to 1.1 percent in the late 1970s as productivity growth slowed from 2.4 percent to 0.5 percent per year. We don't yet have a good understanding of what caused this deterioration.

Although we saw a partial reversal in the 1980s and early 1990s, it's only been since 1995 that labor productivity and per capita GDP growth have fully recovered. Driven by rapid productivity increases in the high-tech industries, overall productivity growth is back to where it was during its post–World War II golden age.

The timing of the increase in productivity growth is noteworthy. Ordinarily, productivity growth surges as we

emerge from a recession, only to taper off as the economic expansion matures. In contrast, the recent increase began after the economy had been growing for nearly five years. So, there's reason to believe the increase is not just a flash in the pan.

Irrationally Exuberant?

Productivity and the Stock Market. The period of rising productivity growth since 1995 has been marked by sharp increases in price/earnings and price/dividend ratios, suggesting a connection between productivity growth and the stock market. A connection certainly has intuitive appeal. For a given rate of labor force growth, the more rapid productivity growth is, the greater the potential growth rates of output, earnings and dividends. With faster expected growth in earnings and dividends, people are willing to pay more for a stock at any given level of *current* earnings or *current* dividends.[1] That's why an Amazon.com can have a market capitalization some 14 times that of Barnes & Noble, despite never having earned a profit.[2]

Of course, interest rates, inflation and investors' risk perceptions also affect stock valuations. However, if all these other factors are held constant, high stock market valuations ought to signal that investors expect rapid productivity growth.

Chart 2
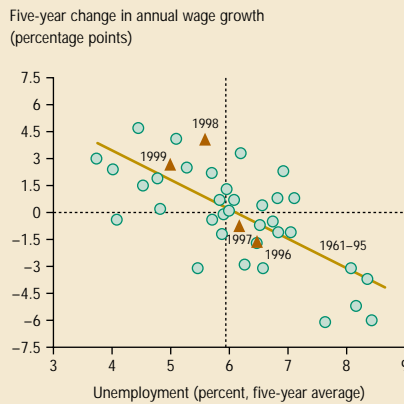### Stock Valuations Predict Strong Productivity Growth

Percent per year
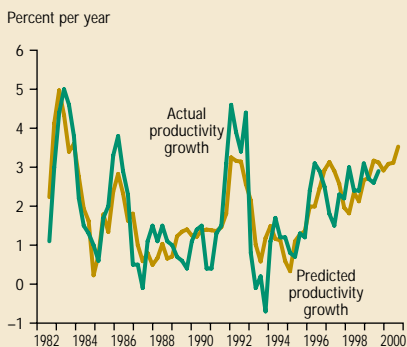
SOURCES: Department of Labor; Federal Reserve Bank of Philadelphia; Standard & Poor's Corp.; Moody's Investors Service; author's calculations.

Chart 3
Wage Growth Accelerates When Labor Market Is Tight

Five-year change in annual wage growth (percentage points)

SOURCES: Department of Labor; author's calculations.

Chart 2 shows what happens when price/earnings and price/dividend ratios are used to predict productivity growth in the nonfarm business sector, after controlling for interest rates, inflation expectations and employment trends.[3] The chart illustrates that although investors have been overly optimistic or overly pessimistic at times, in general they have done a good job of anticipating productivity swings. In particular, recent high and rising stock market valuations have been justified, so far, by high and rising productivity growth.

As of third quarter 1999, investors were anticipating an additional 60-basis-point rise in productivity growth—to 3.5 percent—during the coming year. Hence, current market valuations assume not just that productivity growth will remain rapid but that it will continue to increase in the year ahead.

Productivity Growth and Monetary Policy

That productivity growth is high and may well remain so is extraordinarily good news; it's the story that belongs on the front page with the banner headline. But for monetary policymakers, some more obscure details of the story are important too.

Is Inflation Dead? Since fourth quarter 1995, inflation has remained contained even as output has accelerated and unemployment has fallen to a

30-year low. This performance has led some commentators to proclaim that inflation is dead. Is it true that in the new economy, with faster productivity growth, the Fed need no longer worry about inflation? The answer lies in the linkages between wages, prices, productivity and unemployment.

Chart 3 traces the relationship between changes in wage growth and the level of unemployment over the 35 years from 1961 through 1995. Note that wage growth tends to rise over time when the unemployment rate is low and to fall over time when the unemployment rate is high. The critical unemployment rate is just under 6 percent. Recent experience has been generally consistent with this historical relationship. (See the points marked with triangles.) As Alan Greenspan has noted, at low unemployment rates, "upward pressures on wage costs are inevitable, short of a repeal of the law of supply and demand."[4]

We've just seen that money wage growth rises or falls depending on the amount of slack in the labor market. Chart 4 shows that *real*, or inflation-adjusted, wage growth tracks growth in labor productivity. Faster productivity growth means faster real wage growth. In particular, the higher rates of productivity growth since 1995 have been accompanied by a marked acceleration of real wages. The linkage isn't perfect, but it's quite good. The linkage also makes sense: firms ought to be willing to pay workers more, in real terms, the more productive they are.

Chart 4
Real Wages Rise Along with Labor Productivity

Percent per year

SOURCES: Department of Labor; author's calculations.

Chart 5
Predicted Effects of Rising Productivity Growth

Percent per year

Productivity growth rising | Productivity growth flat

Output growth — Wage growth — Unemployment (percent) — Inflation

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005

SOURCES: Department of Labor; author's calculations.

Chart 6
Where Do We Go from Here? One Extreme: Hold Unemployment Down

Percent per year

Productivity growth rising | Productivity growth flat

Unemployment (percent) — Wage growth — Output growth — Inflation

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005

SOURCES: Department of Labor; author's calculations.

Chart 7
Where Do We Go from Here? The Opposite Extreme: Hold Inflation Down

Percent per year

Productivity growth rising | Productivity growth flat

Unemployment (percent) — Wage growth — Output growth — Inflation

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005

SOURCES: Department of Labor; author's calculations.

Why has inflation not increased despite tight labor markets? The key to the mystery is rising productivity growth. As shown in Chart 4, real wage growth—the difference between money wage growth and inflation—is closely tied to growth in labor productivity:

Wage Growth – Price Growth = Productivity Growth

Turning this relationship around, price growth is linked to growth in unit labor costs—the difference between wage growth and productivity growth:

Price Growth = Wage Growth – Productivity Growth
(inflation)   (growth in unit labor costs)

Hence, if productivity growth is rising quickly enough, inflation can remain steady or decline even if tight labor markets are driving wage growth higher. In other words, rising productivity growth can offset, or more than offset, the inflationary effects of tight labor markets. That's exactly what has happened over the past four years. Faster growth in output and wages, a falling unemployment rate and low inflation have spelled good times for Joe Six-pack and good times for central bankers—all courtesy of the high-tech productivity revolution.

However, if it is rising productivity growth that has kept tight labor markets from putting upward pressure on inflation, policymakers have reason to be wary. Productivity growth, even if it remains high forever, cannot keep rising forever. Once productivity growth stabilizes, the buffer between tight labor markets and inflation will disappear. Inflation isn't dead, merely sleeping—awaiting the day when productivity growth begins to level off.

Tough Policy Choices Ahead. It is useful to run through some examples that illustrate how the policy environment will change when productivity growth stops rising. In each case, I assume the economy enjoys a five-year period during which productivity growth rises from 1.2 percent per year to 3.5 percent per year. This path mimics the actual behavior of productivity growth in the United States since 1995. Thus, the 1.2 percent figure matches the rate of nonfarm productivity growth in the U.S. economy in 1995 (and the trend rate of the early 1990s), while the 3.5 percent figure matches the rate stock market investors expect during 2000.[5]

Of course, real-world productivity growth may rise above 3.5 percent. But it can't keep rising forever, and my illustrations all assume that 3.5 percent is the limit. In each year from 2000 on, the average worker produces and earns 3.5 percent more than the previous year—up from a 1.2 percent annual increase in 1995. There's no question that society in general is much better off because of this transition to a higher rate of productivity growth. People feel wealthier than they did before—and justifiably so.

While productivity growth is rising, life is rosy for Fed policymakers as well. They can simultaneously deliver low unemployment and steady inflation, as illustrated in Chart 5. The unemploy-

ment path plotted in the chart reproduces the actual path seen in the United States since 1995. Given assumed changes in unemployment and productivity, predicted paths for output growth, wage growth and inflation are generated using the historical relationships displayed in Charts 3 and 4.[6] Note that wage growth is predicted to more than double over five years. Inflation remains low. Output growth rises from 2.7 percent in 1995 to 5 percent in 1999. On the whole, the predicted patterns of output growth, wage growth and inflation pretty well approximate what we've observed in the U.S. economy over this period.

The exercise shown in Chart 5 makes the Fed's job look a lot simpler than it was. Productivity-growth and inflation trends don't become obvious until well after the fact. As a result, many economists, fearing that falling unemployment and rapid output growth would lead to higher inflation, wanted a tighter monetary policy during the late 1990s. At the other extreme were analysts concerned that, without a looser policy, we might actually see runaway *de*flation. Fortunately, those in the middle—"new-paradigm optimists"—won the day.

Policymaking in the years ahead—as productivity growth stabilizes—is going to be even more difficult. I look at two extreme policy choices. The first assumes the Fed tries to hold the unemployment rate at its current level (4.1 percent). Results, shown in Chart 6, are as follows. First, because the unem-

ployment rate remains low, labor markets stay tight and wage inflation rises indefinitely. Second, because rising productivity growth no longer acts as a buffer between wages and prices, price inflation changes direction and begins to follow wage inflation upward. Finally, because the unemployment rate is no longer falling, output growth slows a little.

A policy that implies ever-increasing inflation is ultimately unsustainable, so holding the unemployment rate down permanently is not really an option. The point of Chart 6 is that the longer you try to keep the unemployment rate down, once productivity growth has leveled off, the higher the inflation rate you're ultimately going to be saddled with.

At the opposite extreme from a policy that tries to hold down the unemployment rate is a policy that holds down the inflation rate. Chart 7 shows the consequences that pursuing a hardline anti-inflation stance would have for the labor market and output growth. Because prices respond with a lag to changes in productivity growth, holding inflation down does not require that the unemployment rate return immediately to its long-run average level. Nevertheless, the increase is fairly rapid. Rising unemployment and steady productivity growth are sufficient to halt the acceleration of money wages, but rising unemployment also means a period of sluggish output growth—a "growth recession."[7]

In summary, the days of low unemployment accompanied by low inflation will be over once productivity growth begins to level off. If we try to hold the unemployment rate at an artificially low level after this date, we can expect wage pressures to begin spilling over to prices. If we try to hold inflation down, we can expect to experience a period of slow output growth and rising unemployment.

Know When to Hold Them, Know When to Fold Them. How will policymakers know when it's time to shift gears? The conventional wisdom is that low unemployment, rising wage growth, rapid output growth and high stock valuations are all symptoms of an overheated economy. When we see several of these symptoms at once—as we do

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today—it's a clear signal that we need tighter monetary policy.

The conventional wisdom is at best a half-truth. The fact is, low unemployment and accelerating wages are perfectly consistent with a steady or even declining inflation rate if productivity growth is rising. Similarly, unusually rapid output growth and historically high stock market valuations may simply signal that trend productivity growth is higher now than in the past. If low unemployment, rapid wage and output growth, and high stock valuations are accompanied by high and rising productivity growth, they are to be celebrated, not feared.

The implication is that the conventional inflation indicators are of little use unless you know what's happening to productivity growth. Unfortunately,

available measures of productivity growth bounce around a lot from quarter to quarter and are subject to major revisions. So, timely recognition of productivity trends is difficult.

It follows that the best place to look for emerging inflation pressures is probably in the inflation statistics themselves. That doesn't necessarily mean waiting for consumer price inflation to start rising. Changes in commodity prices may give advance warning that retail price increases are in the pipeline.

Conclusions

The good news is that productivity growth has sped up, implying more

Trade, WTO and the Environment

PARTICIPANTS IN LAST month's World Trade Organization meetings in Seattle faced large and intense demonstrations critical of what many demonstrators saw as the organization's indifference to environmental issues.

Environmentalists have long been concerned over what they see as the links between trade liberalization and environmental danger. Some groups argue that polluters that would never be permitted to operate in developed countries take their operations to more compliant developing countries—just as soon as developed countries drop their trade barriers by enough to make exporting back to these countries profitable. According to this view, some developing countries are happy to get the jobs and will tolerate the pollution. Environmentalists sometimes refer to such relocations and exporting as "environmental dumping."

This explanation is troubling, and whether it is widespread enough to be problematic or not, evidence suggests that poor countries sometimes pollute more as they grow. If this is how economic development works when trade liberalization takes place, it is easy to see why so many demonstrators turned out in the streets of Seattle.

The question is, Is this really how economic growth, trade liberalization and pollution interact? Research by Princeton University professors Gene Grossman and Alan Krueger offers a perspective that is subtler and more complicated and that raises questions about the virtues of discouraging or placing conditions on trade liberalization.

As a background, it is useful to recall that trade and trade liberalization spur countries' growth.[1] What complicates the story is the relation between growth and pollution. Grossman and Krueger's detailed picture of the connection between income per capita and air pollu-tion in 42 countries and between income per capita and water pollution in 58 countries suggests a complicated relationship between growth in income per capita and pollution.[2]

The authors investigate whether pollution typically increases with income per capita, whether it sometimes increases and sometimes declines, or whether it always declines. Behind this examination is the question of whether or not, above a certain income per

> **Pollution increases up to a point and then falls as countries with incomes above that point take steps to reduce a particular contaminant.**

capita, countries begin to treat clean air and clean water like anything else they want more of—that as countries grow richer they will pay for laws and law enforcement that will clean up their environment. The other question is, of course, At what levels of income per capita will countries start their cleanups?

Grossman and Krueger perform econometric analyses on the connections between a nation's income per capita (among other variables) and the incidence of sulfur dioxide and smoke in the air and of lead, arsenic, nitrates, fecal coliform bacteria and a host of other contaminants in the water.

The results are rather different from what might make some demonstrators hit the streets. The authors find not only that pollution does not invariably increase with income per capita but that there is typically a humpbacked relation. That is, pollution increases up to a point and then falls as countries with incomes above that point take steps to reduce a particular contaminant.

In the cases of sulfur dioxide and smoke, for example, once a country's income reaches levels comparable with Mexico's and Malaysia's, respectively, the quantities of those contaminants begin to fall. Other contaminants typically reach their peaks at lower incomes per capita. Countries start doing something about lead in the water when they reach an income per capita comparable with Peru's. Countries start to improve the oxygen levels in water at about the income per capita of Botswana. With some contaminants, such as cadmium and nitrates, income per capita levels are relatively high before a country does much. But in all cases, countries begin pushing down pollution when their incomes per capita grow to levels well below that of the United States.

If free trade means growth, maybe free trade is what environmentalists really want.

—William C. Gruben

Gruben is vice president and the director of the Center for Latin American Economics at the Federal Reserve Bank of Dallas.

Notes

[1] An excellent source of information is offered by Jeffrey Frankel and David Romer in "Does Trade Cause Growth?" *American Economic Review* 89, June 1999, pp. 379–99.

[2] Gene Grossman and Alan Krueger, "Economic Growth and the Environment," *Quarterly Journal of Economics* 110, May 1995, pp. 353–77.

AS DESCRIBED IN this issue's cover story, the Texas economy continued its long expansion in 1999, and job growth is projected to increase slightly this year to 2.5 percent from 2.2 percent in 1999.

Because employment is the best of our timely measures of the state's economic performance, we put much effort into getting the best estimate possible. As described by Berger and Phillips in the July/August 1993 issue of *Southwest Economy*, we developed a unique seasonal adjustment procedure that incorporates early job estimates that the Bureau of Labor Statistics later incorporates into its annual revision.

As shown in the table, over the past four years, revisions to our adjusted employment series have averaged only about 0.5 percent. On average, the forecasted growth rates have been off by slightly less than 1 percentage point, and, excluding 1997, the average absolute error is only about 0.5 percent.

Overall, this analysis shows that over the past four years our forecasts of Texas job growth have been pretty accurate. However, 1997's stronger-than-expected national economy and higher energy prices were an example of how quickly conditions—and forecasts—can change.

— Keith Phillips
Frank Berger

Evaluation of Texas Job Growth Forecast

Year	Forecast (percent)	Actual (percent)	Error (percent)	Revision in previous year's growth rate
1996	2.4	3.1	–.7	–.3
1997	2.0	4.4	–2.4	.8
1998	3.0	3.6	–.6	.8
1999*	2.0	2.1	–.1	.3
Average absolute value			.95	.55

Forecast data taken from past *Southwest Economy* articles.
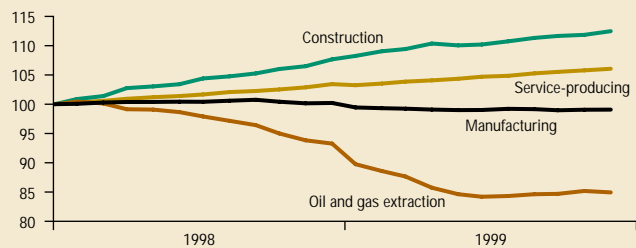* 1999 data are subject to further revision.

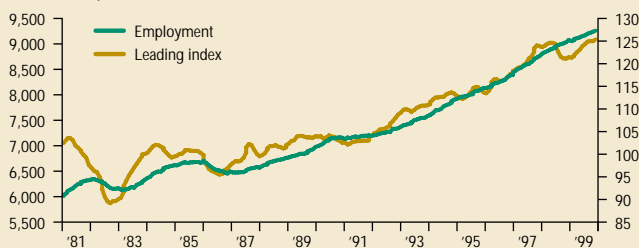## Total Nonfarm Employment
Index, January 1996 = 100

Texas
United States
Louisiana
New Mexico
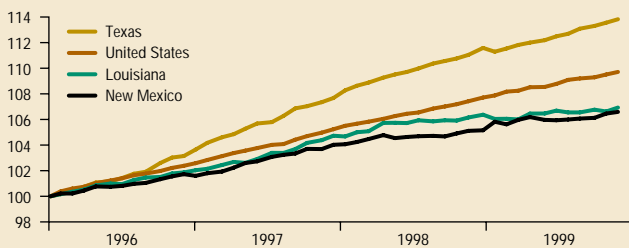
Texas Employment
Index, January 1998 = 100

Construction
Service-producing
Manufacturing
Oil and gas extraction

Texas Leading Index and Nonfarm Employment
Thousands of persons   Index, 1987 = 100

Employment
Leading index

Oil Price and Six-Month Futures Price
Dollars per barrel

Crude oil six-month futures price
Crude oil spot price
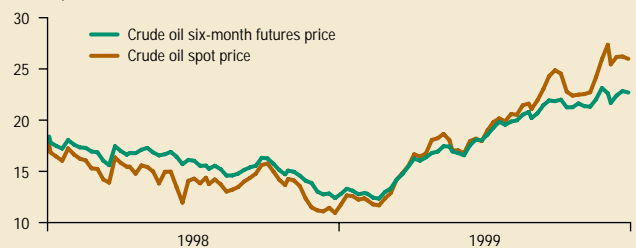
Regional Economic Indicators

	Texas Leading Index	TIPI† total	Texas employment*					Total nonfarm employment*		
			Mining	Construc-tion	Manufac-turing	Govern-ment	Private service-producing	Texas	Louisiana	New Mexico
11/99	126.2	127.2	145.9	537.3	1,094.3	1,548.1	5,934.4	9,260.0	1,913.5	734.3
10/99	125.2	127.2	146.4	534.3	1,094.1	1,545.4	5,918.0	9,238.2	1,908.0	733.4
9/99	124.7	127.2	145.7	533.4	1,093.1	1,544.1	5,901.2	9,217.5	1,910.5	731.1
8/99	125.0	126.7	145.7	531.8	1,095.2	1,537.9	5,889.4	9,200.0	1,906.7	730.7
7/99	125.3	126.3	145.1	529.0	1,095.8	1,524.4	5,873.2	9,167.5	1,906.7	730.2
6/99	124.3	125.2	144.9	526.4	1,093.6	1,524.4	5,862.2	9,151.5	1,909.2	729.8
5/99	123.3	125.9	145.6	525.7	1,093.4	1,524.7	5,837.4	9,126.8	1,905.2	730.0
4/99	123.8	125.5	147.3	527.2	1,094.4	1,522.8	5,819.9	9,111.6	1,905.1	731.5
3/99	122.0	126.5	150.4	522.7	1,096.1	1,522.7	5,804.7	9,096.6	1,896.9	730.0
2/99	121.8	127.2	151.9	520.9	1,097.0	1,520.8	5,783.4	9,074.0	1,897.8	727.6
1/99	122.0	127.2	153.8	517.1	1,098.4	1,521.2	5,763.2	9,053.7	1,897.6	729.0
12/98	121.3	127.6	159.2	514.3	1,106.9	1,518.8	5,778.6	9,077.8	1,903.5	724.4

* in thousands
† Texas Industrial Production Index

Further Information on the Data

For more information on employment data, see "Reassessing Texas Employment Growth" (*Southwest Economy*, July/August 1993). For TIPI, see "The Texas Industrial Production Index" (Dallas Fed *Economic Review*, November 1989). For the Texas Leading Index and its components, see "The Texas Index of Leading Indicators: A Revision and Further Evaluation" (Dallas Fed *Economic Review*, July 1990).

Online economic data and articles are available on the Dallas Fed's Internet web site, www.dallasfed.org.

Productivity

(Continued from page 9)

rapid gains in living standards for the average American and higher real wages for workers.

Investors are counting on continued solid growth in productivity. Indeed, they are betting that productivity growth will increase further in the year ahead. In the past, investors have done fairly well at anticipating fluctuations in productivity growth.

The bad news, from the perspective of the Federal Reserve, is that even if productivity growth remains rapid, policymaking is likely to become more difficult. The tension between our desire for low unemployment and our desire to maintain low inflation will increase in the years ahead.

—Evan F. Koenig

Koenig is vice president and senior economist at the Federal Reserve Bank of Dallas.

Notes

Ricardo Llaudes provided research assistance for this article.

[1] For a brief, informal discussion of this point, see Paul Krugman, "Dow 36,000: A Self-Defeating Prophecy," *Fortune*, December 6, 1999, pp. 70–71. For an in-depth analysis, see Richard W. Kopcke, "Are Stocks Overvalued?" Federal Reserve Bank of Boston *New England Economic Review*, September/October 1997, pp. 21–40.

[2] As of January 14, 2000, Amazon.com's market capitalization was $21.9 billion, as compared with $1.52 billion for Barnes & Noble. (Source: http://biz.yahoo.com)

[3] The estimated forecasting equation is

$$q(t) = 3.500 + .714R(t-4) - 1.427p^e(t-4) - .962I(t-4) -$$
$$\quad (.710) \quad (.167) \qquad (.556) \qquad (.357)$$

$$.297e(t-4) + .484\epsilon(t-4) - 1.229\delta(t-4)$$
$$(.064) \qquad (.198) \qquad (.487)$$

Adjusted R^2 = .601   Standard error = .813

where q is the four-quarter growth rate of productivity in the nonfarm business sector, R is the interest rate on A-rated corporate bonds, p^e is the 10-year inflation expectation from the Federal Reserve Bank of Philadelphia's survey of professional forecasters, I is the four-quarter growth rate of the labor force, e is the four-quarter growth rate of nonfarm employment, and ϵ and δ are the earnings/price and dividends/price ratios for Standard & Poor's 500. The equation is estimated over a sample period that runs from fourth quarter 1982 through third quarter 1999, with due allowance for a moving average error term. Standard errors appear in parentheses.

[4] Humphrey–Hawkins testimony before the House Committee on Banking and Financial Services, July 22, 1999.

[5] More generally, the productivity growth rates I use in my examples equal the actual rates recorded in the nonfarm business sector for 1995–98. I assume 3.3 percent productivity growth in 1999 and 3.5 percent productivity growth every year thereafter.

[6] To generate the wage and price paths displayed in Chart 5, the historical relationships shown in Charts 3 and 4 are generalized to allow for more sophisticated dynamic interactions. (See the box entitled "The Dynamics of Wage and Price Adjustment.") The output growth path is derived from the assumed paths of productivity and unemployment using Okun's Law. See Arthur M. Okun, "Potential GNP: Its Measurement and Significance," in *The Political Economy of Prosperity*, 1970 (Washington, D.C.: Brookings Institution), pp. 132–45.

[7] Chart 7 should be treated with caution. It predicts fairly sharp swings in output growth but takes the path of productivity growth as given. In reality, swings in output growth typically induce endogenous swings in productivity growth in the same direction.

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